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and

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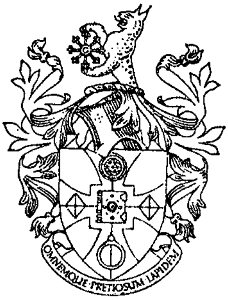

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A MODERN SURVEY OF IMITATION PEARLS

By R. WEBSTER

IN determinative gemmology the identification of imitation pearls is easy. The "blotting paper" appearance under a lens of the surface of the coating, and also the exposure of the glass of the core around the drill-holes, where the pearly coating has been worn away by attrition from the neighbouring pearl, are sufficient to show the nature of these objects. The above is very true, but does the gemmologist know enough about the modern imitation pearl to enable an answer to be given to every question that in some cases may demand an answer?

This is particularly true with regard to the pearly coatings used to give the iridescent appearance to the modern imitation pearl. The current gemmological literature rarely mentions, and certainly never describes, the "synthetic essences" now so often used in place of, or in conjunction with, the well established 'fish-scale' pearl essence. The 'optics' of the iridescent effects produced by these various 'pearl essences' is another factor only cursorily discussed in gem books and needs further consideration. In this article it is hoped to fill in some of these lacunae in our literature.

The history of the imitation pearl goes back a long way and like all ancient history tends to become confused. Probably the earliest imitation pearls were those called "Luli", which, according to Kunz and Stevenson(1), who quote Flinders Petrie, were objects produced in Egypt during the Roman era. They were apparently made by silvering a glass bead and then 'flashing' it over with another coat of glass.

Dieulafait(2) states that no mention was made of artificial pearls till the beginning of the 16th century, when Venice established a reputation for such objects. These must have been hollow glass spheres suitably filled, for Dieulafait writes as follows;—'At first the glass balls were filled with various materials, generally with a base of mercury'.

Various other assemblages of many different materials have been used in past ages to make simulants of pearls. There is little need to discuss these objects in detail as, except perhaps in archaeology and antiquaria, they are not now encountered. However, one type mentioned by Joan Dickenson(3) deserves repeating. It is as follows:- 'One tribe in North America, however, was way ahead of its time in one area at least; it made artificial pearls much like the imitation pearls of to-day. The bead was of baked clay, and the lustrous surface was made up of layer upon layer of thin mica in careful imitation of the layers upon layers of nacre that constitute the real pearl.'

The first real advance in the imitation of pearls was made by a French rosary maker by the name of Jaquin (other versions giving the name as Jacquin or Jonquin) who noticed that the water in which small fish had been washed contained a lustrous substance which, when concentrated, could be used to produce an imitation pearl. Jaquin then made the so-called 'Roman pearl', a hollow sphere of opalescent glass, often treated by an initial exposure to the fumes of hydrofluoric acid to tone down the glassy look, and to the inside surface of which was put a coating of parchment-size upon which was then applied a film of 'pearl essence'—the 'fish scale essence' of Jaquin. The pearl was completed by being filled with white wax or fine gum arabic. It is said that a few large-sized 'half-drilled' pearls are still made in this way for use as earstuds, but the manufacture of pearls of the 'hollow-glass bead' type for use in necklets seems to have died out about 1930.

The modern imitation pearl consists essentially of a central solid bead, usually made of glass, coated on the surface with pearl essence in a cellulose lacquer. Cores other than glass have been used with varying success. Vegetable ivory has been tried but seemingly was insufficiently translucent, and various *organic glasses*, the so-called 'plastics', were once used but the beads were found to be too light in weight for necklets made from them to hang well. Much more successful were the cores made of mother-of-pearl, a type which apparently first came on the Western market during the early 1920's and is now currently marketed. They are to-day sold under the titles 'shell-based imitation pearls' and 'imitation cultured pearls'. Thus the modern imitation pearl has two main parts, the core and the pearly coating, and each of these needs separate discussion.

The cores of the glass bead type consist of an opalescent glass which goes under the name 'alabaster'. This is a type of glass and *not* the alabaster so well known as an ornamental stone. Another unfortunate name applied to such glass is 'girasol', a name which is properly given to a type of opal.

The density of imitation pearls has received scant attention in the literature and the only consideration of the subject appears to be in two articles(4, 5), now over 25 years old. At that time it was found that the majority of the hollow-glass bead type had a density just under 1·55. The density of the solid glass bead types was found to lie mostly between 2·85 and 3·18, with the peak between 2·95 and 3·00. A few pearls of this type were found to have a lower density, down to 2·33, and there is another group about 2·53, a value found during the examination of pearls from a necklet worn by the victim of a sensational murder. This value of 2·53 is also given by Dr L. M. Greenstein of the Mearl Corporation of New York City to the Gemological Institute of America in 1950(6). This was, however, only four years after the English report, and it may well be that for a few years after the war the more usual glasses were not easily obtainable. Experiments on recently produced imitation pearls of this type showed that their density was near 3·00, confirming in general terms the values arrived at by the writer in 1946. The coated mother-of-pearl beads will give a value around 2·75 and would in fact be near the value found for cultured pearls.

The refractive indices of the glasses used for the core of the solid bead type of imitation pearls is less easily determined unless 'flats' are polished on the beads. Some attempt was made to ascertain the index by removing the coating from some pearls having different densities and using the 'distant-vision' technique. The values ranged between 1·50 and 1·60, and, further, it could not be safely said that the glasses with lower density had the lower indices of refraction.

A point to mention here is that in the construction of these glass beads, by forming them on an iron wire with the aid of a torch, it is usually reported that the iron wire was then dissolved out with acid to leave the string canal. Modern technology has modified this method by first coating the wire with a clay slurry or other compound, which prevents adhesion of the glass to the wire and thus allows easy removal of the glass beads(7).

It is now necessary to consider the coatings, and in particular the modern synthetic essences. The 'fish scale' pearl essence of Jaquin is still used to-day, either alone or in conjunction with the newer synthetic essences.

For reasons which will be apparent later 'fish scale essence' is often called 'organic pearl essence'. It is also well known as 'essence d'orient', a name which may have been derived from the notion that the Chinese knew of this substance much earlier. At one time the crystallites were thought to be silver and this led to the name 'fish silver' for the organic essence.

It is now known that the crystallites in the organic essence are fine platy or needle-shaped crystals of the organic compound called guanine, a substance which is actually a waste material allied to uric acid which forms as crystallites in the skin attached to the fish scales. These crystals, which have a refractive index of 1·85 and a density of 1·6, are, when as plates, about 30 by 6 micrometres (μm, formerly micron) in size; and as needles, 30 by 1μm. The crystals are removed by carefully washing them out by the use of a detergent mixture. They are then purified and made into a paste with 'pyroxylin', a nitrated cellulose. This paste is then diluted to a suitable consistency to produce a lacquer suitable for use in dipping the glass beads to produce the simulated pearls.

The rather high cost of the organic essence has led to the production of synthetic essences, the plate- or needle-like crystals of which are inorganic. Two types seem to be used, the most common being crystallites of basic lead carbonate, and the other crystallites of mica which are coated on both sides with layers of titanium dioxide, generally in the form of anatase. These crystallites, whether they be the organic guanine, the lead carbonate or the titanium dioxide coated mica, are disseminated in the lacquer so that they have some degree of parallel orientation. This is readily achieved due to the flow of the pyroxylin vehicle and the shape of the crystallites.

The optics of the 'orient' of natural and cultured pearl and the iridescence of the various pearl essences calls for some comment. Herbert Smith(8) states—'The iridescent lustre of the surface of a pearl and of the nacreous lining of the shell is peculiar and characteristic, and is known as orient; it is the combined effect of two optical phenomena: the interference of light from the succession of thin translucent laminae forming the surface, and the diffraction of light from the grating composed of the closely packed lines in which these laminae meet the surface'. In pearl essences the crystallites are embedded in the vehicle and thus there are no surface edges likely to produce diffraction.

Bolomey and Greenstein(9) enlarge on this by explaining that an interference film is a filter which separates incident white light into a reflected and a transmitted component on a black background, and only the reflection colour is observed as the background absorbs the transmitted ray. On a white background the reflection colour is seen only when the coating is observed by specular reflection. At any other angle of observation the transmission colour appears, as the incident light on passing through the film to the white background is reflected back through the film. The two colours appear simultaneously when an interference film (in paint technology often called a 'pigment') is applied to a white curved surface, the reflection colour in the highlight and the transmission colour everywhere else.

These workers also state: 'This phenomenon is observed in nature in the pearl oyster, where the highlight is often bluish or greenish and the rest of the pearl appears orange or pink. The colour of the pearl is produced by multiple interference films consisting of alternate layers of aragonite and conchiolin. The phenomenon is reproduced in simulated pearls in which a translucent white bead is coated with a green- or blue-reflecting interference pigment in a lacquer'.

An excellent survey of iridescence is given by Hilda Simon(10) in her work on the 'structural colours' of birds and insects, and does include, but less fully, something on mother-of-pearl and pearls; in the latter cases the thin layers of nacre are said to produce the colours. In this work the various causes and effects of iridescent colours are clearly discussed and include the colours obtained by interference of light at thin films, by diffraction from gratings, and also from space lattices where there is a precision arrangement of definite layers of two structures having different refractive indices and forming a Bragg lattice.

From investigations using electron-microscopy this concept of diffraction from a Bragg optical lattice has been found true for many of the colour effects seen in birds feathers and insect scales. How much this Bragg lattice concept can apply to the iridescent effects of pearls and imitation pearls is debatable. This notion of a Bragg lattice may well be the answer to the 'packed spheres' structure of opal as shown by electron-microscopy. As far as the writer knows there has been no investigation of pearl and mother-of-pearl by electron-microscopy. It might supply some helpful answers. Maybe at this time the older idea of phase differences from reflections and refractions at thin films producing colour will be the safer avenue to explore. Indeed Bolomey and Greenstein(11) in their excellent but highly mathematical paper, do not refer to space lattice but only to microscopic platelets of uniform thickness causing phase interference leading to the production of colour.

How the films of titanium dioxide on mica platelets are prepared does not seem to be divulged, nor how the crystallites of basic lead carbonate are produced. These latter are said to be hexagonal crystals, but whether this refers just to the outline and does not imply the system of crystallization is not clear. The natural lead carbonate—cerussite—is orthorhombic and such crystals often do have a six-sided outline. In the titanium dioxide on mica platelets it is the TiO_2 layers which have the same thickness: the thickness of the mica is not controlled and does not seem to be of consequence.

Interference colour is determined by the optical thickness of the film, which is the geometrical thickness multiplied by the refractive index of the film, and it is reported that one complete cycle of interference colours is covered by the range of optical thickness of present commercial TiO_2/mica 'pigments', and two complete cycles in the case of basic lead carbonate. The length of the mica platelet, and maybe this also applies to the lead carbonate platelets, has an effect on the 'pigments', a size range of 2-20 μm producing a soft smooth appearance, while a range of 10 to 50 μm gives a glinty sparkling effect. When the optical thickness of the film is below 200 nm (nm = namometre, earlier millimicron), and specifically in the range 100-140 nm, the reflection is essentially white and these give the pearl pigments. The properties of interference pigments are shown by the following table from Bolomey and Greenstein's article.

PROPERTIES OF INTERFERENCE PIGMENTS

	TiO_2-coated mica		Basic lead carbonate
Approximate	TiO_2 layers	mica	
Effective refractive index	2·3*	1·58	2·09
Average plate length, μm	20	20	20
Thickness, nm	90-170	250	100-340
Optical thickness, nm	200-400		200-680
Specific gravity	3·5	2·8	6·8

**the value is lower than for conventional TiO_2 because of some porosity in the coating.*

It has already been expressed that as far as determinative gemmology is concerned there is no problem with imitation pearls. The 'fun' begins, if one may call it so, when a much closer investigation is needed. Although such cases may be extremely rare, present day gemmology has extended so far into other disciplines that all sorts of unsuspected problems may call for solution, and, indeed, may call for the co-operation of scientists in other fields.

Ever since the problem of the matching of an imitation pearl found in a murder suspect's pocket with the pearls found around the body of the victim, it has always intrigued the writer as to how far one would need to go in order to prove 'without reasonable doubt' that certain imitation pearls were similar. In the case mentioned the one pearl was 'prime evidence' and could not be destroyed or damaged. In this case then only a few tests were possible, *i.e.* surface appearance, density and size of drill hole. In a hypothetical case where pearls can be damaged or destroyed without consequence, what would be the problems then? There are two main sections to consider; the first to agree the core, and the second to agree the coatings.

Taking the core first; if it be of plastic—polystyrene and perspex have both been used—determination of the type of plastic needs to be made. If the core is glass, as is most usual, the density and the refractive index would need to be determined, and, by spectrographic analysis, the composition of the glass should be found to agree. The diameter of the string-hole may give added information, but in the writer's opinion this is less trustworthy. Not a lot can be done if the core is mother-of-pearl.

Determination of the coating is much more involved, especially if there is the problem of mixed coatings. Further, there are two factors to be taken into account here—the crystallites producing the iridescence, and the vehicle in which they are embedded, which is usually a cellulose lacquer.

Microscopic examination of the coatings of imitation pearls tended to show the difficulty of resolving crystallites of less than 30 μm in length. Using a $\frac{1}{6}$ objective in conjunction with an 8 × ocular operating with a tube length of 6½ inches gave a magnification of about 200 ×, and observation was made on scrapings from the surface of imitation pearls of different ages. The peelings were placed on a 2 x 1 glass slip, with a drop of amyl acetate in order to dissolve out the cellulose lacquer and free the crystallites.

In ordinary white light and in dark field illumination there could be seen in the undissolved pieces a mass of crystallites whose boundaries could not be resolved and in the still liquid amyl acetate what were probably loose crystallites. However, when the slide was examined between crossed polars the loose crystallites readily revealed themselves by their bright polarization colours as thin needles, whose length could to some extent be measured by using an eyepiece graticule.

The only result of any seeming importance from this microscopic examination is that the crystallites from the coatings of older imitation pearls seemed to have a greater length than the crystallites from pearls of more recent origin and from a sample of 'Neoperl' synthetic pearl essence made by Neogene Paints Ltd. Measurement of these crystallites showed that the longer crystals, probably guanine crystals, had a length of about 28 μm, and in the synthetic material the crystals had a length of 15 to 18 μm—values which tend to agree with the published literature—and this may be of significance in identification.

Finding the chemical nature of the coatings is more the province of an analytical chemist than a gemmologist. However, the results of some tests carried out might be of interest. The vehicle holding the crystallites, most commonly a nitro-cellulose lacquer, may be more or less proved by 'spotting' the surface with a solution made up of diphenylamine in concentrated sulphuric acid, when the spot of reagent will turn blue if the lacquer is nitro-cellulosic.

A number of imitation pearls were so tested and all gave a positive reaction. The reagent is made by dissolving in 10 ml (cc) of concentrated sulphuric acid 0·5 grams of diphenylamine, but the actual values do not seem to be critical.

Testing for the composition of the crystallites is far less easy and would certainly need the services of a trained analytical chemist to produce an accurate answer. The organic guanine crystals ($C_5H_5ON_5$) and the cellulose lacquer, which has a composition near $C_6H_7O_5(NO_3)_3$, are so similar that chemical tests may be extremely difficult to perform. Titanium in low concentration is hard to detect, and so would be the mica platelets, either chemically or mineralogically, when of such small size.

The detection of lead seemed to have a slightly better chance of success, for there are a number of chemical tests for this metal and one of these was chosen for experiment. This was the reagent known as 'dithizone', which consists of diphenylthiocarbazone dissolved in chloroform or carbon tetrachloride. The test reagent used was prepared by dissolving 1 to 2 mg of the diphenylthiocarbozone in 100 ml of carbon tetrachloride, but the actual quantities do not seem to be critical and only a small quantity should be made as the reagent does not keep too well after being made up. The presence of lead is shown by the green colour of the reagent solution turning a red colour.

The reagent was tested by seeing its reaction on an aqueous solution of lead acetate. The colour of the reagent turned from green to red, proving the efficiency of the test. Blank tests were also made on water, amyl acetate and acetone, for the reagent is very sensitive.

Scrapings from the coatings of a number of imitation pearls were placed in depressions in a 'spot plate' or in a micro test-tube and dissolved by the addition of amyl acetate or acetone. A separate test was made on the essence 'Neoperl' and this gave a convincing red colour to the reagent. The coatings of the beads gave varying results, from a strong red to a very weak pink, generally a weak reddish colour around the edge of the liquid in the 'spot plate' depression, the centre still being green. The experiments would have had a much greater value if essences of known composition had been available. It can, however, be assumed that if a strong red colour is produced lead is certainly present.

Another type of experiment was made in an attempt to see if the layers given to the coating by successive 'dips' into lacquer could be counted in a similar way that a forensic scientist counts the layers of paint from cars or window frames. To do this some imitation pearls were ground down so as to reveal the thickness of the coating which could then be microscopically examined. The experiments were not successful and the coatings due to the various dips could not be identified.

Examination of imitation pearls under ultra-violet light showed that under the long-wave lamp (3650Å) the solid glass bead types showed a weak mauve to a dull yellow glow, whereas the hollow glass bead types showed a strong bright blue glow, perhaps similar to but stronger than the glow shown by natural or cultured pearls. Under the short-wave lamp (2637Å) the results were found to be similar but much weaker. However, the glass beads which had had their coating removed showed a bright blue glow which, when the coating was present, was masked—this probably being due to the short-wave radiation being absorbed by the coating.

Coloured imitation pearls may be made by the addition of dyes to the dip solution or by using 'interference pigments' in which the light reflected is of a different colour from that transmitted by the crystallites. Iridising is another technique modernly used for some of the more expensive simulated pearls. In this scheme each pearl is separately treated by rubbing on to the surface a special powder and then a heat treatment for 24 hours is given which causes the powder to fuse and coalesce into a microscopic film which covers the bead. A final coat of lacquer is then applied in order to protect the iridescent coating.

The coating of imitation pearls is much less hard than the nacre of a natural or cultured pearl and will thus abrade rather easily if such a necklet is 'jumbled' in a jewel case with metallic and gem-set jewellery. Imitiation pearls need to be put away in their case after wearing, or wrapped in soft paper.

The resistance of the coating of imitation pearls to chemical attack from (usually) cosmetic aids is low, and many scents will cause pitting of the surface of such pearls. This can commonly occur if a scent spray is used while wearing pearls. The vapour from the scent does not seem to be at all detrimental but the liquid droplets from a spray are most certainly so. Likewise sprays from hair-setting lotions will cause a secondary coating to form on the surface of pearls which later tends to flake off, leaving the wearer to think that her pearls are peeling. Careless use of nail-varnish, or worse nail-varnish remover, is detrimental to imitation pearls for they are solvents of the 'pyroxylin' used for the coatings of imitation pearls.

The question of the darkening of imitation pearls from sulphide fumes in the atmosphere does not seem to be a problem, although on the face of things the synthetic essences containing a lead salt should be susceptible. Indeed, the manufacturers state that these types of essences have a poor stability to sulphide. However, as these lead crystals are bonded in a cellulosic lacquer some sort of protection is afforded to them and it is rare to see darkening of imitation pearls.

It is hoped that this article will have shown that there is much more in the study of imitation pearls than was formerly imagined. It is true that even now there are issues which have not been covered; even so, indications have been given of possible lines of enquiry from the gemmological point of view which may act as guides to and for other disciplines which may be able to cover such factors. In conclusion the writer's thanks are due to the technical staff of Cornelius Chemical Company Ltd. and to E. Trillwood, F.G.A., of Pampadour Pearls Ltd., for their advice and assistance.

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OBSIDIAN AND SOME OBSERVATIONS ON THIS TYPE OF NATURAL GLASS

By T. F. ZOOK

OBSIDIAN is a natural glass of brilliant lustre which has a conchoidal fracture. It is generally of rhyolitic composition (a composition corresponding to granite) and is of volcanic origin. Obsidians may be black, grey, red, green or brown and are often banded. They may vary greatly in their chemical composition, but contain from 66-72% of silica.(1) Technically, an obsidian has a very low water content, usually 1% or less, when it is contrasted with other natural glasses of volcanic origin such as pitchstones and perlites.(2)

Common inclusions in Obsidian are crystallites (skeletal crystal embryos which are non-polarizing units, and therefore isotropic, and which cannot be identified as to species). In black, grey, green or brown obsidians it is the presence of crystallite inclusions which helps to identify the obsidians from the other natural glasses of similar colour such as tektites. Obsidians have an index of refraction which ranges between 1·480 to 1·510, with a mean R. I. of 1·495.(3) The specific gravity of obsidians varies between 2·33 and 2·42, at least in the types used in jewellery.(4)

Crystallites are isotropic (this means that when these inclusions are viewed between two crossed polaroid discs they stay dark as the specimen is rotated). Heinrich(3) in his study divides the types of crystallites into six different forms:(5)

(1) globulites—round crystallites
(2) cumulites—grouped globulites
(3) longulites—rod-like forms
(4) scopulites—fern-like forms
(5) trichites—hair-like clusters or snarls
(6) margarites—beaded aggregates.

If there is continued growth of the crystallites, they may become microlites (small polarizing crystals which can be recognized as belonging to a particular species).

Microlites are usually lath or rod-like in form and augite and feldspar microlites are common in Obsidian. Based upon the crystal perfection, microlites may be classed in three categories:(6)

(1) euhedral (idiomorphic, automorphic) where there has been maximum development of characteristic crystal form;
(2) subhedral (hypidiomorphic, hypautomorphic) where there is partial development of characteristic crystal form; and
(3) anhedral (xenomorphic, allotriomorphic) where there has been no development of characteristic crystal form.

Obsidians do not contain many larger well formed crystals (phenocrysts).

If the glass is very old, it may have become microcrystalline by means of a process called devitrification which usually starts along cracks and results in a mixture of rock minerals and their alteration products. Heinrich in his work states that only in some cases can the mineral species be distinguished, but the jumbled mass is faintly birefringent. He states further that rocks older than the miocene generally contain devitrified "glass" rather than true glasses. (Miocene is a division of the cenozoic era in the geological column of earth history. The cenozoic era, which encompasses 60 million years, begins with the paleocene and includes recent times.(7). Where mineral species have been recognized in cases of devitrification they have included feldspars, clay minerals and various forms of silica.

Other typical inclusions in obsidians include differently coloured bands. Also present are banded structures formed by the alignment of crystallites, microlites and spherulites (small radiating or concentrically arranged aggregations of one or more minerals).(8) Spherulites are formed by the rapid growth of acicular (needle-shaped) crystals in rigid glass about a common centre or inclusion.

Irregular swirls, streaks and turbulent structures, as well as lamellar flow structures are also found. Lithophysae (large, hollow, bubble-like or rose-like spherulites usually having radial and concentric structure) are also found as are highly vesicular perlitic structures (structures produced in homogeneous material by contraction during cooling and which consist of irregular, convolute and spheroidal cracks.(9)

At very high magnifications, Ross reported pyroxene microlites having the form of a coiled spring were found in volcanic glassy flow-rock in New Mexico and Mexico. Pyroxene microlites with the form of a hook of unusually large diameter were also found.

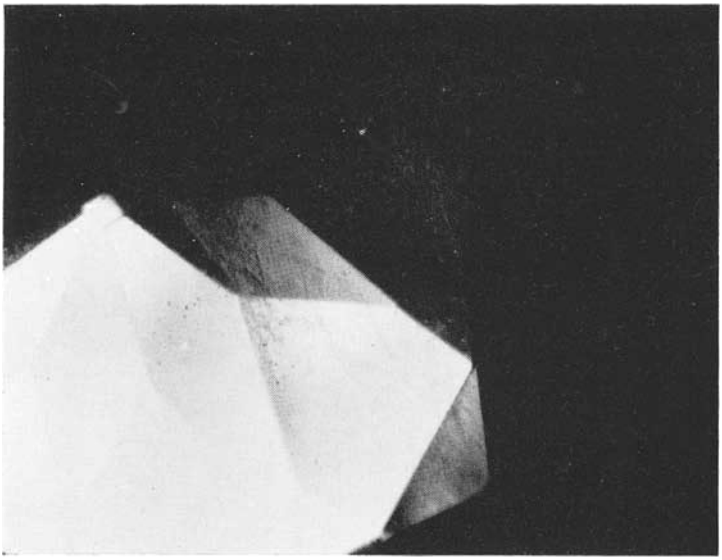

Fig. 1. Obsidian—Coloured bands, and tiny crystallites, transmitted light. 10 ×.

Fig. 2. Obsidian—Coloured bands, tiny crystallites, dust clouds, transmitted light. 30 ×.

Amphibole microlites were found in only a few specimens where they ranged from 0·02 to 0·08 mm. in diameter and from 0·04 to 0·15 mm. in length arranged as stellate groups which radiated out from magnetite grains that served as the points of crystallization. These amphibole needles tapered to very slender points. The magnetite grains were very irregular and occurred in diameters of 0·003 mm. and also as clouds of minute dust-like grains. Biotite microlites were found to occur only rarely. The most frequent type of microlite found by Ross was pyroxene.(10)

Recently, a faceted obsidian from Arizona was studied to see what inclusions it showed in contrast to those already reported by the other researchers mentioned in this article. This obsidian measured 18 mm. in diameter at the girdle and had a depth of 9·6 mm. from the table top to culet and weighed 16 carats. This specimen stone appeared dark brown and could be mistaken easily for a smoky quartz. However, it showed a refractive index of 1·480 and was isotropic. It was also inert to both long- and short-wave ultra-violet light. The spectrum showed a very sharp cut-off at the end of the green, beginning around 5100Å and continuing so that no blue or violet was visible.

Photomicrograph number 1 shows the appearance of the specimen looking down through the tilted table in transmitted light at a magnification of 10 ×. The differently coloured bands can be seen both in the star-facets and the kites. The tiny crystallites appear as minute specks of pepper both on the edge of the table and on the star-facet. Study number 2 shows these same inclusions at a magnification of 30 × and it is now possible to see that some groups of crystallites are arranged in bands and that there is also a cottony banding, which may be the clouds of minute magnetite dust mentioned by Ross. Study number 3 shows the inclusions in the pavilion at this same magnification (30 ×). Looking closely, one can see that there are small black octahedra visible. At much larger magnifications, these octahedra could possibly be taken for chromite on the basis of their being isotropic and having the colour and morphology of this oxide. Study number 4 is included for an interesting study of what can happen in studying inclusions. This was made in transmitted light at a magnification of 200 ×, and it would appear that the stone had tube-like inclusions. Further study showed that these tubes were at or almost at the surface. The way that they are arranged parallel to one another and their orientation to the

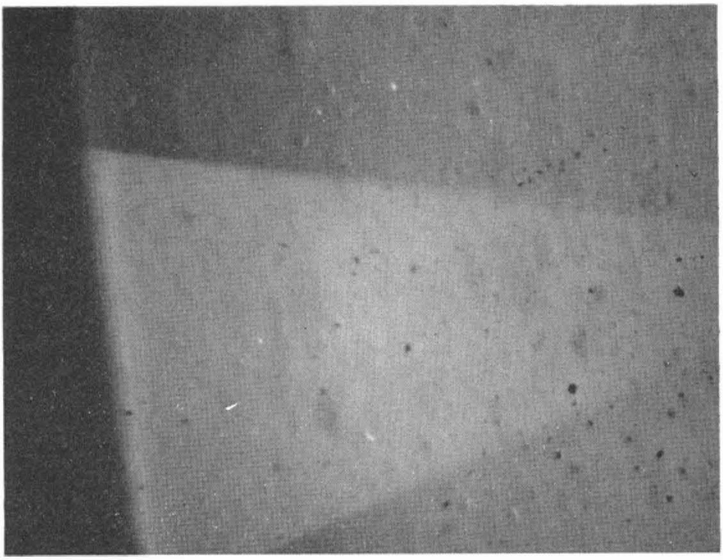

FIG. 3. Obsidian—Crystallite inclusions in pavilion, transmitted light. 30 ×.

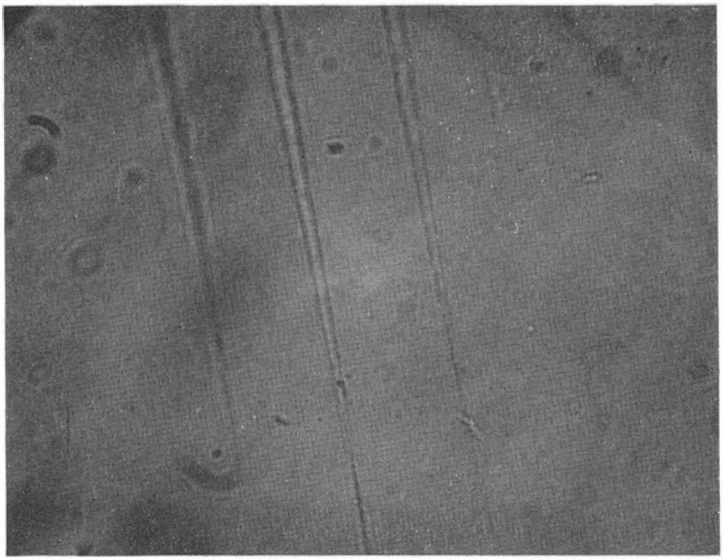

FIG. 4. Obsidian—Tubes which appear as inclusions but are probably end results from the polishing process, transmitted light. 200 ×.

facet junction led to the conclusion that these inclusions are probably the result of the polishing process.

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THE FLUORESCENCE OF SCAPOLITE

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THE fluorescence of scapolite has been attributed to uranium by Webster[1] on account of the discrete nature of the spectrum. The structure consists of the superimposition of a vibrational series on an electronic transition. Structure of this type in a spectrum is not restricted to uranium. Kirk[2] has shown that sulphur is the activator in fluorescent varieties of sodalite and related materials, including scapolite. He manufactured similar materials by the heat treatment of mixtures containing sulphur. Recently it has been suggested[3] that the likely form of the luminescent centre is the S_2^- molecular ion, since the frequency difference between bands in the series is in the range 500-600 cm^{-1}. For comparison, the frequency difference for the uranyl group is in the range 800-950 cm^{-1}.

Simple tests have been carried out which support the role of sulphur. A sample of the opaque massive yellow variety found in Canada had the characteristic strong yellow fluorescence under long-wave ultraviolet radiation. It was found to have 0·57 wt. % of sulphur by electron microprobe analysis. However, a transparent scapolite, probably from Burma, showed only a weak red fluorescence under short-wave ultraviolet radiation. In this case no sulphur was detected by electron microprobe analyses, but iron was found to be present to the extent of 0·16 wt. % and the sample showed an absorption spectrum characteristic of the ferrous ion. Iron is not an activator and tends to quench luminescence. It is not clear what is causing the weak red fluorescence, especially as both manganese and chromium are present to an extent less than 0.06 wt. %.

As a final check on the uranium hypothesis autoradiographs ranging from 3 to 66 days were taken of the two types of scapolite and of a zircon containing 0·57 wt. % equivalent uranium as independently determined by Vance and Anderson[4] using neutron activation analysis. It was shown that equivalent uranium is present in the massive variety to an extent of only 50 ppm and the transparent variety had no detectable uranium with an upper limit of 20 ppm. If the radioactivity is due to thorium it would have to be present in treble the estimates based on uranium. Although it appears certain that sulphur rather than uranium is the principal activator, more research is needed to decide whether small amounts of sulphur are also the cause of the weak red fluorescence in the transparent scapolite. Kirk[5] has also shown that sulphur can cause a weak red fluorescence when suitable mixtures are heat-treated for a short period, but this fluorescence is reported as being excited by long-wave ultra-violet radiation.

I am indebted to the Department of Geophysics and Geochemistry in the Australian National University which kindly carried out the electron microprobe analyses.

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Gemmological Abstracts

Bastos (F. M.). *Brazil, Land of Tourmalines.* Lapid. Journ., 1972, 26, 8, 1224-1229. 8 illus.

An account of the occurrences of tourmaline in the classic and new Brazilian locations. The best specimens come from Barra de Salinas. Methods of recovery from pegmatites and modes of occurrence are discussed.

M.O'D.

Beckwith (P. J.), Hutton (D. R.), Troup (G. J.). *Optical & radio frequency spectroscopy of impurities in blue zoisite.* Australian Gemmologist, 1972, 11, 7, 20-22. 3 figs.

A study of the impurities causing the colour in blue zoisite with particular interest in the vanadium content, 1% being the amount which gives the colour. The vanadium may substitute for aluminium. The optical spectrum was displayed on a recorder for each of the a, b and c vibration (X-ray) directions, the range of the spectrum being from 4000Å to 8000Å. Measurements on heat-treated stones show that the yellow spectrum becomes identical to the blue. The experiments are proceeding.

R.W.

Cassedanne (J.) *Le gite de cordierite gemme de Picui* (Occurrences of cordierite, a gem from Picui.) Bull. Assoc, Française de Gemm., 1972, 33, 10-12.

A description of the discovery of cordierite in the vicinity of Picui, in the State of Paraiba, Brazil. Specimens are found in a mica schist as nodules with sillimanite and garnet found in association. Cordierite is also found in quartz veins. Gem quality stones are found with pleochroic colours of a deep violet and a milky greenish-grey. The specific gravity was found to be within 0·02 of 2·63, the hardness less than 7, and the refractive indices 1·538 and 1·551, giving a birefringence of 0·013.

M.O'D.

Coe (J. C.). *Feldspar, a unique mineral family.* Lapid. Journ., 1972, 26, 9, 1286-1290. 9 illus.

A review of the gem feldspars illustrated with colour plates. Common confusions are explained, particularly between aventurine quartz and amazonite. Most of the possible gem varieties of the orthoclase and plagioclase feldspars are discussed.

M.O'D.

Cotty (W. F.) & Wikks (E. M.). *Differences between diamonds from different sources.* Intern. Criminal Police Rev., 1972, 27, 150-156. 7 figs.

The proportions of unbroken gem quality diamonds in the different morphological forms (octahedron, rhombic dodecahedron, and cube) are variable between different sources but fairly constant for any one source. It is thus possible, given sufficient numbers of diamonds from different sources, to identify the various sources with some degree of certainty. For the Yakutian pipes at least, the size distribution within a mine is constant with depth, thus different sources could also be compared on the basis of a size variation.

R.A.H.

Crowningshield (R.). *Developments & Highlights at G.I.A.'s Lab. in New York.* Gems & Gemology, 1972, XIV, 2, 50-57. 18 illus.

Details of a number of jade-like articles including articles made of grossular/idocrase, serpentine/zoisite, hydrogrossular and natural coloured green quartzite. An emerald from Mozambique and an emerald-green YAG with myriads of oriented small bubbles looked a sleepy-green. Foil-backed and abraded diamonds, and a brown diamond with a colourless diamond inclusion causing it to show a strong anomalous birefringent pattern between crossed polars are mentioned, as well as a flux-fusion synthetic ruby with a 'seed' of synthetic Verneuil-grown ruby. The article concludes with a discussion on the laser drilling of diamond.

R.W.

Ferguson (J.) & Fielding (P. E.), *The origins of the colours of natural yellow, blue and green sapphires.* Australian Journ. Chem., 1972, 25, 1371-1385. 7 figs.

Spectral analysis of yellow sapphire containing 0·99 wt. % Fe, from the Anakie field in Queensland, shows that the visible portion of the spectrum is dominated by a complex peak in the region of 22 000 cm^{-1}, which corresponds with the $^6A_1 \rightarrow {}^4A_1, {}^4E$ spin-flip transition of Fe^{3+}. Other spectral features are attributed to Fe^{3+} ion pairs. The blue and green colours of sapphire are attributed to Ti^{4+}–Fe^{2+} interaction, which gives rise to absorption bands at 17 800 and 14 200 cm^{-1}. Absorption in the IR region of blue and green sapphire as well as synthetic flux-grown yellow sapphire indicates Fe^{2+}–Fe^{3+} interaction.

E.H.N.

FURBISH (W. J.). *Unusual Quartz Inclusions in North Carolina Emeralds.* Gems & Gemology, 1972, XIV, 2, 34-37. 4 illus.

Rounded quartz crystals are found as inclusions in emeralds from the mine near Little Switzerland, North Carolina. A study is also made of the inclusions in these included quartz crystals. It is suggested that the inclusions described may well be characteristic for emeralds from this mine.

R.W.

HARTIG (H.). *Entwurf eigener Facettenschliffe.* (Designing one's own facet cuts.) Z. Dt. Gemmol. Ges. 1972, 21, 3, 160-174.

The author encourages amateur lapidaries to try out new ideas and design their own styles of cutting. He has worked out a basic classification listing various traditional and new cuts according to whether the table is 3, 4, 5, 6, 8 or 12-sided (the standard brilliant-cut being 8-sided). According to Hartig a "pure" cut includes the trap, brilliant, star, cross and spiral cuts, but also such variations as the Swiss cut (8/8), zircon, double brilliant and Portuguese cuts. Some of these cuts lend themselves to being produced in various ways, such as a French, a double star and a ray cut, as illustrated in the articles. He then goes on to explain mixed cuts (such as the "ladybird" and the "Juliana") and various fancy cuts, which include the Princess cut by Nagy, the Colorant by Elbe, antique shapes, such as the Mogul, and very modern irregular shapes, such as the cap or bastard cut. From there the author goes on to suggest designing new forms of cutting, some being produced by using a traditional or newer cut and adding or omitting some facets, combining various cuts or altering the ratio of facets to each other. Many ideas are illustrated.

E.S.

LIDDICOAT (R. T.). *Developments & Highlights at G.I.A.'s Lab. in Los Angeles.* Gems & Gemology, 1972, XIV, 2, 38-46. 16 illus.

A repair to a natural ruby by filling with epoxy resin and an unusual synthetic pink sapphire with natural-like parallel formations but given away by a gas bubble are interesting items reported. There is a discussion on the variations of the constants for rhodolite garnet. Three unusual opals are recorded and the results of an examination of a black diamond. A blue Mabe pearl with the colour due to a black pitch-like cement being used to hold in the bead, a crystal of the spinel group which showed pronounced 'trigons' on the octahedral faces, a large rock crystal vase, thought at first to be glass, and a glass 'jade' substitute are mentioned. The story of an opal doublet and a remarkable natural sapphire with an 'alexandrite' colour-change complete the account.

R.W.

MALES (P. A.). *Why Crystallography?* Australian Gemmologist. 1972, 11, 7, 4-6.

A note on the value of elementary crystallography in the study of gemmology. The use of the optical indicatrix is explained and the value of the Miller Indices in its simpler form is discussed.

R.W.

MEYER (H. O. A.) & BOYD (F. R.). *Composition and origin of crystalline inclusions in natural diamonds.* Geochim. Cosmochim. Acta, 1972, 36, 11, 1255-1273. 6 figs.

Monomineralic inclusions (10 to 200 μm) of olivine (11), garnet (14), chromite (6), enstatite (4), and diopside (2), in diamonds from Africa, Venezuela, and Thailand have been analysed by electron microprobe and their cell parameters determined. The chemical compositions of many inclusions resemble those of minerals occurring as xenocrysts and in peridotite zenoliths in kimberlite; however, there are consistent differences. It is suggested that the diamonds formed from igneous melts and that the inclusions crystallized in equilibrium with these melts. In contrast, the minerals in peridotite zenoliths may have equilibrated at lower temperatures either in a volatile-rich liquid or in the solid state. The inclusions would not have participated in this lower temperature equilibration because they were armoured by diamond.

C.M.B.H.

MONFORTE (A.) *A tectónica lineamentar e a repartição espacial e genetica das fontes primárias de diamantes.* (Tectonic framework and particular genetic distribution of primary diamond sources.) Serviços de Geologia e Minas, Angola, 1970, Boletim 22.

A survey of diamondiferous localities in north-eastern Lunda. The concentrations are explained in two distinct theories; that diamonds occur from one primary source only and that their transportation is complex; the other that the diamonds are found from multiple sources with little subsequent movement. A further theory is that many kimberlitic pipes may supply diamonds whose transportation may be complex or simple.

M.O'D.

MCLOUGHLIN (D.). *Gemmology in Japan.* Australian Gemmologist, 1972, 11, 7, 18-19.

An account of a visit to the headquarters of the Gemmological Association of All Japan in Tokio. The Association is not financially supported by outside bodies. Its main income is derived from membership and student fees and the issuing of gem identification certificates. The students gem course takes six months consisting of four full days each month and one course is held each year to allow for lectures to be held in other towns. The Association is accepted as a scientific body by the public.

R.W.

TAYLOR (J. S.). *The story of White Cliffs opal field.* Gems & Gemology, 1971, XIII, 11, 334-343. 8 illus.

Reprinted from the Commonwealth Jeweller & Watchmaker with additions. The story is told of the history of the finding and of the mining of the black opal deposits of the White Cliffs field in New South Wales. Much is told of the personalities of those early days. Nothing is told of the situation after the end of the 19th century.

R.W.

THOMPSON (J.). *Auditing in depth.* Coopers Journal (House Journal of Cooper Brothers, London Accountants). 1972, 21, 17-18. 2 illus.

The story of a trip made by one of the firms auditors to assess the potential of a cultured pearl farm at a small island in the Persian Gulf. Kish Island lies a few miles off the coast of Iran and north of

Abu Dhabi in the Trucial States. The farm and factory is run by the Persian Gulf Pearl Company and is operated by a young Australian couple and two Japanese, with a number of local divers. It is apparently a pilot scheme so far.

R.W.

TOMBS (G. A.). *Valuation principles as applied to coloured gemstones.* Australian Gemmologist, 1972, 11, 6, 9-14,

Taken from an address given by the author to the New South Wales Gem Club, the article takes on an ambitious subject. The author has taken considerable pains and the basis he gives for his pricing has merit. The article makes excellent reading and the author wisely refers to pitfalls. The prices are given in Australian dollars (currently A2·20 dollars to the English pound).

R.W.

WEBSTER (R.). *Some experiences and investigations into damage to gem materials.* Lapid. Journ., 1971, 25, 1077-1084. 2 photos.

Damage to gem materials can be caused either by percussion (knocks, blows, ultrasonic cleaning), by undue heating, by radiation (below the thermal range), or by chemical attack (in the jewellery trade, by household chemicals or by cosmetics).

R.A.H.

WILKINS (R.). *An amateur gemcutter looks at refractometers.* Lapid. Journ., 1972, 26, 432-434. 1 fig.

For a plane polished surface of a transparent material in air with normal incident light, the percentage of reflected light $R = [(n-1)/(n+1)]^2$. For high refractive indices it is thus easier to determine the value of n indirectly by measuring the reflectivity with a photo-cell and amplifier. The working curve, using standards such as quartz and rutile, is essentially linear.

R.A.H.

ANON. *New mosaic triplet.* Australian Gemmologist, 1972, 11, 7, 23 & 32. 1 illus.

An account of a new type of composite stone in which the central layer is a coloured photographic transparency of a coloured polygonal pattern of three basic colours. It is so-far purely experimental.

R.W.

BOOK REVIEWS

Australian and New Zealand Gemstones. Edited by Bill Myatt. Paul Hamlyn Pty. Ltd. Dee Why West, New South Wales, Australia, 1972. pp. 511. Illus. in black-and-white and in colour. Coloured maps. Price on application to the publisher.

This large book is divided into four sections, (a) general information, dealing with prospecting, collecting, jewellery-making and tables, (b) geology, (c) gemstone identification and (d) gemstone localities. Each section is compiled by a specialist team and is accompanied by coloured plates. The book is directed at the serious amateur rather than the professional gemmologist; the section on gem identification would have been helped by tables and more diagrams of testing instruments. There is a short glossary at the end of the geology section and a good bibliography at the end of the book, where it is accompanied by coloured maps with gem locations marked. The index is surprisingly short. In all, an excellent book with high-class coloured plates.

M.O'D.

Campbell (N.) and Stone (D.), *Gemstones of New South Wales.* Jacaranda Press, Melbourne, 1969, pp. ix. 125. Illus. in black-and-white. £1·20.

A brief introduction to gems and their crystal form leads to detailed descriptions of the species likely to be encountered in the fields of New South Wales, individual areas of which are outlined with sketch maps. There are hints for prospectors, notes on polishing methods and a glossary. An interesting book, bearing in mind that the State of New South Wales includes Lightning Ridge and White Cliffs.

M.O'D.

Cooper (L.) and (R.). *New Zealand Gemstones.* A. H. and A. W. Reed, Wellington, 1972. pp. 125. Illus. in black-and-white and in colour. £2·10.

Despite the general nature of the title, most of this book is devoted to the fashioning of gemstones found in New Zealand. There are good maps of gem deposits and the coloured illustrations are good. A useful guide for the New Zealand amateur.

M.O'D.

EVANS (I. O.). *Rocks, Minerals and Gemstones,* Hamlyn, London, 1972. pp. 128. Illus. in black-and-white and in colour. £1·75.

A pleasingly illustrated book which depicts rock formations as well as the colourful crystals excitingly photographed, which one has come to expect from books in this price range, of which this particular item is otherwise a characteristic example. The section on gemstones is loosely written and while mentioning hardness and streak together with frequent allusions to glassy lustre leaves out refractive index. The book ends with a section on cutting.

M.O'D.

HUGHES (G.). *The Art of Jewellery.* Studio Vista, London, 1972. pp. 248. Illus. in colour and in black-and-white. £8·00.

The author suggests that jewellery may be the oldest of the arts and in this survey of the jeweller's craft from prehistoric times to the present day he presents examples of the finest pieces from Egypt, Crete and Babylon up to work created for the Diamonds-International awards. The book opens with an account of the evolution of design, including a particularly interesting survey of art nouveau, examples of which are beautifully illustrated. The next section, under the heading "The Artist Jeweller", deals with design and workmanship in leading countries today. A chapter on technique describes the development of various aspects of the craft; this section also is superbly illustrated. A valuable list of the major jewellery collections and some thoughts on value conclude this magnificent book.

M.O'D.

MACFALL (R. P.). *Gem-hunter's guide.* Fourth edition. Thomas Y. Crowell Co., New York, 1969. pp. 279. $6.95.

A state-by-state guide to the gemstone resources of the United States, with earlier chapters on crystal forms and other means of identification of gem material in the field. Good sketch maps are provided for the more important localities and up-to-date information on availability of access is given.

M.O'D.

ROGERS (C.). *Finding Britain's Gems.* Lapidary Publications, London, 1972. pp. 62. 30p.

Originally published as an article in the magazine *Gems*, this is the work of a number of writers each of whom covers a particular area of the British Isles, listing the gem materials to be found there. No attempt is made to enhance the quality of the specimens and the information given on specific localities is clear and sensible. A useful map shows the major gemstone sites, and the whole book is designed for easy reference and portability.

M.O'D.

SCARFE (H.). *Lapidary in a Nutshell.* Lapidary Publications, London, 1972. pp. 44. 30p.

This handy book provides an introduction to the lapidary arts for the amateur. Most of the book deals with faceting rather than tumbling and the best methods of using the large choice of machinery now on the market are suggested. Diagrams and photographs illustrate various techniques.

M.O'D.

SCHUBNEL (H.-J.). *Pierres Précieuses dans le Monde.* Horizons de France, Paris, 1972. Illus. in black-and-white and in colour. pp. 190. 68F.

The book was originally written as a thesis for the degree of Doctor of Science of the University of Paris and the later sections reflect this earlier ambition. The book opens with a general review of gems followed by an account of their economic importance, including tables of production and consumption and relative values of the important stones over the years. The production tables cover up to 1969 in most cases; these facts are very difficult to find elsewhere, save in the United States Minerals Yearbooks. The author next reviews the museums of the world and explains the reasons for the changes in fashion which affect gemstones. The guide to mineral and gem collections is most useful and it is pleasant to see that the author regards the collection in the Mineral Gallery of the British Museum, (Natural History) as the finest in the world. The next part of the book deals with the occurrence and working of precious stones together with photographs taken at the mines. The final part of the book explains the methods of gem testing, including tables, and an excellent bibliography which for once contains periodical articles. The best part of this important book is the section on inclusions which is backed up by some fine coloured photographs.

M.O'D.

SINKANKAS (J.). *Gemstone and mineral data book.* Winchester Press, New York, 1972. pp. 346. $8.95.

The book is subtitled "A compilation of data, recipes, formulas and instructions for the mineralogist, gemologist, lapidary, jeweler, craftsman and collector." Chapters begin with weights, measures and conversions, chemicals, lapidary equipment, abrasives and jewellery manufacturing data. From chapter six to the end of the book the material is more specifically gemmological and includes full tables of minerals under their specific gravities, hardnesses, crystal system and habit. Colour changes are listed by mineral and the last chapter deals with the optical properties of minerals and gems.

In the preface the author asks for additional data to be sent to him for inclusion in further editions. One can scarcely imagine anything missing from the existing edition; the only criticism being that the type-face is clear but the layout somewhat cramped—but in a book of such reasonable price this is inevitable. The book is an example of painstaking compilation of data and the serious gemmologist must have this book constantly at hand.

M.O'D.

SMITH (G. F. H.) *Gemstones.* Revised by F. Coles Phillips. 14th Edition. Chapman & Hall, London, 1972. 580 pp. 35 plates (12 in colour). £7·50

Gemmologists should be very grateful to Professor Phillips for undertaking once more the formidable labour of bringing out this up-to-date fourteenth edition of Dr. Herbert Smith's classic work which, for the older ones amongst us, served in its early editions as our gemmological "bible". It is difficult for anyone who has not experienced the trials and tribulations of authorship even of a small book to appreciate the care and hard work needed even to revise a book of this stature.

Surprisingly, the publisher is no longer Methuen but Chapman & Hall, but the printers are still Richard Clay of Bungay, and this has ensured that the book has much the same workmanlike form and feel as the last edition. Publishers find it wise, in issuing a new edition of a book, to alter the frontispiece if nothing else, as a potential customer, flipping through the pages of the volume in a bookshop will notice any change here and assume it to be symptomatic of other and more important changes. In this fourteenth edition there is in fact no frontispiece, but the wise step has been taken of replacing all the previous colour plates which were based on water-colour drawings by a series of fine colour photographs taken at the Institute of Geological Sciences under the skilled direction of Mr. E. A. Jobbins.

Each of the photographs occupies one half of a page, which provides an adequate scale for the stones to be displayed. The relationship to natural size is not stated and may well vary a little, but the names, the weights and in most cases the origins of the stones are given in an excellently arranged "Key" immediately before the plates, which are grouped together near the middle of the book. The specimens, which include rough as well as cut stones and show all available colour-varieties of each species, are taken from the very fine collection to be seen on the ground floor of the Geological Museum in Exhibition Road, South Kensington. Undoubtedly these plates add very appreciably to the value and (alas!) to the price of the book.

In undertaking the revision of a book there is a natural tendency to think first of the additions that must be made to bring it up to date and to make it more useful to the present-day reader. What is far less easy is to eradicate the signs of old age which often lie dormant in the text for a generation, or can even be seen in some of the illustrations. An example in the present case is seen in Fig. 75—a drawing which represents a balance arranged for hydrostatic weighing. This has been used since at least the 1923 edition, and might now be retired in favour of a more credible piece of apparatus to suit modern times. Illustrations in the refractometer chapter also need a face-lift, where five drawings are concerned with the 1907 model of the Herbert Smith refractometer and its limited scale, and there are none shown of any newer instrument except in Plate I where the recent Rayner "Dialdex" is shown. One recognizes the piety that urged these retentions, since both the book and the refractometer were Herbert Smith's greatest contributions to gemmology, but one feels that he himself would have recognized the need for change.

Another illustration due for correction is on Plate 19, where the zircon spectra shown are in reversed position, with the red absorption bands in the violet and vice versa. This block was taken from the Gemmologist for August 1939, where the bands are shown correctly placed, which is puzzling. The same error was in Coles Phillip's 1958 revision, and we as readers were remiss in not warning him of the fact.

On the positive side there are many useful and welcome additions. The microscopes now recommended include the Olympus Stereoscopic Zoom Model JM, a fine instrument of Japanese manufacture, which is specially designed for the examination of gemstones. This incorporates built-in bright and dark-field illumination and also a special inclined illuminator.

The most important new material, as one might expect, is concerned with the new synthetic stones, which multiply in these days at such a disturbing speed. These are well described, but there is perhaps too complacent an attitude to the danger they represent. Thus to say (p. 195) that synthetic quartz is unlikely to be often encountered in jewellery has already been shown untrue, as synthetic citrine is apparently being marketed on a very large scale. Also the statement (p. 203) that the production of modern synthetic stones has greatly reduced the need for composite stones has not been borne out. Some of the trade's worst headaches in recent years have been ingenious forms of composite stones specially designed to deceive not merely the jeweller or public, but the gemmologist.

Newly discovered varieties of natural gemstones such as blue zoisite and transparent green grossular have been mentioned, but in a book which includes such extreme rarities as taaffeite, painite and ekanite one is surprised to note that scheelite is omitted, since both natural and synthetic scheelite can look quite magnificent when brilliant cut, and have a considerable resemblance to diamond.

The criticisms included in this review are of trivial importance when compared with the excellence of the production as a whole. One can recommend this latest version of a famous book with complete confidence to any serious student of gemmology and indeed to any lover of precious stones.

B.W.A.

TANK (R. R.). *Indian Gemmology*. Dulichand Tank, Jaipur, 1971, 171 pp. Rs.15.

An English version of an unusual book on gemmology published as *Ratna Prakash* in 1961. The book is not a scientific treatise but a classification of gems into their suitability for jewellery; those deemed advantageous for medicinal purposes; those with astrological connections and those needed for the manufacture of toys and, surprisingly mortars., A survey from ancient times about Indian romance and mythology of gems and pearls, intermingled with technical data. Some typographical errors are corrected at the end of the book, and the binding is not impressive. However, *Indian Gemmology* presents a charming and unusual facet of gemmological interest.

S.P.

WALLER (E.). *And there's opal out there*. Lansdowne Press Pty Ltd., Melbourne, 1969. pp. 151, maps. $5.50.

Set as reminiscences of three opal miners this book gives an exhilarating picture of life in the Lightning Ridge opal fields. There are entertaining sketches and maps showing the main opal fields of Australia. A good deal of useful information is given.

M.O'D.

WALTON (Sir James). *Tabellen zur Edelstein-Bestimmung*. Translated by W. F. Eppler. 2nd edition. Rühle-Diebener-Verlag KG, Stuttgart, 1970. pp. 83. DM.20·00.

A translation of the author's *Pocket Chart of Ornamental and Gem Stones*, for some time out-of-print in Great Britain.

M.O'D.

WILLMAN (L. D.). *Gem and mineral localities of South Eastern United States*. Published by the author at Jacksonville State University, Alabama 36265. With maps. 2 vols. Vol. 1. pp. vi. 97. Vol. 2. pp. x. 271. $11.00.

The book is divided into two sections, the first consisting of minerals listed alphabetically and the second giving mineral locations arranged by state and county. A particularly useful feature is the provision of geological maps with gem locations superimposed. The states covered are rich in gem materials and include Alabama, Georgia, North Carolina, Virginia and Tennessee.

The book is reproduced from typewriting but lacks nothing in clarity. The localities are described in full detail including the precise whereabouts of the gem occurrence. Many of the finds are vouched for personally by the auhtor.

M.O'D.

WHITLOCK (H. P.). *The story of the gems.* Emerson Books, Inc, New York, 1963, pp. 206. Coloured plates. £7·50.

A re-issue of a popular American study of gems which first appeared in 1941. The book covers all the better-known gems, with a good deal of historical anecdote, and leaves most of the scientific data for a table at the end where it is accompanied by a short bibliography. The coloured illustrations are representations, not photographs, which would have been preferable in a book of this price.

M.O'D.

WYNDHAM (R.). *Enjoying gems.* Stephen Greene Press, Brattleboro, Vermont, U.S.A., 1972, pp. 128. $4.95.

A small-format guide to the better-known gemstones written for the amateur who is interested in the legendary and historic aspects of stones. The author writes with an engaging flavour of humour and includes some observations on the scientific background to the subject, including references to the cause of colour in amethyst which he admits still causes controversy and to the cause of the play of colour in opal, stated to be due to cracks in the material—an error, but the book does not set out to be a scientific treatise. There are some attractive illustrations and the book concludes with a short bibliography.

M.O'D.

ASSOCIATION NOTICES

JOURNAL OF GEMMOLOGY

Mr. J. R. H. Chisholm, M.A., F.G.A., has been appointed editor of the *Journal* in place of Mr. G. F. Andrews, who has acted in that capacity since 1947, when the *Journal* first came under the control of the Association. For several years Mr. Chisholm has undertaken much of the proof-reading. Mr. G. F. Andrews has been appointed librarian of the Sir James Walton Library, which is jointly controlled by the National Association of Goldsmiths of Great Britain & Ireland and the Gemmological Association of Great Britain.

SITUATION VACANT

The Gem Testing Laboratory of the London Chamber of Commerce and Industry requires a young London-based F.G.A. to augment the present staff.

Applications to Mr. F. T. Atkins, London Chamber of Commerce and Industry, 69 Cannon Street, London EC4N 5AB.

GIFTS TO THE ASSOCIATION

The Council of the Association is indebted to the following for gifts to the Sir James Walton Library:

Mr. I. Pike, Cairns, N. Queensland, Australia, for a collection of mineral specimens of topaz, corundum, peridot, calcite, fluorspar and agate from Queensland, Australia. Also four pieces of black coral from the Great Barrier Reef in Australia.

Mr. D. Bradshaw, London, for a red spinel crystal.

Mr. A. Chikayama, Tokyo, Japan, for his book "Jewellery", printed in Japanese.

Mr. and Mrs. Ki Nemoto, Khartoum, Sudan, for a piece of petrified wood from the Bayuda Desert of North Sudan, approximately 160 million years old.

The China Development Corporation for a book entitled "Chuo Pao Shih Chieh (Jewels World)" by the Corporation's late President, Mr. Felix S.Y. Chang, G.G., F.G.A.

Japanese translation of R. T. Liddicoat's *Handbook of Gem Identification* published to celebrate the tenth anniversary of the Gemmological Association of Japan, presented by Mr. Taichiro Imai, F.G.A.

The Gemmological Association of All Japan for a Diamond Proportional Handscope.

MEMBERS' MEETINGS

London

On the 29th January, 1973, Mr. B. W. Anderson, B.Sc., F.G.A., gave a talk to members at Goldsmiths' Hall, London, entitled "1925 and All That". A full report will appear in the July issue of the *Journal.*

Midlands Branch

Mr. Alan Jobbins, B.Sc., F.G.A., of the Institute of Geological Sciences, London, spoke to members of the Midlands Branch at the Auctioneers' Institute, Birmingham, on the 2nd February, 1973. The subject of the lecture was "Jade".

Scottish Branch

A meeting was held on the 16th January, 1973, at the North British Hotel, Glasgow, when Mr. Alan Jobbins, B.Sc., F.G.A., spoke on "Gemstones of South-East Asia." His talk was illustrated by colour slides.

RETIRING SECRETARY

Mr. G. F. Andrews thanks all those members who contributed to his retirement presentation.

OBITUARY

Professor Samuel Tolansky, Ph.D., D.Sc., D.I.C., F.R.S., who died on Sunday, March 4th, 1973, at the age of 65, was a man of great ability and colourful character, who despite being an exceptionally busy physicist of international repute, found time to set and mark examination papers for the Gemmological Association of Great Britain.

He was known to the general public through his articulate television broadcasts in documentaries and then explaining aspects of the Apollo Moon missions, when he forecast that there would be "industrial" diamonds on the Moon and later, in 1969, that the surface would be covered by tiny glass "marbles". He was one of the first group of scientists to be chosen to study dust brought back from the Moon, and, from his sample, picked out about 200 glassy spherules, each smaller than a pinhead, thus proving his theory in less than a year in the face of learned scepticism.

Professor Tolansky was born in Newcastle-on-Tyne of Russian Jewish parents and was educated at the Universities of Newcastle, Berlin and London, but retained always his Newcastle accent. After 12 years as a member of the staff of the Physics Department of Manchester University, he was appointed Professor of Physics at the University of London and Director of the Physics Laboratory at Royal Holloway College, London University, posts he held for 26 years until his death.

He made significant contributions to the understanding of optical and electronic phenomena, branches of research that are only distantly related. The first concerned interferometric studies and optical studies of surfaces and the second hyperfine structure studies of line spectra and atomic nuclear spin. He and his very active research school were responsible for the introduction of many research techniques.

It was in 1945 that, through the use of his multiple beam interferometry methods, he became interested in diamond, the height and depth features on the surface of which he was able to photograph with an effective magnification of half a million times. This brought him into contact with Dr. J. F. Custers, P. Grodzinski, and many others in the diamond industry, and eventually to his association with the G.A. Some of the research workers who passed through his laboratory also became interested especially in diamond, among them Dr. E. Wilks.

Teaching was supplemented by writing scientific papers, articles and books in simple, concise and very readable manner, whether the book was for the specialist such as "Microstructures of Diamond Surfaces" (N.A.G. Press, London, 1955) or for the general reader, such as "The History and Use of Diamond" (Methuen, London, 1962). Lecturing to audiences such as Fellows of the G.A. appeared to be almost a relaxation for Professor Tolansky, as he obviously enjoyed the experience as much as his audience.

He was elected a Fellow of the Royal Society in 1952.

The range of activities in which he took part actively was astonishing. They included psychology, music, folklore, history of the Old Testament, and gardening. He was Chairman of the Governors of the Richmond Institute of Further Education and also a Governor of Sir John Cass College, City of London Polytechnic, which houses the centre of the silversmithing, jewellery, and allied trade training in London, including gemmology and gem diamonds. From the start of the gem diamond course in 1964, he enthusiastically accepted the task of examiner and set and marked the papers himself.

PRESENTATION OF AWARDS

The 1972 Presentation of Awards was held at Goldsmiths' Hall on the 27th November, 1972. Mr. Norman Harper, Chairman of the Association, presided, and welcomed members, especially those who had come from overseas. "It is always a pleasure" Mr. Harper said "to hold the Presentation of Awards in this splendid hall and we are most grateful to the Goldsmiths' Company for making it available to us once again."

He announced that 448 candidates had sat for the 1972 preliminary examination, the highest ever, and 284 for the diploma, which was 23 less than the previous year. Overall, however, the number of entries for the examinations was the greatest there had been. In the Gem Diamond Examination there were 41 entries.

Mr. Harper said that he was delighted to see various members of the Spanish Gemmological Association, including their President, M. Masso, who has been attending these occasions for the past five years. "It must be a matter of great pride and satisfaction" the Chairman continued, "to those responsible for gemmology in Spain that when one writes to the University of Barcelona one receives a reply which is headed 'School of Gemmology, Barcelona University'."

In introducing Dr. G. F. Claringbull, who presented the diplomas, Mr. Harper said, "In 1937 the late Dr. Herbert Smith recommended that Dr. Frank Claringbull would be a suitable person to act as an Examiner for the Association. He was appointed in

1938 and served in that capacity until 1970. It was a long stint that interrupted summer holidays and we are most grateful to him for the work he did in that capacity. This year the Association, at its annual meeting, elected Dr. Claringbull as its President, in succession to the late Sir Lawrence Bragg. Dr. Claringbull is an eminent person in his own particular field of mineralogy and crystallography, but he is here tonight to present the awards in his office as President of the Association."

Dr. Claringbull congratulated those who had gained their diplomas and referred to the high standard of the examinations that had been maintained since they had first commenced. That insistence on a high standard had been correct was reflected in the ever increasing numbers of candidates from overseas who wished to obtain the Association's diploma.

He recalled the situation of the early 30s when the advent of synthetic emeralds was causing problems for the jewellery industry and reminded the audience of the subsequent development of other synthetics such as synthetic rutile, strontium titanate, and finally of diamond. One of his early recollections was the forecast that one kind of gemstone which would always defy synthesis was the star stone. This, like many other predictions, had long since been proved false by technologists.

The early production of synthetic corundum and spinel by the Verneuil process had been a direct attempt to produce synthetic materials to substitute for natural stones, although subsequently they had been used industrially for bearings, etc. and more recently in lasers, but the production of the most recent synthetics stemmed from the development of the science of solid state physics. This had come about partly because of the demands of modern technology, which had caused to be made available the large capital investment necessary for the means of production of suitable crystals. Crystal growing had become an industry. One offshoot of this had been the unusual substances like yttrium aluminate (yttrium aluminum garnet) which were offered as good substitutes for diamond under spurious names incorporating anything up to the first five letters of the word diamond and implying a misleadingly close resemblance in properties. None of these products could begin to measure up to diamond in a number of ways. It was interesting scientifically that no substance other than synthetic diamond itself had so far been produced which had the hardness of diamond.

When as an examiner he first came into touch with the Association there were worries about nomenclature including the use of such names as quartz-topaz for citrine, and various prefixes to diamond for rock crystal. It was surprising that after nearly 40 years in which the Association had done excellent work in identifying by its diploma those who were well qualified to discriminate between all types of gemstones, the old problem was still with us in what seemed to him a more subtle form. Ought the Association perhaps to engage in an educational role at the public level by making more widely known the facts about natural and synthetic stones, and especially about the modern simulants of diamond?

Yonder Towan Field Centre

The 1973 programme of the Yonder Towan Field Centre includes:

Rock, gem and mineral hunting 12th–19th May; 8th–15th September; 6th–13th October. Gem hunting and jewellery making 27th October–3rd November.

Details from Mr. M. G. Weller, M.B.E., Yonder Towan Field Centre, Beachfield Avenue, Newquay, Cornwall.

CORRESPONDENTS WANTED

Gemmologist, 26 years, with a fair knowledge of Japanese, wishes to contact and correspond with those interested in gemmology and gem business from all parts of the world. Z. Ameen Saleh, c/o M.A.C.M. Saleh Jewellers & Gem Merchants, 63 York Street, Colombo 1, Sri-Lanka (Ceylon).

COUNCIL MEETING

At a meeting of the Council of the Association held on Monday, 29th January, 1973, the following were elected to membership:

FELLOWSHIP

Abhyankar, Jagannath S., Poona, India. D. 1972
Bennett, Frederic C., Hazel Grove, Cheshire, D. 1972
Butterworth, Joan L., Rochdale, D. 1972
Clarke, Roger D., Maidstone, D. 1972
Connard, Charles, R., Southport. D. 1972
Fernando, Siddhamarakalage U.H., Idar-Oberstein, W. Germany. D. 1972
Frost, Julia J., Cambridge. D. 1972
Gardner, Wilfred C., Reading. D. 1972
Hammonds, Robert, Newcastle-on-Tyne. D. 1972
Johnson, John W. S., London. D. 1972

Johnson, Robert C., Nuneaton. D. 1972

Kean, John S., Ayr, Scotland. D. 1972

Knight, Irene, Liverpool. D. 1971

Lyall, Linda, Alloway, Scotland. D. 1972

Lynch, Eric, Wallsend-on-Tyne. D. 1972

MacDonald, Kenneth C., Leicester. D. 1972

Magnussen, Rita H., Drobak, Norway. D. 1972

Miller, Graham J., Chesham. D. 1972

Murto, Kalei K., Soukka, Finland. D. 1972

Ord, Ronald, Harrogate. D. 1972

Peacock, Pamela M., Stourbridge. D. 1972

Plotzeneder, Josef, Salzburg, Austria. D. 1972

Popperwell, Elizabeth, Stockport. D. 1972

Rehtijarvi, Pentti A., Helsinki, Finland. D. 1972

Richmond, Philip S., Mansfield. D. 1972

Sayer, Glynis V., Strood, Rochester. D. 1972

Schrader, Hans-W., Hamburg, Germany. D. 1972

Smith, Betty C., Nottingham. D. 1972

Soratie, Kyllikki, Helsinki, Finland. D. 1972

Sukapaa-Harsunen, Leena, Helsinki, Finland. D. 1972

Sweeney, John M., Rowlands Gill, Co. Durham. D. 1972

Wainwright, Nicholas A., Wirral. D. 1972

Walton, Brian, Dukinfield. D. 1972

Westerback, Simo, Helsinki, Finland. D. 1972

ORDINARY

Adler, Peter, Montreal, Quebec, Canada.

Alden, Philip J., Cape Town, S. Africa

Alexanian, Hagop, Cairo, Egypt

Arseculeratne, Rex F., Gardena, Cal., U.S.A.

Ascher, David S., Santa Ana, Cal., U.S.A.

Ashcroft, Vera, Liverpool.

Ballin, Peter E., Birmingham

Barker, Clement B., Newcastle, Staffs

Baster, Patricia, Enfield

Beattie, Robert, Wisbech

Bergamali, Mario K., Buenos Aires, Argentina

Bergdahl, Sten R., Umea, Sweden

Bishof, James L., Miami Beach, Fa., U.S.A.

Bond, Patricia M., Solihull.

Brown, Anthony J., London

Carter, R. G., Codsall

Clark, Victoria E., Newport-on-Tay, Fife, Scotland

den Brok, Johannes D., Oss, Holland

de Robert, Michel, Paris, France

Fisher, Peter Norman, London

Harris, Louis L., Lincolnwood, Ill., U.S.A.

Hayashi, Hidenori, Tokyo, Japan

Hewitt, Robert H., Gosforth

Hosaka, Masakata, Yamanashi-Pref., Japan

Jenkins, William J., St. Louis, Missouri, U.S.A.

Katoh, Takenori, Kyoto, Japan.

Kerry, Peter E., Wellington, New Zealand

Kobayashi, Shichiro, Yamanashi-Pref., Japan

Kotahwala, Purushottam, D., Jaipur, India

Kubota, Hironobu, Yamanashi-Pref., Japan
Lea, L. A. A., Frankston, Victoria, Australia
Mahuroof, Fahmi N., London
Makidaira, Tadashi, Tokyo, Japan
Marble, Carolyn C., New York, U.S.A.
Mason, John, Harrogate
Merritt, Joan M. B., Richmond
Mills, Joyce, Accrington
Mitsui, Kazuyoshi, Yamanashi-Pref., Japan
Miyabara, Jiro, Yamanashi-Pref., Japan
Mochizuki, Hideko, Yamanashi-Pref., Japan
Mochizuki, Sadae, Yamanashi-Pref., Japan
Morimoto, Tsutomu, Kobe, Japan
Mosielski, Boguslaw S., Toronto, Ont., Canada
Nakamura, Katsuo, Yamanashi-Pref., Japan
Nakano, Satoru, Ooita-Pref, Japan
Nowak, Wladyslaw, Bexley
Oh, David, K. Y. Singapore
Oohara, Minoru, Yamanashi-Pref., Japan
Ono, Hiroshi, Yamanashi-Pref., Japan
Palmer, Eileen M., Liverpool
Pike, Ian K., Cairns, Qld., Australia
Roche, Mary S. R. M., Colombo, Sri Lanka
Rosenberg, Paul, Lake Worth, Fa., U.S.A.
Rossetti, Luigi, Lourenço Marques, Mozambique
Saigusa, Shiged, Yamanashi-Pref., Japan
Scarratt, Kenneth V. G., Ilford
Smith, Brian R., Kingston, Ont., Canada
Takahashi, Norio, Yamanashi-Pref., Japan
Takano, Asatada, Yamanashi-Pref., Japan
Tamura, Yoshitaka, Yamanashi-Pref., Japan
Watanabe, Kunihiko, Yamanashi-Pref., Japan
Watkins, Sandra, Bouldon, Shrops.
Will, Richard, A. F., Salisbury, Rhodesia
Wolfe, Peter H., Windlesham, Surrey
Wood, Ronald S., Peterborough
Yamashina, Toshio, Osaka Pref., Japan
Zacharewicz, Henryk, Toronto, Ont., Canada.

LOOKING INTO DIAMONDS

The British Association for Crystal Growth is arranging a talk "Looking into Diamonds" by Dr. A. R. Lang of Bristol University, which will be concerned with the application of such techniques as x-ray topography. Dr. Lang has many years experience in this field and his work has revealed some interesting features on the growth history of diamonds.

The lecture will be on Wednesday, 18th July, in Lecture Theatre A, College Block, Imperial College, South Kensington, S.W.7., at 6.30 p.m. and members of the Gemmological Association are invited to attend. There is no entrance fee.

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