Vol. IX No. 9 January, 1965

THE JOURNAL OF GEMMOLOGY

and

PROCEEDINGS OF THE GEMMOLOGICAL ASSOCIATION OF GREAT BRITAIN

GEMMOLOGICAL ASSOCIATION
OF GREAT BRITAIN
SAINT DUNSTAN'S HOUSE, CAREY LANE
LONDON, E.C.2

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Vol. IX No. 9 JANUARY 1965

AN UNUSUAL DYED AGATE

By P. C. ZWAAN, Ph.D., F.G.A.

INTRODUCTION

At the beginning of last year I received a letter from Dr. R. van Tassel, a mineralogist at the Royal Belgian Institute of Natural Sciences in Brussels, who wrote about a problem for which he asked my assistance.

An Italian, living in Brussels, had requested him to identify a cabochon-cut agate; in particular he wanted to know whether the included material, resembling the head of a negro, was of natural origin.

Although Dr. van Tassel could not believe that this inclusion was natural, he was not able to prove it. He measured the specific gravity of the stone (2·58) and made an X-ray reflection diffraction photograph from which he concluded that the stone was a quartz (chalcedony). At the edge of the stone he could not find a junction plane so that, according to him, the stone in question was not a doublet.

The owner of the stone, Mr. Fedeli, came to Leiden to show me the stone, together with certificates, written in Italian, from the beginning of this century, on which the inclusion was described as being natural.

Though I saw immediately that the inclusion could not be natural, I was not able to prove this within a short time. Indeed there was no question of the agate being a doublet. The stone was left at my disposal so I got full opportunity to make a close examination.

FIG. 1. *Left: natural moss-agate. Right: agate with "moss" imitation.*

FIG. 2. *The stone in question.*

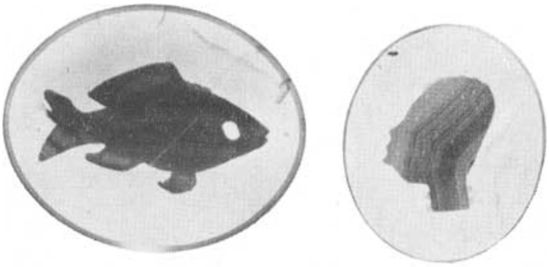


FIG. 3. *Agates with "moss" imitations, made by B. F. M. Collet.*

PROPERTIES OF THE STONE

The stone has a milky-brown colour and weighs 8·98 carats. It is a cabochon-cut oval translucent stone and its size is 21·5 × 16·6 × 3·7 millimetres. The specific gravity is 2·585, the refractive index 1·538. The characteristic agate structure can distinctly be observed.

After studying the inclusion I spoke about the matter with our draughtsman, Mr. B. F. M. Collet, for it came into my mind that here was the possibility of "staining".

There were two important arguments which are contradictory to a natural origin. Firstly the inclusion lies in one plane only which is never the case in natural moss-agate, for there the "dendrites" have expanded in three dimensions (Fig. 1). Moreover the likeness to a negro-head is too startling (Fig. 2). Mr. Collett affirmed my opinion. The dark-brown negro-head has been made artificially by staining locally for at least four times. This is seen under the microscope as the different layers do not completely cover each other. The white layers of the agate have, as usual, not absorbed the dye and are clearly observable in the negro-head. Probably the stone was repolished after treatment.

The inclusion is not found lying on the surface but below. This means that the dye was made to penetrate before letting it take effect. Silver nitrate is very suitable for this, as in the dark it simply penetrates and as soon as it is put in the light, it stains the stone. However, through the whole stone pigment spots of the dye can be noticed. Under the microscope they give the stone a speckled appearance.

In order to trace whether this statement was right, Mr. Collet carried out a few experiments with different "white agates". He also stained these stones locally with silver nitrate. The results are shown in Fig. 3.

It became evident, however, that the structure of the agate has a big influence on the success of this "staining process", and also the colour. With yellow to yellow-brown coloured stones, as well as with pearl-grey "agates" he obtained the best results. Stones with thick white (hard) layers were not suitable.

It is nevertheless obvious that a procedure, as described above, can lead to the same result as is seen in the stone in question. Therefore it goes without saying that this stone has been treated in such a manner.

THE GREAT DIVIDE

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

TESTING gemstones always sounds an exciting and interesting business and possibly conjures up visions of scientific types surrounded by "complex" apparatus, occupied with distinguishing parcels of "erudites" or some such stones.

There are two kinds of gemmology to my mind, commercial gemmology and gemmology proper. Commercial gemmology is the one which keeps the other going, whilst gemmology proper keeps commercial gemmology on the right lines. There is no easy way for commercial gemmologists to acquire knowledge sufficient for them to expedite their own gem testing without learning certain of the gemmologist proper's syllabus. However, it has always been my impression that somewhere along the line a series of articles could be produced to illustrate the main requirements of commercial gemmologists.

In jewellery to-day, the demand for coloured stones has increased and will increase but not for anything or even a little, "erudite". It is interesting to think back upon the more or less straightforward names of gemstones such as ruby, sapphire, emerald, garnet, zircon, spinel, tourmaline, topaz, peridot, jade, diamond, amethyst, citrine, opal.

All of these latter have been used to a very large extent in jewellery and to-day, with a more affluent age and teenage demand, very many more dress rings, brooches, etc., are being sold.

To-day's manufacturers, using casting methods, can produce rings very cheaply and the accent is upon colour. Because of this demand for coloured stones it is obvious that synthetics (which are very pretty stones) will play an increasing part in decorative effect. Other stones very much in demand are tourmalines, peridots and garnets, with half pearls (cultured) as cluster variations. These, to my way of thinking, do not demand too much of a gemmological knowledge.

Nowhere, to-day, does one see stones in jewellery (modern) with any of the more recent gemmological named stones in them. Taafeite is still very scarce and not very decorative, and andalusites, whilst occurring in batches every now and again, do not seem to catch on with the public, and benitoite, although very pretty, is not a sought after stone for jewellery. Even jadeite causes confusion—people like their jade to be Chinese, not Burmese. Curiously, the Americans like their alexandrites to be Russian.

It is almost certain that stones whose names end in *ite* do not make the cash registers ring, let alone finger rings.

And here we come down to basics, the jewellery trade retail, wholesale, secondhand, manufacturing, stone-sellers, dealers, mounters, etc., all revolve upon supply and demand, which can harshly be termed "how much".

It is the "how much" section which keeps the gemmologists going commercially and they seldom deal in stones which have a termination of *ite*. There are exceptions to this but by and large there does seem to be a great divide between retail jewellery stones and dilettante gemmologists' stones.

In a like manner I have recently been busy in a more mundane fashion on gem-testing for non-gemmologists by encouraging the use of a lens only and have harped (monotonously) on double refraction of back facets and 10x lens to such an extent that I thought of stone testing approaches in terms of D.R. or S.R.

Here again there seemed to be a great divide and for some time I bemused myself wondering why some were doubly refracting and some singly refracting.

Taking very ordinary well known gemstomes which are fairly common I tabulated them and tried to find a reason for the division of D.R. and S.R. stones but failed, except to note that because of the orderly structure and close packing of their atoms they imposed no alteration to the directional properties of light passing through them, other than normal refraction on passing from a rarer to a denser medium.

The cubics, it would seem, are the squares of the gemmological world and the others are the deviationists! The isotropics and anisotropics have good in each camp, as do the trade and erudite gemmologists. The common factor which bridges the great divide between "commercial" and "proper" is that they all must eat.

DICHROISM THROUGH THE MICROSCOPE

by R. S. G. Miles, F.G.A. and J. T. Herring, F.G.A.

The disadvantages encountered in the observation of dichroism under the microscope by conventional methods, include the facts that only one of the dichroic colours may be seen at any one time, and, that the stage must be revolved for any change of colour or shade to be seen. Thus the eye must "remember" these changes as they pass before it. Similarly, the dichroscope, although not suffering from the above drawbacks, has difficulties of its own, particularly in relation to the holding and rotation of the specimen, especially if it is mounted.

A simple aid which we have devised minimises these problems by combining the advantages obtained by using the above instruments, while eliminating some of their disadvantages.

We took a piece of ordinary polaroid sheeting and cut from it two semi-circles, from edges at right-angles to each other (Diagram 1), so that, when fitted together to form a circle, their respective

DIAGRAM 1 (polaroid sheeting)

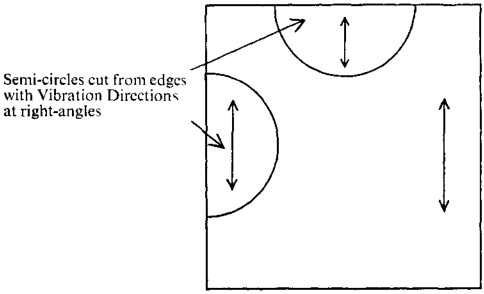


DIAGRAM 2
Semi-circles of polaroid forming circle.(directions of polarisation at right-angles).

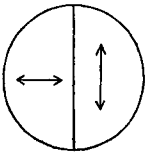
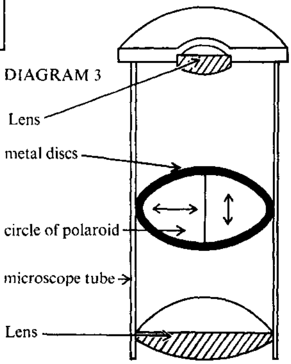


DIAGRAM 3



directions of polarization were also at right-angles to each other (Diagram 2). These were then carefully placed within the tube of a microscope eyepiece (secured between two metal rings) in such a manner that the circle they formed was orientated centrally within the tube and parallel with the eyepiece lenses (Diagram 3). The eyepiece was replaced, polarizer and analyser removed, and the microscope focused with a coloured stone upon the stage. Since each semi-circle of polaroid was orientated with its vibration directions perpendicular to the other, and there was a variation in the colours seen in the two semi-circles, we knew that this difference in colours must be due to differential selective absorption of light, and, therefore, the stone must be dichroic. When the stage (or eyepeice) was rotated through 360°, dichroism was seen to vary from a maximum to a minimum (nil) quantity, four times during the rotation, the dichroic colours alternating in each semicircle, through consecutive variations.

The advantages of this device are: (1) The stone can be rested in a dish or on a slide, and rotated with ease, thus eliminating the fixing or holding necessary when using the dichroscope. (2) Weaker dichroism can be observed because the dichroic colours can be observed side by side, thus eliminating the necessity for the eye to "remember" the colour changes. This is not possible with ordinary microscope methods.

When using this method, it must of course be remembered that if no dichroism is evident at first glance, (A) the stage may need to be rotated to a position which will show maximum dichroism, or (B) it may be necessary to re-orientate the stone in order to avoid an optic axis.

It will be apparent that an eyepiece fitted with this device cannot be used in the microscope in conjunction with polariser and analyser. We, in fact, used a spare eyepiece, which we have retained for this purpose.

Gemmological Notes

GREEN BERYLS

Among recently tested stones were some fine green beryls which looked like emerald of good medium quality. They were green when viewed through the Chelsea filter, had a density of 2·72 and were inert between crossed filters. They showed no trace of chromium in their absorption spectrum. They were fairly clear stones but, immersed in monobromonaphthalene, revealed thin layers of phenakite (?) crystals. The refractive indices were 1·588 to 1·594. The owner said they were from a new mine in Brazil but would not vouchsafe its actual location. Later, from another source, two hexagonal broken green crystals were submitted for testing. After a flat had been put on the crystals their refractive indices were found to vary from 1·587–1·593 to 1·585–1·592. The S.G. was 2·72 and inclusions were observed of a similar nature to those of the cut stones. They were green when viewed through the Chelsea filter and when viewed under the mineralight and Burton Lamp. These stones are a pleasing green, have natural inclusions, give beryl readings, and remembering that Transvaal emeralds look drab through the filter and have refractive indices of similar nature, they could be dangerous where a little knowledge of gemmology exists.

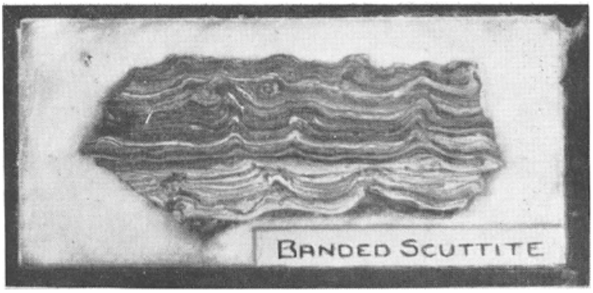
A.F.

* * * *

NOT IN DANA

A report made in the Summer 1964 issue of the American journal *Gems and Gemology* mentions an unusual product of an amateur lapidary who had produced "gemstones" by polishing the hardened paint drippings from the painting room of one of the major automobile manufacturers.

This note recalls to mind that during the Gemmological Association's meeting of November 1956, one member, who had connexions with the paint industry, exhibited such a paint specimen which had been polished as an "agate slice".



The witty caption read: "A unique specimen of a foliated concretion occurring in later geological period, differing from most by forming on the vertical surfaces of carboniferous or, in some cases, organic matrix. Notable for its fine range of colouring considered as accidental and allochromatic. The essential composition of the basic material varies within comparatively narrow limits. Not yet listed in Dana's Textbook of Mineralogy".

R.W.

* * * *

JADE AND NOT JADE

Recent oriental motif carvings, looking very much like deep green Bowenite and having very misleading patches or flaking in their structure and yielding rather readily to a carefully applied needle point hardness test, have proved to be nephrite.

Although bulky it is possible to do a specific gravity test by means of spring balance, bucket of water and thread suspension. The bulk will average out crudities of the balance. A useful figure of 2·9 to 3·00 was obtained for the carvings tested.

Similarly, green-coloured carvings sold as "jade" or "new jade" have been found to be bowenite. Jewellers should be on their guard when offered "new jade".

A.F.

Gemmological Abstracts

LIDDICOAT (R. T.). *Developments in the synthetic emerald field.* Gems and Gemology, 1964, XI, 5, pp. 131-138.

A general discussion on the new French synthetic emerald. This agrees in substance with the descriptions given by other workers. The second part describes, for the first time, a new departure in the Lechleitner synthetic emerald-coated beryl. This new stone consists of alternate layers of synthetic emerald and white beryl. The layers of synthetic emerald show the same characteristic inclusions as are seen in the Chatham synthetic emerald. The refractive indices differ for the two different types of layers, being 1·560-1·563 for the synthetic emerald layers and 1·564-1·569 for those of beryl. The density—the average for two specimens—was found to be 2·678. The polariscope showed both the overgrowth and the beryl body; and the layers in the new type gave single crystal reactions. The synthetic emerald layers showed a mosaic pattern of interference colours, and this was also true of the French synthetic emerald. The luminescence of the Lechleitner stones was found to be crimson and it was noted that the effect was stronger under the long-wave ultra-violet lamp. The layered stones are a better emerald colour than the original synthetic emerald-coated beryls.

R.W.

GÜBELIN (E. J.). *Two new synthetic emeralds.* Gems and Gemology, 1964, XI, 5, pp. 139-148. Repeated in Australian Gemmologist (with different illustrations), 1964, 38, pp. 5-11.

A survey of the German Zerfass and the French Gilson synthetic emeralds. Both types showed characteristic inclusions which are similar in essentials with the American synthetic emeralds. The low density of these new synthetic emeralds, about 2·66, is again similar to that found with the Chatham synthetic emeralds. The Zerfass synthetic emeralds are reported by the author, to have R.I. 1·558-1·562, with a birefringence of 0·003. This is normal for synthetic emeralds of American, French and early German syntheses, but disagrees with the measurements reported by K. Schlossmacher, who gave 0·006 as the double refraction of Zerfass synthetic emerald. The behaviour under crossed filters and under ultra-violet light is discussed. The article states that the glow under ultra-violet light given by the French synthetic emerald is olive green; other workers state that there is a yellow glow shown by this stone. The article includes a comparison table and a short list of references.

R.W.

CROWNINGSHIELD (R.). *Developments and highlights at the Gem Trade Lab. in New York.* Gems and Gemology, 1963/4, XI, 4, pp. 99-106.

Describes and explains the multi-drill holes often seen in the beads of cultured pearls when radiographed. These extra drill holes are said to be used to direct bleach on to the conchiolin layer in order to whiten the pearls. Notes are given on an unusual star-effect seen in amethyst, wax-treated amazonite beads, and the alteration in colour in turquoise by the action of cosmetics. Notes on inclusions in a Mexican topaz, and in an alexandrite cat's-eye are given. The Mohs's scale hardness given for synthetic spinel is questioned. A synthetic fluoride (?) boule is described.

R.W.

LIDDICOAT (R. T.). *Developments and highlights at the Gem Trade Lab. in Los Angeles.* Gems and Gemology, 1963/4, XI, 4, pp. 114-121; 1964, XI, 5, pp. 149-156.

Describes a number of interesting articles submitted to the Los Angeles laboratory, among which were a transparent labradorite feldspar, blue-dyed plastic-coated marble beads, an early type of synthetic star-sapphire and a synthetic scheelite. Comments are made on a number of diamonds submitted. These included a note on the effects of heat on the surface of diamonds, twinning in a pink diamond, a cyclotroned diamond, an unusual spectrum in a brown diamond, and how an estimation of the weight of a damaged diamond before and after recutting may be made. A synthetic bromellite (beryllium oxide), a star-labradorite, and a coated glass intaglio were other specimens mentioned.

R.W.

GÜBELIN (E. J.). *Black treated opals.* Gems and Gemology. 1964, XI, 5, pp. 157-159.

Describes an examination of the treated black opals and some notions as to how such stones may be detected.

R.W.

DRAPER (T.). *A new source of emeralds in Brazil.* Gems and Gemology, 1963/4, XI, 4, pp. 111-113 and 124-125.

A cattle herder named Abel knew of green pebbles found on the Fazenda Sao Thiago, near Salininha, Municipality of Pilao Arcado, in the State of Bahia. In 1950 he tried to find out what they were, but it was not until 1962 that any attempt was made to mine the stones. The locality may be the one Coutinho discovered in 1612, but he died without revealing the source. It is an entertaining article in which the author describes the country and the background stories of the finding and exploitation. Other sources of emerald in Brazil are also mentioned.

R.W.

OSTWALD (J.). *On the microstructions and origin of emerald.* Australian Gemmologist, 1964, 35, pp. 7-10.

Reasons are suggested to account for the formation of emerald in both mica schist and in calcite. Notes on the emerald-bearing locality at Poona, near Cue, in Western Australia are given, and on the emeralds which are found there. The inclusions in these stones are said to be andradite garnet, staurolite and spots of a black material, with two types of liquid inclusions. Correlation between the orientation of the inclusions and the mica schist mother-rock was experimentally shown by the author. Some reasons are deduced for the chromium present in the emeralds from the calcite veins in S. America.

R.W.

GORTON (V.). *Fossicking for sapphires.* Australian Gemmologist, 1964, 37, pp. 5-8.

An interesting article describing the hunting for sapphires by visitors to the Anakie fields. There is a description of a screen and how to make one. Full details of construction are given.

R.W.

STEVENS (D.). *The Opal—Queen of Gems.* P. & O. Lines quarterly "Posh". Reprinted in Lapidary Journal, 1964, 18, 8, p. 882.

A short article noteworthy for the magnificent coloured photographs of Jeanne G. M. Martin, of the Gemological Institute of America. S.P.

POUGH (F. H.). *Topaz.* Lapidary Journal 1964, 18, 8, p. 868.

An interesting article, containing information not usually encountered in text books. S.P.

BASTOS (F. M.). *The Topaz Mines of Ouro Préto.* Lapidary Journal 1964, 18, 8, p. 918.

Ouro Préto, in the state of Minas Gerais, is virtually the only production district for yellow and yellowish-red topaz. S.P.

SCHLOSSMACHER (K.). Der Gang einer Edelsteinuntersuchung. *Gem testing.* Zeitschr. d. deutsch. Gesell. f. Edelsteinkunde, 1964, 48, pp. 27-32.

This article was first published in the Diebener's Goldschmiedejahrbuch 1964 (Diebener's Goldsmiths' Almanack for 1964) and gives a general survey of gem testing, explaining the basic gemmological instruments, their use and application.

E.S.

THEISEN (V.). Die Gruppe des Epidots. *The epidote group.* Zeitschr. d. deutsch. Gesell. f. Edelsteinkunde, 1964, 48, pp. 24-27.

The name epidotes derives from the Greek "epidotos", meaning added, because to the basis of the prism an edge has been elongated, i.e. added. The other common name is "pistacite", from the green pistacio colour. The chemical composition is $Ca_2(Al\ OH)Al_2(SiO_4)_3$. If there is less calcium but more magnesium or iron, the variety is either piemontite or zoisite. Without aluminium, but with instead either iron, manganese, cerium or yttrium, the resulting mineral is called allanite. Piemontite is manganese—containing epidote. There are other combinations, such as orthite and clino-zoisite. Epidote is monoclinic, with hardness 6·5, spec. gravity 3·25-3·50. The mineral is mainly green, but other colours are found as well. A table shows R.I., varying from 1·716-1·78, with the double refraction varying from 0·005-0·039. The most beautiful specimens are found in the Untersulzbachtal in the Tyrol. There are also occurrences in Norway, Bohemia, Saxony, France, Italy, Switzerland. Zoisite is found with rubies in Tanganyika, allanite in Sweden, Greenland, Canada and California.

E.S.

BANK (H.). Smaragdvorkommen in Südrhodesien. *Emerald occurrences in Southern Rhodesia.* Zeitschr. d. deutsch. Gesell. f. Edelsteinkunde, 1964, 48, pp. 14-21.

Details of occurrences, with three maps of the district. The history, geology and geography of the finds are discussed. There is a bibliography, and chemical composition, physical data and details of inclusions are given. The most important finds are at Sandawana, Filabusi, Novello and Chikwanda.

E.S.

BURKART (W.). Zum Schleifen und Polieren von Elfenbein. *Cutting and polishing of ivory.* Deutsche Goldschmiedezeitung, 1964, 62, 9, pp. 765-766.

It is suggested that ivory should be polished with Italian pumice powder, if possible of the grain size 3·0, mixed with water. To obtain a better polish it is advised first to use the grain size 3·0, and then the finer grain size 5·0, both made into a paste with water. For the last polish one uses a wax, but care has to be taken that no metallic oxides are included in these waxes; especially Fe_2O_3 and Cr_2O_3 must be avoided. The last polishing wax must be used dry.

E.S.

EPPLER (W. F.). Ungewöhnliche Kristall-Einschlüsse im Aquamarine. *Unusual crystal inclusions in aquamarine.* Deutsche Goldschmiedezeitung, 1964, 62, 9, pp. 769-770. 7 photomicrographs.

In the Deutsche Goldschmiedezeitung, 1960, 12, pp. 736-738 the author considered an inclusion in a Brazilian aquamarine to be apatite. It was pointed out that the inclusion was "mica-like" and consequently the aquamarine was cut so as to examine the inclusion more thoroughly. It was then found to be biotite, that is a magnesium-iron mica. The presence of these minerals in aquamarine is rare but not surprising as both are pegmatite minerals. In the course of these examinations it was also found that on rare occasions garnet is found in aquamarines, most probably pyrope.

E.S.

FISCHER (W.). Facettiert oder gemuggelt? *Facets or cabochons?* Deutsche Goldschmiedezeitung, 1964, 62, 9, pp. 781-782.

Short explanation as to when to apply faceting and when to fashion a stone in cabochon style. An article for the apprentice.

E.S.

PARSONS (C. J.). *Practical Gem Knowledge for the Amateur.* Lapidary Journal, 1964, 18, 7, p. 750.

The first of a series written to assist in the acquisition of fundamental knowledge about gemstones. There will be four main sections—descriptive, determinative and historical knowledge, and gemstone nomenclature. In the first article condemnation of the use of incorrect names is not emphatic enough.

S.P.

POUGH (F. H.). *Rare Faceting Materials.* Lapidary Journal, 1964, 18, 7, p. 730.

The beginning of a series on silicates. This follows an extensive series, in the same Journal, which has dealt with the faceting of phosphates, borates, carbonates, sulphates and oxides.

S.P.

THURM (R.). Spektrographische Studien am Amethyst. *Spectrographic studies of amethyst.* Zeitschr. d. deutsch. Gesell. f. Edelsteinkunde, 1964, 48, pp. 34-37.

Detailed spectrographic examination of amethyst showed strong lines for silica, aluminium, chromium and copper. The copper content was metallographically determined as 0·03%. Weak traces were found of magnesium and titanium, but hardly any of iron, while the amethyst-coloured synthetic corundum has a ruby spectrum, as it is coloured by the addition of TiO_2, Fe_2O_3, Cr_2O_3.

E.S.

Bölsche (R.). Das Schicksal der Habachtal Smaragde. *The fate of the Habach valley emeralds.* Zeitschr. d. deutsch. Gesell. f. Edelsteinkunde, 1964, 48, pp. 32-34.

There is a constant theft of emeralds from the district. This is not due to serious mineralogical students or collectors, but to "poachers". The owner is now offering students a free holiday in return for guarding the sites.

E.S.

Guebelin (E.). Absorptionspektren von Edelsteinen. *Absorption spectra of gems.* Zeitschr. d. deutsch. Gesell. f. Edelsteinkunde, 1964, 49, pp. 14-20.

Tables of the latest figures for the absorption spectra of gems, incorporating the results published by B. W. Anderson. The gems are grouped as follows: A. Zircon, B. gems coloured with Cr_2O_3: pyrope, ruby, red spinel, pink topaz, alexandrite, chrome diopside, chrome enstatite, demantoid, disthene, euclase, hiddenite, jadeite, emerald, C. gems coloured with iron: almandine, aquamarine, axinite, chrysoberyl, diopside, cyanite, enstatite, epidote, hypersthene, idocrase, iolite, kornerupine, green obsidian, olivine, orthoclase, sapphire, sinhalite, blue and violet spinel, yellow spodumene, green tourmaline, vesuvianite, D. absorption spectra caused by manganese: hessonite, rhodochrosite, rhodonite, spessartite, red tourmaline, E. absorption spectra caused by other ions: blue apatite, azurite, sphalerite, chrysoprase, dioptase, yellow fluorite, taaffeite, willemite, Zn-spinel, F. absorption spectra caused by the actual structure of the gem: yellow and brown diamond. G. absorption spectra of rare earth: andalusite, apatite, danburite, didymium glass, green fluorite, idocrase, calcite, sphene. H. the spectra of 14 synthetic stones are listed under this heading, 9 spinels, 3 corundums, one emerald, and one rutile. I. This deals with 6 different types of glasses. K. green-coloured chalcedony, green-coloured jade and artificially coloured yellow, green and pink diamonds.

E.S.

Bank (H.). Imitationen von Smaragdkristallen. *Imitations of emerald crystals.* Zeitschr. d. deutsch. Gesell. f. Edelsteinkunde, 1964, 49, pp. 20-23.

Most articles deal only with cut and polished synthetic or imitation emeralds. The author relates a case where rough crystals were imported from Colombia. Some of these crystals were from Muzo, some from Chivor and some from Barbur. There was also a small lot which was said to come from a new find, the mine of Vega de San Juan de Gachala, or Gachala in short. This mine was discovered in 1954 and is about 9 km away from Chivor. The Gachala lot consisted of 11 stones weighing 37·24 cts. At a first glance these crystals seemed real enough, even having traces of the matrix. The crystallography, however, gave rise to some suspicion, and it was found that these crystals were in fact glass. The R.I. varied from 1·51 to 1·64, no double refraction and no dichroism were found.

E.S.

THEISEN (V.). Der wiedergefundene Wittelsbacher Diamant. *The Wittelsbach diamond found again.* Zeitschr. d. deutsch. Gesell. f. Edelsteinkunde, 1964, 49, pp. 40-42.

This historic blue diamond weighs 35·5 cts and was first mentioned about 300 years ago, when it was part of the wedding ornament of Margareta of Spain and Emperor Leopold of Austria. In the year 1722, by the wedding of Maria Amalia to Karl Albrecht of Bavaria, the diamond came into the possession of the house of Wittelsbach, and from then on it kept that name. In the year 1931 a Wittelsbach tried to sell the diamond in London, but the offer was too low, and nothing more was heard of it till 1961, when it was bought by some Antwerp diamond merchants who recognised it.

E.S.

CROWNINGSHIELD (R.). *Developments and highlights of the Gem Trade Lab. in New York.* Gems and Gemology. 1964, 6, XI, pp. 180-184.

Jewellery set with synthetic emerald overgrowths on beryl have been submitted for examination. Green-dyed chalcedony and chrysoprase-coloured opal are noted. Stained jadeite which had not faded and plastic-coated and dyed jadeite are mentioned. Two bytownites, diamond doublets, stained marble beads, dumortierite quartz and a fine green enstatite are some of the stones examined in this laboratory. A hololith ring, probably of magnesite, a magnetite in tiger's-eye, clam pearls, and the alteration of colour in a jadeite after steam-cleaning are discussed. A tumbled "agate" consisting of a mass of paint drippings is mentioned.

3 illus. R.W.

LIDDICOAT (R. T.). *Development and Highlights at the Gem Trade lab. in Los Angeles.* Gems and Gemology. 1964, 6, XI, pp. 185-189.

Items submitted to this laboratory included an emerald in which a flaw indicated staining but was proved to have the higher colour due to reflection from deeper coloured parts of the stone. Also seen was an emerald with a large three-phase inclusion—a long multi-strand pearl rope, an opal doublet and swirl lines in aquamarine. Some notes on diamonds are given.

9 illus. R.W.

MILES (R. R.). *Coated diamonds.* Gems and Gemology, 1964, 6, XI, pp. 163-168.

Further notes on the "colour correction" of diamonds by coating the back facets with a suitable film—a treatment more extensively carried out in America than in Europe. The points suggested to be looked for are—an unclassifiable colour when colour grading by colorimeter is carried out and that despite the coatings' resistance to chemical attack they are not necessarily resistant to abrasion. The results given by examination with phase-microscopy are discussed and techniques for the best viewing of the bluish streaks and the metallic lustre of the coatings are given.

8 illus. R.W.

EPPLER (W. F.). *Polysynthetic twinning in synthetic corundum.* Gems and Gemology, 1964, 6, XI, pp. 196-174 and 191.

The existence of polysynthetic twinning in synthetic corundum is ably discussed. Reference to the Landmeier/Plato effect is made. This shows a lozenge-shaped pattern running parallel to the first order prism. There is another kind, much like that seen in natural corundum, which lies parallel to the faces of the primitive rhombohedron. Some suggestions are made to account for these, and a warning is given that "twin-planes" cannot be a wholly reliable sign for natural corundum.

8 illus. R.W.

ANTON (B.). *The pink pearls of Pakistan.* Gems and Gemology. 1964, 6, XI, pp. 175-179 and 191.

Pink pearls have been found in nine districts of East Pakistan. They have been known since the Mogul period of Indo-Pakistan history. The producing molluscs are *Lamelliden perreysia* and *Lamelliden jenkinsianus*, and they are fished by gypsies and nomad fishermen. A number of these pearls, mounted in jewellery, were on display at the Pakistan pavilion at the New York World's Fair. There is much information of a local nature but little scientific description of the pearls.

13 illus. R.W.

BOOK REVIEWS

LIDDICOAT (R.) and COPELAND (L.). *The Jeweler's Manual.* Gemological Inst. America. 1964. ($4.95).

This book has its ancestry in R. M. Shipley's *Jeweler's Pocket Book*, first published in 1947. The present work has a new format and differs in scope and purpose from the original work It is a useful handbook, mainly for the N. American jewellery trade, with much information for new entrants to the trade. In the gemmological section the term "semi-precious" receives further condemnation and recommended names for the more important gemstones coincide with those of the Gemmological Association of Great Britain,with two minor exceptions. In the U.K. the term "cinnamon stone" is no longer used for describing hessonite garnet and almandite garnet is not an acceptable alternative for almandine garnet. The plethora of trade names used in the U.S.A. for synthetic stones is formidable, and the manual sensibly sets out how each should be described. In the chapter on diamonds there is a useful section on the grading and evaluation of diamonds.

S.P.

WEBSTER (R.). *The Gemmologists' Compendium.* N.A.G. Press Ltd., 1964. 25s.

A revised edition of a standard work first published in 1938 as *The Gemmologists' Pocket Compendium.* The compendium includes information about many of the newer gem materials fashioned as gemstones and it is an extremely valuable book of reference for all interested in gemstones.

S.P.

SINKANKAS (J.). *Mineralogy for amateurs.* D. Van Nostrand, 1964. 97s. ($12.50).

This is another classic from the pen of Captain Sinkankas. The subject is thoroughly discussed, from atomic structure, physical properties, optical properties, the formation and association of minerals to identification procedures and tests. 250 minerals are well described, and the book has 136 photographs and 191 line drawings prepared by the author. A useful feature in the descriptive part of the book is the derivations of mineral names and their current pronunciation.

S.P.

CAVENAGO-BIGNAMI. (S.). *Gemmologia.* Holpli, Milan, 1965 (2nd edition). Lire 30,000.

An extensively revised and augmented edition of the most impressive book on gemmology yet published. Many illustrations, both in colour and black and white, have been added, and the text has been revised to take account of developments in gemmology since the first edition was published in 1959. The quality of the colour illustrations is excellent. The nomenclature has been tidied, though some misnomers still remain. The book has had impressive sales in Italy. It is a desirable book for the many colour plates and illustrations alone. One wishes for an English edition, but unfortunately there seems little likelihood of this.

S.P.

WHEATLEY (W.). *Isaac le Gooch, the King's Jeweller and Benefactor.* Hammersmith History Group, 1964. 10s. 6d.

Mr. Wheatley's small booklet is the result of a painstaking quest into the life of a Court Jeweller whose charitable bequests included gifts to the Dutch Church of London and the Latymer Foundation of Hammersmith. Isaac le Gooch was jeweller to King Charles II. He was born in Antwerp and came to England in 1656.

S.P.

METZ (R.). *Precious stones and other crystals.* Thames & Hudson, London, 1964. £8 8s. 0d.

I have never seen colour photographs reproduced better than the eighty-nine which illustrate Dr. Rudolf Metz's book. It is difficult to know who deserves the most praise, Mr. Arnold E. Franck who photographed these remarkable specimens from the museums and private collections of Europe, or Messrs. Thames and Hudson, the publishers responsible for their reproduction. All one can say is that the blockmaking and the printing are worthy of a set of truly magnificent photographs. It is indeed hard to believe as one leafs over the pages that these are illustrations to a text book. But then this is a curious textbook, lavish and splendid and pleasant, discursive, its author ranging about the world of crystallography like a traveller in a strange and fascinating city. He pauses for a moment to consider lustre and colour, and then goes on to delve into the question of specific gravity and then gives us a few paragraphs on the formation of minerals. He ends up by drifting back into the past and into mythology, tracing the history of gem cutting, and then, perhaps inevitably quoting Plimy the Elder, who set down the belief that amethyst "is not only safeguard against drunkenness if one writes the name of the moon or the sun on it and hangs it round one's neck with baboon's hair or swallow's feathers, it protects one against sorcery, is helpful to those who have to deal with kings, and wards off hail and locusts". As Mr. Georg O. Wild, the well known Idar-Oberstein stone dealer and collector, says in his introduction: "Rudolf Metz, who is a mineralogist and geologist, has very lucidly and with scientific thoroughness set down the data which will give us a fuller understanding of the structure and origin of minerals". And perhaps for once the writer of a preface might have gone further in praise of his author, for besides being lucid and learned, Dr. Metz is also a gracious and an entertaining writer.

K.B.

LEIPER (H.). *Gem-cutting shop helps.* Lapidary Journal, Calif., U.S.A. 1964. $3.95.

This book, compiled with the assistance of Pansy D. Kraus, consists of valuable aids to the gem-cutter that have appeared in the Lapidary Journal over the past seventeen years. In some instances there is duplication and the authors have wisely not made any eliminations, as different approaches to the same problem add to the interest of the book. This selection of broadly written articles should encourage the beginner to probe more deeply into his craft or hobby.

S.P.

ANDERSON (B. W.). *Gem Testing*. Heywood (Temple Press Books Ltd.). Seventh Edition. London. 1964. 377 pages. One coloured plate 123 black and white illus. 60s.

It would not be expected that a book which had already passed through six editions would require much in the way of a review. This cannot be said about the seventh edition of Anderson's "Gem Testing", for the volume has been enlarged by some fifty more pages and much new material has been added.

In general the book follows the arrangement of the earlier editions, except that two new chapters have been included. The introduction has been partially re-written and there follows a completely new chapter on "Collecting, handling and housing gemstones", in which the use of the loupe and tongs are described and the way to make a stone paper is told in words and pictures.

The chapters on refraction, colour and density have been increased by the inclusions of notes on R. K. Mitchell's modification of the Becke line examination and a new section on dispersion. A very practical method for obtaining the density of large specimens by the use of a camera tripod and a spring balance is explained. The addition of notes on the new French and German synthetic emeralds, and on the Lechleitner emerald-coated beryl brings the chapter on synthetic stones up-to-date. In the chapters on the individual species (or varieties) much more information is given on the artificial coloration of gem diamonds. Scheelite and zinc blende are added as diamond simulants. The rubies from the new sources in Tanganyika are mentioned.

The chapter on zircon has been re-written and much more information is given of the characters of this stone. Small additions are made to other chapters in order to bring them up-to-date. The beautifully written chapter on pearl is completed with a new section on non-nucleated cultured pearls. The author, who has a great interest in the subject, has embellished the chapter on luminescence with much new material on diamond fluorescence.

The inclusion of notes on "electron volts"; "frequency"; "laser" and "maser"; "micron" and "millimicron" are timely. The determinative tables have been increased to take in a fuller range of gem materials. A list of recommended reading is given and the book concludes with a very full index.

There is very little that can be criticized in this work, but the reviewer does take exception to the implication (on page 106) that acetylene is used in place of hydrogen in the furnace used to make synthetic rutile. This notion apparently came from a report on the initial experiments carried out by the scientists of the National Lead Company who used an *oxy-acetylene torch*, not necessarily with acetylene, in their first experiment. (Journ. Gemmology, pp. 131-140. No. 4. Vol. II. October 1949). The author will agree, I think, that to-day a three-cone Verneuil type furnace is used. It is perhaps a pity that references to the crystal systems were not amended to the seven systems as now agreed in the Gemmological Association's examination syllabus—and the author is an examiner to that body. The older spellings "disk" and "conchyolin" make quaint reading but may tend to confuse a young reader as no other book on gem materials seems to use these spellings.

The type is clear and printed on a better quality paper than used for the earlier editions. The colour plate is excellently chosen and printed and does much to illustrate the text on crossed filter technique.

R.W.

Begriffe und Bezeichnungen für Edelsteine, Schmucksteine, Perlen, Korallen sowie Synthesen, Dubletten, Imitationen und Phantasieerzeugnisse. RAL 560 A5. (Definitions and nomenclature of gemstones, ornamental stones, pearls, corals, as well as synthetics, doublets, imitations and fancy products). German Bureau of Standards, 1963, 5th edition.

This being the 5th edition of the German Nomenclature, only the amendments and additions create interest. And they are both interesting and disturbing.

The preface boldly claims that this work is based not only on the BIBOA nomenclature of 1935 but also on the American Federal

Trade Commissions Rulings of 1957 and the British Nomenclature of 1961.

Most surprising is the statement that a letter of full agreement dated the 12th June, 1962, has been received from the president of the International Confederation of Jewelry, Silverware, Diamonds, Pearls and Stones (CIBJO), in which organization the following countries are represented: Austria, Belgium, Denmark France, Great Britain, Italy, the Netherlands, Spain, Switzerland and Western Germany.

The work is further backed up by 31 Western Germany trade organizations and by the Centre International de Promotion de la Qualité, in Paris, and has been lately joined by the Instituut tot Voorlichting bij Huishoudelijke Arbeid, which seems to be an organization promoting good cooking recipes for Dutch housewives.

No wonder that this so universally accepted nomenclature is published also in French and Italian. An English translation is in preparation, it is stated, but the German text shall prevail (Massgebend ist allein der deutsche Wortlaut).

The new edition contains three divisions, viz., definitions and trade rules; a table of permissible trade names; an alphabetical list (a small dictionary) accredited to a well-known professor. The first part is reasonable. It repeats the rule that all stone names must conform with the scientific names; it is not permitted to apply the same name for two different species; the naming of a stone must exclude the possibility of the stone being classed under a different mineralogical category.

A curious paragraph, also inherited from the former edition (but not from BIBOA etc.), recommends the qualification of gemstones by adding such words as "natural", "precious", or "noble", although it is also stated that a stone shall always be understood as genuine when it is not preceded or followed by any qualifying words.

To ascertain the purity of diamonds, the 10x lens is recommended. It is gratifying that this rule is accepted by the CIBJO, since they have adopted, some time ago, a resolution to the effect that the loupe used should enlarge *not more than* 10 times. (No minimum was stated).

How does the willing spirit of these trade rules permeate the second and third part of the work?

New names have been inserted in the table. One is *rhodocrosite* (sic), for no obvious reason spelt incorrectly. Another new name is the alternative for the German *zinkspat*, viz., *smithsonite*, but this is repeatedly spelt "smithonit", although the species in question is named after James Smithson, the founder of the famous Smithsonian Institution in Washington. An alternative name for cordierite is now given as *iolite*, unfortunately spelt "jolith" in the table, despite the fact that the name is derived from the Greek word ion, which bears the accent over the letter i and not over the o. Another addition is the name cairngorm, persistently spelt "cairngorn".

Conjured up afresh is the most unlucky name "topaz" for various varieties of quartz. This misnomer did not exist in any of the previous editions. But the 5th edition states, in a footnote under "permissible trade names", that in commerce citrine is often called goldtopas, madeiratopas, palmeiratopas (sic), or bahiatopas. And in the same table, "smoky topaz" is now confirmed as a permissible denomination for smoky quartz.

The misuse of the name topaz is in sharp contrast to the rules in the first part, and there can be no doubt that it has been inserted on purpose. For this reason it appears rather audacious to claim, as does the preface, that this new edition is based on American and British nomenclatures.

After this disheartening discovery it is tempting to look into part 3 to see what the professor writes about topaz. He states "Topaz = citrine. False name for natural citrine (yellow crystal) or burned amethyst. *Vide* also precious topaz".

So we learn that topaz is both equivalent to citrine *and* a false name for citrine. It is not stated that a topaz is a topaz which, in fact, is the only thing it can be. There is a reference to precious topaz, and under this caption we are told that precious topaz is the same as topaz! And since we already know the learned meaning of the word topaz, we find it meaningless to stay in this merry-go-round, which cannot possibly be the work of the esteemed professor. As a final word "opalisieren" (opalescence) is used for the girasol effect seen in some fire opals, as well as for the play of colours in precious opal.

F.J.

TWO TRICKY ITEMS

by G. V. Axon, F.G.A.

The pleasure one gets from "guessing" an identification and then "proving" it to be correct is always to be offset by the tendency to read the various gem instruments incorrectly with the guess uppermost in mind. Two stones recently gave the author a rather sharp lesson.

The first stone, about half-a-carat, was bright green, and with "horse-tail" inclusions. The stone appeared pink with red flashes under the ordinary colour filter, and even in ordinary light without the filter appeared to give off red flashes. The second stone, of some 22 carats, was quite a lively brown.

The first "guess" was demantoid garnet. The stone turned out to be chrome sphene. The second "guess" was heat-treated amethyst. The stone was golden calcite. Neither chrome sphene nor golden calcite is seen frequently, the former because it is still rather rare, and the latter because it is so difficult to cut and so fragile.

Here were two very good examples of tricky looks. Of course, closer examination would have revealed that the "horse-tail" in chrome sphene did not appear to radiate, and that the doubling of the black facets in the calcite was apparent. The same would no doubt apply to a small clean chrome sphene examined under a lens.

Both stones were extremely tricky items, to say the least, for the "horse-tail" inclusion of demantoid has practically become its most important single identification, yet here was a stone with very similar inclusions and almost identical in appearance. Thus "horse-tail" inclusions will have to be watched rather more closely now.

As for golden calcite, so few specimens are to be seen that few jewellers will ever encounter them. Even so, heat-treated amethyst is by now almost recognisable at sight—at least I thought it was, but after the shock of receiving a golden calcite and finding what appeared to be a heat-treated amethyst, I have again learned the importance of never taking anything for granted, and of always making at least two tests, exluding the first "informed guess".

SCHILLER AND PSEUDOCHROMATISM IN MINERALS AND GEMSTONES

By J. OSTWALD, B.Sc., F.G.A.A., A.M.Aus. I.M.M., F.G.S.

As indicated by its title this short paper is simply an attempt to define two phenomena found in a variety of minerals, some of which have minor importance as gemstones. The author feels the necessity of such a definition as a variety of terms have been used in this connexion, some not too happily, while a number of explanations as to the origin of the phenomena do not seem to fit the observed facts. In the following pages the nature and origin of schiller inclusions and pseudochromatism are studied with particular reference to the pyroxenes and feldspars.

The following terms and definitions may be found in the text books in any geological library. In each case the authority for the definition is given.

Schiller

1. A bronze-like lustre or iridescence due to internal reflection in minerals which have undergone schillerization. (Fay)
2. A type of mineral structure which is manifested by a play of colour. (Herbert-Smith)
3. A bronze-like lustre in definite crystal directions. (Groth)
4. A nearly metallic lustre. (Rutley)
5. A lovely blue sheen. (Herbert-Smith)
6. A term (from the German) applied to the peculiar lustre, sometimes nearly metallic observed in definite directions in certain minerals. (Dana's Text Book)
7. Minute plates of iron oxides systematically distributed through individual crystal. (Wahlstrom)

[NOTE 1. The definitions of Dana (6) and Groth (3) are to be preferred.]

Schillerization

1. The development, along certain planes in a mineral of minute inclusions which reflect light simultaneously and so give use to the appearance known as "schiller". (Holmes)
2. The charging of a mineral with definitely oriented inclusions. (Rosenbusch)

3. A deep-seated metamorphic process resulting in the presence of inclusions of a secondary origin. (Teall)
4. The development along certain planes within the crystal of tabular, bacillar or stellar enclosures which, reflecting light falling on them at certain angles, give rise to the peculiar phenomenon known by the name "schiller". (Judd)

Perthite

1. An intergrowth of potassium and sodium feldspar, probably crystallized as a result of exsolution. (Challinor)
2. As first described, a flesh-red aventurine feldspar from Perth, Ontario, called a soda orthoclase, but shown by Gerhard to consist of interlaminated orthoclase and albite. (Dana's Text Book)

(NOTE. Herbert-Smith, though he does not use the term just defined, says that the optical effects seen in moonstone result from thin layers of orthoclase and albite.)

[NOTE 2. Though many aventurine feldspars are perthitic this does not imply that the aventurine reflection results from the perthite layering. It seems likely that in this case exsolved plates may most easily be orientated at the junctions of potash and soda rich layers.]

Chatoyancy

The property of having a lustre resembling that of the eye of the cat at night. (Dana's Text Book).

Play of colours

A term used to describe the appearance of several prismatic colours in rapid succession on turning the mineral. (Dana's Text Book)

(NOTE. Rutley speaks of play of colour in relation to diamond. There can be no excuse for such loose terminology, when the correct term, dispersion, is so well known.)

Change of colours

An expression used when each particular colour appears to pervade a larger space than in the play of colours and the succession is less rapid, e.g. labradorite. (Dana's Text Book)

Iridescence

The exhibition of prismatic colours in the interior or on the surface of a mineral. (Dana's Text Book)

A display of prismatic colours due to the interference of rays of light in minute fissures which wall in thin films of air or liquid. (Rutley)

(1) This latter "definition" seems to be totally inconsistent if we take it that "prismatic colours" are those which are produced by a prism.

(2) Herbert-Smith terms the labradorite colours iridescence colours and states that they are due to its lamellar nature, the results of repeated twinning.

Pseudochromatism

The property of being pseudo-chromatic, that is to say, the colour they show is not a true colour but rather a play of colour produced by certain physical effects e.g. precious opal, labradorite. (Berry and Mason)

Schiller plates

Tiny platy inclusions arranged in varying sets of parallel planes. (Read and Watson)

Aventurine structure

Having the appearance of a glass containing gold coloured inclusions. (A.G.I. Glossary)

(Bauer relates the "improbable" story that the artificial aventurine glass of Venice was produced by accident (*par aventure*) when copper fillings were dropped into a vat of molten glass. The art was lost until 1827 when Bibaglia, a glassmaker, rediscovered it.)

Microplakite structure

Inclusions of small rectangular plates of a brownish colour, strongly pleochroic, generally parallel to the base of hypersthene crystals. (Johannsen)

(The term "schiller" was probably first used in 1819 by K. von Raumer, as a term (from the German, schillern, "to vary in colour") to describe the peculiar optical reflection seen in "schillerfels" (hypersthene)).

From the above list, which is not exhaustive, one may see the wide range in terminology and definition used. It will also be seen, however, that we are dealing with two types of phenomena. These are as follows:—

1. *Reflection phenomena*

   This occurs when a more or less transparent silicate has orientated inclusions of a platy nature arranged in certain crystal planes. If these inclusions have metallic lustre it is reasonable to assume that the mineral will have a metallic lustre in certain directions and its normal appearance in others. This is "schiller".

2. *Interference—Diffraction—Scattering phenomena*

   According to the wave theory many colourful phenomena may be explained by assuming that colours are removed from white light on reflection by destructive interference of waves, as in the case of thin films, while coloured spectra may be produced by reflection off striated surfaces (diffraction gratings). Tyndall scattering may also produce a blue and a red colour in some cases.

In the former case the colours are subtractive, as may be seen with a simple spectroscope, whilst in the latter they are pure spectral colours. This phenomenon is here called "pseudo-chromatism". It is this which occurs in precious opal and perhaps occurs in labradorite. It is also interesting to note that whilst the colours of opal were generally assumed to be subtractive colours due to interference, the term "play of colours" was generally used in this relation, though Dana had stated that this term referred to "prismatic colours".

Figs. 1 to 4 are sketches of typical examples of the phenomena discussed above.

The origin of "schiller structure"

The changing metalloid lustre seen at certain orientations in the minerals of the enstatite-hypersthene group was first studied in the late 18th century. The name "schillerspar" was used by J. C. H. Heyer in 1786, in Crell's Annalen, to designate the mineral we call bastite, a decayed and altered ortho-pyroxene. Bronzite, a name applied to schillered enstatite dates from 1807. The first extensive studies in the nature of the inclusions were those of

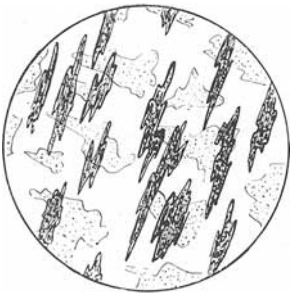


Fig. 1.

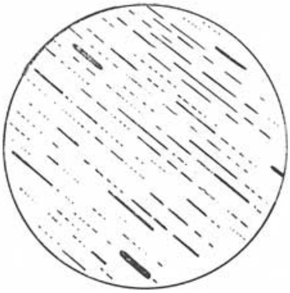


Fig. 2.

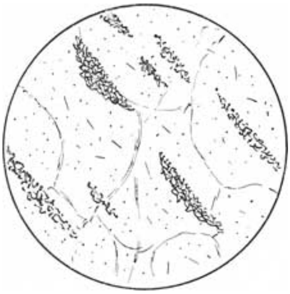


Fig. 3.

Fig. 4.

Trippke (1878) and Kosmann (1869). These authors found that among the more easily identifiable inclusions of magnetite, apatite and zircon in hypersthene there were commonly developed "tabular microlithic interpositions", lying in three different directions, with their plane faces parallel to the principal cleavage face (010). These plates are generally rhombic or irregular, and appear in thin section as thin opaque strips or even points in all sections which are not parallel to the plane of the most perfect cleavage. In colour they range from dark brown and opaque, through shades of red, brown and yellow, to almost colourless. In reflected light the thicker opaque plates have a metallic habit, while even the transparent ones are sub-metallic. Generally the elongation of these plates is parallel to the "C" crystal axis. Both Trippke and Kosmann thought them to be of secondary origin, and found that in diallage they were isotropic in nature. From this they deduced them to be opaline.

The extensive researches of J. W. Judd stemmed from an investigation in 1885 on the peridotites of Scotland. In these basic rocks, which he believed to have formed at considerable depth and under great pressure, he found the crystals of feldspar and ferromagnesians to be "shot through" with minute rods and plates of a more or less definite form. As an example, the feldspar of the Cuchullin Hills, Skye, was full of minute black rods and plates often occurring in layers in five planes, those of the pinacoids and prisms, producing the labradorite play of colours. The pyroxenes, both monoclinic and orthorhombic showed similar orientated inclusions. Judd regarded the inclusions as amorphous in nature, being composed of hydrated oxides, such as opal, hyalite and limonite. He further decided that these inclusions were of secondary origin, the result of a deep-seated metamorphic process which he termed "schillerization".

In his paper of 1886 Judd proposed a theory of schillerization based on five postulates. These are as follows:

1. If a crystal is subjected to intense strain, planes of easy solution arise parallel to the directions along which the strain is exerted and as a result certain cavities filled with liquids or solids, the products of the solvent action, will be formed along such planes.
2. In every crystal, in addition to the cleavage planes and the glide planes, Judd postulated the existence of a third set of structural planes along which chemical action occurred most readily. These planes of chemical weakness had a definite crystal orientation.
3. Under great pressure solvents act in these planes of chemical weakness to produce cavities, or negative crystals. These often become filled with decomposition products. At any one depth the plane of greatest chemical weakness is attacked first.
4. There appears to be a definite relation between the planes of cleavage, gliding and chemical susceptibility.

In proof of this hypothesis Judd put forward the following observations:

1. In faulted pebbles from the Old Red Sandstone from the Highlands, cavities filled with liquid and secondary solids were found in planes parallel to the faulted surface. These cavities were produced by solvent action in directions of strain.
2. Since their discovery by Daniell in 1816, etch figures on crystal faces have received much study. But it was not until 1884 that Von Ebner of Gratz discovered the presence of the solution planes (Lösungsflächen). Mainly studying calcite and aragonite Von Ebner was able to show that certain planes exist in

these crystals in which chemical action takes place most easily.

3. According to Mugge there is evidence to show that cleavage planes and glide planes are mutually interchangeable. In actual experiment it was found that cavities developed under pressure in twinning planes just as in natural cleavage planes.
4. In many plagioclases the minute black enclosures are parallel to the albite and pericline twinning planes.
5. In certain feldspar crystals from a gabbro at Humlebak Scharf, Norway, albite twin lamellae and layers of inclusions may be seen under the microscope in those parts of the crystal which have suffered most deformation.

Thus, briefly, Judd believed that "schiller structures", commonly seen in pyroxenes, feldspars and olivines were structures characteristic of deep-seated rocks and were produced as secondary phenomena by pressure. In this theory he is followed by A. G. MacGregor (1931) who, however, regarded them as a result of regional metamorphism. In favour of the theory is the fact that the labradorite and hypersthene from the great Archaeozoic "shield" of the Labrador area of Canada both show orientated inclusions, as though they were developed as a result of strain (or regional metamorphism). If, on the other hand, the inclusions are primary, it seems rather a coincidence that two "classic" examples of the phenomenon should occur side by side.

It would be wrong, however, to assume Judd's theory is the only one which can explain the lineation of micro-inclusions in feldspars and pyroxenes. In fact most modern petrologists believe these textures are the result of unmixing in solid solutions. During certain conditions of cooling these solid solutions unmix, producing in minerals special exsolution textures. The moonstone structure is certainly produced by this phenomenon. Kozu and Suzuki have shown in this case that the x-ray pattern of this gemstone indicates the presence of two space lattices at room temperature (one orthoclase, the other albite), and this is no doubt the result of unmixing during slow cooling of an original homogeneous potash-soda feldspar. In the case of enstatite-hypersthene (and perhaps plagioclase) unmixing may produce schiller structures. Perhaps the relationship between schiller structures and deep-seated origin may then not be due to the ideas Judd put forward, but rather to the results of slow cooling which occurs in these bodies; rapid cooling would prevent unmixing.

This concept of solid solution in minerals was discovered early in the 19th Century, soon after the development of accurate methods of chemical analysis. Minerals were found, not to be constant in chemical nature but rather, they were variable within certain limits. Minerals were then looked upon as mixed crystals, as though a single perfect crystal could contain molecules of two or more substances. We now know, however, that there are no molecules in ionic crystals, only an ordered pattern (or lattice) running through the whole crystal, with atoms of various elements situated in various parts of the lattice. The whole structure might be made up mainly of atoms A and B, but here and there atoms X take the place of an A, and Y takes the place of B. Mason illustrates the concept with the idea of a bricklayer who, when he runs short of red bricks for a wall, incorporates a yellow brick here and there. But the yellow bricks must fit the red bricks and must be of the same size, or double the size or three times and so on. Certain definite conditions govern the atomic replacement. These may be found in textbooks such as Goldschmidt's "Geochemistry" or Winkler's "Structure und Eigenschaften der Kristalle".

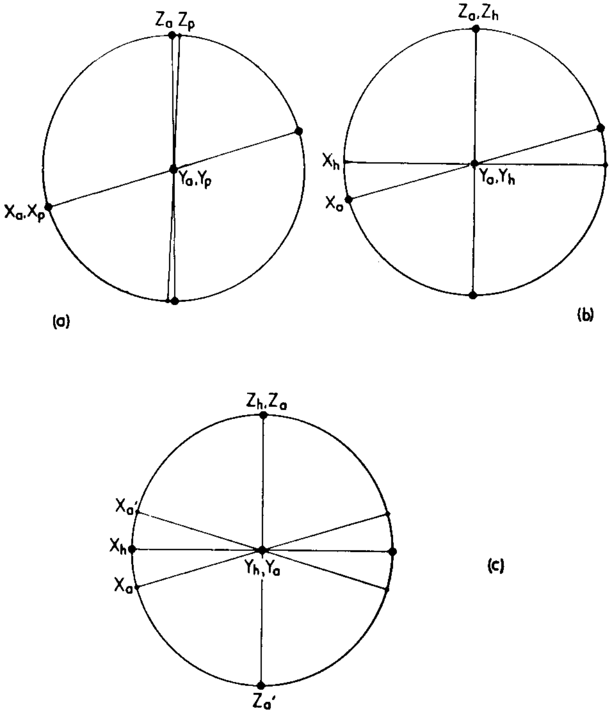
Identification of "schiller" inclusions

Within the last two decades a powerful x-ray technique has been applied to the identification of orientated inclusions in minerals resulting from exsolution, alteration or partial inversion. This method uses oscillation photographs i.e. the crystal under study is made to rotate slowly around an edge (say, the C axis) and the x-ray reflections are recorded on a cylindrical film whose axis coincides with the rotation axis of the crystal. In the pyroxenes studied by this method, by Bown and Gay in 1959, the crystal was made to oscillate in two 15° ranges, across the normals to (100) and (010). These experimenters made use of a general principle called by them "the intergrowth symmetry principle", to determine the nature of the orientated intergrowth. Basically, this means that orientated crystallites give spots on the photograph governed by the host symmetry, not by their own symmetry or orientation. Now if a similar photograph is taken of a "pure" pyroxene and the two photos compared, certain spots will be seen on the first photograph which are due to the inclusions.

The problem is one of (*a*) identification and (*b*) orientation of inclusions. If the inclusion is also a pyroxene it may be identified by matching similar photos of pure substance spots and "inclusion" spots as to position and relative intensity. For example, augite lamellae in schillered hyperthene could be identified by comparing the inclusion spots with the spots of pure augite. The orientation of the lamellae would be the same as the orientation of the "pure" augite crystal. More difficult identifications and orientation studies may involve the use of powder photographs.

Some of the combinations studied by Bown and Gay included: (1) Augite + (001) Pigeonite lamellae; (2) Augite + (100) Hypersthene lamellae; (3) Pigeonite + (001) Augite lamellae; (4) Hypersthene + (100) Augite lamellae; (5) Hypersthene + (100) Magnetite lamellae; (6) Hypersthene + Ilmenite + Hematite lamellae; (7) Augite + (100) and (001) Magnetite lamellae.

Some of these no doubt include the common schillered hypersthenes, bronzite, etc. Fig. 5 (*a*, *b*, *c*), shows the orientation of inclusions in cases 1, 2, and 4 above.



The aventurines

Apart from the coloured glass, the term "aventurine" is usually applied to varieties of two minerals, quartz and feldspar. Only the latter shows a true schiller. This is essentially a potash feldspar containing orientated exsolved plates of a reddish coppery mineral, which is usually thought to be hematite, though O. Anderson discovered an aventurine labradorite from Modoc County, California, in which the inclusions were metallic copper. The main deposits of aventurine feldspar are in Norway, near Lake Baikal, U.S.S.R; near Archangel; and in U.S.A.

Aventurine quartz is essentially a translucent granular quartz containing scattered glistening spangles of silvery, reddish and green micaceous minerals (the green from India containing fuchsite) without definite orientation. Owing to its hardness this is more suitable than the feldspar for cutting but it is inferior to feldspar in beauty.

A "schillered" quartz from Manhattan Island, described by Scott, appears to be quartz containing thin films. The term "schiller" is used incorrectly.

Conclusions on schiller

The phenomenon of schiller arises from the development, either by exsolution or secondary alteration, of orientated lamellae, which have a definite relation to certain crystal structural planes. If these lamellae are metallic in lustre, then the host mineral shows a brilliant metallic reflection in certain orientations. This is true schiller, resulting from simple reflection. If on the other hand the lamellae are transparent it is possible that interference effects may be produced, though in this case the phenomenon is not a schiller as defined above.

Pseudochromatism

This term is used by Berry and Mason as equivalent to the term "play of colour" of the older writers. In this section only the pseudochromatism of labradorite will be discussed at any length, as the writer feels that the results of modern studies on precious opal are too well known to be described here.

Labradorite

The mineral now known to us as labradorite was discovered in 1770 by Moravian missionaries, who found it in use by the Esquimaux of the Labrador coast. The first specimens reached Europe in 1775, some specimens consisting of pure labradorite with its beautiful deep blue play of colour, while others were slabs of an igneous rock containing, as well as labradorite, crystals of hypersthene, with a beautiful coppery red "schiller". The rock, a norite, occurs on the Isle of St. Paul and along the adjacent mainland.

Soon afterwards, in 1781, similar labradorite was discovered, as boulders, at Peterhof, near St. Petersburg, in Russia. Here the boulders showed the characteristic blue colour, but weaker than that of the Labrador material. Near Kiev it occurs again *in situ* in a gabbro, along with diallage. Here single crystals of labradorite measure up to five inches, though most are smaller. Many other localities occur in Russia.

About 1825 specimens were discovered in Finland, near the iron mines of Abo. Here the material tends to be transparent and colourless, with beautiful colours, often in concentric zones about a dark nucleus. The United States of America has a number of important localities, in New York State, and in Pennsylvania, Arkansas and North Carolina. Bauer, in his "Precious Stones", states that some fine material had come on the market from Brisbane, Australia. No such material was known to the writer, who was a student of geology in that town, though some large boulders of "augen" gneiss containing labradorite in the Botanic Gardens, reputedly brought from South America (?) as ballast in the days of sail may have provided the material.

Incidentally, as would be expected, Bauer gives an excellent account of the material and its play of colour. He notes the general opaque nature of the mineral, its ash gray colour and the magnificent display of colours at one particular orientation. In this position it shows metallic sheen and the colour together. As Bauer states: "There is no art by which a reproduction or an imitation of it in any way comparable to the original may be produced". He likens the colour to that seen on the wings of certain South American butterflies, to the blue of *Morpho cypris* and M. Achilles and the green of *Apatura seraphina*. Also, although he does not pretend to have made a detailed scientific study of the cause of the play of colours, he notes particularly that the colours may be produced in more than one way, the yellows and greens in one way, the characteristic blues in another. This fact will be referred to later.

The first scientific study was made by Von Hessel in 1827. With the aid of a two-circle goniometer he discovered the following facts: (1) The play of colours occurs at only certain definite orientations. (2) The reflection of coloured light came from certain definite planes. He attributed the play of colours to reflections from inner cleavage planes. In 1829 Brewster stated that: (1) The reflecting plane made an angle of 10°52′ with the cleavage face P. (2) The colour of the transmitted light is complementary to the reflected. His theory was that the colour was produced by reflection from an infinite number of planes.

In the same year Nordenskiold, after studying the Finnish material noted that the colours are sometimes concentric and the reflecting plane may be a cleavage plane. He further postulated that the atoms of transparent crystals can be arranged for the refraction of light in different ways.

Senff, also in 1829 (a great year for the study of labradorite) discovered that in Finnish labradorite the colour was visible when the crystal was turned 22°30′ from the plane of the (010) cleavage.

In 1830 Bonsdorff postulated a reflection from layers of silica in the material. Reusch in 1863 imagined the colour was due to reflection from minute cleavages.

Far more important was the work of Vogelsang in 1868 This experimenter divided the colour into 2 classes:

Class A. The common blue colour which he thought was a polarization phenomenon due to its lamellae structure.

Class B. The golden reddish "schiller" with the rarer yellow and green, due to the presence of black acicular microlites and yellowish red microscopic lamellae.

Anderson, writing in the "American Journal of Science". describes the play of blue and green colours as a "glaukisiren" and makes the very important statement that the colours are probably due to light scattering by submicroscopic inclusions.

Rayleigh in 1923 made some interesting observations on the subject. His conclusions were:

1. The colour of the mineral results from reflections of two types.
2. The first reflection is specular, from micro-inclusions in the

cleavage plane (perhaps (010) though crystal notation is not used in this paper). This is a blue or sometimes a yellow reflection. (A thin plate colour.)

3. The beautiful colours of the "play of colours" occur as a diffuse reflection from a plane about 15° from the above cleavage.
4. The nature of the particles which make up this diffuse plane is not easy to determine, though they are parallel sided, irregular in outline approximately 0·005 mm in dimension and distributed at random in depth. (Also variable in thickness.)
5. The bright colours are probably the result of interference of streams of light from the two surfaces of each "patch".
6. The brightness of the colour is explained by a large number of reflecting "patches" adding their effects, without definite phase relations, such as would give use to regular interference.

In 1924 Boggild studied both labradorite and peristerite. His boservations included:

1. Play of colour only occurs in plagioclases of composition 92.5–85.5 AL and 49–38 AL.
2. Peristerite has only one plane of reflection of coloured light.
3. Labradorite has 3 planes of reflection of coloured light.
4. In all cases the coloured material is either twinned or laminated.
5. In peristerite the reflecting plane is between $(0.8.\bar{1})$ and $(\bar{1}.21.\bar{2})$.

However, Boggild notes that gedrite from Avisiarfik, in Greenland, also shows colours reflected from the (010) plane, without any visible twinning or lamenations.

Parsons, in 1930, put forward a list of points which he thought to be of prime importance in the study of the play of colours:

1. Iridescent colour in crystals is reflected from definite crystallographic planes.
2. In most cases the material that has been examined was twinned.
3. The colours are interference colours of the first and second order.
4. The colours of the iridescent light is complementary to that of the transmitted light at a given angle of incidence.
5. The coloured light is not plane polarized.
6. The atoms of crystals can be so arranged that light will be refracted in different ways.

7. The colours of plagioclase are shown only by those of certain chemical composition.

Statement 6 in the list is considered most important by Parsons, who concludes that the colours are produced by optical interference from large numbers of atomic structural planes which make angles of 23°15′ ± 1° with the (010) face. Yet further on in his article he states that the particular tint of colour seen is determined by the thickness of the twinning lamellae, variation in colour (in concentric zones) being due to bending of the twinning layers. So the paper seems to oscillate between attributing the colour to twinning lamellae and certain structural atomic planes.

The most recent investigation of the labradorite colours is that of Raman and Jayaraman in 1950. According to these workers the colours are not due to the visible inclusions (the layers of rod-like structures so commonly seen) because of their irregular distribution. Rather they believe that the colour, particularly the metalloid blue, is due to variations in the mineralogical nature of the soda-lime feldspar. In fact they consider that most labradorites are grey and translucent rather than transparent because of the presence of an extremely fine micro-perthite structure of orthoclase microliths in the labradorite host.

While the albite twinning of labradorite is not fundamental to the development of the colour it does govern the orientation of the orthoclase microliths. In albite twinning 010 is both a composition plane and a reflection plane. Now if we number the twin lamellae, clearly visible in the 001 face, in the order 1, 2, 3, 4, 5, 6 etc., then the orthoclase microliths in layers 1, 3, 5 are parallel to each other, as are those in 2, 4, 6, but the orientations of microliths in the two sets would be different.

Raman and Jayaraman put forward five criteria of prime importance:

1. Every specimen of labradorite which is twinned according to the albite law and shows iridescence should display the latter in two distinct settings of the specimen, if the direction of incidence of light and the direction of observations are constant.
2. For the same reason, for any given position of specimen and light the iridescence should be observable in two divergent directions.
3. The two reflections have their origin in different parts of the

crystal, namely the two differently orientated parts of the albite twin.

4. The two sets of reflections show similar colours.
5. The settings of the crystal required for observing the two independent sets of reflections should make equal angles with the setting required to obtain a specular reflection from the composition plane.

The author then describes in some detail slight complications due to the presence of pericline twinning. In (5) above the angle of maximum intensity of iridescence is 14° on either side of the 010 face.

As to the origin of the colours themselves the writers are rather indefinite, and more or less propose that they are "labradorite colours". The concentric distributions, so commonly red-brown, yellow and pale blue, set in a background of metalloid blue, is not a thin film colour or Newton's rings colour. The writers however state that the colours seen depend on the size and distribution of the orthoclase microliths in the layers. In their finest state they scatter light and presumably the metalloid blue is a Tyndall blue scattered by small particles. The other colours are interference colours due to interference of light in particles of dimension in excess of those required to give the first order Newtonian colours.

So, basically the remarkable metalloid blue is thought by Raman and Jayaraman to be a Tyndall blue.

The writer has in his collection a beautiful thin section of labradorite (0·03 mms thick) which is crowded with parallel rod-like inclusions and which shows the most striking metalloid blue in certain orientations. With the aid of a 5-axis universal stage he was able to determine: the crystal orientation of the thin section; the crystal orientation of the rod-like crystallites; the orientation of the metalloid blue reflecting "plane" (the "diffuse plane" of Rayleigh).

(No details of orientation procedure are given here, as this paper is concerned with results rather than experimental studies, but the interested reader should refer to the Geological Society of America Memoir 8, "The Universal Stage" by R. C. Emmons; a standard text).

The results of the above study are listed below:

1. The rod-like crystallites (some of which are actually cavities rather than crystals), occur in the (010) plane.

2. The metalloid blue reflecting plane (the diffuse reflecting plane of Rayleigh) in centred 22°30′ off (010). This figure is essentially that of Senff (1829) and Parsons (1930). The axis of rotation used was in the (010) plane, and at 90° to the elongation of the crystallites. At 14° (Raman, 1950) and 15° (Rayleigh, 1923) no blue was observed.
3. A rotating Wright analyser indicated that the metalloid blue light was plane polarized to a certain extent. This plane polarized light was not confused with that produced at the Brewster angle, approximately 57°.

Another cut specimen in the author's collection shows a yellowish-red colour by transmitted light and the normal metalloid blue by reflection. The former colour is very similar to the "red" fringes seen on the edges of the isogyres in biaxial crystals showing dispersion.

Conclusions on labradorite

It seems likely that the striking blue reflection of labradorite, a remarkable example of pseudochromatism, is a Tyndall effect. Tyndall scattering occurs also in some chalcedony, and in the so-called blue quartz. A major point of distinction between these and labradorite seems to be that the scattering particles have a definite orientation in the latter, while in the former they are randomly distributed in the host mineral.

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ASSOCIATION NOTICES

PRESENTATION OF AWARDS

A reunion of members was held at Goldsmiths' Hall, London, on Monday, 26th October, 1964. This was followed by the annual presentation of awards at which Mr. Norman Harper, Vice-Chairman of the Association, presided. He said: "The Gemmological Association are very pleased and happy to welcome you all to this presentation ceremony, and to congratulate all the successful candidates in our recent examinations. Once again we are able to do this in this delightful and impressive Livery Hall of the Worshipful Company of Goldsmiths, and our sincere thanks go out to the Company for their kindness in allowing us this privilege. The Gemmological Association is now entering its second half century, and is stronger and healthier than ever. This year we had the largest entry for our examinations in the history of the Association, when 273 entered for the Preliminary and 139 for the Diploma. The examiners have been at pains to ensure that the Standards required in the examinations have been maintained. It is our aim to favour neither a brilliant theoretical person, nor a particularly excellent practical worker, but a balanced gemmologist who does not fall too low in any branch of the subjects covered by our syllabus. For the second year the Association has arranged the examinations for the Diamond Certificate, and once again all the candidates passed both in theory and practice. I would like on behalf of the Association to thank De Beers for their help and all their interest in these Courses.

"I would also like to take this opportunity of placing on record the Association's indebtedness to the Midlands Branch, and the West of Scotland Branch for their continued keenness and enthusiasm. Their is one person to whom special tribute is due, and that is our Secretary, Mr. Gordon Andrews. He has been our Secretary for 25 years, and has done a splendid and dedicated job of work. I am sure we all hope that Mr. Andrews is our Secretary for many years to come.

"I specially welcome Fellows and visitors from overseas including Miss U. Tillander, Finland, Dr. H. Nairis and Dr. C. Neilsson from Sweden, Mr. P. Vanderkelen of the Gemmological Association of Australia, and Mr. J. A. Fleming, New Zealand. I am also glad to welcome Mr. J. Pike, of Messrs. Rayner and Keeler Ltd., who so kindly present the Rayner and Tully prizes.

"We now come to the object of our gathering here tonight, which is to present diplomas and certificates to successful candidates in our examinations and I am extremely pleased to introduce you to Mr. A. E. Shipton, President of the British

Jewellers' Association, who will perform this ceremony. Mr. Shipton is well known in the jewellery trade, and he became a Fellow of the Association in 1932. He was for some time Chairman of the Midlands Branch of the Association and in that capacity did some splendid work. He is managing director of an important firm of precious stone cutters and merchants in Birmingham, and it is a great pleasure to us to have him with us during his term of office."

Mr. Shipton, in congratulating the successful candidates, said they were only at the start of their career. Often they would have to be tactful when they were shown a magnificent "alexandrite" bought at a bargain price in Gibraltar.

The treasurer of the Association, Mr. F. E. Lawson Clarke, in thanking the B.J.A. President, said that those who studied gemmology were introduced to new worlds of interests, such as those of optics, mineralogy, microscopy, photography and the work of the lapidary, which was Mr. Shipton's special interest.

MIDLANDS BRANCH MEETINGS

Members of the Midlands Branch of the Association visited the Barber Institute of Fine Arts, Birmingham University, on the 25th September, 1964. They were welcomed by Dr. Garlic, a member of Professor Ellis Waterhouse's staff, who outlined to members the history of the Barber Institute, and discussed examples of the varied European schools of painting exhibited there. Members were able to inspect the four galleries and, apart from paintings, were shown a carved jade bowl and drinking cup of the Ching Dynasty and a bloodstone bowl with silver-gilt settings by Paul Storr.

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An informal social evening was held by the Branch at "La Reserve", Sutton Coldfield, Warwickshire, on Wednesday, 21st October, 1964.

TALKS BY MEMBERS

Caffell, E. W. "Gemstones", Heston Congregational Church (Ladies' Friendship Club), 22nd September, 1964.

Gillougley, J. H., Jnr. "The Diamond Story", Ralston and Oldhall Townswomens Guild, Paisley, 15th October, 1964.

Kent, D. G. "Gemmology", Bromley (Branch) Young Conservaties, 4th November, 1964.

Oliver, R. J. N. "Diamonds", Liverpool 41 Club, 6th November, 1964.

Jones, T. G. "Gemstones", Abingdon Abbey Townswomen's Guild, 10th October; "Science of gemstones", Haselmere Natural History Society, Surrey, 14th November, 1964.

Caffell, E.W., "Gemstones", Coulsdon Rotary Club, 16th November, 1964.

WEST OF SCOTLAND

A meeting of the West of Scotland Branch was held in Glasgow on 22nd October, 1964. It took the form of a film show, at which "Diamonds in the West" and "The Conquest of Time" were shown.

OBITUARY

Mrs. Gordon Glennie (née Elsie Ruff), at Barbados, 1st November, 1964. Miss Elsie Ruff will be remembered by her many friends for her inate courtesy and for the painstaking researches which she made in connexion with the problem of jade. Her book "Jade of the Maori", published by the Association in 1950, won her great esteem and since that time she had published, in various gemmological journals, her studies of the occurrence, nomenclature and working of jade in Europe and the Americas. She became a Fellow of the Association in 1924.

COUNCIL MEETING

A meeting of the Council of the Association was held at Saint Dunstan's House, Carey Lane, London, E.C.2, on Wednesday, 30th September 1964. Dr. W. Stern presided. The following were elected.

ELECTED TO FELLOWSHIP

Adshead, Christine V., (Miss), London, E.12.
Algar, S. Forbes, Hamilton, Ont., Canada
Barker, Brian M., Pinner Middx.
Bromly, Ivan P., London, N.10. (D.1963)
Colclough, Albert C., Rainham, Essex.
Graham, Martin J. P., Reigate, Surrey
Kelly, Hugh, London, W.1.
Kerry, Stewart M., London, N.W.11.
King, Michael L., Witham, Essex
Koller, Tibor, Melbourne, Australia
Lechleitner, Paul A., Lucerne, Switzerland
Reid, Wilmot P., Kitwe, N. Rhodesia
Snider, James R., Willowdale, Ont., Canada
Bagi, Julius, Toronto, Canada

TRANSFERRED TO FELLOWSHIP FROM ORDINARY OR PROBATIONARY MEMBERSHIP:

Dowie, Frederick G., Christchurch, New Zealand
Larcher, David M., Sheffield
Bjørn-Hansen, Eva (Mrs.), Oslo, Norway
Bond, Cecil A., Waltham Abbey, Essex
Bradburn, Gwendoline (Mrs.) Sydney, Australia
Climie, Robert, Newtown St. Boswells, Roxburgh
Greene, Jane B., (Mrs.), Princeton, U.S.A.
Hunt, Elyane M. (Mrs.), London
Johnson, Arthur W., London
Knox, Christine G. (Miss), Hamilton, Canada
Kothari, Ramesh R., Madras, India
Marshall, M. Sheila (Mrs.), Ibadan, Nigeria
Miles, Richard S. G., Nottingham
Myers, Julia H. (Miss), Double Bay, Australia
Schiffman, Charles A., Geneva, Switzerland
Wyer, Philip G., Birmingham

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Bastos, Francisco M., Minas Gerais, Brazil
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Berkowitsch, Leo, Zurich, Switzerland
Blondel, Vera A. (Miss), Guernsey, C.I.
Butland, William M., Natal, South Africa

Decoster, Micheline (Miss), Brussels, Belgium
Dryden, Kenneth E., Spalding, Lincs.
Holcombe, John W., Queenstown, South Africa
Hightower, Jackson C., Twin Falls, Idaho, U.S.A.
Kasliwal, Nemichand G., Bombay, India
McTeigue, Walter J. Jr., New York, U.S.A.
Machlup, Harry, Johannesburg, South Africa
Meyer, Frederic W., San Francisco, Calif., U.S.A.
Okayama, Jiro, Tokyo, Japan
Owen, Stephen E., Talgarth, Breconshire
Parsons, Carlos D., Burbank, Calif., U.S.A.
Price, Robert A., Welling, Kent
Reed, George W. H., Dar-Es-Salaam, Tanganyika
Schneider, S. Herman (Dr.), Zurich, Switzerland
Silver, Nevis G., Auckland, New Zealand
Sonne, Sigurd V., Copenhagen, Denmark
Stanislaus, Saverimuttu J. L., Colombo, Ceylon
Simpson, James E., New York, U.S.A.
Stroud, Gerald M., London, E.C.1.
Suzuki, Tadahiko, Hokkaido, Japan
Taylor, Allan M., New York, U.S.A.
Van Starrex, Gertrud (Mrs.), Colombo, Ceylon
Ward, Muriel J. (Mrs.), West Perth, W. Australia
Weber, Adolphe, Geneva, Switzerland

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Blom, Karin S. (Miss), Schwabisch Gmund, Germany
Bloom, Harry, Johannesburg, South Africa
Dryden, John F., Spalding, Lincs.
Foulser, Terence F., Hatch End, Middx.
Gadebusch, Dedo-Alexander, Koln, Germany
Gilewicz, Richard N., Southampton, Hants.
Maynes, Georgina (Miss), Belfast, Ireland
Nicholson, William, Botcherby, Carlisle
Reiter, Peter O., Zurich, Switzerland
Roos, Peter, Amstelveen, Holland
Sansford, Paul V., Weymouth, Dorset
Thomas, Graham A., Mold, Flints.
Ubben, Els (Miss), Roermond, Holland
Winkler, Gunter, Jr., Augsburg, Germany

The Council gave consideration to matters arising in connexion with examinations. The Chairman emphasized that the Association was taking great care to ensure that the standard required for qualification in the examinations was being maintained.

The Council considered a request received from the National Association of Goldsmiths for advice concerning the definition of a flawless diamond and also considered comments made on the gemstone nomenclature draft by the Association, which was in the course of being revised in the light of current trade practices.

GIFTS TO THE ASSOCIATION

From Nigel Kennedy, F.G.A., a group of phenakite crystals, showing twinning. From Professor S. Cavenago-Bignami, Milan, a copy of the second edition of her book *Gemmologia*.

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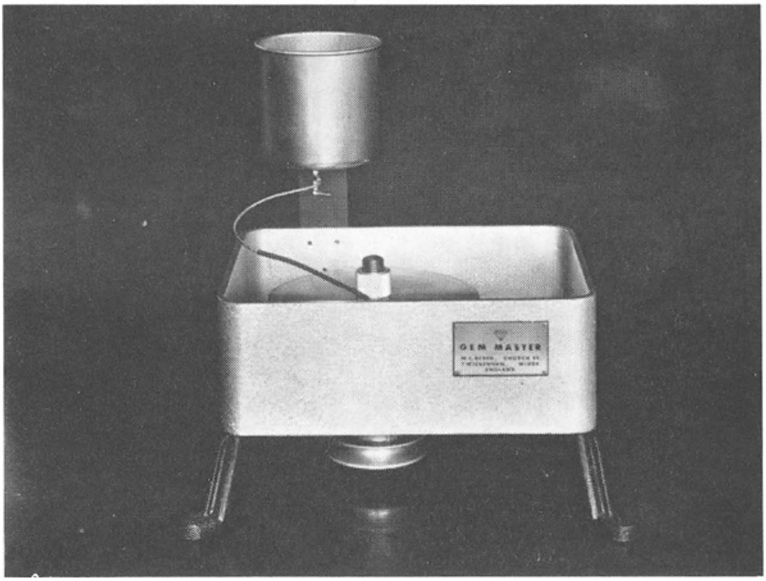
GEM MASTER

Vol. IX
No. 9
January, 1965

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Printed by F. J. Milner & Sons Ltd., Brentford and London