Vol. 10 No. 5 January, 1967

THE JOURNAL OF GEMMOLOGY

and

PROCEEDINGS OF THE GEMMOLOGICAL ASSOCIATION OF GREAT BRITAIN

GEMMOLOGICAL ASSOCIATION
OF GREAT BRITAIN
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Vol. 10 No. 5 JANUARY 1967

ANOTHER NEW SYNTHETIC

By KEITH MITCHELL

A RECENT trade enquiry for demantoid garnets produced two rather unexpected results.

One stone, submitted from abroad, was described in a letter as "— not demantoid, but another kind of green garnet". Having in mind the newly reported emerald-like transparent green grossular garnet, I was full of interest to see the stone. But it was nothing more than a very handsome green zircon, a fact revealed at once by its absorption spectrum. The price asked was something like ten times its value as a zircon.

A second stone, oval, weighing 2·94 carats, was described as "fine green garnet", and was of an attractive medium quality demantoid colour, bright and well cut — a beautiful gem.

A chance request that evening for me to examine and comment on a new light source for the Rayner Microscope when used for absorption spectroscopic work gave me the idea of looking at the demantoid spectrum. This is normally one of the less easy absorptions to see because the areas that matter are at the end of the spectrum where light transmission and optical acuity are least effective.

Having the 2·94 carat stone with me I used this one for the test, fully expecting to get a good demantoid spectrum. The result surprised me.

It gave one of the most impressive arrays of intense sharp absorption lines that I have yet seen. Some ten strong lines with another 20 or so weaker ones to fill in the gaps. (Fig. 1). It was like looking at a brilliant spectrum through irregularly spaced bars. A staggering display and, needless to say, not one to be expected from demantoid garnet.

Fortunately, I remembered seeing a somewhat similar spectrum reported from America. This stone was one of the new "garnets" which have been synthesised in the search for laser materials and which have not yet been officially released for gem use. How this one got through is still not known. It certainly is the first seen by gemmologists in the U.K. and is apparently the first cut specimen to be reported in gemmological literature.

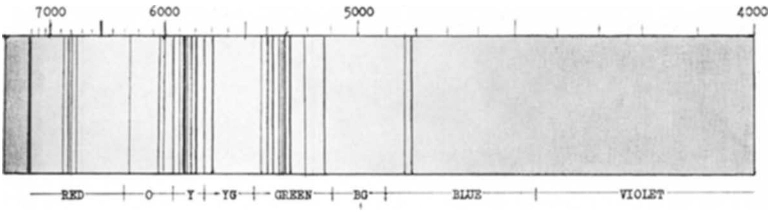


FIG. 1.

The physicists responsible for producing these substances call them garnets simply because they crystallize in the garnet structure but, unlike true garnets, they actually contain no silicon. The three that have so far been reported are YAG (yttrium aluminium garnet), YIG (yttrium iron garnet) and YGaG (yttrium gallium garnet). The present stone was undoubtedly YAG, doped with chromium to give the fine green colour.

A natural-looking flat cavity filled with a reddish fluid (possibly melt-flux) completed the illusion that the stone might be natural. But this was far removed from the byssolite fibres of almost every true demantoid.

Subsequently Mr. B. W. Anderson measured the lines and my drawing is based on his readings. Apart from a slight general shift of our readings towards the blue (the American readings may have been taken from a super-imposed scale) there are also one or two differences in the intensity of individual lines between the two versions. The lines are thought to be due to one or both of the rare earths generally known collectively as didymium, and to chromium, but the discrepancies suggest that these are either there in different proportions in the two specimens or that some extra impurity is present. If chromium has been used it is almost certainly responsible for the group of lines in the red and probably also for the intense 7320Å line just visible in the very deep red. However, the normally characteristic absorption of a broad band of the orange-yellow-green sector was either absent or so faint as to be missed in the excitement of the other intense lines of this region.

Mr. Anderson, with characteristic thoroughness, checked other features of the stone so that it is possible to give a fairly complete record of its constants. Density was 4·60, considerably higher than for demantoid (3·84). The R.I. for sodium light was 1·834, which is lower than that for demantoid (1·89), but still above the normal range of the refractometer. Dispersion was not measured. But once the nature of the stone was realised an empirical assessment of this property suggests to me that in a demantoid I would have expected to see rather more fire than was in fact present. But this is only an impression and may well be erroneous.

The stone fluoresced strongly in short and long ultra-violet wavelengths, the colour being red. X-rays gave an orange fluorescence with strong phosphorescence. In an intense beam of visible light the stone also glowed reddish through the green. The Chelsea filter test also gave a strong red colour. These last two features also occur in the new Linde synthetic emeralds and argue chromium saturation.

The YAG material is reported to have the formula $Y_3Al_5O_{12}$. Pure, it is colourless, but can be doped with various colorant ions. YIG, the iron-containing version, is opaque with important magnetic properties. Less is known about YGaG, but it has turned up in the form of a small pink cabochon cut stone in America. Again it has a very startling absorption spectrum, substantially different from that of YAG. These spectra appear to be mainly due to rare earth impurities present in the yttrium, but variations in their line content must be expected as the colorant elements are changed.

Perhaps the most disturbing factor of the present stone was its complete unexpectedness. It was offered as a fine green garnet at a very high price and was handled in all good faith on both sides of the Atlantic by persons of very high repute. Not only did they accept it as demantoid without query, but the present writer was also prepared to do the same.

I hope that the publicity which I am now giving it will prevent other such synthetics being accepted as natural demantoid.

CRYSTALS OF TAAFFEITE FOUND IN CHINA

By B. W. ANDERSON

THAT exceedingly rare gemstone, taaffeite, for many years known only in the form of three small cut specimens, has been found in at least one locality in China, and its crystal structure analysed. The bare details of this work appeared in the Mineral Abstracts in 1964; but being in the "Crystal Structure" section, had escaped the notice of gemmologists, myself included.

The paper itself, "Discovery of 8-layered close-packing crystal structure—analysis of taaffeite" by Pen Chzhi-Chzhuh and Van Kug-zhan, of the Peking Geological Institute, was published in 1963 in Scientia Sinica, and I was able to obtain a copy from the Patent Office Library. It was written in Russian, and I found it rather intriguing to see my own name, in ordinary type, surrounded by a sea of Russian characters. Fortunately, Dr. G. F. Claringbull was able to have a translation made by Miss Fejer of the Mineral Department at the Natural History Museum, where so much of the original work on taaffeite had been done. From the title of the paper it is clear that the discovery of taaffeite crystals was no new thing to the authors: their purpose and their interest lay in elucidating in detail its crystal structure. The only details of the occurrence itself lie in the sentences "the crystals used in our investigation come from one of the localities of our country. They were hexagonal prismatic. They occur in white banded sediments as isolated crystals together with fluorite and nigerite". Miss A. Fejer reports having seen a taaffeite specimen from Hunnan Province, China, in the Mineralogical Museum of the Academy of Sciences in Moscow—and that is the extent of our knowledge of its occurrence at the moment: let us hope that means may be found to obtain a specimen for the Natural History Museum in London.

Presumably pyramidal faces were present as well as prisms, since the authors were able to make an estimate of the axial ratio $a:c = 1:3{\cdot}227$ from goniometric measurements.

The whole story of Count Taaffe's original discovery (in 1945) of the mineral which now bears his name reads like a gemmologist's fairy-tale, and the sequel, too, was sufficiently strange. At that time, at least, Taaffe had no refractometer. His most dependable means of gem identification was by careful examination under a binocular microscope magnifying 21 diameters. On this occasion he was sorting through a mixed parcel of stones selected earlier from a local (Dublin) jeweller's junk-box. According to his usual practice, the stones were first meticulously cleaned, and then sorted by eye into categories, mainly by colour. Amongst some pale mauve spinels was one specimen which puzzled Taaffe greatly because, looking through the stone, every tiny mark or scratch on the back surfaces showed distinct "doubling" which, of course, was out of order for spinel, which in appearance and density (taken with a hand-held balance) it otherwise resembled. As a result, Count Taaffe sent the strange stone to me for a Laboratory identification.

The properties of Taaffeite No. I, as eventually determined, were as follows: Weight, 1·419 cts, density, 3·613; refractive indices, 1·7230 for the ordinary ray, 1·7182 for the extraordinary, giving a double refraction of 0·0048; H = 8. A clear, uniaxial interference figure was seen. The absorption spectrum was almost too faint to be measured, but resembled that of pale blue spinel. An absorption spectrogram revealed a narrow band at 3820 Å in the near ultraviolet, which was missing in spinel.

These properties were unlike any to be found in the literature, and the final identification had to rest on chemical and crystal analysis by Dr. G. F. Claringbull and Dr. M. H. Hey at the Natural History Museum. This, of course, entailed sacrificing part of what was then a unique specimen, and a small one at that. To his eternal credit, Count Taaffe agreed to this being done—only stipulating that he should receive the remainder back in the form of a gemstone. The tricky operation was performed by the skilled lapidary Mr. G. Bull Diamond, and we were able to return a bright and pretty little stone weighing 0·55 carat to its anxious owner.

After preliminary spectrographic investigation, Dr. Hey later achieved the feat of carrying out a complete chemical analysis on only 6 milligrams (0·30 carat) of the material, which showed the composition to be beryllium magnesium aluminate, intermediate in composition between chrysoberyl and spinel. Dr. Claringbull's X-ray work showed that the new mineral belonged to the hexagonal trapezohedral class of the hexagonal system (the first mineral to do so, with the exception of "high" quartz, stable only between 573° and 870°C).

Despite thorough search amongst parcels of spinels of similar colour, and careful scrutiny of all likely Museum specimens, no further examples of the new mineral came to light until October 1949. A Gemmological Exhibition was being held in the Goldsmith's Hall, and C. J. Payne was working alone and rather late in the Laboratory on an interesting collection of 100 stones in a case. Most of these were green sapphires and pale spinels, but one was a kornerupine, acting as a sort of curtain-raiser for the pale mauve stone which later came to light, and which proved to be Taaffeite No. 2. This weighed only 0·86 carats, was slightly paler than the first, and had slightly lower constants. Fortunately I was able to purchase the stone, and it is now in the Natural History Museum, London.

The completion of the analytical and X-ray work took a considerable time, and so far, nothing had been published concerning the new mineral: even our name for it, "taaffeite" (pronounced tarfite), after its discoverer was unofficial. The discovery was made known and the christening performed, in a letter to "Nature", published in March 1951, while for gemmologists the story was recounted in the following month by C. J. Payne in this Journal and by myself in the *Gemmologist.* The full paper appeared in the *Mineralogical Magazine* in December, 1951.

The hunt was now on; and I for one confidently expected that some enthusiastic gemmologist would soon unearth another specimen, or better, would find a pebble of taaffeite in the illam of Ceylon. There were many "false alarms"; stones which turned out to be spinels, but the finding of Taaffeite No. 3 had to wait until Christmas

Eve, 1957—its discoverer, most appropriately, being our friend G. Robert Crowningshield of the G.I.A. Laboratory in New York. This third sample weighed 0·84 carats, and was amongst a parcel of drop-shaped vari-coloured spinels. Its properties agreed closely with those of the other two specimens. This American stone, after changing hands more than once has, I understand, now found a permanent home in the magnificent collection of gems in the Smithsonian Institution, Washington.

Since then, silence. Hence the shock of surprise to learn of the work being done on the mineral in China. True to form, taaffeite has continued its "first ever" record. It was the first new mineral ever to have been first discovered as a cut gemstone: it was the first mineral to be found to contain both beryllium and magnesium as essential constituents: it was the first mineral to be found belonging to the hexagonal trapezohedral class of symmetry. And now the Chinese workers have found that taaffeite is the first mineral in which the oxygens in the crystal structure lie in a particular form of eight-layered arrangement, which they propose to call the "taaffeite type".

The ripples from that first keen observation of double refraction in Dublin have spread very far. Here is one instance at least where gemmology has been able to repay some of the debt it must always owe to its mother-science of mineralogy.

ORNAMENTAL SERPENTINE

By ROBERT WEBSTER

TO most lay people in Britain, the name serpentine brings to mind the ornaments fashioned from the soft, but attractive, rock-like ornamental stone found at the Lizard peninsula in Cornwall. This is the material called *serpentinite* by the geologist, but there are many other serpentines of interest to gemmology. One of these serpentines, the variety called *bowenite*, is at the present time used extensively for "jade" carvings and thus has considerable interest to the gemmologist. Strangely, however, the scientist does not take due cognizance of this harder variety of serpentine.

What is serpentine? Briefly, it is a hydrous magnesium silicate approximating to the formula $3(Mg,Fe)O.2SiO_22.\ H_2O$, and is derived by the hydration of ultra-basic igneous rocks rich in olivine, amphibole (hornblende) or pyroxene (augite). Serpentine may be a member of an isomorphous series. The mineral never forms distinct crystals and is found mostly in compact rock-like form, but sometimes occurs as more distinctly crystallized fibres, probably of monoclinic symmetry, filling veins in massive serpentine. This fibrous type, which forms the *chrysotile asbestos* of commerce. has no gemmological significance. Serpentine has a world-wide occurrence, but in only certain well-defined areas can be obtained material suitable for ornamental purposes.

There can be many variations of the mineral. Mineralogists, since the beginning of the 19th century, have divided the serpentines into groups, and again into varieties, to some of which specific names have been applied. Most of these have no place in gemmological studies.

A better division of the serpentines—the name *serpentine* being derived from the fancied resemblance to the skin of a serpent—for our purposes is as follows—*precious* or *noble serpentine* comprising the purer translucent and massive varieties, which have a rich oil-green colour. J. Sinkankas confines the noble serpentines to the mineral varieties *bowenite*, *williamsite*, and the resinous-waxy yellow to yellow-green translucent serpentine called *retinalite*. The second type is the so-called common serpentine which includes the rock-like types; the third type is the fibrous serpentine exemplified by the aforementioned *chrysotile* and some others, including a variety which at one time was used as a gemstone under the name *satelite.* The fourth type comprises the foliated varieties, such as *antigorite* and *marmolite.*

From X-ray studies G. Selfridge divided the serpentines into two groups, *serpentine* and *antigorite,* and he suggested the name *serpentinite* for the rock-like forms of serpentine, antigorite or mixtures of both. E. Whittacker and J. Zussman have more recently divided serpentine into three groups, *lizardite, antigorite* and *chrysotile.* Further, there is an aluminous serpentine called *pseudophite,* often referred to in gem literature under the misnomer "Styrian jade"; and the *polyphant stone* from Launceston in Cornwall is also classed as a serpentine. To this list may be added the serpentinous calcites called *ophicalcites,* such as "Connemara marble" and "Iona stone".

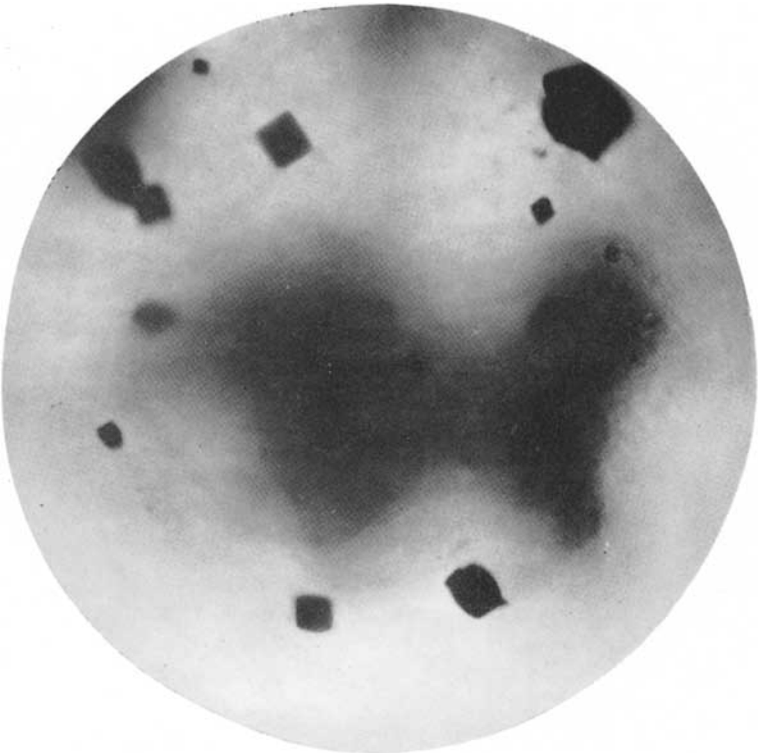
The most important variety of serpentine met with in gemmology is *bowenite.* The first use of this material as an ornamental stone appears to have been made by the Maori of New Zealand, who were said to have worked the deposits of the serpentine found in the South Island before and up to the European times. At its best a lovely rich deep oil-green to bluish-green material, bowenite is found at Anita Bay, Milford Sound, on the west coast of Otago County in the South Island of New Zealand.

The Maori called this material by the name "Tangiwai", which means "water of tears". According to Elsie Ruff, who quotes Eldon Best, the mythology of "Tangiwai" tells that it is the result of the weeping of Hina-ahua, wife of Tama-ahua, for her far-distant home in Polynesia, her tears permeating the stone, a story that may have arisen owing to the apparent globules of water seen in polished specimens of New Zealand bowenite when viewed by transmitted light. Another version suggests that the apparent globules are the result of the weeping of the mythical navigator Tamatea for his deserted wives.

A. Finlayson describes the New Zealand bowenite as a translucent variety of serpentine composed of a dense felt-like aggregate of colourless serpentine fibres with occasional patches of magnesite, flakes of talc and grains of chromite. The serpentine occurs as veins in a foliated rock containing the same minerals, but with talc as the dominant constituent.

At one time known under the Persian name of "sang-i-yashm" is the hard bowenite variety of serpentine which is mined in the hills of Safed Koh on the Afghan side of the border with North-west Frontier Province, in what is now West Pakistan. This material, usually pale apple-green in colour, is found as rock masses at the head of one of the mountain gorges which run into the valley of the Kabul river, and near to the Kyber Pass. This Afghan bowenite was, and probably still is, brought down to Bhera, a trading centre which lies about a hundred miles north-west of Lahore in the Western Punjab. Here the material is cut for sale.

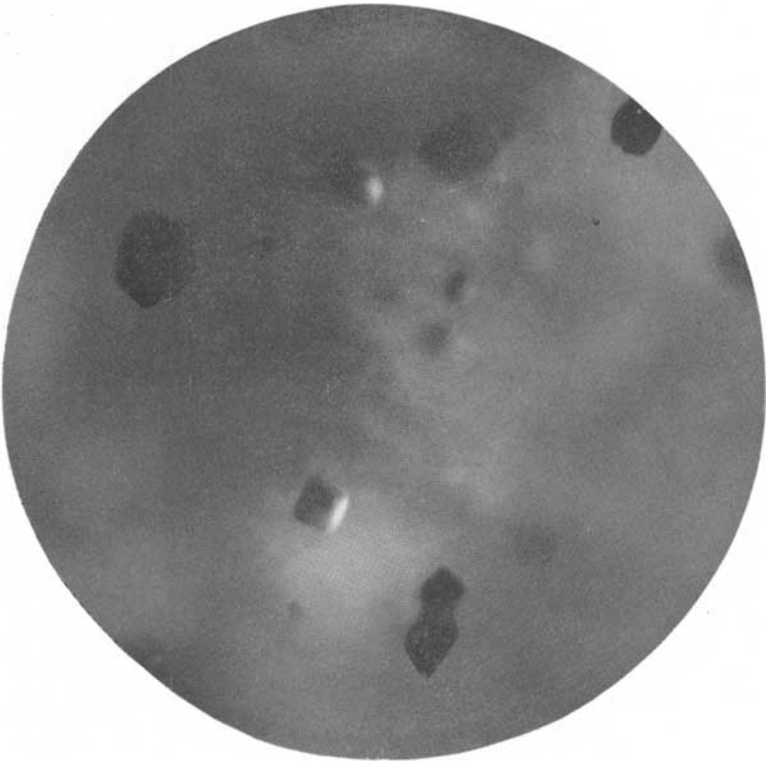
Coggin Brown mentions that there are other deposits of apple-green bowenite not far from Kabul in Afghanistan. Other bowenite of a darker green colour is found (with true nephrite jade) at



Opaque crystals of cubic symmetry in a specimen of the williamsite variety of serpentine. Transmitted light.

Khotan in the autonomous region of Sinkiang-uigar of China. Both the jade and the bowenite are brought across the frontier and sold together in the Srinagar bazaars. Small quantities of dark and light green bowenite with calcite are found in the Aravalli rocks near Baman Vada, Idar States, Bombay.

The same author also states that a translucent bowenite of apple-, bottle-, grass-, and dark green, and rarely sulphur yellow colours is found in the vicinity of Shigar in Baltistan in Kashmir. The material, which is fashioned into small cups and vases at Shigar, occurs in rocks of doubtful age at an elevation of 18,000 feet above sea-level, so that mining is limited to two months during the year. Coggin Brown further tells that "mottled and veined, dark and light green semi-precious serpentines occur at other



Opaque crystals of cubic symmetry in a specimen of the williamsite variety of serpentine showing that they may have octahedral habit. Reflected light.

A native-fashioned tea cup of serpentine from the Karakoram mountains, Kashmir.

localities in Kashmir and elsewhere, as for example in the Pulivendla area of Cuddapar district of Andhra, but they have so far (1955) not been used by lapidaries".

The interest in the above paragraph is that recently some worked serpentine was examined by the writer, which was said to have been obtained from a location some 16,000 feet up in the Karakoram mountains in an area covered by snow eight months of the year. This is suspiciously like the location mentioned by Coggin Brown, but this material was far too soft to be bowenite as the hardness was found to be about 2¾ on Mohs's scale. The density of this material was 2·56 and the index of refraction about 1·56. The absorption spectrum showed a strong band at 4650Å and a weak band about 4970Å. There was no luminescence. From X-ray powder photographs officers of the Geological Survey stated that the material is lizardite with some brucite.

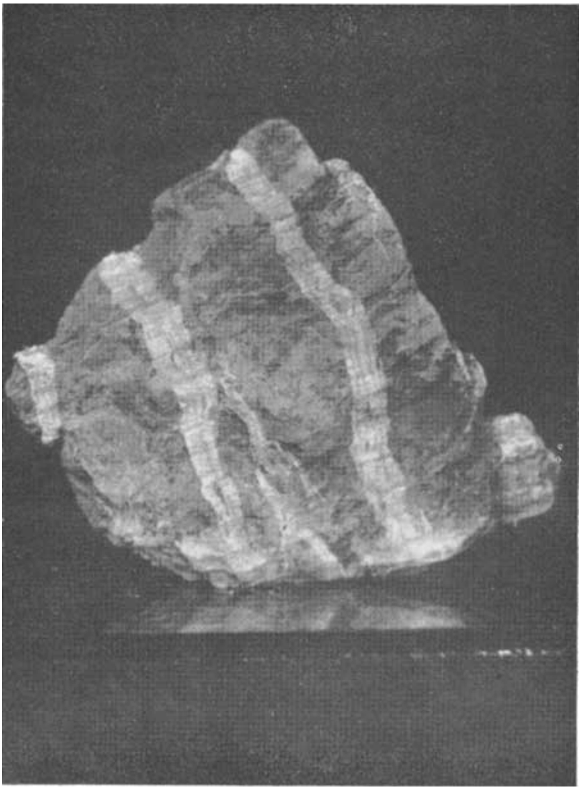
During 1922, G. T. Bowen identified a jade-like mineral from the northern part of Rhode Island State, in the United States of America, as nephrite. The actual locality is given as Smithfield Township but may now be, according to Sinkankas, the Dexter lime quarry of Lincoln Township. A later investigation on this material (J. D. Dana 1950) found it to be a variety of serpentine and *not* nephrite, and the name *bowenite* was applied to it after the name of the original worker. The bowenite from this source has historical but no commercial significance.

Much of the material used for the carved figurines and other pieces which come from China at the present time is bowenite serpentine. This material varies in colour from that of misletoe berries to a distinct yellowish-green, and it is usually characterized by included whiteish patches, which may be chlorite. Carved pieces of this material are sold under the misnomers "New Jade", "Soochow Jade" or "Korea Jade", but are, of course, not true jade—nephrite or jadeite. It is not known with any certainty where this bowenite is found, but one source is said to be Tuoyuan in Hunan.

Bowenite is generally considered to be a sub-variety of the antigorite group of serpentines and an X-ray analysis of a specimen of "New Jade" taken by the officers of the Geological Survey confirmed the material to be antigorite. The material has an exceptional hardness for serpentine being between 5 and 6 on Mohs's scale against about 2½ for ordinary serpentine. This greater hardness may be due to the interlocking of the fibrous crystals which form the serpentine into a compact mass. The refractive index is about 1·56 and the density is fairly constant ranging from 2·57 to 2·59, but a Maori ear-pendant of rich deep bluish-green translucent material gave a density of 2·617. The absorption spectrum of bowenite is unrewarding. There are vague bands near 4970Å and a stronger band at 4640Å but they can scarcely be said to be diagnostic. Some of the paler bowenite glows with a weak whitish-green fluorescence under all radiations of ultra-violet light and X-rays, but the darker-coloured material seems to be inert.

A variety of noble serpentine sometimes met with in jewellery is *williamsite*, a beautiful emerald-green translucent stone which usually contains square-shaped metallic crystals, which are probably chromite. The best-known locality for williamsite lies on the borders of Maryland and Pennsylvania in the United States of America, where it is found in the chromite mines of the district—mines which have apparently not been worked since 1920. Williamsite is rarely found in large pieces as the mass is extensively fissured with veins of brucite.

Like bowenite, williamsite has a refractive index near 1·56, but like all these massive materials it only gives a vague shadow-edge on a jeweller's refractometer. The density, as determined by the writer on nine specimens, varied from 2·603 to 2·619, which, except for the bowenite Maori ear-pendant mentioned earlier, is higher than for the bowenites. The hardness was found to be less than that for bowenite but slightly greater than for the ordinary serpentines. One specimen examined was found to be weakly scratched by apatite but not by fluorspar, and could be assessed as $4\frac{3}{4}$ on Mohs's scale. The absorption spectrum shown by williamsite usually exhibits the chromium lines in the red. This is to be expected in view of the chromite environment, it being probable that some chromium replaces the magnesium. Any lines or bands

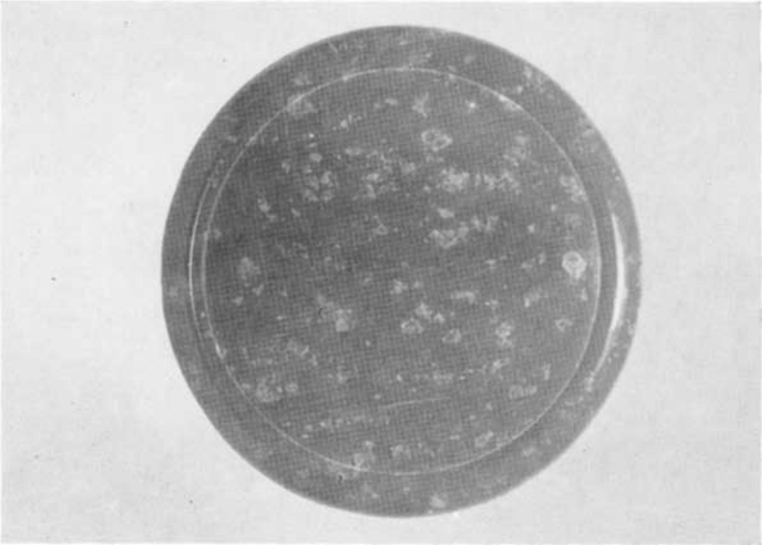


Veins of chrysotile asbestos in serpentine rock (from Conway).

in the blue part of the spectrum so commonly seen in serpentines are either too faint or are masked by the chromium absorption. There is no luminescence seen with williamsite.

Sinkankas mentions some other varieties of serpentine, but as specimens have not been available to the writer they will only be mentioned cursorily. They are *retinalite,* said to be a waxy translucent serpentine in bright yellow or yellow-green colours, *ricolite* from Rico in New Mexico, which is a fine-grained serpentine occurring in curious coloured bands, and *satelite,* a fibrous greyish to greenish-blue coloured material which produces a type of cat's-eye. It comes from California and Maryland in the United States of America.

Serpentinite, the rock-like type of serpentine, is found in many places in the world and is extensively used for the production of small ornamental objects and also for architecture. Predominantly green in colour, although browns and reds are not uncommon, the material owes much of its attraction to the varied and striking mottlings caused by included crystals and veins of other minerals. Sinkankas mentions an unusual serpentine once found near



A teapot stand of red serpentine spotted with green crystals. Lizard, Cornwall.

Gouveneur in New York State which is of a peculiar dull grey opaque kind called "London smoke".

Famous throughout the world is the serpentine rock found at the Lizard peninsula of Cornwall. The Lizard serpentine forms a mass of rock nearly circular in outline which is bounded by schists, except where on the coastal side they have been eroded away, the serpentine having welled up and intruded through them.

The domain is ably described by E. Davidson who states that the serpentine occupies a larger area than any other of the Lizard rocks and gives to the area its distinctive character, for the rocks weather to a clayey impervious soil which forms barren moorland. Where it reaches the coast it forms picturesque cliffs and coves and nowhere is this better illustrated than at Kynance Cove, which is made so beautiful by the varied colours of the exposed rocks.

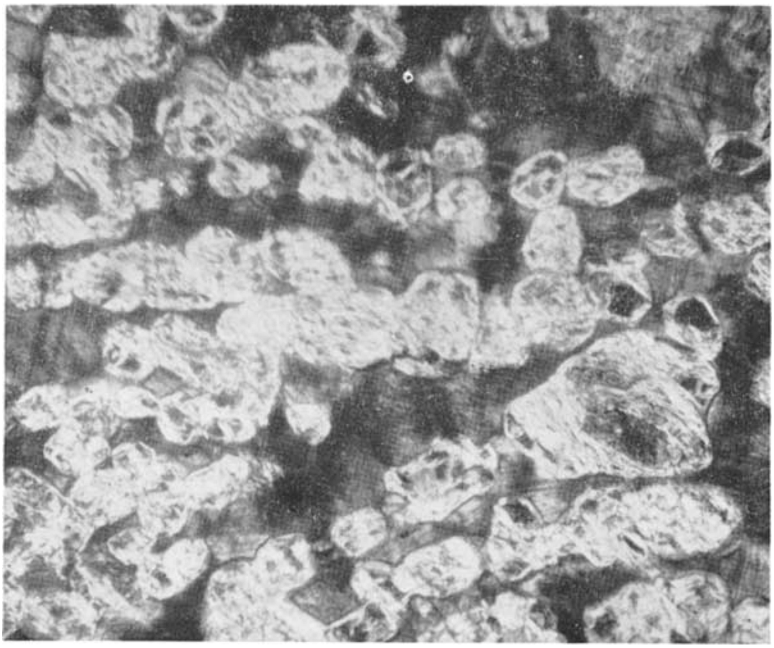
Mineralogically there are three main types of serpentine rocks found at the Lizard. One is the *bastite serpentine*, a rock which contains large shining crystals of bastite (a serpentinized hypersthene or enstatite) profusely scattered throughout the rock, which has a platy cleavage and an almost metallic lustre. This bastite serpentine forms the core of the intrusion and is surrounded by *tremolite serpentine*, a streaky-banded rather fissile rock. The last type, the *dunite serpentine*, is the marginal rock abutting on the schists which surround the intrusion. Dunite serpentine is a dark green resinous to glassy rock traversed by fine satiny veins. The rock shows a conchoidal fracture.

The Lizard serpentine varies considerably in its appearance and in its consistency. Seemingly the best material for cutting comes from the moors behind Kynance Cove and this material varies in colour from a blackish green with reddish markings, or reddish with green spots to a dark green with lighter green spots, but there are many variations in colour and mottling. Towards the Lizard Head itself the serpentine is a light grey-green marked with paler greens and with numerous dark-coloured veins. This material is more porous and less hard than the compact material from the moors.

Most of the serpentines from Cornwall are cut by local lapidaries who supply the gift shops which are a feature of the Cornish tourist centres. These lapidaries, who at the Lizard often carry out the work in small wooden huts in full view of the tourists, use conventional methods in fashioning the serpentine. Large pieces of the rock are sawn to suitable size by the use of vertical "mud saws", and where necessary these pieces are turned on a simple lathe. The grinding and polishing of flat and curved surfaces is carried out on horizontal laps, using emery or carborundum as an abrasive on the grinding laps and soft powders to put on the final polish. Buffs may also be used.

Other sources of serpentine in the British Isles are those at Portsoy, Banff, in Scotland, where a thin belt of serpentine up to 400 yards wide and six miles long runs SSW from Portsoy itself. The serpentine found here is light to dark green in colour and may be veined with white or black, and sometimes has red spots. Dark green serpentine, sometimes with angular black crystals, is found at Roscolyn in Anglesea, N. Wales.

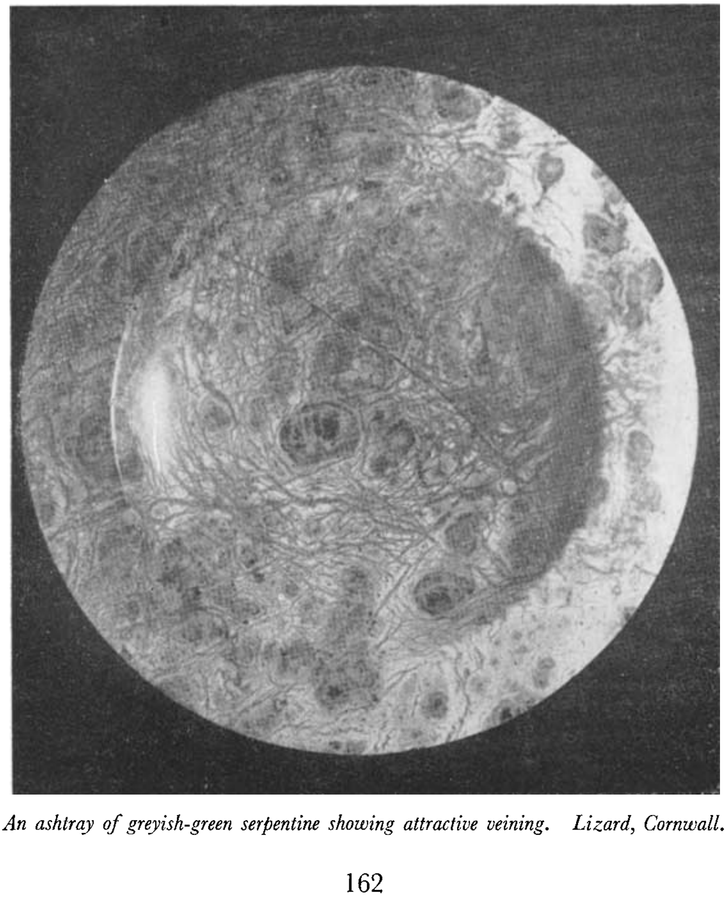
Of the many other localities for serpentine throughout the world mention may be made of the following—the dark grey-green serpentine from Hospenthal, St. Gotthard, Uri and from near Zermatt in Valais, Switzerland; the garnetiferous serpentine



A photomicrograph of a thin section of ophicalcite (serpentine marble).

from Zöblitz in Saxony, which is usually a dark blackish green with inclusions of red garnets, a material which has been fashioned into decorative articles; the serpentine found at New Caledonia, which has been used for beads by the natives there.

Much serpentine is found in Italy and at Snarum in Buskerud, Norway. Finland, Sweden, Rhodesia and the U.S.S.R. are other sources of serpentine, the occurrence of which is in fact world-wide. Some serpentine is a brownish-red in colour and may have a distinctly metallic lustre. From Franklin Furnace, New Jersey there is a manganiferous variety, but it is doubtful whether it has ornamental significance. It has been reported from America that a "black jade" cabochon mounted with other coloured jades



An ashtray of greyish-green serpentine showing attractive veining. Lizard, Cornwall.

was found to be serpentine. This stone may in fact be a very dark green and it is interesting to note here that G. Kunz refers to a serpentine of dark greenish-black colour which admits of a fine polish. It comes from the neighbourhood of Patterson, Caldwell Co., North Carolina.

The properties of the rock types of serpentine, as would be expected with such impure material, vary considerably. The refractive index, about 1·56, can only be measured vaguely on a refractometer, and the hardness too can vary quite a lot, but all rock serpentine can easily be scratched by a knife blade. The density can also show considerable variation. Experiment has shown that a range of from 2·4 to 2·7 may be expected. Some typical values are shown below:—

Green with magnesite; Hoboken, New Jersey	2·44
Light grey-green (soft material); Lizard, Cornwall	2·45
Yellow-green (talcose); Norway	2·49
Grey-green; Portsoy, Banff, Scotland	2·51
Mottled green; Ledalfoot, Girvan, Scotland	2·54
Dark green; Vosges, France	2·56
Green with bastite; Cadgwith, Lizard, Cornwall	2·57
Blackish-green and red; Kynance moor, Lizard, Cornwall	2·59
Green and red (metallic lustre); Lizard, Cornwall	2·62
Dark green; Norway	2·62
Grey-green; St. Gotthard, Switzerland	2·67
Green (schistose); Italy	2·67
Green with light spots; Lizard, Cornwall	2·68
Medium green; Norway	2·69

The vague lines in the blue sometimes seen in the absorption spectra of the rock-like serpentines do not seem to be diagnostically valuable, and, as is to be expected, the electro-conductivity which is usually present, is variable and is sometimes strong.

Another variation of serpentine which forms rock masses is the serpentine mixed with more or less calcite, dolomite or magnesite. This produces a rock of clouded white and pale to medium greens which is called *ophicalcite* or *ophicite*. The material known as *verde antique* is a brecciated serpentine with fragments of limestone and is usually classed with the ophicalcites. This rock was originally brought from Atrax in Thessaly by the Romans and was called by them "Lapis Atracius". "Irish green marble", perhaps better known as "Connemara marble", is a serpentine marble from quarries near Streamstown, Lissoughter, Recess and Clifton in Connemara, Galway, Eire. Much of the marble from these deposits is fashioned into small decorative objects for sale to the tourists. A similar material is found in the small island of Iona, which lies off the island of Mull in the Inner Hebrides of Scotland. Small pieces of this rock are fashioned into cabochons and other forms and are mounted into jewellery and the trinkets sold to visitors to Scotland. The material is commonly known as Iona stone.

Connemara marble is found in many shades of colour, the best being a fine cloudy green, but yellowish-green is common, and a pale greyish-green with brownish to black veins and spots makes attractive polished specimens. Coggin Brown mentions the beautifully marked serpentinous varieties of the "sauser teksil", which is found in the Chhindwara district, Madhya Pradesh, India as being a serpentine marble worthy of mention.

The ophicalcites may be derived from impure limestones containing silica and argillaceous material, which by metamorphic action develop various silicates of lime and magnesia, such as tremolite, forsterite, diopside and grossular garnet. The magnesium silicates become readily altered into green serpentine by later chemical action resulting in serpentine marbles. An unusual ophicalcite, which at one time attracted much attention, is that from the pre-Cambrian rocks of the Grenville district of Quebec, Canada. This material has the silicate minerals formed as rhythmic bands round more siliceous patches simulating a structure thought at one time to be organic and then given the name *Eozoon Canadense.*

As with serpentinite, the constants of ophicalcites are variable. The hardness is about 3 on Mohs's scale and the index of refraction about 1·56. Readings taken on a refractometer are very vague. As the rock is in the main a mixture of calcite (2·71), dolomite (2·85) and serpentine (approximately 2·50), the material should have a density within this range and experiment has shown that this is generally true, except where porosity lowers the density of the piece or inclusions of other minerals raise it. The range found on determining the density of sixteen specimens extended from 2·48 to 2·77.

The absorption spectrum of ophicalcite (Connemara marble) shows, according to B. W. Anderson, a strong band at 4650Å and a weak vague band at 4950Å. The material generally fizzes with cold acid and shows a certain amount of electro-conductivity. During electro-conductivity experiments it was noticed that the higher the density of the material the less was the conductivity and also the effervescence with acid was more pronounced with the lower density and higher conductive material.

A compact chlorite, sometimes referred to as an aluminous serpentine, is called *pseudophite*, or may be better known under the misnomer "Styrian jade". The material comes from Bernstein, which lies on the borders of Styria and Upper Austria just south of Vienna, an area which, before the Treaty of Versailles, was part of Hungary. A similar material is *miskeyite*, a "precious serpentine" found at Gurtiphol, near St. Gallenkirch, Montafon valley, Vorarlberg in the Austrian Tyrol. Pseudophite has a hardness of 2½ on Mohs's scale and a refractive index of about 1·57; the density has been determined as 2·69. There is seen a vague absorption band centred at 4980Å in specimens of pseudophite.

The serpentine diabase found near Launceston in Cornwall, called "Polyphant stone", has little application in gemmology. A density determination on a specimen of this material gave a value of 2·86.

Academic experiments on the synthesis of serpentine have achieved success. These syntheses have provided useful information in the scientific study of serpentinization, but they have no commercial significance.

The intention of this article was to give a description of the various types of serpentine used for ornamentation, and to consider aspects which would suggest future lines of enquiry. One of these may be further discussed. It is the question of the chemistry of the iron coloration of serpentine. Perusal of the literature seems to show some difference of opinion as to whether the colour is influenced by iron in the ferric state or the ferrous condition. Anderson suggests, from examination of the absorption bands seen in the various serpentines that ferrous iron (FeO) is the cause of the colour. Some authorities however, probably deducing from chemical analyses, prefer to consider iron in the ferric state (Fe_2O_3) as the cause of the colour in serpentine.

Assuming Anderson's assumption that absorption bands near 5000Å indicate ferrous iron, and that those of ferric iron are positioned near 4500Å, it may be well to give some consideration

A photomicrograph of a thin section of bowenite serpentine from Afghanistan. This shows the interlocking nature of the crystals to which the superior hardness of bowentite may be due.

to the bands seen in the serpentines. In bowenite the strong band is at 4640Å with a weaker band at 4970Å. Williamsite has a vague band at 5400Å; a strong band at 4950Å and a vague band at 4600Å. Connemara marble (ophicalcite) shows a strong band at 4650Å and a weaker one at 4950Å. The same worker mentions the examination of the absorption spectrum of antigorite and found the specimen to have a vague band in the green near 5400Å; a narrow "clear" band at 4950Å of moderate strength; a broad absorption band in the blue ending in a concentration at 4520Å, and lastly a strong band at 4300Å forming a cut-off to the end of the spectrum.

From a study of the absorption bands of various gemstones known to be coloured by ferrous iron, such as almandine garnet, idocrase, actinolite, kornerupine etc., it appears to the writer that the band about 4650Å may be the more "characteristic" band for ferrous iron.

An interesting report made by N. D. Sobolev might here be mentioned. This worker, from analyses of peridotite from the Caucasus, and in rocks in various stages of serpentinization, showed $FeO = 6{\cdot}96\% - 0{\cdot}43\%$ and $Fe_2O_3 = 0{\cdot}71\% - 7{\cdot}14\%$ and infers that the degree of serpentinization can be assessed from the ferric iron content. The table given by Kunz of the various analyses of serpentine (all prior to 1892) shows that out of 28 analyses referred to, only two showed ferric iron to be present. On the other hand the table given by F. H. Hatch to illustrate the chemical changes necessitated in the conversion of olivine and augite to serpentine seems to show some agreement with Sobolev. On balance it does seem that Anderson's inference from the observed absorption spectra that ferrous iron is the essential colouring agent in serpentine is correct, but it may still be true that iron in the ferric condition can have some influence on the colour.

In conclusion it may be mentioned that the serpentines were known to the Ancients, but none of the specific varieties were named until the beginning of the 19th century. Many of the names known to literature have little present day usage, but, as such names may at times be met with, a list of such varietal names which have at times been used for the serpentines is appended:—

Antigorite.	One of the three major divisions of the serpentines.
Baltimoreite.	A variety of picrolite from Bare Hills, Maryland, U.S.A.
Bastite (*Schiller spar*).	Enstatite altered more or less completely to serpentine. Mainly chrysotile and/or lizardite.
Bowenite.	A hard compact form of antigorite.
Chrysotile.	One of the three major divisions of the serpentines. Fibrous, and one type of the "asbestos" of commerce.
"*Korea jade*".	A misnomer for bowenite serpentine.
Lizardite.	One of the three major divisions of the serpentines.

"*London smoke*".	The name applied to a dull grey opaque type of serpentine found at Gouveneur, in New York State.
Marmolite.	A type of serpentine made up of thin folia and found at Hoboken, New Jersey, U.S.A Probably chrysotile and/or lizardite.
Metataxite.	A type of serpentine from Silesia (chrysotile).
"*New jade*".	A misnomer for bowenite serpentine.
Noble serpentine.	The name applied to the translucent serpentines used for ornamentation.
Ophicalcite.	A rock, a mixture of serpentine, calcite, dolomite, or magnesite. Connemara marble is an ophicalcite.
Ophiolite.	See ophicalcite.
Pelhamine.	A greyish-green serpentine (?) which takes a good polish. From Pelham, Mass., U.S.A.
Precious serpentine.	Same as noble serpentine.
Picrolite.	A type of antigorite serpentine.
Picrosmine.	Similar to picrolite.
Polyphant stone.	A serpentinous diabase from Cornwall, England.
Porcellophite.	A variety name for a type of serpentine. Probably of the antigorite group.
Pseudophite ("*Styrian jade*").	An aluminous serpentine found in Styria and elsewhere in Austria.
Radiotine.	A serpentine (?) in spherical aggregates of radiating fibres. From near Dillenburg in the Westerwald, Nassau, West Germany.
Retinalite.	A massive yellow to light oil green serpentine with a waxy lustre.
Ricolite.	A fine-grained serpentine with coloured bands from Rico, New Mexico, U.S.A.
Satelite.	A fibrous serpentine found in California and Maryland. Cut as cat's-eyes.
Schiller spar.	Alternative name for Bastite.
Schweizerite.	A variety of serpentine usually from Zermatt, Switzerland. Mainly chrysotile.
Serpentinite.	The name applied to the rock-like types of serpentine.
Serpentine marble.	Any rock-like type of serpentine.

"Soochow jade".	A misnomer for bowenite serpentine.
"Styrian jade".	A misnomer for pseudophite.
Tangawaite (Tangiwaite).	Bowenite serpentine from the South Island of New Zealand.
Thermophyllite.	A variety name for a serpentine from Finland.
Verde antique.	A rock composed of a breccia of serpentine and limestone.
Vorhauserite.	A disused name for a type of serpentine.
Williamsite.	An attractive noble serpentine found in Texas, U.S.A. A variety of antigorite.
Zermattite.	A type of serpentine from Zermatt, Switzerland. Probably a type of schweizerite.

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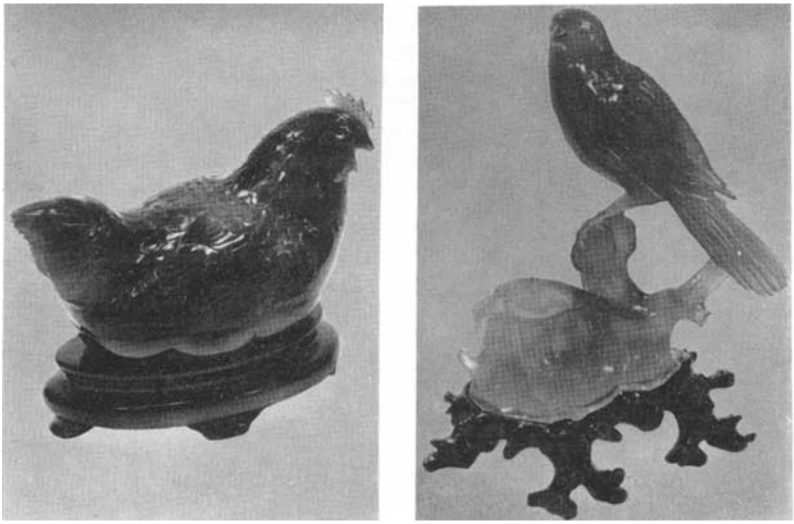

Carved bowenite serpentine.

LEFT. *Sitting chicken of dark green (nephrite colour) "New Jade". 4½″ × 3″ high.*

RIGHT. *Bird resting on a branch in the more usual pale green bowenite ("New Jade"). 3½″ × 4½″ high.*

photo by courtesy of Asprey & Co., Ltd.

Gemmological Abstracts

ROESCH (S.). *Messung und Uebersicht von Edelsteinfarben mittels de DIN Farbemkarte.* Survey and measuring of gem colours with the DIN colour chart. Zeitschr. d. deutsch. Edelsteinkunde, 1966, 56, pp. 12-18.

Colour is not a physical property but depends on the impression of the eye. It has been shown that 3 independent numbers are necessary, but also sufficient, to describe a colour. These numbers represent: colour tone, colour intensity and colour lightness. For the actual measuring of colour the author recommends DIN (German standard) colour chart 6165. One difficulty is that the stones are often transparent, which cannot be realistically represented on a chart. A new name is suggested: Colour variation number. This would be a large number in the case of, say, quartz and a small one for, say, citrine or aquamarine. Large bibliography.

E.S.

HAHN (M.). *Zur Frage nach dem Alter der Idar-Obersteiner Edelsteinindustrie.* The question of the age of the gem industry in Idar-Oberstein. Zeitschr. d. deutsch. Gesell. f. Edelsteinkunde, 1966, 56, pp. 24-26.

The oldest document about agate finds in the district is dated 1454, and the first mention of agate polishing was dated 100 years later. Although the whereabouts of these documents is unknown the dates mentioned seem to be correct.

E.S.

HOLLAENDER (H.). *Der Smaragd.* The emerald. Deutsche Goldschmiedezeitung, Vol. 63, 1965, p. 1164.

Short historical essay on emeralds. It is known that the Egyptians knew emeralds in 2000 B.C. and prized them as much as the Incas and Mayas in the New World.

E.S.

ANON. *Die Diamant Syntheses.* Diamond Synthesis. Zeitschr. d. deutsch. Gesell. f. Edelsteinkunde, 1966, 55, pp. 3-7.

A diamond synthesis by the high-pressure and high temperature laboratory of the Mineralogical and Petrological Institute of the University of Bonn. The work was done under the direction of Professor A. Neuhaus. The apparatus used is described and illustrated. The diamonds produced had a length of up to 0·5 mm; they included some slightly yellow or even greenish, but also some colourless. The habits obtained were octahedral and cubic.

E.S.

BAIER (E.) and PENSE (J.). *Edelopaloptik in Kunstprodukten.* The optics of precious opals in man-made materials. Zeitschr. d. Gesell. f. Edelsteinkunde, 1966, 55, pp. 7-20.

The optics of precious opal are discussed in detail and a reflectogram is shown in stereoprojection. By examination with the electron-microscope it is shown that the cause of the particular light reflection of opal is a lattice made up of balls of equal size. The authors discuss the possibility and advantages of a future synthesis of opal by opalising packs made up of SiO_2-balls.

E.S

LENZEN (G.). *Die Farbbezeichnungen des Diamanten als internationaler Handelsbrauch.* Colour-nomenclature of diamonds as used internationally in the trade. Zeitschr. d. deutsch. Gesell. f. Edelsteinkunde, 1966, 55, pp. 20-30.

During the end of the last century certain terms were used for describing the colour of diamonds, these were: Jager, River, Top Wessleton, Wesselton, Top Crystal, Crystal, Top Cape, Cape, and Yellow. These are now known generally as "Old Terms". Before the first World war an alternative nomenclature was introduced: finest blue white, blue white, fine white, finest silver cape, silver cape, cape, light yellow and yellow. These names did not include the brown-reddish types and these were sub-divided into very finest light brown, very very light brown and light brown. Various tables are compiled showing the various terms and comparing the name given to the actual colour of the stone. A RAL (German) standard has been published on this theme, but does not seem to cover the problem.

E.S.

STRACK (E.). *Der Flusspat.* Fluorite. Zeitschr. d. deutsch. Gesell. f. Edelsteinkunde, 1966, 55, pp. 30-42.

Very detailed article dealing with many aspects of fluorite. Chemistry, crystal form and habit, cleavage, hardness, specific gravity and optical properties are given. Pure CaF_2 is colourless but rare. Fluorite is usually found in violet, blue, green and yellow, also pink to red, orange, brown and grey coloured. A certain blue colour can be produced by x-ray radiation, but this fades in day-light. Cathode-ray treatment produces permanent colours—white fluorite becomes violet, pale green changes to pale violet and pink darkens. Luminescence is described. Fluorite is found in England (Cumberland, Durham, Cornwall and Devonshire), Saxony, in the Swiss Alps near the St. Gotthard, also in Austria, Norway, Poland and Italy and Russia. There are many occurrences in North America, British Columbia and in South-west Africa. Apart from gem or ornamental uses fluorite is used in the optical and chemical industry. In optics the low RI (1·434) and low dispersion (0·0045) make it suitable for the production of lenses in microscopes, and the chemical industry used to use fluorite for the production of fluoric acid. It is also used in metallurgy. Fluorite was well known and used by the Romans.

E.S.

BOOK REVIEW

CHUDOBA (K.) AND GUBELIN (E.). *Edelsteinkundliches Handbuch.* Stollfuss, Bonn, 1966. 269 pp., 4 colour pl., numerous illus.

First published under the title of *Schmuck und Edelsteinkundliches Taschenbuch*, there is a change for the second edition. The text has been substantially revised and much new material has been added. More attention has been paid to the importance of absorption spectra in distinguishing between gemstones and the new book is essential to all using the German language who are interested in the study of gemmology.

A.G.

ASSOCIATION NOTICES

UNESCO

A vacancy exists in the Department of Geology, Arts and Science University, Rangoon, Burma, for an expert in gemmology. The work would involve the "teaching and supervising of laboratory work, initiation of research programmes and the improvement of gem collections suitable for training. Experience is required in mineralogy with a knowledge of rubies, sapphires and associated minerals, as well as especially in jade. Language qualification is English. The duration of the appointment is one year commencing April 1967 and the appointment carries a basic salary of the equivalent of $17,400 gross, with adjustments for assignment and family allowances. Travel is provided for the expert and his dependants (spouse and children under 18 years of age). In addition, Unesco contributes towards the cost of installation at the duty station, the education of dependent children, and the medical expenses of the staff member. On separation from Unesco, a repatriation grant is paid".

HERBERT SMITH MEMORIAL LECTURE

The 1966 Herbert Smith Memorial lecture was given at Goldsmiths' Hall, London, on Tuesday, 8th November, by Mr. R. C. Chirnside, Chief Chemist at the Hurst Research Centre of the General Electrical Company at Wembley. Mr. Philip Riley, Vice-Chairman, introduced the speaker.

Mr. Chirnside said that moon projects had made it possible to undertake extensive research in gem synthesis. Most people in his audience, he said, would, when they thought of crystals, think first in terms of those which had been prized for centuries as precious stones. But many crystals were of considerable commercial importance.

He first discussed the quartzes, reminding the audience that 60 per cent of the earth's crust was composed of silicon dioxide. Clear quartz, he said, lacked fire and was little used in jewellery, so that the stimulus to produce synthetic quartz was unlikely to come from the jewellery trade. Its greatest importance, he said, was for optics and telecommunications. The fact that it would transmit ultraviolet and infra-red light made it an ideal lens and prism material. Its oscillation at a standard frequency when activated by an electrical impulse had led to its extensive use in telecommunications.

He recalled that there had been great anxiety both in the U.S.A. and in this country during the war, because we were dependent on Brazil for quartz suitable for these important uses. This had been the impetus that had led to the synthesis of quartz. The scientists had got silica to dissolve in water and recrystallize at temperatures of over 300 deg. centigrade in an autoclave (a pressure cooker). Crushed quartz was put in a basket and dissolved in this way, then a seed of quartz was put in and the silicon dioxide in the solution crystallized around it. This technique known as the hydrothermal process, made it possible to grow large perfect crystals in a short time. It was this technique that was, he thought, being used to grow the latest synthetic emeralds, and it was possible to grow a great variety of other crystals in this way.

He then went on to describe developments that had taken place in the Verneuil furnace, the flame-fusion process of producing synthetic corundum. These developments had resulted from the demand for synthetic corundum rods for watch and instrument jewels and for very large crystals for maser and laser work.

Then he turned to the crystallization of titanium oxide to form rutile. This, he said, formed a dark grey or black crystal, but it became colourless when heated. It had a higher refractive index than diamond and a very high dispersion, but a slight yellow tinge, and was of course much softer than diamond. The latest development he said had been the crystallization of strontium oxide and titanium oxide to produce strontium titanate, which had been given the despicable name Fabulite.

He then went on to talk about the early attempts to synthesize diamond, and the ultimate success of the G.E.C. laboratory in the U.S.A. in 1954. This had been possible as a result of research into the vast temperatures and pressures which were necessary to achieve this synthesis.

He concluded by saying that while the jeweller preferred the natural stone to the synthetic, the scientists preferred the synthetic because of its greater purity.

Mr. Basil Anderson in thanking Mr. Chirnside said that the gemmologists couldn't have too much first hand information about synthetics, and reminded the audience that Verneuil might be considered to be the father of gemmology. His invention had made gemmology really necessary.

WEST OF SCOTLAND BRANCH

A meeting of the West of Scotland Branch of the Gemmological Association was held at the North British Hotel, Glasgow, on Thursday, 10th November 1966. Mr. J. Gilloughley, Chairman of the Branch, presided.

After welcoming the 115 members of the audience, the chairman called upon Mr. R. Webster, the guest speaker, to present diplomas to two successful candidates in the recent examinations.

Mr. R. Webster then gave a comprehensive review of synthetic stones. After dealing briefly with their history he discussed modern stones, their manufacture and points of difference from natural stones. The lecture was illustrated by colour-slides and many interesting examples of synthetic stones were on display. Following a question time, the chairman announced that Mr. W. C. F. Butler, Vice-Chairman, would be leaving Scotland, and thanked him for all the work and time he had devoted to the Association.

Acknowledging the thanks, Mr. Butler expressed the Branch's indebtedness to Mr. R. Webster for coming to Glasgow and giving such an interesting and stimulating lecture.

GIFTS TO THE ASSOCIATION

The Council of the Association is indebted to Mr. A. Nagy, of the Diamond Polishing Works Limited, for a diamond crystal weighing 1·85 cts.

COUNCIL MEETING

A meeting of the Council was held at Saint Dunstan's House, Carey Lane, London, E.C.2, on Tuesday, 13th September, 1966. Mr. Norman Harper presided. The examiners and instructors attended, and the year's examination results were considered. The Council decided to make an application to the College of Heralds for a Grant of Arms, based upon a design submitted by Mr. H. Ellis Tomlinson, M.A.

The following were elected to membership:—

To Fellowship:

Boudreau, Guy A., Montreal, P.Q. Canada. D.1952
Tyerman, John T., Newark-on-Trent, Notts. D.1962
Ash, Grahame D., London, N.21. D.1966
Zwollo, Paul, Oosterbeek, The Netherlands. D.1966
Ingram, Roger, Sheffield, 11. D.1966
Guthu, Steinar, Sandefjord, Norway. D.1966

To Ordinary Membership:

Beaumont, Roy A., Market Harborough, Leics.
Beers, Larry D., California, U.S.A.
Black, John H., Christchurch 5, New Zealand
Buchanan, Kenneth R. Oklahoma, U.S.A. 74135
Buckner, George D., Florida, U.S.A.
Butler, Terence, Bologna, Italy
Chow, Robert, Kowloon, Hong Kong
Chow, Sammy, Kowloon, Hong Kong
Dingle, Patricia N., Ontario, Canada
Edwards, Roland V., California, 90069, U.S.A.
Evans, David G., Cookham, Berks.
Facchinelli, Carlo A., Trento, Italy
Graves, K. (Mrs.), London, S.W.16
Hamblym, James H., Lower Hutt, New Zealand
Hasan, M., Southall, Middx.
Hopkins, Jr., Norman B., Bowie, U.S.A.
Importservice Imp. Ind. Ltd., Sao Paulo, Brazil
Ishizawa, Shinkichi, Tokyo, Japan
Takahashi, Akio, Tokyo, Japan
Canes, Joel, J., Johannesburg, S. Africa
Kern, Joseph F., New York 11758, U.S.A.
Ledbetter, Susan, Dublin 4, Eire
Mac Leod, Dan M., Vancouver, Canada
Matthews, Pauline, Nairobi, Kenya
McKeown, Peter M., Hastings, New Zealand
Milligan, James C., Aberdeen, Scotland
Namiki, Mosao, Tokyo, Japan

O'Donoghue, Michael J., London, N.W.3
Oki, Yoshiro, Tokyo, Japan
Okumura, Mosahiro, Wakayama City, Japan
Ono, Matuo, Chibaken, Japan
O'Rourke, Edward A., Maryland, U.S.A.
Beyda, Raphael, Geneva 17, Switzerland
Roberts, William N., Johannesburg, S. Africa
Ryding, John S., Victoria, Australia
Schnetz, John V. P., Kriens, Switzerland
Selormey, Clement E., Kumasi, Ghana
Smyth, John J., Dublin 6, Eire
de Souza, Victor J., Kobe, Japan
Steib, Fred, Illinois 60615, U.S.A.
Suita, Nagayasu, Tokyo, Japan
Wilson, O. G., Kentucky, U.S.A.
Peyerl, Wolfgang, Johannesburg, S. Africa
Yamamoto, Yuji, Osaka, Japan
Yiu, Nellie, Kowloon, Hong Kong
Beckmann, Jr., Frank L., Hitchin, Herts.
Horden, Anthony B. H., Lusaka, Zambia
Psaros, James C., Florida 32925, U.S.A.
Schippers, Gustaaf, Ryswyk, Holland
Schreiber, Ludwig, Auckland, New Zealand
Turner, Peter H., Salisbury
Weder, Anton, Hong Kong
Lam, Lionel K. P., Hong Kong
Beadon, D. V., Kingston-on-Thames, Surrey

To Probationary Membership:

Amedeo, James, New York 13, U.S.A.
Blastiaan, Sluis, Vlaardingen, Nederland
Davey, Christopher M., Nr. Crediton, Devon
Fraley, Robert J., N. Carolina, U.S.A.
Harris, Anthony M., Hove 4, Sussex
Holmes, Graham J., Bexhill-on-Sea, Sussex
Horden, May C., Lusaka, Zambia
Hutchins, Andrew J., Auckland, New Zealand
Kenney, Francis J., Leigh-on-Sea, Essex
Krumpelmann, Georg, Bad Salzuflen, W. Germany
McLachlan, Catherine, Boksburg Tvl, S. Africa
Mitchell, Terence, Salisbury, Africa
Muwaffer, Mohamed R. M., Ratnapura, Ceylon
Pattni, Navinchandra D., Glasgow W.2, Scotland
Piederiet, J. J. M., Breda, Nederland
Rutter, Marilyn J., Ridgmont, Bedford
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Soni, Dineschchandra R., Nairobi, Kenya
Staatsen, Albertus C., Utrecht, Nederlands
Viswakula, V. A. N., Colombo 4, Ceylon
Winder-Toole, Angela B., Penzance, Cornwall
Arman, Michel G., Buenos Aires, Argentina

Transfers from Ordinary and Probationary Membership to Fellowship:

Reiter, Peter Otto, Lucerne, Switzerland
Azzopardi, Joseph, Floriana, Malta
Gatward, Anna B., Hitchin
Ponahlo, Johannes, Vienna, Austria
Salt, Ilse E., Fort Nelson, Canada

Wilkins, Robert F., California, U.S.A.
Bastos, Francisco M., Minas Gerais, Brazil
Boruszak, John K., Blackpool
Butland, William M., Natal, S. Africa
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Cameron, Donald A., Ottawa, Canada
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O'Connell, Sean, Harrow
Popper, Madeleine C., London
Pryke, Christine M., Colchester
Sweet, Ronald D., Sidcup
Winkler, Gunter, Jr., Augsburg, Germany

LONDON MEETINGS 1967

25th January—Film Show, Hanover Street, W.1.
6th March—Conversazione, Goldsmiths' Hall.
23rd May—Annual Meeting.

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Vol. 10
No. 5
January 1967

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Printed by F. J. Milner & Sons Ltd., Brentford and London 67/20·00