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Four-rayed star produced by reflection of light from dense inclusions in cabochon-cut ekanite.
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Ekanite

another new metamict gem from Ceylon

by
Dr. Edward J. Gubelin, C.G.

Ceylon, renowned for more than 2,500 years for its treasures and famous as one of the most prolific sources of gemstones, has again given birth to a new gemstone, which, in honor of its discoverer, Mr. F. L. D. Ekanayake, has received the name ekanite. Although benitoite, unearthed in San Benito County, California, USA, in 1907, was the last gemstone found before the World War I and no further find was made during the ensuing 38 years, several new rare gems have been discovered within the first decade after World War II. The first was brazilianite followed by taaffeite and later by painite. Sinhalite and amblygonite were not really new gem minerals in the true sense, since they had been known for years under wrong names, but their exact nature has only recently been recognized. Two of these newcomers on the gem market originate from Ceylon, two from Brazil and one from Burma. Ekanite is thus the sixth new gem of the last 15 years, the third from Ceylon and, together with the low green zircon, the second metamict gem known.

We owe our appreciation for this new contribution to the already great collection of gemstones to Mr. F. L. D. Ekanayake, F.G.A., a keen and well-versed gemologist of Colombo, Ceylon. The author met this gentleman personally in January, 1960, and was sincerely impressed by his profound gemological erudition and his generous hospitality. His well-equipped laboratory was a surprising sight and when entering it one is really taken aback by the awe-inspiring aspect of his spectacular gem collection, which comprises all gem species and varieties found in Ceylon.

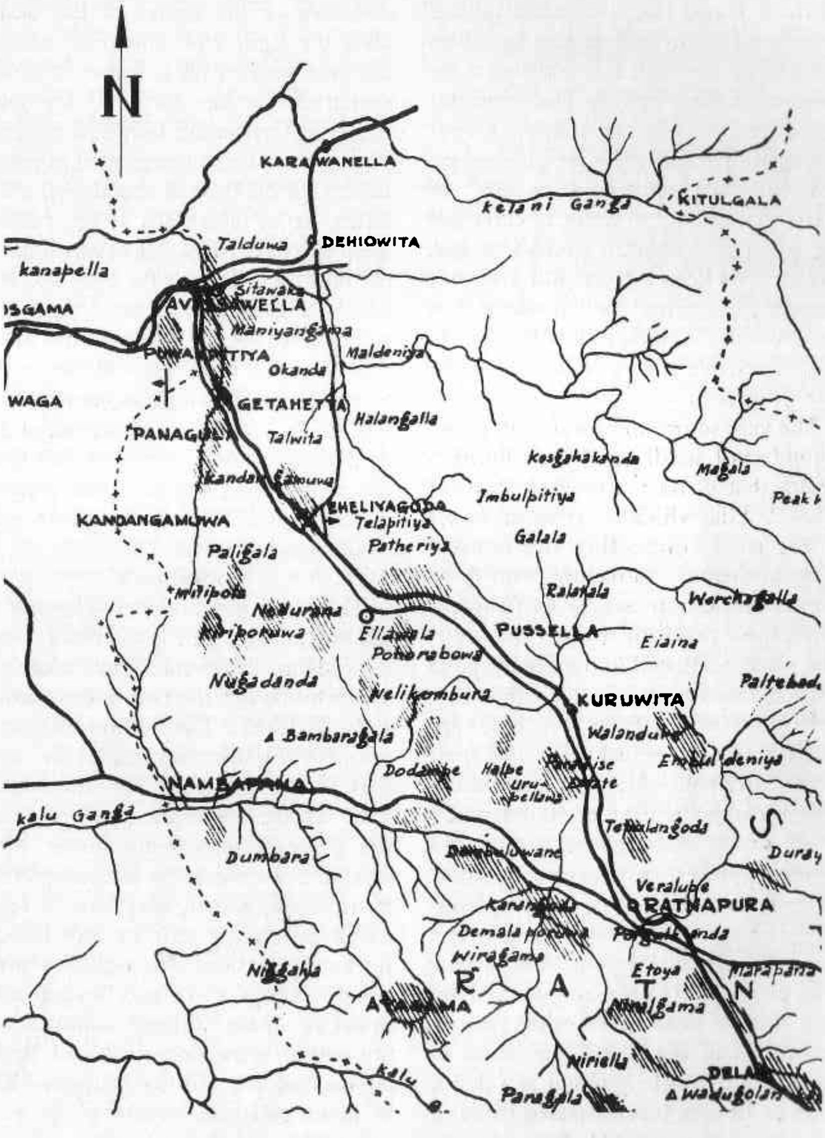
Mr. Ekanayake's ever-keen interest in rare gem minerals prompted him to purchase two dark-green cut stones in the local market of Colombo, which, to his well-trained eye, looked different from any of the known species. In his laboratory he observed unusual optical and physical properties, which were apparently those of glass, whereas the inclusions were characteristic of natural minerals. Every gemologist who afterwards made his first acquaintance with this new mineral was puzzled by these observations. K. Mitchell, who received the first specimen, confirmed Ekanayake's findings and published the results of his observations in the Journal of Gemmology (1954). Later he passed it to The Laboratory, 15 Hatton Garden, London, where B. W. Anderson carried out a preliminary investigation, the results of which Mr. Anderson communicated in his lecture to the participants of the European Gemological Conference in Copenhagen 1955. This first specimen tested was a green cabochon that displayed asterism. The refractive index was found to be 1.5969 and the specific gravity amounted to 3.280. The material proved to be isotropic to X-rays and so disordered as to fail to reveal any trace of crystal structure; yet it could not be a glass, because the inclusions were conspicuously oriented and seemed to parallel crystallographic directions. In order to solve the problem, a chemical analysis was made and, apart from Ca, Si and Pb, a content of 28% thorium was found. This explained all apparent incongruencies: why it was amorphous without glassy characteristics and contained lead. It was a radioactive, metamict mineral. High-temperature tests did not at that time yield conclusive results. While those investigations were being carried out, a second specimen with similar properties turned up. Since then, research has continued and the first results, including those of heat treatments, have recently been published in Nature (L), just as the author of the present study was getting ready to compile this paper.

Since no record of this new mineral of gem quality has hitherto been published in any gemological periodical, the present findings may, in spite of that first report, be described and it may be instructive to compare them with those first brought out in England, for which purpose they have been included in the present paper.

Thanks to the vagaries of a good fate, early in 1957 the author was fortunate enough to purchase his first ekanite, a beautiful, brilliant-cut gem weighing 17.71 carats. This remarkable specimen received much attention and comment at the International Exhibition of Precious Stones in Geneva, in 1959, and also stimulated the writer to intensify his wish to collect more specimens.

Locality

Meanwhile, Mr. Ekanayake had continuously been on the lookout for his new mineral and was thus attracted to the Eheliyagoda District, where, while watching river-bed mining, he examined some of the *illam* and found a pebble that looked like kornerupine. But after checking the constants in his laboratory he noticed, to his great delight, that he had not only discovered another ekanite but, apparently, the actual source. However, further searches for this stone in the river mines proved futile. Yet, following the clue that ekanites are a possible accessory in that area, he visited all gem pits in operation



Map of Ratnapura district, Ceylon, marks the situation of the source of ekanite at Ellawala (0) in the vicinity of the Ellawela village, examined the washings of both the final gem concentrates in the baskets *(dullam)* and the discarded gravel *(nambuwa)*. He had to pay generous sums to be permitted to scrutinize the contents of these baskets. His strenuous perseverance was rewarded, in that through all these years he gleaned no less than 20 specimens of ekanite; of these, the author, in order to carry out the present research, thanks to Mr. Ekanayake's keen interest and generous friendship, acquired twelve pieces, thus accumulating a sufficient collection to make a reliable survey of the characteristic properties.

The very source of ekanite comprises a number of small gem mines lining a stream that skirts the range of hills at Ellawela Ella, which is a few miles west of the road connecting the famous "City of Gems," Ratnapura, with Arisawella and almost exactly halfway between these two little towns (see map). The place is situated in the Eheliyagoda district, from whence some other rare gems such as andalusite, diopside, enstatite, kornerupine, sinhalite and spessartite originate. Here in association with these gems ekanite occurs in alluvial strata. Among the commercial stones sapphires, garnets, spinels, tourmalines, and zircons are found plentifully, whereas chrysoberyls and beryls are scarce in this region. Most of the gem pits in this area are worked on lines similar to those of other famous gem mines of the island. The *illam* in the pits at Ellawela is found at a depth of 35 to 40 feet. It is excavated through the means of vertical shafts sunk into the ground and hoisted to the surface in rattan baskets. It is then washed in large, conical, plaited baskets that are rotated by a swiveling motion by the washers until enough gems have concentrated in the center of the basket after the light and worthless material has been washed off and over its rim by centrifugal action. 90% of the gemstones in Ceylon are found in the beds of streams, flood plains (such as paddy fields), in the beds of abandoned tributaries, or in talus fans at the foot of steep slopes of hills. However, most of the mining is done at the foot of a hill, which is generally at the fringe of a paddy field, because these are the places where swift mountain torrents debauched into the sluggish, slowly flowing valley streams and deposited the detritus that they carried down from the decomposed primary gem deposits in the pegmatite veins of the higher mountainous regions.

Appearance

The new gem mineral ekanite resembles kornerupine in many ways, and it needs an experienced and acute observer to discern the two in the state of a rough pebble. The hue varies from a greenish light-brown tea color to a dark yellowish green. The intensity of light reflected from the polished facets has a greasy to vitreous luster. Most specimens are fairly, yet not completely, transparent; rather, they have a tendency to be slightly, or in some cases, conspicuously turbid. This turbidity gives rise to chatoyancy or asterism on cabochon-cut stones. Stones submitted to the author were first examined under the microscope, and this instigated him to investigate the reason of the phenomenal light effect.

Microscopic Examination

Under the microscope all the stones

tested teemed with clouds of ultra-tiny inclusions, which were either evenly distributed through the entire body of the stone or concentrated to form straight zones in parallel directions *(Figure 1)*. If a strong beam of light is thrown through the stone, it is strongly reflected from the minute inclusions, producing a Tyndall effect *(Figure 2)*. Most of these pinpoint inclusions, which seem to be solid rods and platelets, are oriented along straight directions, traversing each other at 90°. Strong magnification of between 120x and 500x provided a surprising revelation: the single pointlike inclusions are of variegated matter and shape. In most instances, they consist of two-phase inclusions; i.e., rectangular cavities filled with liquid and a vesicle *(Figures 3 & 4)*. A much more rare, but for that more intriguing, inclusion forms four-rayed stars, which in their entirety certainly contribute to the formation of the asterism *(Figures 5 & 6)*, although the dense, minute, two-phase inclusions that are also oriented parallel to straight directions and cross each other at right angles are mainly responsible for this phenomenon. In some samples, these densely packed clouds of minute two-phase inclusions are traversed at irregular intervals, or their own zoning is emphasized by straight rows of more coarse two-phase cavities *(Figure 7)*. Occasionally, such rows cross each other at right angles, thus forming crosses *(Figure 8)*. These crosses, as well as the previously described four-rayed star inclusions, render clear signs of a former crystal structure whose prevailing crystallographic orientations they follow.

Another very conspicuous and typical inclusion is formed by relatively large, double-refractive crystals that are always surrounded by a defective area in the shape of a minutely dotted halo *(Figure 9)*. The alien crystals, whose form is either broken or resorbed, are transparent or so densely filled with inclusions as to appear opaque and black. The tiny dots marking the halos are likely to be either residual liquid droplets left behind by the microlites after they had formed by extracting the necessary ingredients from these drops of foreign mother liquor, which had adhered to former surfaces or secondary fractures, or turbidity centers formed through the influence of particularly concentrated radioactivity. Some of the mineral inclusions were found to be strongly resorbed mica scales of irregular shapes with rounded contours, whereas the nature of the more coarse and more angular crystals could not be definitely identified, although their broad and dark reliefs and vivid interference colors raise the conjecture that they might be zircons *(Figure 10)*. Others of these opaque microlites look like grains of some black ore with strong surface reflections. All three species of microlites seem normally to be simultaneously present and often to aggregate in small clusters surrounded by the dotted halos.

A further type of inclusion consists of ultra-small, spherical bubbles *(Figures 11 & 12)*. Whether or not they are caused by helium gas that was produced as a result of nuclear radiation has yet to be determined conclusively. The phenomenological picture of these internal features is so significant and typical that ekanites can readily be identified by the general appearance of their

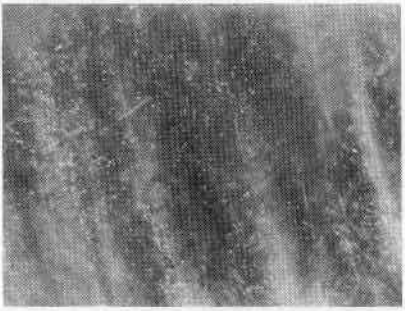


Figure 1. Ekanites team with parallel, straight zones of densely packed pinpoint inclusions. (12x)

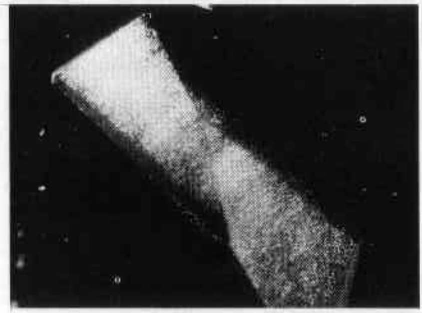


Figure 2. Strong, narrow beam of light reflects brightly from pinpoint inclusions. (10x)

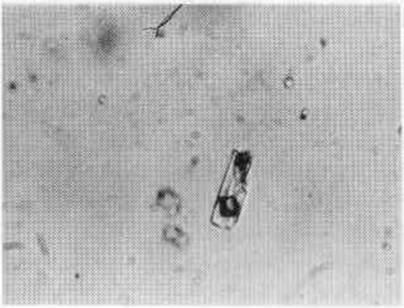


Figure 3. Strong magnification of pinpoint inclusions manifests them to be rectangular two-phase inclusions. (500x)

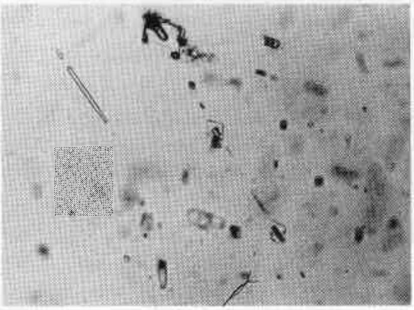


Figure 4. Rectangular two-phase inclusions, in which the gas vesicle is clearly visible. (250x)

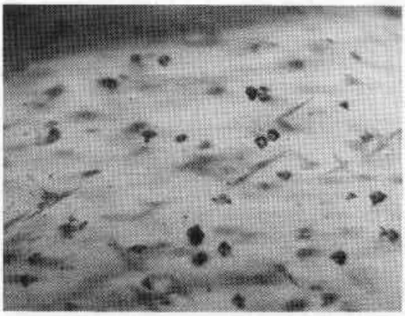


Figure 5. Varieties of• inclusions in star ekanite. (40x)

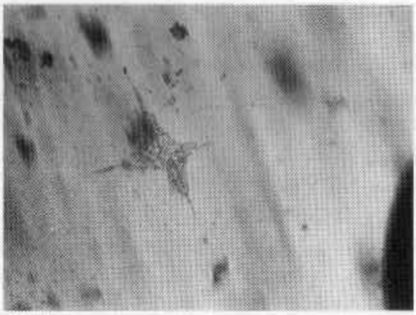


Figure 6. Four-rayed star formed by directionally arranged, minute two-phase inclusions. (120x)

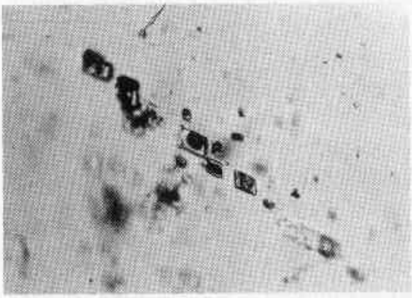


Figure 7. Row of large, rectangular two-phase inclusions. (250x)

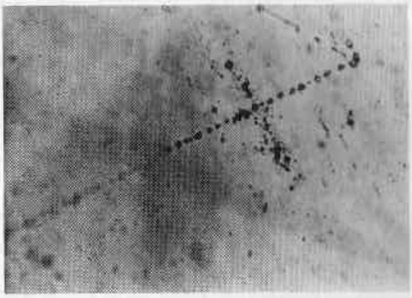


Figure 8. Two straight rows of more coarse, two-phase inclusions crossing each other at 90° to form a cross. (120x)

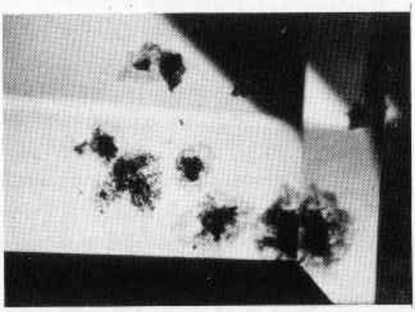


Figure 9. Large, opaque mineral inclusions surrounded by dotted halos. (20x)

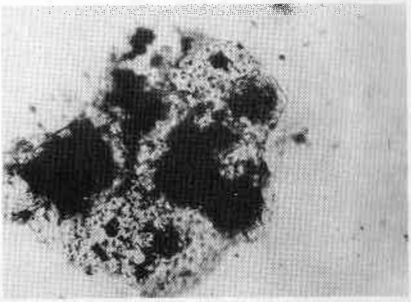


Figure 10. Opaque, not yet definitely identified, solid inclusions. Transparent portion shows high interference colors and double refraction. (120x)

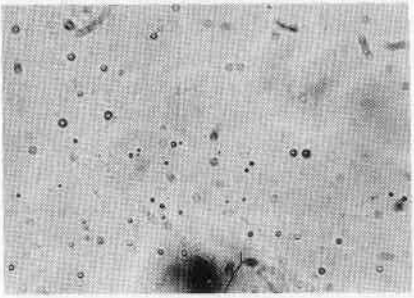


Figure 11. Rather evenly distributed spherical bubbles that might consist of helium gas produced by nuclear activity. (250x)

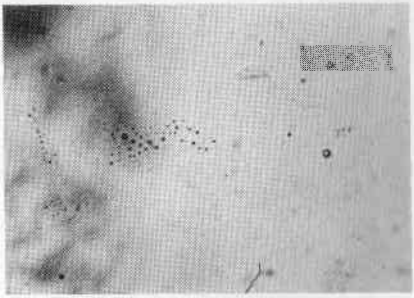


Figure 12. Tiny swarm of gas bubbles (usually a typical feature of glass) appeared as a surprising exception among natural inclusions. (250x)

inclusions. Neither the metamict, low zircons nor any other gemstones from Ceylon have been found to be host to this specific kind or combination of inclusions, which appear to be highly diagnostic for this new radioactive gem.

Physical Constants

Of all the specimens on hand, ekanite No. 10, which was a particularly clear sample, was chosen for an exact refractive-index determination. The measurements were achieved by the minimum-deviation method with the most accurate one-circle goniometer available and in combination with a powerful monochromator. A pair of facets and an enclosed angle, which transmitted good signals and facilitated the calculation, was chosen. The accuracy of the values for the dispersion determination varied by ± .0005. Unfortunately, the quality of the stone's cut did not permit a diminishing of this figure; yet this degree of accuracy was considered sufficient in view of the good concurrence of the n_D values of this sample, as obtained on three different instruments, and considering slight individual variations of the refractive constants of the various stones measured.

Wavelength	*Refractive Index*
4300 G	1.609_5
4600	1.606_0
5000	1.602_2
5400	1.598_5
5890 D	1.595_1
6400	1.592_7
6870 B	1.591_2
7300	1.590_1

The indices were measured for six different wavelengths between the limits of 4300 Å and 7300 Å, in order to obtain the dispersion values within the established standard B-G range, so that a complete dispersion curve could be plotted.

Limits of accuracy for the wavelength were ± 20 Å and for the refractive index (minimum deviation) ±.0005. The difference between the readings for B and G gives the dispersion figure of .0183 ±.0005. The refractive index for sodium light of this same sample was also examined on a Zeiss Abbe-refractometer and found to be $n_D = 1.595$ ±.0002.

In order to obtain evidence about the individual departures of other ekanite specimens from the above n_D 1.595_1 (minimum deviation) and from each other, the refractive indices of all 12 stones were carefully measured for sodium light on a Fuess Abbe-Pulfrich-refractometer. Inasmuch as ekanite No. 10 was also included in this series of readings, this procedure afforded a valuable criterion on the precision of these measurements, as compared to the results of the minimum deviation. The limit of accuracy amounted to ±.0002. The medium values ascertained from five readings of each sample are tabulated in Table I, together with the density data and some other interesting details.

All specimens were large enough to warrant exact density determinations, which were carried out by hydrostatic weighing in ethylene dibromide with a semiautomatic Mettler balance. Table I shows that slight individual variations from stone to stone occurred, but remained within normal limits. The mean value of 3.280 may be established as density constant. The absorption spectrum appears to be blotted out by absorption at both ends, setting in at 7000

TABLE I

Ekanite	Carat	Color	Refractive Index	Specific Gravity	Inclusions
No. 1	24.86	Green, star	1.5951	3.2849	Inclusions manifested in Figures 5 & 6 and pinpoint inclusions as in Figures 1 & 2.
No. 2	17.71	Tea color (dark greenish brown)	1.5949	3.2828	Pinpoint two-phase inclusions, as in Figures 1 & 2, 3 & 4.
No. 3	6.82	Dark yellow green	1.5950	3.2808	Inclusions, as in Figures 1, 2, 3, 4, 7, 8, 9 & 10.
No. 4	3.98	Dark yellow green	1.5949	3.2813	All inclusions described and those depicted by Figures 7 & 8.
No. 5	3.35	Dark yellow green	1.5950	3.2806	All inclusions, as shown in Figures 1, 2, 3, 4 and 7-12.
No. 6	3.25	Dark yellow green	1.5950	3.2808	Inclusions, as in Figures 1, 2, 3, & 4.
No. 7	2.88	Dark yellow green	1.5950	3.2808	All inclusions, except those in Figures 5 & 6.
No. 8	2.90	Dark yellow green	1.5951	3.2808	Inclusions, as in Figures 1-4 & 7-8.
No. 9	1.90	Medium yellowish green	1.5951	3.2831	All inclusions, except those in Figures 5 & 6.
No. 10	1.56	Medium yellow green	1.5950	3.2802	Inclusions, as in Figures 1-4 & 7-8.
No. 11	2.54	Dark yellow green	1.5950	3.2807	Inclusions, as in Figures 1-4 & 7-8.
No. 12	7.79	Dark yellow green	1.5952	3.2808	All inclusions, except those in Figures 5 & 6.
Mitchel's		Dark green star	1.5960	3,280	Microscopic inclusions parallel to two directions at right angles; occasional larger opaque inclusions (1.).
Solomon's		Dark green	1.5966	3,280	

Å in the red region and at 4750 Å on the blue side, thus inducing the yellowish-green to the greenish-brown body color typical of ekanites. The clearest and best colored stones displayed two weak and blurred absorption bands, of which the stronger appeared at 6651 Å, whereas the fainter band was situated at approximately 6375 Å. The spectrum of each stone was first observed in the jeweler-spectroscope (constructed by the author), in which the spectra showed more clearly and sharply; the position of the bands was measured by means of a Hartridge reversion spectroscope. To a certain extent, the general appearance of this spectrum resembles rather that of the green metamict zircon. B. W. Anderson, who also tested ekanite No. 2, thought to have observed a weak trace of a third line in the red, but found it too difficult to measure exactly.*

Chemical Analysis

The specimen chosen for chemical work was ekanite No. 9, which weighed 1.90 carats and was thus large enough to supply sufficient material for a detailed analysis. First, the sample was subjected to a qualitative spectroscopic examination, which corroborated the following chemical elements to be present: Ca, Th, Si, Al, and Pb. To be sure that no constituents present in significant quantities had been overlooked, the spectrum was specially scrutinized for the following rare-earth elements: Y, La, Ce. Since none of them could be discovered, their contents, if present, must be smaller than .1%. Hence, it may be concluded that the other lanthanide metals are absent, since in nature they never occur by themselves. Zr was another element that was expected to be seen, but was conspicuous by its absence. The complete chemical analysis of ekanite resulted in the quantitative chemical composition that appears in Table II and therein is compared with the analytical results published in Nature (1.).

The figures of the analysis for the present study have been made up or down to the last definite decimal, which leads to the slight differences by a few fractions between the two analyses. There are, however, two rather disturbing discrepancies between the two analyses with regard to the contents of uranium (difference 30%) and lead (difference 25%). Future chemical work will certainly shed light onto these irregularities.

Iron does not seem to be a regular constituent of all the ekanites. The complexometric titration of ThO_2 does not supply very exact results on account of the mol weight of this molecule. The content of lead is particularly interesting, since it was formed through the disintegration of part of the uranium and thorium present, being the stable end-product of the radioactive decay series. Hence, it is not the orthogenic Pb, but consists of the radiogenic lead isotopes Pb^{206}, Pb^{207} and Pb^{208}. The sample was also tested for P, but the amount seemed to lie below 0.2%. The formula figures (unit-cell contents) represent the ratio of the number of atoms to each other and they are arbitrarily referred to 20 oxygen atoms, thus resulting in the following formula of the chemical composition of ekanite: $Ca_2Th\,Si_8O_{20}$, which may tentatively be written as:

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*Unpublished communication to the author.

TABLE II

	Chemical analysis for present study	Unit-cell contents	Chemical analysis by D. I. Bothwell (1) for comparison
SiO_2	55%	7.9	55.6
Al_2O_3	0.8	0.14	traces
ThO_2	28	0.9	27.6
UO_3	3.0	0.09	2.1
PbO	0.65	0.02	0.8
CaO	12	1.9	13.7
Fe_2O_3			0.5
MgO		(recalculated	traces
MnO		atomic ratios to	traces
Total	99%	20 oxygens)	100.3%

SiO_2 was determined by the colorimetric method using molybdenum blue (Riley, 10).
Al_2O_3 was semi-quantitatively measured by spectral analysis.
ThO_2 was obtained by complexometry, using xylenol-orange (Pribil, 8.).
UO_3 reacted to the colorimeter determination with H_2O (Sandel, 11.)
PbO was colorimetrically analysed, using dithizon (Sandell, 11.) and
Ca was established by the complexometric process, using HHSNN (made by Messrs. Siegried, Zofingue, Switzerland).

$$Ca_2Th[Si_4O_{10}]_2$$

D. I. Bothwell established: $(Th, U)(Ca, Fe, Pb)_2Si_8O_{20}$ (1.). This is definitely a new formula, and no mineral has ever been known before being composed of these chemical constituents. Consequently, ekanite is truly a new mineral and, thanks to its gemlike features, a new gemstone. Properly speaking, only two self-reliant thorium minerals have heretofore been known in nature, namely:

1) ThO_2 thorianite, usually containing a great percentage of uranium.

2) $ThSiO_4$ dimorphic: thorite, isostructural with xenotime; huttonite, isostructural with monazite.

In nature most thorium is found in the two minerals zircon and monazite, both of which occur as accessory minerals in most rocks. The association with zirconium and the rare-earth metals is therefore most characteristic of thorium. On the basis of this knowledge, it is surprising that neither zirconium nor rare earths have been found in ekanite. Monazite may contain as much as 10% of ThO_2. In comparison to this, the content of 28% of thorium is remarkably higher, so that ekanite may righteously be claimed as a self-reliant thorium mineral.

Radioactivity

The relatively high content of the radioactive elements uranium and thorium elucidates the unusual character of this new gem, which puzzled so many a gemologist at the dawn of its appearance because its physical properties did not fall into any of the categories of known minerals. Any mineral with such an exceptionally high percentage of thorium must be strongly radioactive. Indeed, remarkable radioactivity could easily be determined qualitatively by holding the specimens towards a Geiger counter, which responded vigorously by rattling noisily. However, the num-

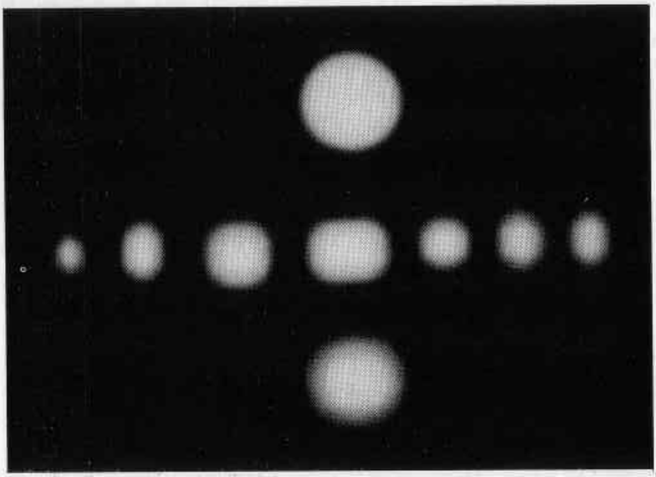

Figure 13. **Radioactive self-portrait of nine ekanites. Exposure: five days.**

ber of impacts was not counted. A more impressive proof is rendered by photographic film, which yields the self-portrait of any ekanite within a day when placed on it *(Figure 13)*.

In order to determine whether the handling of ekanites could be dangerous, the intensity of their radioactivity was carefully measured. For this investigation ekanite No. 2 was chosen because its large size facilitated exact measurements and ensuing calculation. Considering the sample's self-absorption, the results of the determination of the radioactivity have been expressed in as general a way as possible, in that the γ-radiation was referred to one gram (5 carats) of ekanite, whereas the α- and β-emanation was applied to 1 cm^2 of gem surface. This conversion proved to be valid, if the stone's dimensions eclipsed 0.1 cm, which was the case with the chosen sample. The majority of the α- and β-particles are absorbed in the interior of the stone, thus allowing only the most external layers to contribute towards surface radioactivity, the latter being proportional to the stone's surface. On the other hand, the γ-radiation is not likely to be absorbed within the specimen unless it be rather large; i.e., if the specimen is not a big stone the γ-radiation is hardly absorbed within the ekanite. Hence, the radioactivity is proportional to the stone's weight. Results:

α-intensity
20 disintegrations/sec cm^2
β-intensity
90 disintegrations/sec cm^2
γ-intensity
2900 disintegrations/sec g.

The total intensity of this radio-emanation corresponds approximately with the radioactive intensity of a normal, fresh watch dial. The practical conclusion is that ekanites could be worn in jewelry without any greater harm nor running any more serious risks than by wearing a watch with a luminous dial. Yet, since it is not likely that there will ever be an abundance of ekanites, it will be safer to leave them to the delight of gem collectors.

Approximately ¾ of the radioactivity originates from the disintegration of the thorium content. The corresponding results of the chemical and the γ-spectroscopic analyses show that Th^{232} happens to be in radioactive equilibrium with its daughter elements. Since the measured intensity of radioactive radiation is hardly influenced by the small content of uranium, the radioactivity equivalent of the latter with its decay products was not determined.

The considerable absorption of the α- and β-particles inside the ekanite lead to a catastrophal chaos among the atoms of the original crystal lattice, resulting in a complete breakdown of the structure into glass. In order to make this irradiation response comprehensible to the lesser-informed gemologist, it may be necessary to describe briefly the possible effects of the nuclear radiation accounting for this structure damage. The effect of nuclear radiation from the disintegration of uranium, thorium and their decay products on the physical properties and unit-cell dimensions of zircon were studied by H. D. Holland and D. Gottfried (4.), who suggested that the transmutation was prevailingly due to the dislocation of atoms by recoil nuclei and by thermal effects along the tracks of nuclear particles. They also postulated that the process progresses through three phases:

a) The displacement of atoms in essentially undamaged material is ascribed to the direct dislocation by collisions with recoil nuclei,

b) The structure that thus becomes saturated with displacements (nucleation) converts into a mosaic structure of crystallites of ordered zircon under the influence of high temperatures generated in the wake of α-particles, and

c) The eventual breakdown into glass is caused by a coordination of these processes in the zircon crystallites.

Very similar factors may have been active in the ekanite during the hundreds of millions of years of its age. Under the effect of recoil nuclei and α-particles a very great number of displacements of atoms were produced. F. Seitz (12.) claimed that about 50 displacements might occur at the end of each α-path, so that at least 500 displacements should be induced in the structure during any single α-emission. During the course of irradiation, a sufficiently great quantity of displacements could thus have been brought about to disrupt and, finally, completely destroy the original crystal lattice and so transform it into an amorphous substance with altered properties. If the mechanism proposed above for the decay of the crystal lattice of zircon generally holds true for the formation of metamict minerals, the critical step in inducing radiation damage may be the transmutation of phase 1 into phase 2; and if phase 2 be disordered, as is the case in zircons, the ultimate breakdown to a glass may be readily achieved.

The final result of such a decay process is a complete isotropization of the material: cleavage disappears, hardness becomes equal in all directions, physical properties are usually lowered, transparency diminishes and the product becomes turbid. Optically, and in its response to X-rays, the mineral turns isotropic and so disoriented as to fail to yield recognizable X-ray diffraction peaks. In the realm of gemstones, zircon has hitherto been the only known example of such a state of isotropization. Formerly, these minerals were called "pyrognomic." Later, Brögger (1906) suggested the adjective "metamict," because he suspected the complicated chemical composition to be responsible for the abnormal behavior. This term was universally accepted and is still in general use. P. Ramdohr (9.) proposed referring to them as "minerals in isotropic state of secondary origin." If such minerals are heated, they start to glow and lose their abnormal behavior after cooling off. Apparently, a few undamaged structure areas are sufficient to serve as a scaffolding to reorientation and to act as centers of recrystallization in order to regenerate the damaged lattice and restore its original properties.

Research into Relations

With the idea of finding out whether the original structure of the ekanite's ancestor could be restored by heat treatment, experiments to this effect have been carried out in England and afforded instructive information (1.). After heating at 510° C. for 24 hours, the values of the refractive index and specific gravity surprisingly dropped to $n_D = 1.5933$ and $s = 3.276$, respectively, instead of rising, as might be expected. At temperatures between 650° and 1000° C. the mineral recrystallized to a phase of which X-ray powder and single-crystal diffraction patterns could be indexed, on the basis of a body-centered tetragonal cell having dimensions $a = 7.46$, $c = 14.96$ Å, but instead of regenerating into a monocrystal the product was polycrystalline. After heating at 1000° C. for 24 hours, the density rose to 3.313 and the refractive index to approximately 1.61 (readings were very indistinct). This means an increase of the R. I. by 1% and of the S.G. by 0.8%. At the high temperature of 1000° C. the mineral became opaque and putty colored, while rosettelike formations appeared on the surface.*

The indication of a tetragonal symmetry is particularly interesting on the basis of A. Pabst's (7.) attempt at a possible explanation of the fact that the tetragonal modification of thorium silicate is characteristically found in the isotropic state of secondary origin. The same condition occurs with zircon (high zircon = tetragonal; low zircon = metamict), a fact with which every gemologist is familiar.

Heating the ekanite at higher temperatures, involving remelting, led to the development of huttonite ($ThSiO_4$). This monoclinic form of thorium silicate is conspicuously enough found as clear crystal fragments only, without displaying the slightest sign of transmutation. In connection with this observation, it may be appropriate to consider that huttonite represents the end member of a suite of replacements during which rare earths were completely replaced by Ca and Th. The admixture of thorium caused an increased cationic charge that was balanced by an equal replacement of the rare earths by

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*Private communication by B. W. Anderson

Ca and by the substitution of Si for P. When later in following up the heat experiments the ekanite was entirely melted and then recrystallized at 1000° C., the material was found to be a thorium compound akin to the britholite-lessingite-cerite group (1. and 2.). As a consequence of these thermal examinations, ekanite appears to represent the end member of a complex replacement series that started with rare-earth minerals.

X-ray investigations carried out in the Institute of Crystallography and Petrology, ETH, Zürich, led, however, to results somewhat different from those reported by Anderson *et al* (1.). The body-centered tetragonal cell ($a=7.46$; $c=14.96$ Å) did *not* appear after heat treatment at 1000° C. (2 and 20 hours), but the powder diagram of a structure "X" yet undetermined was observed. In addition, very weak huttonite lines were present. A continued heat treatment at 1200° C. produced the tetragonal structure reported by Anderson *et al.* whereas the "X"-lines vanished completely and the huttonite lines became even weaker. Additional heating to 1500° (2 hours), at which temperature some sintering was observed, led to powder diagrams with lines of the tetragonal structure reported by Anderson *et al* without lines of huttonite but with very weak additional lines not yet correlated to any known compound. The problem of indexing the "X"-lines is still under investigation.

Age Determination

The afore-described properties, and especially the presence of the radioactive elements Th and U and their ultimate decay product Pb, offered a challenge to engage in an age determination. Dating studies have already been achieved with metamict zircons (green gem-type zircons of low character) from Ceylon, and an average age of about 570 million years was found (3.). It is a well-known fact that the natural disintegration of uranium results in the ultimate formation of two stable isotopes of lead, Pb^{206} (RaG) and Pb^{207} (AcD), whereas the disintegration of thorium leads to the single isotope Pb^{208} (ThD). The dating is based on the radioactive decay of the uranium isotopes U^{238} and U^{235}, as well as of the thorium isotope Th^{232} into their corresponding stable end products Pb^{206}, Pb^{207} and Pb^{208}. Thus, it can be seen that from the known decay constants of uranium and thorium, together with the chemical Pb/U and Pb/Th ratios for a radioactive mineral, it is possible to compute the mineral's age, provided one knows the amount of common lead impurity present. Since the atomic weight of common lead (207.21) differs remarkably from that of either uranium lead (approximately 206.03) or thorium lead (approximately 207.98), the amount of contamination can usually be found from the atomic weight of the lead in question. Through application of the equation:

$$N_t = N_0 \cdot e^{-\lambda \cdot t}$$

where N_0 = number of atoms of parent element at the time t_0

N_t = number of atoms of parent element still present at time t

λ = decay constant of the parent element, which refers to the radioactive disintegration, three independent age determinations can be established for every mineral containing uranium and thorium (provided there exists radioactive equilibrium) according to the equations:

$$[Pb^{206}]\ \mathrm{rad} = [U^{238}]\ (e^{\lambda\cdot t-1}) \quad a)$$
$$[Pb^{207}]\ \mathrm{rad} = [U^{232}]\ (e^{\lambda'\cdot t-1}) \quad b)$$
$$[Pb^{208}]\ \mathrm{rad} = [U^{232}]\ (e^{\lambda''\cdot t-1}) \quad c)$$

where λ, λ' and λ'' are the disintegration constants of U^{238}, U^{235} and Th^{232}, respectively; the chemical symbols in square brackets represent the atom number per gram of the sample; and the index "rad" refers to the amount of the radiogenic lead isotope in question.

Apart from the above-mentioned three lead methods, which demand reliable knowledge of the chemical lead/uranium and lead/thorium ratios, respectively, an isotopic analysis supplies similar information—data that, as will be seen, furnish an important check in the mineral's age as computed from the isotope ratios of the disintegrated lead. By dividing equation (b) by equation (a) this equals:

$$\frac{Pb^{207}\ \mathrm{rad}}{P1^{206}\ \mathrm{rad}} = \frac{U^{235}}{U^{238}} \bullet \frac{e^{\lambda'\cdot t-1}}{e^{\lambda\cdot t-1}} = \frac{1}{137.7} \bullet \frac{(e^{\lambda'\cdot t-1})}{(e^{\lambda\cdot t-1})} \quad (d)$$

where: $^{1}/137.7 = U^{235}/U^{238}$ ratio, today.

If all the constants in the above equations have been properly evaluated, it is possible to date the age from the Pb^{207}/Pb^{206} ratio (corrected for ordinary lead contamination).

The Pb^{207}/Pb^{206} age, as computed from equation (d), represents a value that is dependent of the Pb^{206}/U^{238} and Pb^{207}/U^{235}-age, which, however, will be relatively insensible to changes of the chemical Pb/U- and Pb/Th-ratios that might be caused by recrystallization, diffusion or replacement processes in the mineral. Even a considerable loss of lead, uranium or thorium shortly after crystallization of the mineral or immediately before the analysis would hardly affect the Pb^{207}/Pb^{206}-age, whereas conversely the other three ages would be falsified.

Lead has been extracted from ekanite No. 9 by means of the complexometric method using dithizon, and the relative abundance of the lead isotopes was determined. The measurements were achieved in the "Atlas CH_4"-masspectrometer in the Institute of Physics of the University at Berne. The following values were obtained:

atom %, 206 = 100

204	206	207	208
0.051 ± 0.003	100.0	6.59 ± 0.10	400 ± 5

common lead: 0.73 weight %

In each case, the indicated limit of accuracy is the tripled medium square of the deviation figure of the mean value.

The content of common lead proved to be trivial, so that the choice of the correction lead could hardly influence the age determination. The ratios of the isotopes as applied for the correction are:

206/204	207/204	208/204
18.13	15.76	38.12

and they correspond to a model age suggested by F. G. Houtermans (5 & 6) of 550 million years.

From the ratio of the radiogenic isotopes Pb^{207}/Pb^{206} the age of the ekanite was computed as amounting to 560 ± 50 million years.

This result concurs well with the geologic age of Ceylon zircons, as determined by G. R. Tilton *et al* (13.):

Pb^{206}/U^{238}	Pb^{207}/U^{235}	Pb^{208}/Th^{232}	Pb^{207}/Pb^{206}
540 ± 12.10^6 yrs.	544 ± 16.10^6 yrs.	538 ± 25.10^6 yrs.	555 ± 30.10^6 yrs.

while D. Gottfried *et al* (3.) obtained an average age of 561 million years by the Larson method for 21 zircon crystals and 570 million years for 12 samples corrected for possible thorium. The age of the gem-type green zircons was proposed to average about 570.10^6 years.

B. W. Anderson *et al* (1.) indicates different analytical figures for $Th\,O_2 = 27.6\%$, $UO_2 = 2.1\%$ and $Pb\,O = 0.8\%$ (as shown on page 9). Considering the measured composition of the isotopes of the disintegrated lead, as well as the analytical values for Th, U and Pb, the following lead age results for ekanite:

Pb^{206}/U^{238}-age = 560.10^6 years
Pb^{207}/U^{235}-age = 565.10^6 years
Pb^{208}/Th^{232}-age = 531.10^6 years

The lead dates give a concordant age of ekanite, which concurs excellently with the age obtained from the isotopes ratio of the radiogenic Pb^{207}- and Pb^{206}-.

The discovery of this new metamict and radioactive gem mineral has opened a fascinating field of investigation and supplied a score of valuable facts. Yet many more interesting problems remain, such as

a) total amount of radiation dosage
b) the drop of the R.I. and density as a function of the radiation dosage.
c) exact amount of displacements and
d) percentage of displaced atoms necessary to effect complete isotropization and others are still to be solved, challenging the inquisitive minds of better-versed scientists than the author of this thesis.

Acknowledgments

It is a pleasure to acknowledge the keen help of Mr. F. L. D. Ekanayake, who generously supplied the author with samples. The author is also deeply indebted to Prof. Dr. F. Laves, of the Institute of Crystallography and Petrology of the Swiss Federal Institute of Technology, Zürich, who took a vivid interest in this study and kindly encouraged his coworkers (Dr. H. U. Bambauer, minimum-deviation measurements; Dr. M. H. Grünenfelder, age determination; Dr. M. Weibel, chemical analysis; Dr. R. Gubser, X-ray work) to contribute the results of valuable investigations towards this study. Best thanks are also due to Dr. J. Feitknecht, Berne, who made the measurements of the intensities of the α-, β- and γ-activities.

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1. Anderson, B. W., *et al. Ekanite, a New Metamict Mineral from Ceylon,* NATURE, June 10 (1961) p. 997.
2. Gay, P., *An X-Ray Investigation of Some Rare-Earth Silicates: Cerite, Lessingite, Beckelite, Britholite, and Stillwellite,* MINERAL MAGAZINE 31 (1957), pp. 455.
3. Gottfried, D., *et al. Age Determination of Zircon Crystals from Ceylon,* AMERICAN MINERALOGIST 41, pp. 157.

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Developments and Highlights

at the

GEM TRADE LAB

in New York

by

Robert Crowningshield
Director of Eastern Headquarters

More on Star Sapphire Doublets

In the Spring, 1961, issue of *Gems & Gemology,* we described a star-sapphire doublet. The top part that produced the star, as well as the base that furnished the color, were natural sapphire. *Figure 1a* is a photograph of another natural star-sapphire doublet of a slightly different type. In this stone, the top of translucent gray provided an exceedingly sharp and attractive star, whereas the base, also of natural sapphire, provided the fine-blue color. However, in the spectroscope we detected a cobalt spectrum and the stone appeared bright red under the color filter. Close observation of the base showed that it was crackled and the "fine blue" had been introduced by a dye. It was the appearance of the peculiar crackled base when viewed under the loupe that prompted the jeweler to have the stone examined by the Lab. *Figure 1b* illustrates a third type of star-sapphire doublet. In this stone two sections of a natural-gray sapphire are joined with blue cement. *Figure 1c* illustrates an aborescent, or treelike, pattern visible in the cement layer, which is due to separation. It appears red under the color filter and its absorption spectrum shows the presence of cobalt. We made a few inquiries in the trade and learned that natural star-sapphire doublets are nothing new, although the present "rash" of such stones could indicate greater activity toward fraudulent ends, possibly on the part of an individual.

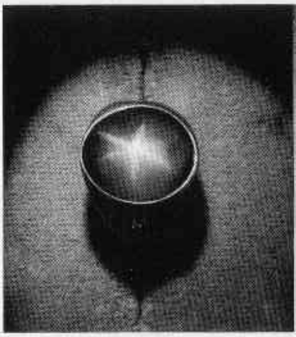


Figure 1a

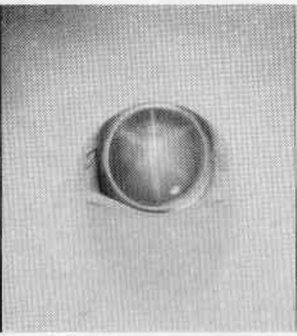


Figure 1b

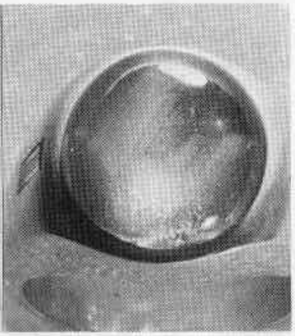


Figure 1c

Crackled Synthetic Rubies

Figure 2 is a photograph of one of eight identical and beautifully crafted platinum, diamond and crackled synthetic-ruby ornaments for a massive cuff bracelet. The synthetic rubies had been so artfully crackled (with added dye in some of them) that the jewelry had been appraised as being comprised of natural stones. A *Gems & Gemology* reader in the trade spotted the deception.

Chatoyant Quartz Cabochon

Figure 3 illustrates an unusual quartz cabochon in which the chatoyancy was due to hollow tubes that caused the stone to resemble a cat's-eye tourmaline.

Carved Pearl

Figure 4 illustrates a likeness of Jan Masaryk, the Czech patriot, beautifully carved in a Tahitian blacklip pearl shell measuring more than nine inches across.

Thick Diamond Girdles

For the past six or seven years, we have noticed a progressively greater thickness of the girdle of diamonds, particularly on smaller brilliants. Stu-

Figure 2

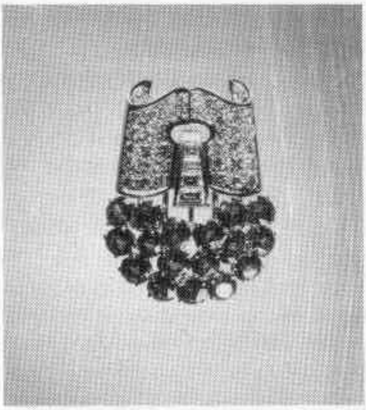
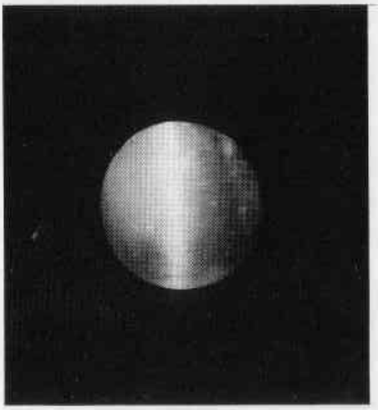


Figure 3



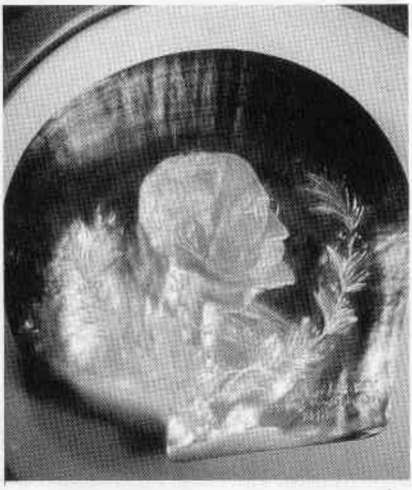
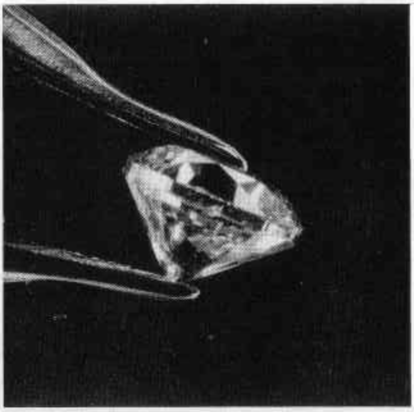


Figure 4

dents of the GIA's Diamond Course are aware that a thick girdle may save the cutter as much as 10% in excess weight. However, until recently, such excessively thick girdles appeared usually on stones below one-half carat in weight. *Figure 5* illustrates one of 23 stones, all weighing more than a carat (the one illustrated weighs 1.68 carats), on which the girdles were so thick that in some instances the excess weight retained was as much as 15%. The girdles had been carefully faceted, to disguise them as much as possible. In diamond grading, we ordinarily describe a 10% girdle as "exceedingly thick." For these girdles that exceed 10%, perhaps a new grading term, "preposterously thick," will be necessary.

Figure 5



Backed Stones

Figure 6 illustrates a type of setting that calls on all the skills and, frequently, most of the instruments of a trained gemologist. The individual plaques are of a mastic compound encased in gold. The transparent stones are backed to increase brilliance, and, in some instances, color. When color has been deepened in green beryl, for example, it is necessary to analyze both the strength of the chromium absorption lines and the dichroism; otherwise, the appraiser may overevaluate the stones. The same applies to backed rubies. In the piece illustrated, most of the transparent stones were buff topped and several were set below the surrounding gold (as all the small stones in the corners were), making it impossible to use the spot-method technique on the refractometer, one of the most reliable instruments for colored-stone identification. In these cases, a microscope with a bull's-eye overhead light and the spectroscope must be resorted to, as well as ultraviolet light and the dichroscope. However, with the exception of the pearls in the plaque at the upper right, all stones were satisfactorily identified. If positive identification of the pearls had been required it could only have been accomplished by unmounting them, since they were almost completely surrounded by metal.

Vivianite

The mineral vivianite, a hydrous-ferrous phosphate, if observed before it has been exposed to light for an extended period, is a beautiful bluish-green color with strong dichroism. Although much too soft and too easily cleaved for use as a gemstone, crystals of this mineral grace many gem and mineral cabinets. *Figure 7* is the absorption spectrum in the X direction, whereas *Figure 8* shows the spectrum from the Y and Z directions. We have never encountered in the literature an illustration of this unusual spectrum.

Williamsite

The williamsite variety of serpentine frequently resembles an attractive variety of jadeite and is, by eye, frequently mistaken for jade. An especially vivid-green specimen was examined recently and found to contain numerous black chromite octahedra, which are common to this variety. On a hunch, we examined it with the spectroscope and were rewarded with the appearance of unmistakeable chromium lines. A fairly distinct broad absorption band from 6400 to 6300 Å with a faint band from 6300 to 6150 Å, together with the weak lines at 4950 and 4600 Å, as mentioned by B. W. Anderson, of the London Laboratory, were present. This absorption spectrum is illustrated in *Figure 9*.

Greenish-Yellow Grossularite

A handsome crystal group of greenish-yellow grossularite, from Mexico, was examined under the spectroscope and gave a very satisfactory spectrum (*Figure 10*). From the position of the absorption lines, it is assumed that the spectrum is due to rare-earth impurities in the garnet, since the spectrum resembles that of green apatite, which owes its absorption lines to this cause.

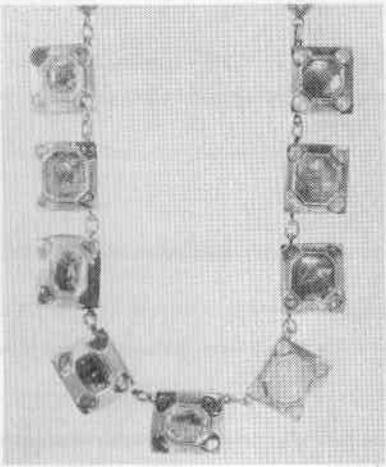


Figure 6

Imitation Turquois

We identified two very fine imitations of turquois that transmitted light to a greater degree than most imitations. The material was very low in specific gravity, suggesting plastic. The refractive index was about 1.58. When warmed slightly, the stones gave off a most disagreeable odor, similar to that of burned hair or feathers. The absorption spectrum is illlustrated in *Figure 11,* with the transmission in the red from about 6500 to 6680 Å very strong. We were unable to have the stones long enough for more exhaustive tests; however, we feel that they are just another of the many attempts to satisfy a continuing demand for a popular gemstone in short supply.

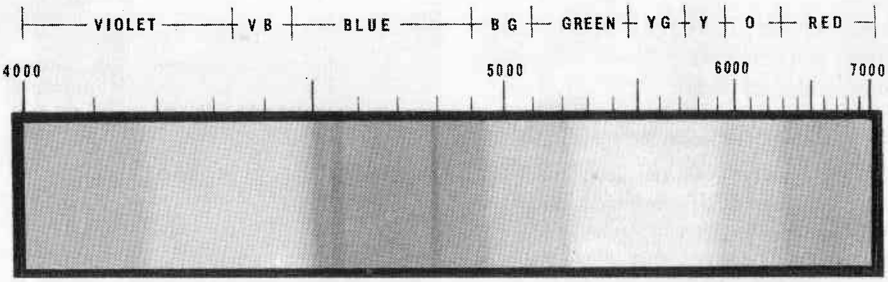


Figure 7

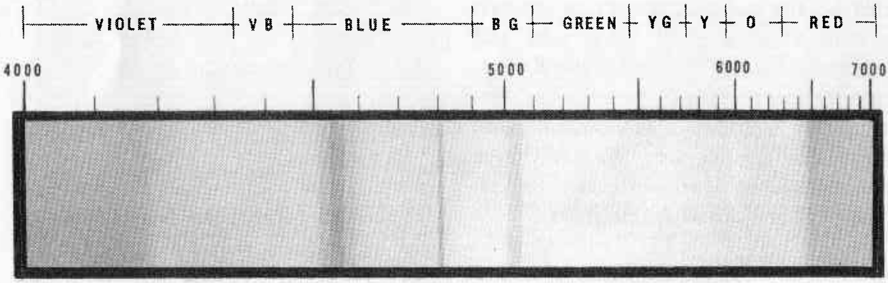


Figure 8

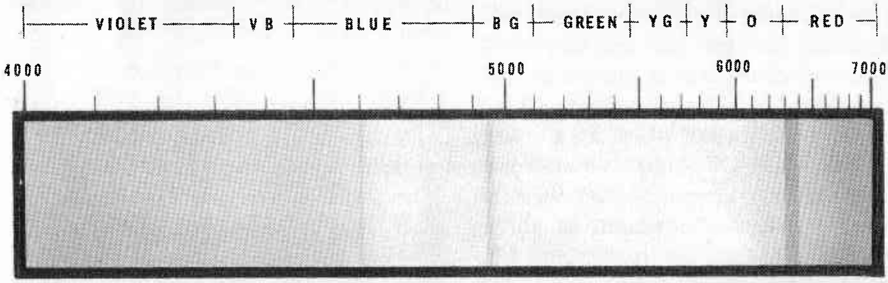


Figure 9

Natural Yellow Diamonds

It has been our finding, having observed thousands of natural yellow diamonds, that up to a point, the deeper the yellow the stronger will it display the "Cape" series of absorption lines in the spectroscope. However, a truly fine, rich-yellow natural stone will display no absorption bands whatsoever. Therefore, we were surprised when we examined a five-carat marquise of a color in which no bands were expected to see the absorption spectrum illustrated in *Figure 12.* Instead, the "Cape" series was stronger than we have ever seen, and, in addition, there were two lines, one at about 5120 and another at

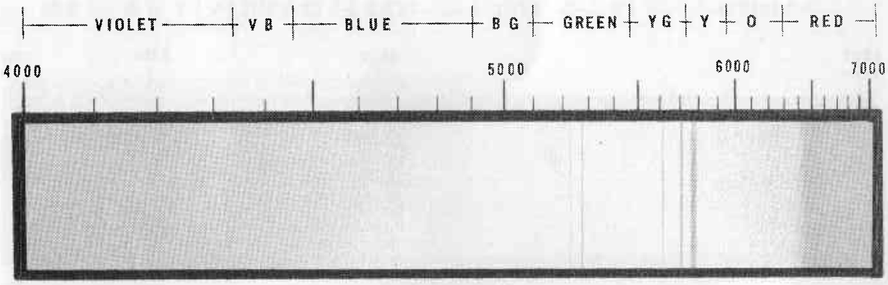


Figure 10

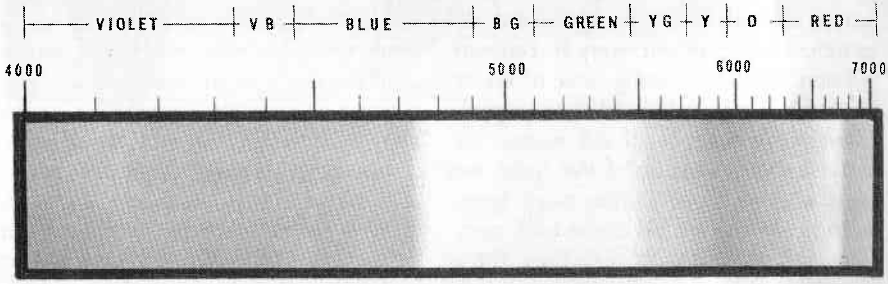


Figure 11

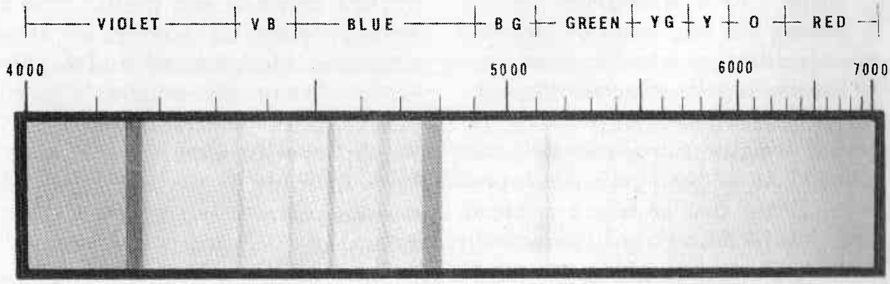


Figure 12

5040 Å. Its fluorescence was sulphur yellow under 3650 Å ultraviolet.

Andalusite

We were pleased to have the opportunity of examining a large parcel of rough Brazilian andalusite through the courtesy of student Sam Leonard, of New York City. In the spectroscope, we were surprised to see, quite sharply, the lines mentioned by B. W. Anderson as "sometimes weakly seen at 4360 and 4550 Å." (In our instrument, we noted them more nearly at 4380 and 4520 Å, as illustrated in *Figure 13*). We had rarely seen these weak lines with our former equipment, but, since we were

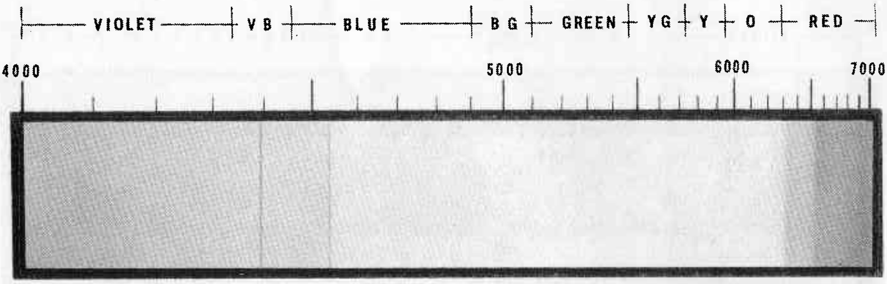


Figure 13

using the spectroscopic equipment recently designed by Lester B. Benson (described in the Spring issue of *Gems & Gemology*), we decided to experiment with some small cut stones. By reducing the intensity of the light, we were able to see the same weak lines, even in stones as small as one-half carat. This is a valuable additional test for a gemstone that is occasionally mistaken for tourmaline.

Rare Minerals

Among the rare minerals identified since last issue are scheelite, transparent yellow smithsonite, stibiotantalite, hambergite and a brownish-yellow apatite crystal weighing approximately two pounds. An 82-pearl-grain conch pearl is the largest that we have ever identified. A natural ruby crystal, purportedly from Brazil and weighing 285 carats, although not too gemmy, indicates that this country is just beginning to yield its treasures. A rough crystal of synthetic periclase that would cut into attractive, but fragile, stones was also identified.

Acknowledgments

We received from **Eric Engel,** mineral and gem dealer of New York City, a handsome cabinet-specimen of beryl. It was particularly interesting, since there were rich blue-green spots of color that showed both the aquamarine and the emerald absorption spectra, whereas other areas showed only the common beryl lines.

From **Mr. George A. Bruce,** International Import Company, Atlanta, we received a much-needed specimen of opaque yellow opal (sometimes called "opalite" in the trade); a phantom amethyst cabochon, attractively marked in white and purple; and a rarely encountered specimen of psilomelane, a black-banded and highly lustrous manganese mineral.

We are very much indebted to **Mr. Ralph Esmerian,** gem dealer of New York City for display specimens of assorted colors of faceted zircons, fine natural spinels, garnets and topaz.

From **William V. Schmidt, Inc.,** we received specimens (for each office of the GIA) of their new "Star of Destiny," described in the Winter issue of *Gems & Gemology* and also in a recent issue of the *Jewelers' Circular-Keystone*. Also, the gift of rough specimens of opal, garnet, sphene, chrysoberyl and topaz was a welcome addition to our mineral-display case.

Continued on page 191

Developments and Highlights

at the
GEM TRADE LAB
in Los Angeles

by

Lester B. Benson, Jr.

Director of Research and Laboratories

Pearl Deterioration

A jeweler who had replaced a strand of cultured pearls was beginning to think that his pearls were of inferior quality, when, after a few months of wear, the second strand was also returned with many of the pearls worn to a barrel shape — the same rapid wear encountered in the first strand. Pronounced etching was associated with the worn areas on a number of the pearls. A few that were highly lustrous had been largely unaffected, thus indicating a definite difference in their resistance to the medium causing the wear. The deterioration probably was caused by a skin-acid condition, possibly accentuated in its action by an ingredient in one or more of the wearer's cosmetics. The ends of the pearls, as well as the string, were saturated with what appeared to be face cream and powder. If skin acids were responsible, which seemed obvious, the better condition of the few more-resistant pearls would require additional investigation for an explanation.

What Does Value Mean?

The values quoted for some gem materials by publicity seekers often seem to be a disservice to other jewelers. Here are a pair of recent examples.

After issuing a routine report on a large blister pearl of no particular interest, the Laboratory staff was surprised to learn a few days later that they had tested "one of the largest pearls in the world, valued at $50,000."

A cultured-pearl-set "million-dollar

crown" featured on television must be close to a record for this sort of "evaluation."

Green Zircon

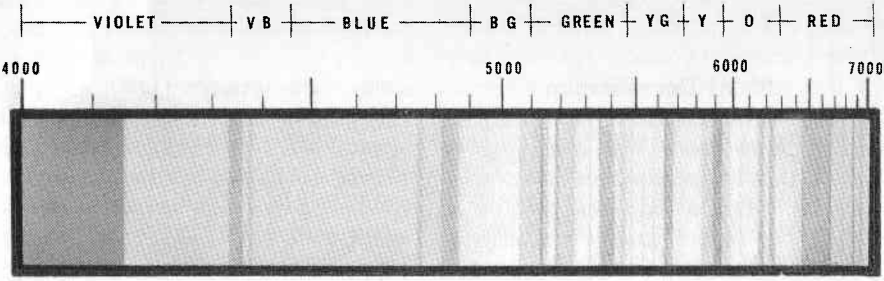
The Laboratory received an attractive fifty-two carat green zircon for testing that proved interesting and unusual. It was well cut and of good color, although it possessed a very slight brownish overtone. Normally, green zircons are associated with the low- to medium-property end of the zircon range. However, this stone displayed the characteristics of the high type; i.e., strong birefringence and a 4.70 specific gravity. Most unusual were the exceptionally pronounced absorption spectra, illustrated in the accompanying diagrams. Different patterns were obtained for the ordinary and the extraordinary rays and were associated with strong dichroism.

Pearl Strands — Imitation, Cultured and Natural

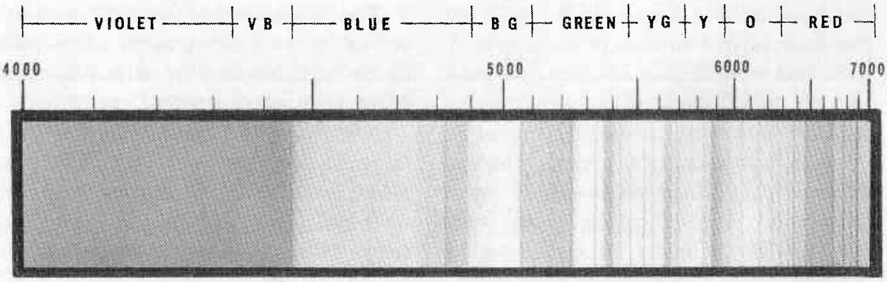
A double-strand pearl necklace, believed to be natural by the owner, caused considerable disappointment when one strand turned out to be cultured. However, she was less disturbed than another client, whose double strand was half cultured and half imitation.

"Cape May Diamond?"

A stone represented as a "Cape May diamond" is apparently being given a new national promotion. (This is the incorrect name that has long been ap-



Green zircon absorption spectrum obtained for the extraordinary ray.



Green zircon absorption spectrum obtained for the ordinary ray.

plied to rock crystal found on the beaches near Cape May, New Jersey.) However, the sample submitted was not the so-called Cape May diamond, but a synthetic spinel.

Peridot

A jeweler had convinced a customer that a large, but rather lifeless, peridot needed recutting to improve its appearance. After the job was completed, the stone was unchanged in appearance, other than a slight reduction in size. The disappointed customer submitted it for analysis of the recutting, claiming that the jeweler had failed to do a proper job. Magnification revealed a multitude of pinpoint inclusions that imparted a cloudy texture to the stone, thus reducing the brilliance.

Reassurance

We frequently have Laboratory calls that involve consultation and reassurance, rather than identification. A recent example was interesting. A wealthy woman bought a highly flawed but fine-color ruby. A jeweler mounted it, according to her unusual request, so that no metal surrounded the stone to hold it in place. Since the stone had a rather flat pavilion, a strong adhesive was employed to secure it in the mounting. The GIA Laboratory was consulted more than a year later, after the woman, upon her return from a foreign trip, had taken the ring to a prominent eastern jeweler to have it reaffixed in the mounting. (It seems that the stone had fallen out during the trip.) The salesman for the eastern firm informed her that the stone had been broken and cemented together. Since the eastern firm had a fine reputation, indignantly she returned it to the original seller, who sent it to the Laboratory for a report. The stone had not been broken, although it was highly flawed. Evidently, what misled the eastern salesman was a spot or two of cement on the girdle. He assumed that it had squeezed out of a crack, rather than having been used to hold the stone in the setting.

Diamonds From Solution?

Recently, a medical doctor came to the Lab with "diamonds" that he had grown from solution. He believed that the idea expressed to him while a medical student — that carbon was difficult to take into solution — must be in error, because so many organic materials contain carbon. He said that he had discovered a means, which he intended to hold secret, by which carbon could be taken into solution readily. Later, when one of the solutions evaporated partially, colorless crystals were found in the bottom of the container. He concluded that diamond was the only possibility, since the crystals had a form that he associated with diamond. A quick check showed the crystals to be singly refractive, to have a cubic habit and a refractive index of 1.54. At this point, we asked the doctor to touch his tongue to one of the crystals. His reaction confirmed the identification of halite (common salt). Perplexed, he left the Laboratory, trying to decide how the salt had gotten into a solution containing only carbon and water.

No Trade!

We received a letter from a hobbyist who wanted to pay for the GIA courses on a bartering basis, rather than with currency. He stated that he had discovered a deposit of diamonds, a small sample of which was enclosed with the letter. The specimen proved to be a slightly concave fragment of glass that had been polished on both sides. When this was pointed out to him, we received an answer stating that perhaps he had inadvertently sent the wrong material. The second mailing that we received contained several pieces whose appearance was unlike the first in every respect, although they, too, were transparent fragments of glass. As of this writing, the gentleman is not a student of the GIA!

Acknowledgments

We are very grateful to **Howard Millar,** Murfreesboro, Arkansas, for his donation of a quartz replica of the "Star of Arkansas." It makes an interesting addition to our replica display. The original 15.33-carat diamond was picked up on the surface of the Crater of Diamonds, March 4, 1956, by Mrs. A. L. Parker, of Dallas, Texas, and was cut into an 8.27-carat marquise by a firm in New York City.

Nine synthetic-spinel triplets were donated by **Ernest W. Beissinger,** Pittsburgh, Penna. They will make an attractive addition to the Institute's assembled-stone display, and will be invaluable for use in class work. The colors closely simulate those of amethyst, citrine, peridot, garnet and sapphire.

A rare orange-yellow scheelite brilliant and an assortment of faceted peridots were given to the GIA by **Martin Ehrmann,** Los Angeles gemstone dealer. We greatly appreciate this addition to our gemstone collection.

Through the courtesy of GIA Graduate **Robert Klippel,** Sherman Oaks, California, an interesting pink diamond has been added to our diamond collection.

We are indebted to GIA student **J. L. Bynum,** San Antonio, Texas, for a selection of opal specimens.

An attractive blue cat's-eye tourmaline, a gift of **Charles Kaufman,** of the Tourmaline Cat's-eye Corporation, New York City, now graces the tourmaline shelf of our gemstone display. It is the first specimen of this color we have had.

A choice specimen of crystal labradorite was donated by **Thomas B. Haynes,** Cloverdale, California.

We appreciate the interesting and varied assortment of stones donated by GIA Graduate **John Fuhrbach,** Amarillo, Texas. Several now repose in our gem-display cases; others will be invaluable in our practice-stone sets. The collection consisted of spessartite garnet, hessonite garnet, iolite, chrysoberyl, ruby, bloodstone, tourmaline, spinel, doublets, synthetic spinel, quartz triplet, eleven cultured pearls, and an assortment of glass.

Our thanks to **Don Hartley,** Phoenix, Arizona, for several stones that can be used to good advantage in our stone sets. They consisted of synthetic spinel, corundum and green glass.

Through the courtesy of GIA student **Harry Fink,** Tujunga, California, we received several rough specimens of opal, tourmaline, jadeite, agate and calcite.

EKANITE

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From student **Art Reis,** of The Reis Company, Indianapolis, we received a very useful collection of miscellaneous natural, imitation and assembled stones that will be used to advantage in our study sets.

We are very much indebted to Mr. **Betteridge,** of the W. D. Webb Company, Greenwich, Conn., for our first specimen of alexandritelike synthetic spinel. The stone has an exceptionally good color change, and without a test would probably pass as an alexandrite in the trade. We encounter these stones rarely and have tried for more than ten years to obtain a specimen for our collection.

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