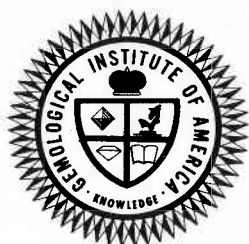


Gems & Gemology



SPRING, 1973



RICHARD T. LIDDICOAT, JR.
Editor

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Examination of Maxixe-type Blue and Green Beryl

by K. Nassau, Ph.D., and D.L. Wood, Ph.D.

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ABSTRACT

Blue Maxixe beryl, kept in the dark since 1917, and current blue and green beryl (R. Crowningshield, *Gems & Gemology*, vol. 14, #4, Winter 1972-73) showing similar characteristics, have been examined by absorption spectroscopy, gamma-ray spectroscopy, chemical analysis, and light, heat, and irradiation treatments. All three show an anomalous dichroism (the ordinary ray is more blue than the extraordinary ray, whereas in aquamarine the reverse is true) and an unusual narrow band spectrum in the red and yellow regions. In all three cases the color is bleached by exposure to daylight or on heating and can be recovered by neutron or gamma-ray irradiation. A color center not involving a transition metal such as Fe, Co, Cu, etc., is indicated. Examination of 23 faceted "sapphire" blue beryl gemstones by gamma-ray spectroscopy indicates that three had definitely been colored by neutron irradiation; the others may or may not have been treated by irradiation.

INTRODUCTION

About 1917, in the Maxixe mine in Minas Gerais, Brazil, blue beryl was found which had the following unusual properties: it showed a strong anomalous dichroism, a narrow band absorption spectrum for the ordinary ray which produces a pronounced "sapphire" or "cobalt" blue (distinctly different from the blue of aquamarine beryl); and the color faded on exposure to light.¹ These and other properties were reported in 1933 and 1935 (1, 2, 3). We consider any beryl to be "Maxixe-type" beryl if it shows these three unusual properties: dichroism with blue in the ordinary ray;

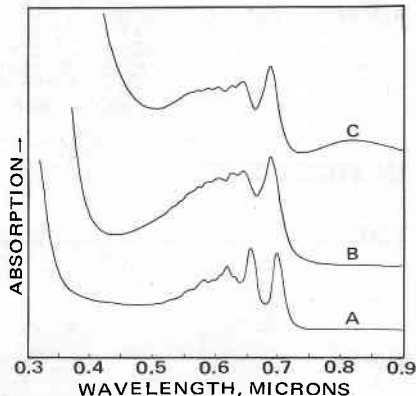


Fig. 1

Absorption spectra of Maxixe-type beryls: (A) 1917 Maxixe specimen; (B) current blue faceted stone; (C) current green rough. Ordinary ray only; extraordinary ray lacks any absorption in the 0.5 to 0.75 micron (5000 to 7500 Å) region.

narrow-banded absorptions in the ordinary ray spectrum; and bleaching on exposure to light or heat. Some recent material of this type has become available, and our attention was drawn to the unusual absorption spectrum by Mr. R. Crowningshield.

EXPERIMENT

We have examined in detail the following: a piece of the original Maxixe find that has been kept from extended exposure to light since 1917, courtesy of Mr. B.W. Anderson; 23

¹ After a brief period of "a lively trade" (1), "there resulted much unpleasantness" (2). [Authors' translation.]

specimens of currently commercially available deep blue faceted stones (ranging from four to ten carats in weight), as well as blue rough from an unspecified locality said to be in Brazil; and three dark green stones and some dark green rough, possibly from the same current locality. All exhibit the three properties just mentioned. Although there were some minor differences, all these specimens showed pronounced blue/colorless, blue/pale pink, or green/yellow dichroism with a similar characteristic ω spectrum in the 5000 to 7500 Å region (Figure 1).

Permission was obtained to expose to light four current deep blue stones, current deep blue and green rough, and part of the old Maxixe rough (either to daylight with intermittent sun or to a 100-watt frosted tungsten light bulb at a distance of six inches in an air-conditioned room). After one week, all had faded significantly, ending with only about half of the original color or less. The bleaching was then completed by heating to a maximum of 235°C (455°F) for one-half hour, resulting in yellow or pale pink color. By comparison, aquamarine is customarily heated to a much higher temperature 400°C (752°F) to improve the color, which remains stable to light (4).

Examination of all the specimens by gamma-ray spectroscopy, using a lithium drifted germanium detector, indicated in three of the faceted stones the presence of a small amount of Cesium-134, a radioactive species with a half life of two years. This is absent in nature, but produced by neutron irradiation of natural Cesium-133 in the specimens. These stones must therefore have been treated by neutron irradiation. The other specimens did not show this behavior and have

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probably not been irradiated with neutrons. On heating one of the partially bleached cut stones to 150°C for one-half hour, there was no significant further change in color. However, after one-half hour at 200°C (about 400°F), only a very pale pink color remained. Neutron irradiation (15 minutes at 10^{13} neutrons/cm²/sec) now returned the stone to a blue color even deeper than its original color. Another similar stone (blue/pale pink dichroism), when heated by Mr. R. Crowningshield, bleached completely to pale pink in less than a half-hour at 95°C (203°F). This stone was exposed to gamma rays (2×10^7 rads from Cobalt-60) and also turned deep blue. This gamma-ray irradiation does not leave any evidence of treatment, producing the usual characteristic ω spectrum. As expected from the ease of heat bleaching, this stone also bleached very rapidly in light (significantly in only 15 hours).

The green material when bleached to a deep yellow by sunlight could be returned to green by neutron irradiation, to a weak blue/green by X-rays, but was hardly changed by gamma rays from Cobalt-60. The re-colored material (both blue and green) could be bleached again by light. The green could also be changed to yellow by a half-hour heat treatment at 150°C, whereas heating to 400°C removed the yellow color, as was previously noted in an ordinary yellow beryl (5); neutron irradiation returned this colorless material to green.

Analysis showed a high iron content in the green material (about 0.2%), but essentially none in the old Maxixe sample (0.000X%). This is consistent with the spectral evidence that the deep yellow component is due to Fe³⁺ in the octahedral Al³⁺ site (5), and

indicates the Fe is not involved in the narrow-banded ω spectrum. Other transition metals, such as Co, Cu, etc., are essentially absent. Since the blue material can be bleached by exposure to light or quite low temperatures and recovered by irradiation, a color center (6) (see Appendix) not involving a transition metal ion is indicated. The minor differences in the spectra in *Figure 1* may well be associated with differences in the total alkali content, the old Maxixe being high (about 2%), the green low (less than 0.1%).

Neutron irradiation was also tried on several of the beryl specimens used in our previous study (5). One of these, a colorless beryl (#451 of *Reference 5*) showed a faint blue color after irradiation, and on examination showed a weak ω spectrum of the Maxixe type. Accordingly, it appears that not any beryl can be irradiated to give a Maxixe-type color; but neither does it appear to be necessary to have material from a unique location. Investigation on this point is continuing.

CONCLUSIONS

There is some variation in spectrum, iron content, alkali content, color, and rate of bleaching by either light² or heat. Nevertheless, in contrast to the many ordinary varieties of beryl known over the centuries, these specimens show sufficient similarity to merit a common designation, and we have used the term "Maxixe-type" based on the first reported occurrence (1, 2, 3). At present there is not enough information to decide if this type of material originates from one or several localities. It appears that the color of some of this material may be as originally found, although some material has definitely been neutron-irradiated either to form the color, to

improve the color, or to return color which has been bleached by exposure to light or to heat. Some or all of the rest may have been colored by gamma rays.

Based on the observations here reported, we believe that any blue or green beryl (particularly if the blue color is of the "sapphire" type) showing anomalous dichroism with the blue color in the ordinary ray and sharp absorption bands for the ordinary ray in the 5000 to 7500 Å region (*Figure 1* and *Reference 7*) should be designated as "Maxixe type." Such a beryl will fade, either on exposure to light or on heating. Such a beryl may or may not have been irradiated with neutrons or with gamma rays. It is in fact not possible to determine whether a given stone has been treated or how fast it will fade. In the words of Mr. Crowningshield, "... potential buyers should be alerted to the possibility that any stone of this type which they consider, may fade too rapidly to be a satisfactory jewelry stone."

Our investigation is continuing and a detailed report will appear in *Lapidary Journal*, together with color illustrations.

Acknowledgments

We are grateful to B.W. Anderson of the Laboratory of the London Chamber of Commerce, England, for the original Maxixe specimen; to R. Crowningshield of the Gemological Institute of America, New York City, for arranging for the loan of the faceted blue stones, for helpful discussions, and for obtaining for us the green rough and stones from Mr. H. Rubin of the Gemset Company of New York City, as well as to S.S. Voris for the gamma ray and Miss B.E. Prescott for the optical spectroscopy.

²A large intensely colored gemstone may need more than a week in bright sunlight (or 150 hours at 6 inches from a 100-watt frosted light bulb) to show pronounced fading.

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APPENDIX: A Note on Color Centers

Most of the color in gems and minerals is caused by unpaired electrons in major ingredients such as the copper in malachite and turquoise, or in impurities such as the chromium in ruby and emerald or the iron in aquamarine and citrine. Alternatively, there is color caused by physical structure, as in opal and labradorite (the optical diffraction grating effect).

But in some materials, where there is no such color causing ingredient or physical structure present, it is possible for "color centers" to cause a variety of colors. Color centers have been studied intensively, but only a few have been understood. Frequently this involves a vacancy (omitted atom) or some other type of defect (sometimes an impurity) which can hold (but does not of itself possess) an unpaired electron.

Examples of color centers occur in halite or sylvite (made purple to black by various treatments), fluorite (green,

purple, etc.) and smoky quartz. A frequent characteristic of color centers is that exposure to light or to relatively low temperatures may permit the unpaired electrons to pair off, thus removing the color. Irradiation by X-rays, neutrons, or some other form of penetrating radiation may cause the color to return by unpairing the electrons again. An unusual, only partly understood, color center is involved in the amethyst form of quartz which also contains iron as an impurity. Amethyst is turned yellow or green by heat, and can be recolored with X-ray irradiation. However, not just any quartz colored green or yellow with iron will go to amethyst with irradiation—some specific defect must still be associated with the iron impurity. Synthetic quartz containing iron must be grown in one specific direction to produce this specific color center and enable amethyst to be produced on subsequent X-ray irradiation. The color of amethyst is unusually stable for a color center, although it will fade over a period of many years or in hours at 400 to 600°C. The relative ease with which the color is produced by X-rays is consistent with this stability to light and to heat.

In the case of the deep blue beryl there does not seem to be any specific impurity present. It is likely therefore that a vacancy is involved which can hold an unpaired electron. The relative ease of fading implies that the electrons pair off readily, and the difficulty of returning the color is consistent with this instability.



Developments and Highlights at **GIA's** Lab in New York

by Robert Crowningshield



Figure 1

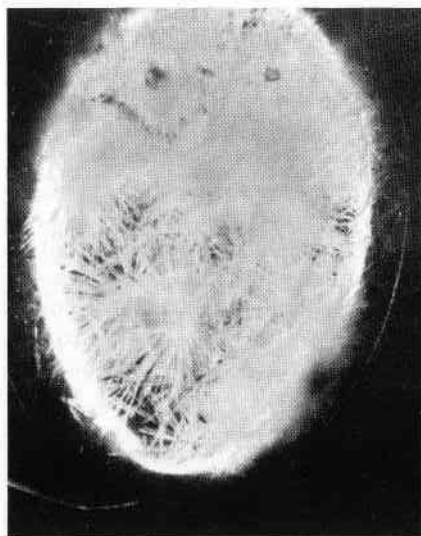


Figure 2

134

Glass

By coincidence we have encountered a number of good green jade imitations from various sources, all submitted within a very few weeks. *Figure 1* illustrates an ordinary glass imitation mounted in platinum and set with diamonds. Although translucent, it had nothing particularly different about it to suggest that it was other than ordinary glass. This is in contrast with others seen later. *Figure 2* was taken by Photoscope to show a most unusual radiating fibrous pattern in another excellent imitation with a fine green color. The process whereby a glass contains crystals, or a partly crystalline structure, we think of as devitrification. In the jade imitation sold in Japan as "meta-jade" or "Iimori stone" the devitrification causes a fern-leaf effect. It is shown in

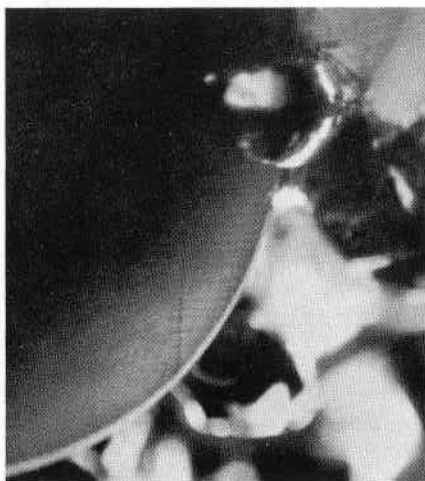


Figure 3

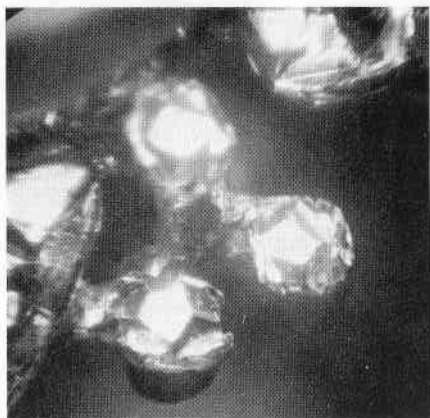


Figure 4

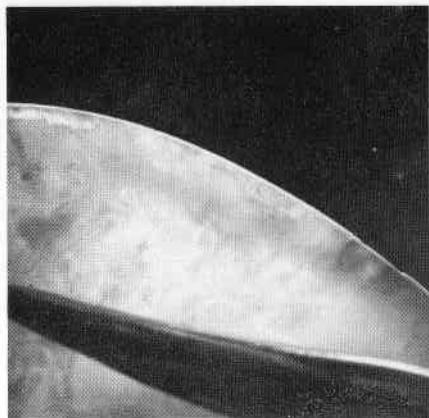


Figure 5

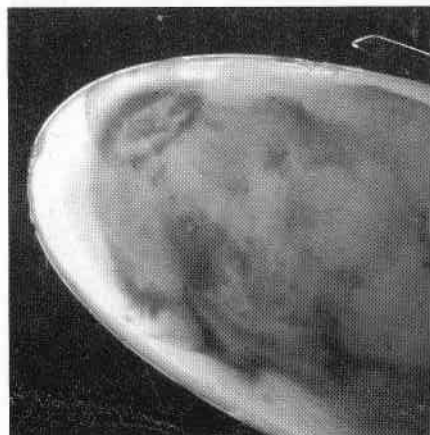


Figure 6

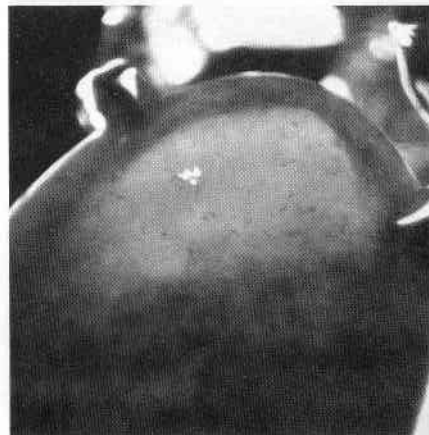


Figure 7

Figure 3. This stone was set in a ring with unusual imitation diamonds. They were cut out of the setting so that both the prongs and the table of the stones were simulated (*Figure 4*). In another 31-carat cabochon which looked certainly like a valuable "imperial jade" cabochon, the devitrification took on the appearance of irregular included crystals or tufts of crystals (*Figure 5*). Another imitation brought in the same day was clearly glass, by virtue of the prominent gas bubbles. However, the refractive index of the mottled appearance to the unaided eye so closely resembled a

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certain quality of jadeite that there was a sizeable bet between two trade members awaiting the Laboratory verdict. This stone is shown in *Figure 6*.

Fine Jade

Not all the jade-like stones we encountered since last issue were imitations. Because of the great demand for fine jadeite and the consequent high prices, we have been seeing an increasing number of fine stones. One of these contained an inclusion which we did not identify, but it appeared to be pyrite (*Figure 7*).

Another quite acceptable jadeite cabochon was unusual in that it had

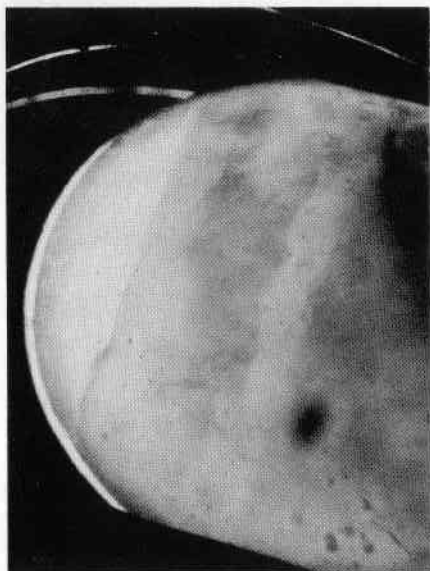


Figure 8



Figure 10

several more or less straight bands of color which are shown in *Figure 8*.

Glass Again

In *Figure 9* we see a bracelet with what the customer bought as natural emerald crystals. They were cleverly made glass imitation hexagonal "prisms," mostly green, but some had a brown "matrix."

More Glass-Imitation Cat's-Eyes

An attempt to manufacture a glass substitute of cat's-eye is shown in *Figure 10*. The maker was unable to color the stones and they appeared white due to the breaking up of the light by the hollow tubes that were introduced to cause the phenomenon. Viewed from the side, these tubules can be seen in *Figure 11*. A later attempt by another manufacturer produced good-looking imitations in various colors, including an approxi-



Figure 9

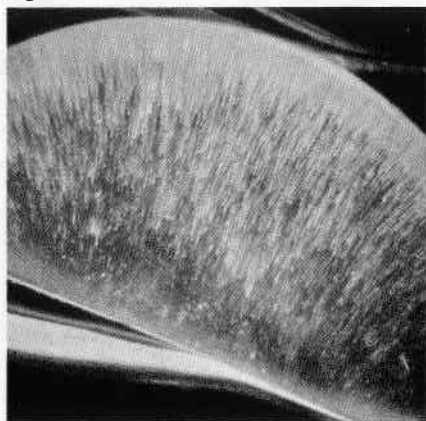


Figure 11

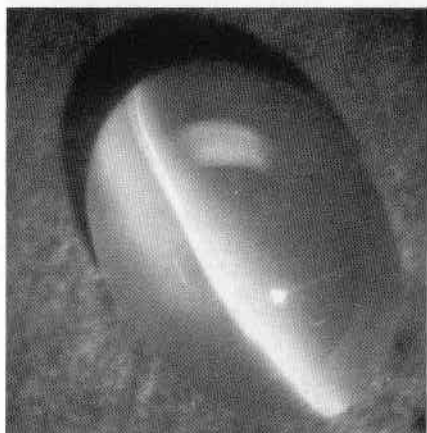


Figure 12

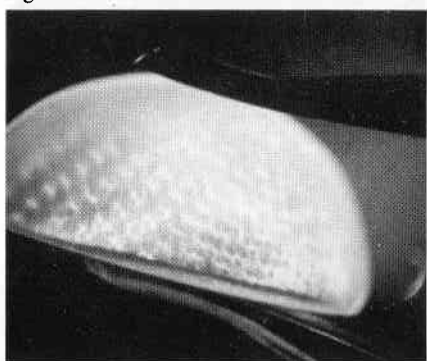


Figure 13

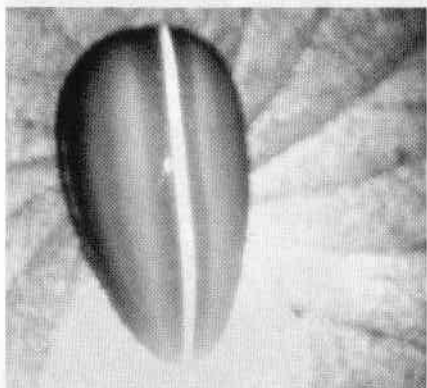


Figure 13-A

mation of the so-called honey color of a chrysoberyl. However, the stone illustrated in *Figure 12* is a pale sapphire blue. As in chrysoberyl, the



Figure 13-B

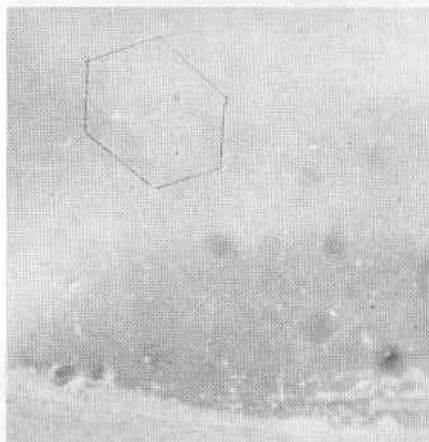


Figure 13-C

structure causing the sharp eye effect is so fine as to be invisible under Gemolite magnification. When viewed from the side, a surprising honeycomb pattern is seen (*Figure 13*). We assume that this is another manifestation of devitrification. In the Polariscope the stone appeared to be doubly refractive when viewed in this direction.

Still another cat's-eye imitation was encountered in which the eye was as sharp as could be desired (*Figure 13A*). It was brownish-yellow in color, resembling chrysoberyl. However, the most remarkable characteristic was the fiber optic effect when viewed from the side (*Figure 13B*). Under magnification the honeycomb appearance was present. In *Figure 13C* one of the hexagonal areas is outlined in black

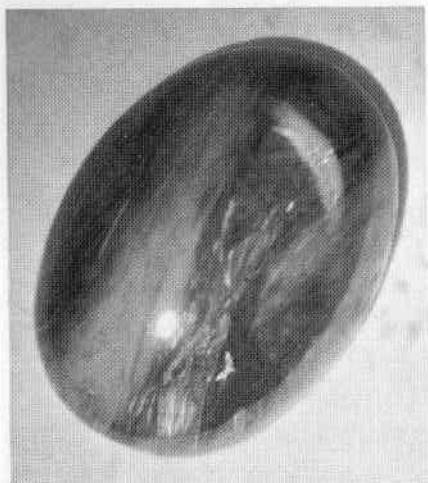


Figure 14

ink in order to delineate the pattern. Within each of the larger hexagonal areas are hundreds of small hexagonal fibers which are obviously the cause of the eye effect when viewed from above. We are not aware of the nature of this glass—possibly it is made of fused optic fibers. However, the refractive index appears to be well over the refractometer scale and the specific gravity is 4.19.

An Unusual Agate

We recently identified a strand of baroque mottled beads in which quartz in the form of agate and what appeared to be strands of tiger-eye intermingled. The necklace had been imported as "Hsichwan Jade." We recalled that we had received a similar-appearing cabochon from Hong Kong Gems, Ltd., some time back.

This stone is shown in *Figure 14*. We do not know if the tiger-eye appearing strands are indeed pseudomorphic asbestos, but it would seem that it could have occurred in nature.

Diamond Finish

In *Figure 15* is shown a beautiful example of the girdle faceter's art. The stone was round and weighed in excess

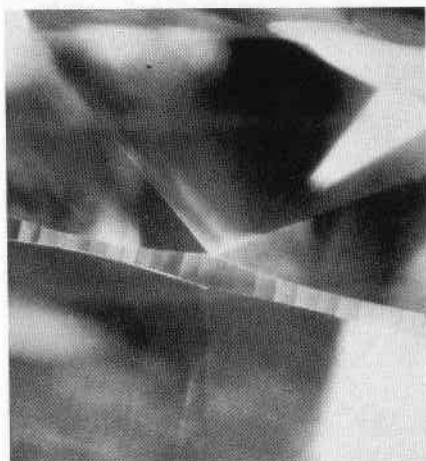


Figure 15

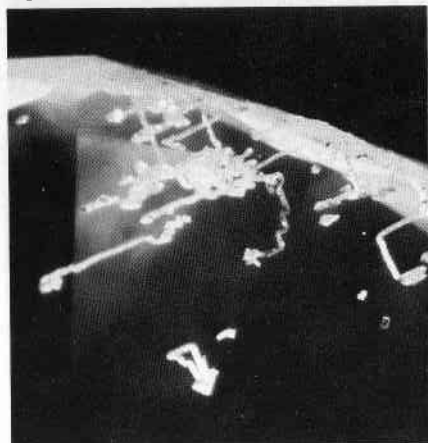


Figure 16

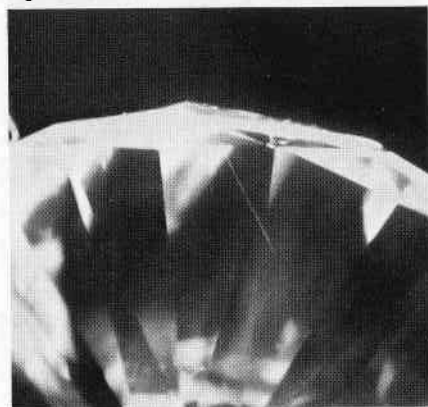


Figure 17

of 13 carats. The girdle facets had been placed on with all the skill and patience one could wish. In addition, the top and bottom main facets pointed up beautifully.

Nature's Crazy Laser?

Some of the wildest-looking inclusions we have ever seen in a diamond are shown in *Figure 16*. The stone was a large light brown round brilliant. The erratic tubules had a squarish outline and meandered through the stone at one edge in a haphazard way—some resembling snakes, lightning, off-beat laser holes or ticker tape. With more study we are sure they could be related to diamond's growth structure. Another unusual inclusion in diamond is shown in *Figure 17*. It has the appearance of a single long, straight needle. By way of review, *Figure 18* illustrates two laser holes penetrating inclusions in a round diamond of 1.60 carats.

Synthetic Emeralds

With the interest in fine emeralds at seemingly an all-time high, it behooves jewelers to study as many natural and synthetics as possible. The microscope remains a very reliable first observation, with ultra-violet and refractive index still important back-up tests. In *Figure 19* we show peculiar inclusions in a synthetic emerald that had led an experienced jeweler astray since these had not been reported in his references for synthetic emeralds. The stone had appeared to be natural until its low refractive index and ultra-violet fluorescence proved it to be synthetic.

WE THANK . . .

Dr. Kurt Nassau and Dr. D.L. Wood for their concern and interest in preparing the article on Maxixe-type beryls for this issue. The Laboratories
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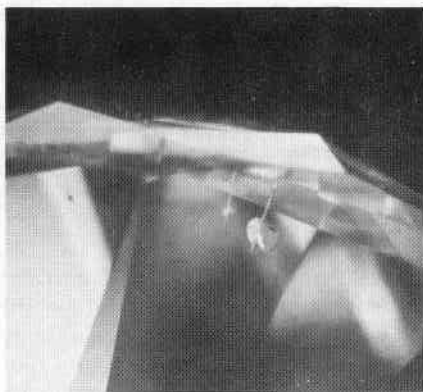


Figure 18

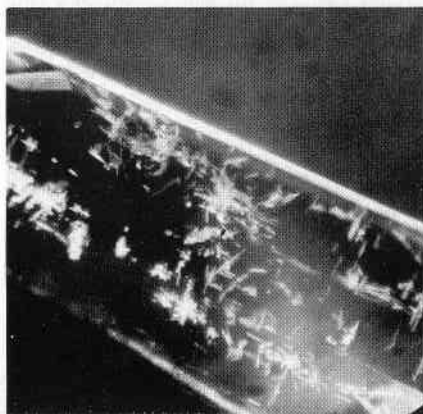


Figure 19

have had many requests for information about the fine blue stones and many overseas telephone calls have come in. In view of the findings, we will specify in our reports any beryls with the Maxixe properties as "Maxixe-type beryl." Several suggestions for recognizing them for those who do not have access to a spectroscope were mentioned in the Winter 1972-73 issue of *Gems & Gemology*. They fluoresce a dull greenish-white under short ultra-violet in a dark room; they appear red under a color filter when viewed in the blue direction (a Poloroid plate will sharpen the results by isolating the blue direction); and since the dark blue is the ordinary

ray (it is the extraordinary ray in typical aquamarine) one can use a Polaroid plate to determine the direction of no dichroism (the optic axis direction). In Maxixe-type stones this will be the dark blue direction, whereas in ordinary aquamarines this will be a lighter blue to blue green direction. In the Polariscope one can find the optic axis figure and note that in Maxixe-type stones it will be the dark blue direction, while in ordinary aquamarines it will be a light blue direction. Of course, to the experienced eye the almost cobalt-like blue color requires no elaborate tests to identify it.

Mr. Martin Harman of A.V. Gumuchian, New York and Antwerp, for a selection of sample qualities of Taiwan nephrite cabochons and two rough diamond crystals—one a lovely orange and the other a partially-cut black stone. It is interesting when viewed over a strong pinpoint light source. There is a central large black crystal and radiating out from it, something like the ripples when a stone is tossed into a still pond, are rings of smaller black inclusions. The photograph (Figure 20) makes it look something like a cosmic explosion.

Mr. Roland Naftule of Nafco Gems, New York, for a selection of nearly colorless grossularite garnets from Tanzania. These will be most useful

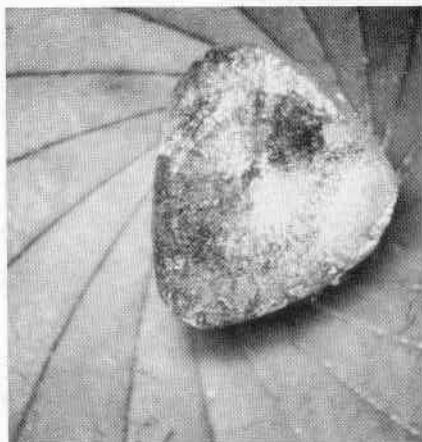


Figure 20

for advanced students of Gem Identification.

Mr. Don LaPore of Airtron Division of Litton Industries, Inc., Morris Plains, New Jersey, for a fine selection of faceted colorless synthetic garnet "YAGS," which will be most useful in class work.

Dr. A.E. Alexander for a selection of synthetic corundum and spinel boules which he secured in the late 1940's when he was a consulting engineer for the Swiss Jewel Company of Locarno, Switzerland. Also in the collection is a boule of synthetic rutile, one of the last grown by Linde Air Products, before they decided not to compete with National Lead but to concentrate on synthetic star sapphires and rubies instead.



Contribution to the Knowledge of the Argentine Rhodochrosite

by Drs. J. Della Sala, J.C. Fuentes, M. Herrero, N. Laserre and J. Viand

INTRODUCTION

Rhodochrosite, or "Rosa del Inca," is from the Greek *rodon* (rose) and *chros* (color). It has been known in Argentina since Spanish colonial times (1). There are some deposits of the mineral in Capillitas and Famatina, Provinces of Catamarca and La Rioja, respectively. The first one belongs to an important ore deposit in the Department of Andalgalá, 3.300 to 3.500 miles high.

The veins of minerals are associated with rhodochrosite and they are located in a volcanic environment (Miocene-Pliocene), according to Angelelli (2). The carbonate of manganese appears as secondary mineral or filling material among the other minerals.

The paragenesis of rhodochrosite is correlated mainly with pyrite, chalcopyrite, bornite, sphalerite and galena. The veins form lenticular bodies of variable length and width, from 3 to 5 meters to 50 to 120 meters at the longest, and 1.50 to 2.90 meters at the widest (2).

Optical Properties

The rhodochrosite samples for this research come from Capillitas (Province of Catamarca, Argentina). Macroscopically, it is opaque, pink colored with vitreous-grease towards pearly brittle and with alternate tiny bands of whitish color with zigzag form, associated with pyrite, chalcopyrite, quartz and calcite.

Under the petrographic microscope in thin section, the mineral is colorless with perfect cleavage in three directions (rhombohedral). Also it shows a high dispersion and it was possible to observe, with crossed Nicols, the uniaxial (trigonal) character and negative sign of rhodochrosite.

With the aid of a Duplex II refractometer several refractive indices were determined, with a mean value of 1.59.

Physical Properties

Some measurements of specific gravity were performed on several samples by pycnometer method, obtaining a variable result between a range of 3.50 to 3.60. At the same time the mineral was tested for hardness with a hardness point-set Rayner, giving about 4.5 in the Mohs' scale.

The ultraviolet analyses were made with Chromato-Vue CC-20 equipment. Using short wave (2.537 Å), it showed a red violet fluorescence color, and with long wave (3.660 Å) a weak black pinkish color was seen.

With X-rays no fluorescence was detected in any samples. For the spectroscopic analysis, a GIA Spectroscope Unit was used, giving a characteristic absorption band between 5.350 and 5.650 Å in the green zone of the spectrum, in complete agreement with the Cavenago-Bignami Moneta 1972 assays (3).

Chemical Properties

The composition of rhodochrosite is formed by manganese carbonate and it could be a member of an isomorphous series among this one and siderite (FeCO_3), according to Zussman *et al.* (4), using the name of manganosiderite when $\text{Mn} \cong \text{Fe}$. Also, it could form another series of the same type, among CaCO_3 (calcite)- MnCO_3 , although in the present work only some traces of calcium were detected.

Qualitative and quantitative chemical analyses were performed for major and some minor elements in rhodochrosite samples from Capillitas, giving the results that follow in *Tables 1-A* and *1-B*. At the same time, for comparison purposes, we transcribed the chemical analysis of another rhodochrosite from Ljubica.

CONCLUSIONS

From the observations and analyses performed on the samples from Capillitas, we arrived at the following results:

1. The Argentine rhodochrosite is quite different from other rhodochrosite from different places in the world. It has a reasonable amount of ferrous iron (Fe^{2+}) and magnesium (Mg^{2+}), which could mean an isomorphous replacement of manganese (Mn^{2+}) by those elements from the series rhodochrosite-siderite and rhodochrosite-magnesite (MgCO_3).

2. The refractive index and the specific gravity have a linear increment with the iron (Fe^{2+}) contained, but magnesium reduces slightly these effects (4). As significant amounts of both elements are present in the researched samples, the obtained results for those parameters give average values in both cases.

3. The beautiful and strong pink color is generally well recognized in the fresh mineral (when it has been recently extracted). After some time it develops an external alteration to manganese oxides of dark color, with a light yellowish tint because of the

Table 1-A. Major Elements

Run Number	FeO %	MnO %	MgO %	CO ₂ %	Total %
I ^a	2.40 ^c	55.82 ^d	2.05 ^e	38.35 ^f	98.62
II ^b	0.77	60.87	Trace	38.26	100.41

Table 1-B. Minor Elements

Run Number	CaO %	Zn ppm	Li ppm
I ^a	Trace ^g	— ^h	— ⁱ
II ^b	0.51	—	—

^a Capillitas, Andalgalá, Catamarca, Argentina (present work).

^b Ljubica, district Bosnia, Penins, Balkan, as reported by Zussman *et al.* in 1970 (4).

^c Spectrophotometry (Beckman spectrophotometer).

^d Julian method (volumetry).

^e Atomic absorption spectroscopy (Arolab spectrophotometer).

^f Total ignition loss (at 1.100°C).

^g Wet chemical analysis.

^h Wet chemical analysis.

ⁱ Flame spectroscopy (Vreeland spectroscope).

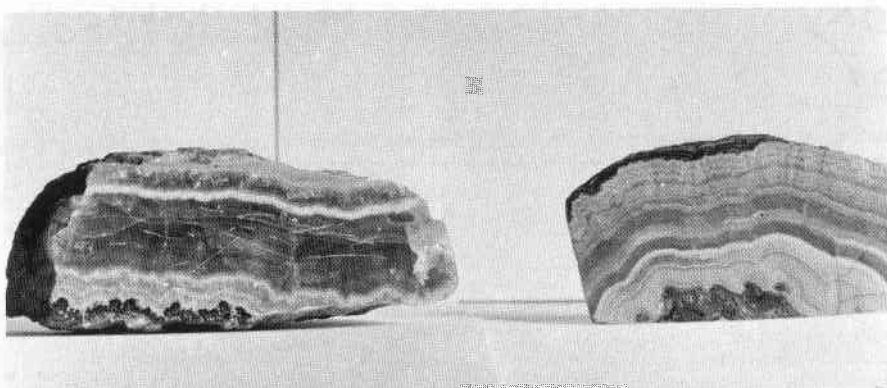


Fig. 1. Polished samples of rhodochrosite.



Fig. 2. A jewel with rhodochrosite.

quite appreciable amount of iron (Fe^{2+}) that replaces to manganese (Mn^{2+}).

4. The Argentine rhodochrosite because of its fine quality is increasing its application in the jeweler's industry as well as in the manufacture of art (Figure 1 and 2) and decorative arti-
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Fig. 3. Silver jewel box with cover and bottom of rhodochrosite.

cles like ashtrays, small statues, etc. (Figure 3).

Acknowledgments

The authors wish to thank Banco de la Ciudad de Buenos Aires, for providing working facilities with full freedom. They also gratefully acknowledge the useful advice given during the chemical analyses by Professor H. Llambias from the Department of Geology of the Buenos Aires University.

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Developments and Highlights at **GIA**'s Lab in Los Angeles

by Richard T. Liddicoat, Jr.

Much has been discussed in the industry with respect to the use of laser drilling to improve the appearance of diamonds with black inclusions. Our comments at this time do not relate to the ethics of laser drilling but merely to the practical aspects of results. When there is a completely enclosed inclusion in a diamond that has a black appearance face-up, we can well understand the desire of the owner of the diamond to have it drilled, and to have whatever is making the inclusion appear black, changed to white. However, we have seen a number of occasions in which laser drilling is used in a manner we consider to be foolish from any point of view. In other words, sometimes the drilling leaves flaws that are much more objectionable than whatever existed before the drilling was accomplished. At other times, when cleavages reach the surface, there is no reason why ordinary bleaching actions could not have accomplished the purpose without the drilling. Even though the jeweler is perfectly ethical about the matter and discloses the fact of the laser drilling to a customer, it seems a very foolish maneuver, if nothing has been done to improve the appearance of the diamond that could not have been done without the drilling. Disclosure of drilling would seem to create some degree of doubt in the mind of a prospective customer, regardless. Recently we had two interesting examples of this. In one case, the drilling

was done very cleverly, from the crown, in a position where the cleavage completely concealed the drill hole, so that it was likely to be detected only when examining the stone from a girdle-up or pavilion-up position. In the second case, the drilling was done from the pavilion, and, without question, the drilling lowered the clarity grade rather than improving it. The first example is illustrated in *Figures 1* and *2* and the second in *Figures 3* and *4*. In *Figure 1*, the drill hole appears only as a tiny white spot against the feather. In the girdle-up position in *Figure 2*, it can be seen on each side of the girdle. On the left it is white, and on the right it is black against the white. The second case, illustrated in *Figures 3* and *4*, shows two bright white lines as seen from above in *Figure 3*, and as two tiny white dots from the pavilion (*Figure 4*).

When the diamond is drilled from a pavilion facet, the drill hole is almost certain to appear as a long white inclusion, which in many cases is more obvious than what the driller was hoping either to conceal or to mitigate, as in *Figure 3*.

One of our local graduates brought in some light green material in an opaque cabochon that could be likened to turquoise, except that it had a bright green color instead of the sky-blue of turquoise. The man from whom the graduate had gotten the material wanted to call it "emerald turquoise." Coincidentally, we received

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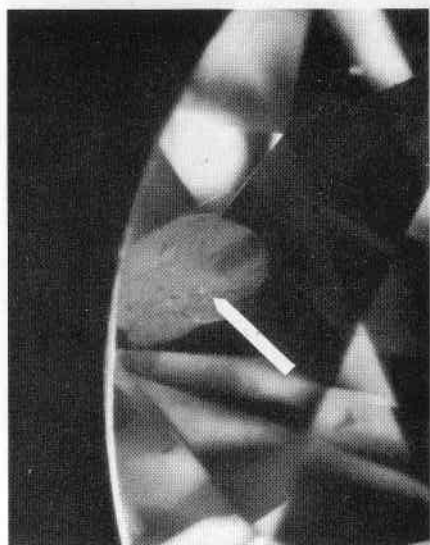


Figure 1

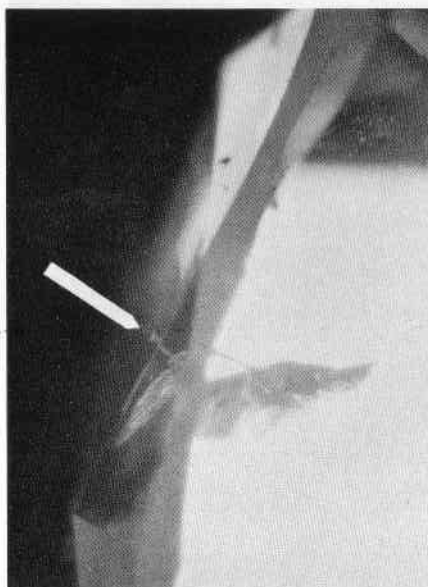


Figure 2

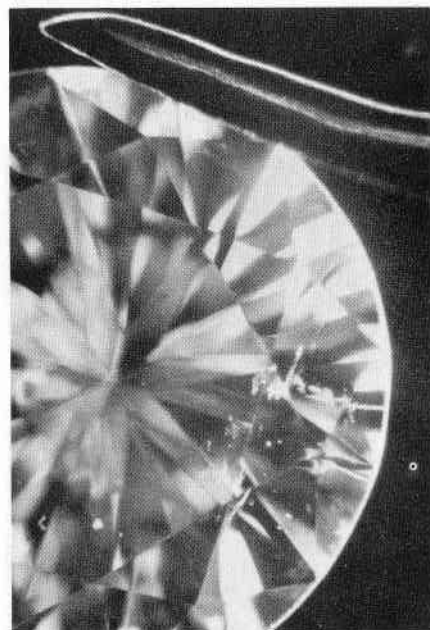


Figure 3

similar material from another source within a week of the same time.

Ordinary gemological tests seemed to correspond with the results we
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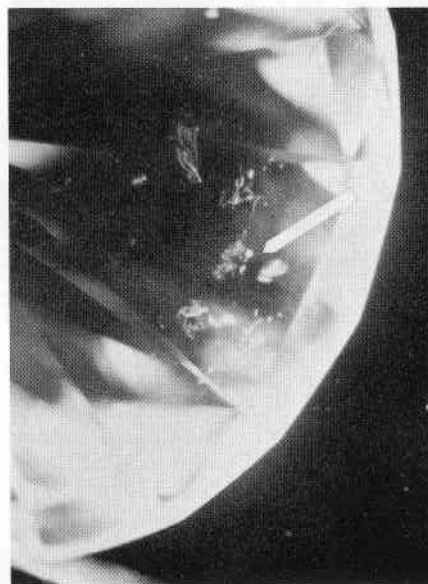


Figure 4

might expect from blue turquoise, so we scraped one of the specimens of the so-called emerald turquoise and utilized X-ray diffraction for more

conclusive results. We were interested to find that the X-ray diffraction powder pattern matched that of normal turquoise exactly. In view of the fact that we had been given enough material to be able to scrape more powder from the specimen, we were able to send it out for a spectrochemical analysis and found that it contained almost no copper (the usual coloring agent for turquoise) but more than 4% zinc. Thus the material was the zincian analog of turquoise which has the mineral name of faustite. This is a turquoise group mineral that was named a number of years ago after George Faust, a mineralogist in the U.S. Geological Survey.

We are endlessly intrigued by a form of glass in which there are numerous crystallites, such as those shown in *Figures 5 and 6*. When these were scraped and tested by X-ray diffraction, as reported some time ago, we obtained a fluorite pattern. However, the material has bubbles, and is clearly a form of glass. We have been



Figure 5



Figure 6

unable to find out what method is used for the manufacture of this material. All of that we have seen to date has been sold as "meta-jade."

An Interesting Synthetic Ruby

It seems that the most frequent subject for identification of colored



Figure 7



Figure 8

stones is a synthetic ruby. Over the course of the year in the Los Angeles Laboratory, we receive—it seems—thousands of synthetic rubies for identification. This becomes the most routine and boring of testing problems. It is only rarely that a synthetic ruby is particularly interesting. Such a synthetic came into the laboratory sometime in May, and is pictured in *Figures 7 and 8*. In *Figure 7* we see a very strange pattern of minute bubbles, more reminiscent of synthetic blue sapphire than synthetic ruby, that tended to spread across the antique cushion cut of the synthetic ruby. In *Figure 8* signs of the prominent curved striae are seen at the right side of the illustration. This was the most interesting Verneuil type of synthetic ruby seen in some time.

Figures 9 and 10 illustrate an attractive green oval brilliant that was presumed by the person having it tested to be natural emerald. Inclusions shown at low magnification in *Figure 9* and under higher magnification in *Figure 10* might have tended to

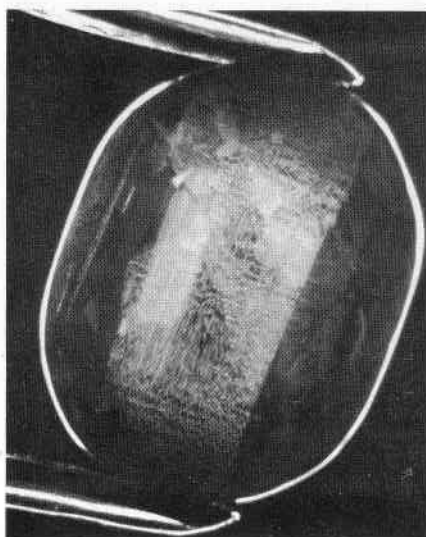


Figure 9

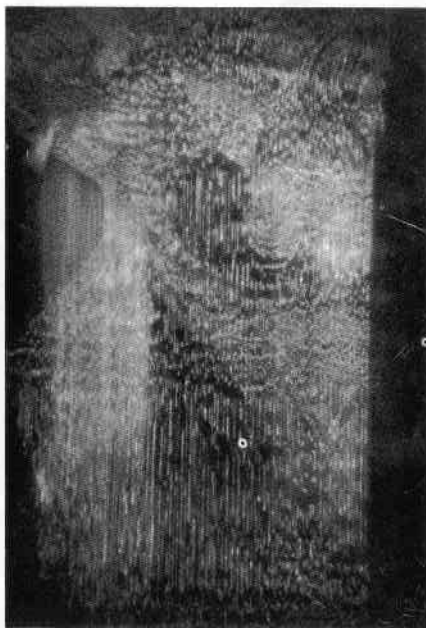


Figure 10

bear out the assumption that the oval brilliant was a natural emerald. Many wisplike or veillike inclusions under the plane of tiny flux inclusions that are prominent in the two figures (*9 and 10*) plus low properties, identified

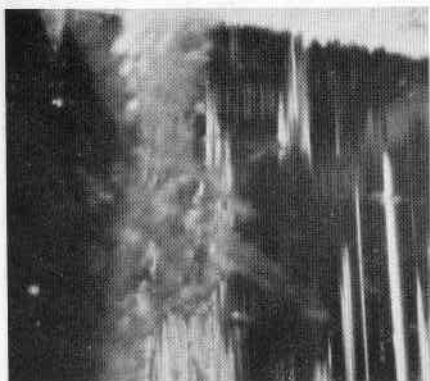


Figure 11
the oval as a synthetic.

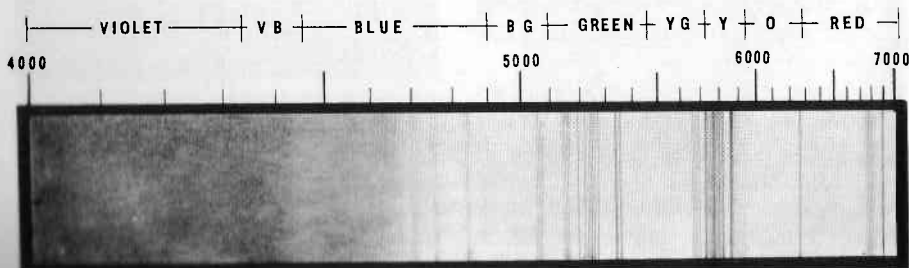
Figure 11 shows some straight zoning that had an appearance similar to that of polysynthetic twinning, as well as gas bubbles. It was a glass imitation.

Graduate Joe Tenhagen of South Miami, Florida, has made several trips recently to Colombia. An article about one of his trips appeared in the Fall, 1972, issue of *Gems & Gemology*. Upon his return from the last trip, he sent us for examination a large crystal of parisite and several trapiche emeralds. Parisite, a fluocarbonate of the cerium metals, is found at the Muzo Mine in Colombia, with emeralds. It has indices of 1.67 to 1.75 and is slightly radioactive.

Parisite is not a gem mineral in any sense, but it is particularly interesting because it is encountered as an inclusion in emeralds from the Muzo Mine

and because that is practically its only well-known occurrence. It is found elsewhere, such as in Italy, Greenland, Quincy, Massachusetts, and Ravalli, Montana, but its hardness of only 4.5 does not make it a practical gem material. Chuck Fryer, GIA's Laboratory Supervisor, was so intrigued with its spectrum that he recorded it in black and white, as shown in *Figure 12*. We do not expect jewelers ever to encounter this material, except as a minute inclusion in an emerald, but the spectrum is intriguing, and, we felt, worth recording. It would be nice if every gem material had such a distinctive spectrum.

The tiny trapiche emeralds that we see most frequently are so small and the areas of transparent emerald material so tiny, that we seldom think of trapiche emeralds as being a source of fine gem material. It is only when this type of emerald is quite large, with large sections of transparent emerald material, that gemstones can be cut from trapiche. In no sense could those sent by Mr. Tenhagen be considered in the gem category, but they did illustrate one typical characteristic of the trapiche, in that they had a much larger carbonaceous black opaque center at one end than at the other. This differential in the percentage of carbonaceous versus transparent beryl material is illustrated in *Figures 13* and *14*. In *Figure 13* the banding parallel to the prism faces is quite obvious.



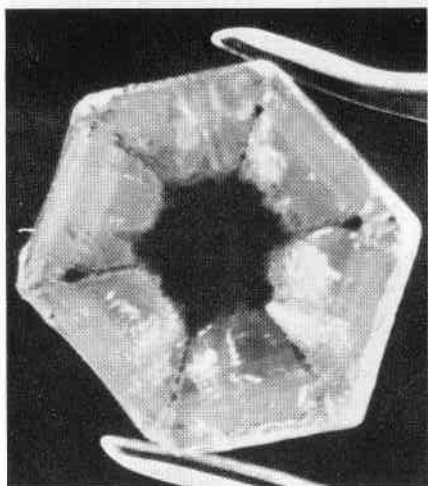


Figure 13

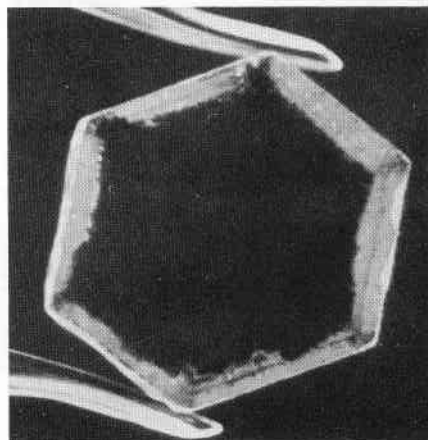


Figure 14

More on Emeralds

So frequently do we see synthetic emeralds with very strong zoning that we decided to photograph a natural emerald which showed the same sort of parallel banding, in this case parallel to the basal pinacoid. As can be seen from the photograph in *Figure 15*, this was not a particularly delightful emerald, but the structural appearance was so vividly portrayed that we thought a photograph seemed in order.

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Percussion Marks

It is not too infrequent that we encounter a series of percussion marks on a diamond, particularly on the table. We assumed from its source that this was a freshly cut diamond and the chatter marks in an arc on the table were quite distinctive, so we photographed them. We assume that the conditions shown were occasioned by the diamond being too loosely held in a mechanical dop, and that as a result it moved quite a bit during the cutting process, in which it was held table-to-pavilion in the dop.

More on Uмба River Corundum

As we have mentioned frequently in recent Laboratory columns, we are seeing more and more sapphires and at least quasi rubies from the Uмба River Valley in East Africa. Recently we received for identification a ruby that had a large number of minute inclu-



Figure 15

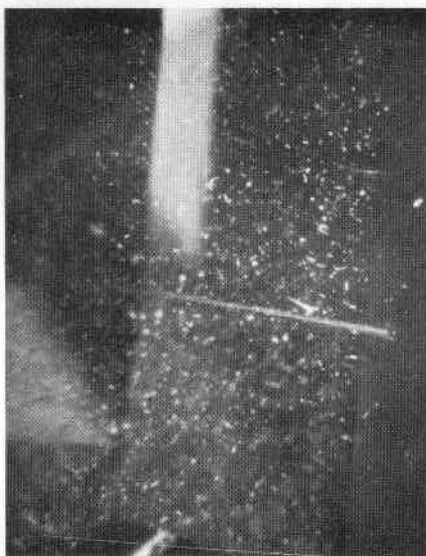


Figure 16

mately 40X in *Figure 16*. We do not show this photomicrograph to indicate really characteristic inclusions, but simply a pattern that we have seen very frequently in Umba River corundums—that is, a large number of very minute inclusions giving a powdery or faintly cloudy impression under magnification.

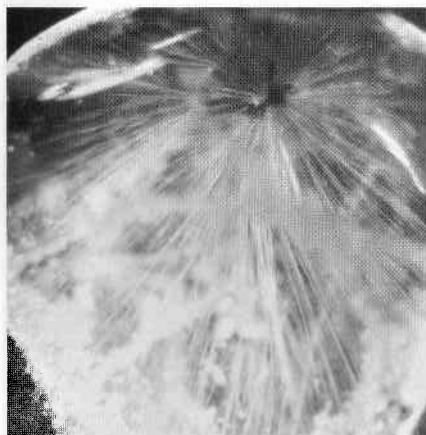


Figure 17

150



Figure 18

Typical Inclusions

During the course of the period since the last Laboratory column was published, Chuck Fryer has encountered some interesting inclusions that he photographed, which were so typical that we felt they were worthy of photography. One was a demantoid garnet with the horsetail inclusions so dramatically portrayed that he took the photomicrograph shown in *Figure 17*.

Transient Bubbles

A movable bubble in a large inclusion in quartz is a common sight to mineralogists, but is seldom seen in a gem quality material. Mr. Fryer was asked to identify a double terminated quartz crystal and when he noted the fact that one of the large negative crystals shown near the bottom of *Figures 18* and *19* contained a bubble that moved, he photographed the end positions. The bubble is seen at the lower end of the first illustration and at the upper end of the second. This makes an intriguing inclusion.



Figure 19



Book Reviews

INTERNATIONAL DIAMONDS/Number Two, edited by A.N. Wilson, M.A. Published by Diamond Annual (Pty) Limited, Johannesburg, South Africa, 1972, 288 pages. Clothbound. Illustrated with black-and-white and color photographs and line drawings. Price: \$20.00.

If anything, *INTERNATIONAL DIAMONDS/Number Two* is even more fascinating than the initial publication, *INTERNATIONAL DIAMONDS/Number One*, which was published in 1971. The scope of the publication is tremendous, covering everything from the diamond fields to all aspects of cutting, marketing, conditions in each of the major countries and really almost everything connected with the diamond business. In general, the articles are entertainingly written and make for easy reading.

We do not think anyone interested in diamonds would fail to be fascinated in reading this book, article by article. The wealth of fact to be found within its covers makes it invaluable also as a reference book.

Even the way the many advertisements are presented is of real interest.

The book covers cutting firms, marketing firms, methods of extraction of diamonds from the rough, designing, salesmanship, situations within various countries that have a bearing on the saleability of diamonds, and many other subjects, all in fascinating detail. This is a book that we feel should be in every gemological library. It is of value even to those not particularly interested in diamonds.

At \$20.00, *INTERNATIONAL DIAMONDS/Number Two* is well worth the price.

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PIERRES PRECIEUSES DANS LE MONDE, by Henri-Jean Schubnel. Published by Horizons de France, Paris, 1972. 192 pages. 110 color photographs and 100 illustrations. Clothbound. Price: \$11-\$12. Text in French.

The initial impression of this diverse and well-organized volume is that of a large number of subject matters which are covered in the four sections, and numerous full-color photographs are previewed by the striking book jacket, which pictures a modern *objet d'art* fashioned from rough crystals.

Originally, *PIERRES PRECIEUSES DANS LE MONDE* formed the basis of a doctoral thesis by its author, Henri-Jean Schubnel, scanning gems from remote antiquity to the present.

The four sections of the book cover the economics of world trade in gems; a brief historical account of gems including worldwide collections of importance; global gem deposits; and gem identification.

The opening remarks by the author in his preface plead the all-too-familiar necessity to simplify and standardize gem and mineral nomenclature. Following is an economic survey of cumulative world production, with import and export tables from various official sources. The second section is a convenient synopsis of noteworthy mineral collections, specifying some of the more exceptional specimens and fashioned objects of the jeweler's craft. Chapter 3 summarizes the geological formation and occurrence of

primary world gem deposits. Country by country, production statistics are stated, sometimes taking into account illegal mining and trading operations. Some of the more complex threads of the trade are stressed, emphasizing economic aspects.

The fourth and final chapter outlines original research by the author in the field of gemology: research on solid inclusions in gemstones by means of the electron microprobe and the micro-reflectometer; and research on X-ray topography for natural versus synthetic separation. Included in this section are photomicrographs of explicit detail, which accompany and support all research. The work on X-ray topography employs the Lang method, Schubnel was particularly interested in the difference between the crystallization of natural minerals from synthetics. Not only can the Lang method separate naturals from synthetics but can also reveal the exact manufacturing process as well.

The outstanding feature of this particular work is its current and up-to-date research. A number of facts contained herein cannot be found elsewhere. The GIA recommends *PIERRES PRECIEUSES DANS LE MONDE* highly.

S.K.

SYNTHETIC GEM AND ALLIED CRYSTAL MANUFACTURE by Daniel MacInnes. Published by Noyes Data Corporation, Park Ridge, New Jersey, 1973. 220 pages. Clothbound. Price: Request from publisher.

Just as the alchemist pursued the key to the mystery of gold, so has man long attempted to synthesize gemstones. True synthetics, by their very nature, duplicate the physical and optical properties of their natural counterparts. Thus, a simple glass imitation or substitute was not thought suitable to duplicate the beauty, rarity, durability and value of natural stones. Since the late 19th century this dream has become a reality and at the present time synthetic minerals provide not only a means of adornment, but have found a permanent place in fields of audio, optics, laser, space, and many other industries.

The entire subject of crystal synthesis has changed from one of speculation to an area of intensive research. Mr. MacInnes—in

SYNTHETIC GEM AND ALLIED CRYSTAL MANUFACTURE presents a discussion of those synthetics used primarily as gemstones.

A major portion of this work is devoted to the history and eventual success of the General Electric Company in diamond synthesis as well as subsequent developments by other companies worldwide. All diamond substitutes are dealt with on an individual basis, from the early rutiles and titanates to the more recent rare earth garnets (YAG and yttrium-iron garnet) and lithium niobate. Corundum is also covered in its transparent and asteriated varieties. A miscellaneous section includes additional synthetics such as beryl, quartz, opal and lapiz-lazuli.

Each chapter outlines all processes used to manufacture a specific synthetic. Numbered line drawings accompany the discussion and correspond clearly with the text. Chemical data also appear, along with temperature specification, seed crystal orientation and rate of growth. A helpful section following the main body lists companies, inventors and patent numbers for all subjects.

The technical possibilities in this field are too numerous to describe, and development will surely be a matter of course. Mr. MacInnes has prepared this book devoid of any extraneous material, intending it not for a general audience. A work of this nature, however, is invaluable and long overdue for those individuals who wish to become familiar with synthesis techniques and terminology.

SYNTHETIC GEM AND ALLIED CRYSTAL MANUFACTURE fills the void between the mere idea and the actual creation of gemstone synthetics.

S.K.

FROM THE WORLD OF GEMSTONES, by Professor Dr. Hermann Bank. Published by Pinguin-Verlag, Innsbruck • Umschau-Verlag, Frankfurt am Main, 1973, 178 pages. Clothbound. Illustrated with 60 full-color photographs plus line drawings. Price: To be announced.

This beautiful new book, printed in Austria and published in West Germany, was received in Los Angeles a short time ago. It

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has perhaps as lovely a set of color plates as we have encountered in a book on gemstones—with the possible exception of *Gemmologia* by Mme. Cavenago-Bignami Moneta, published in Italy.

Since Professor Bank is a very notable colored-stone dealer in Idar-Oberstein (West Germany), in addition to being a former professor of mineralogy at the University of Mainz, one could expect that the text of the book would be of the same high quality as the color plates. This is true—it is very interesting and well-written.

Unfortunately, we do not know the price as yet. It is 178 pages, mostly printed on uncoated paper, but over 60 of the 178 pages are magnificent color plates. Since there are many other pages of line drawings, it does not leave a tremendous amount of room for text. Fortunately, that text is very well-written and worthwhile to a gemologist. We consider it a valuable book and a welcome addition to the gemological libraries of the world.

●

GEMSTONES, by G.F. Herbert Smith. Revised by F. Coles Phillips. 14th Edition. Published by Pitman Publishing Corporation, New York, 1972. 580 pages. 35 plates. Clothbound. Price: \$24.50

First published in 1912, this classic work of G.F. Herbert Smith has been completely revised, with an expansion of the text and specially photographed plates. *GEMSTONES*, by the late president of the Gemmological Association of Great Britain, has long been considered a "bible" of gemological basics, as is evidenced throughout the book. The sections explaining fundamental physical characteristics, including crystal structure, system, and habit can and will always exist as the foundation for any

reader new to the field. Technical clarity is in no way absent for the additional features of refraction indices, double refraction, absorption-spectra optics and specific gravity. In short, the *GEMSTONES* as written by G.F. Herbert Smith and revised by F. Coles Phillips, is a timeless compilation of gemological knowledge.

This present volume delves into instrument advancements and recent synthetics while often expanding the bibliography to include new recent literature pertaining to the field. The illustrations and color photographs replace the previous water color drawings, adding unquestionably to the saleability of the book.

Newly discovered varieties of natural gemstones covered include blue zoisite and transparent green grossularite garnet, and the section on the origin of diamond has been rewritten. In view of the rapid change in the field of synthetics, any writer runs the risk of being out of date by the time any revisions go to press. Notably lacking in the chapter on synthetics are the iron-rich type of Gilson synthetic emerald, additional rare-earth synthetic garnets other than YAG, synthetic opal, and synthetic turquoise. The section on synthetic quartz mentions that gem use of this material is doubtful—a statement that has since been proven erroneous, based on the large scale use that the material has found in the commercial gem market.

As far as instrument advancement is concerned, the Smith refractometer marketed in 1907 is discussed side by side with the newest model of the Rayner refractometer. Similar instruments can be noted through this section, thereby providing historical background data with truly current developments.

GEMSTONES has provided a foundation for many gemologists for countless years and will continue to do so. Any points of omission in the recent volume are minute when considering the overall value of the work. *GEMSTONES* is an invaluable book.

S.K.

● ● ●

The Derivation of Gem Names

by L.L. Copeland

[Editor's Note: It was not until the first section of the Copeland article appeared that the absence of an entry for "diamond" was noted.

The term is derived from the Greek *adamas*. The common form in Latin became *adiamentem*, from which *diamond* was a natural development.]

keystonite (chrysocolla quartz). After the Keystone Copper Mine, Gila Co., Arizona, a source of the variety.

kochenite (a fossil resin). After its occurrence at Kochenthal, Tyrol.

kornerupine. In honor of Danish geologist A.N. Kornerup, after its discovery in Greenland in the mid-19th century.

kunzite (a variety of spodumene). After George Frederick Kunz (1856-1932), American mineralogist and gem expert.

kyanite. From the Greek *kyanos*, meaning *dark blue*, since that is its usual hue.



labradorite (a species of the feldspar group). After the country of Labrador, where it was first found by Moravian missionaries in the 18th century; at that time it was called *labrador stone* or *labrador spar*.

lapis-lazuli. From the Latin *lapis* (stone) and *lazuli* (blue); actually, *lazulus stone*. These words were derived from the ancient Persian *lazhuward* and the Arabic *lazaward*, both of which meant *blue*, the color of the gem.

laurelite (a variety of idocrase). After its occurrence at Laurel, Argenteuil, Quebec.

lazulite. From the Late Latin *lazurius*, which, in turn, was adopted from the Arabic word *azul*, meaning *heaven, sky* or anything blue.

lechosos opal. From the Spanish *leche*, meaning *milk*, in allusion to its white background color (with green play of color).

lepidolite. From the Greek *lepidos*, meaning *scale*, because of the scaly aggregates of much lepidolite.

leucite. From the Greek *leukos*, meaning *white*, because of the color of the crystals.

lucinite (variscite). After its occurrence near Lucin, Box Elder Co., Utah.



macle (chiastolite). Through the French from the Latin *macula*, meaning *spot* or *blemish*, because of the crosslike patterns of carbonaceous inclusions in crystals cut crosswise.

malachite. From the Greek *malache*, meaning *mallow*, because its color is similar to the leaf of this plant.

malacolite (a variety of diopside). From the Greek *malakos*, meaning *soft*, because it is softer than feldspar, with which it is associated.

marcasite. From the Late Latin *marcasita*, although its origin, thought to be Arabic, is uncertain.

- marialite** (a member of the scapolite group). After Marie Rose, wife of G. von Rath, a German mineralogist.
- meerschaum** (sepiolite). From the Greek *meer* and *schaum*, meaning *seafoam*, because of its light weight and porosity.
- meionite** (a member of the scapolite group). From the Greek *meion*, meaning *smaller*, in allusion to the small pyramids of the crystals.
- melanite** (a variety of andradite garnet). From the Greek *melas*, meaning *black*, in allusion to the variety's color.
- menilite** (common opal). After Menilmontant, France, where it has been found.
- microcline** (a species of the feldspar group). From the Greek *mikron* and *klinein*, meaning *small* and *to incline*, because the cleavage planes are mutually inclined at an angle that differs slightly from a right angle.
- microlite**. From the Greek *mikron*, meaning *small*, because of the very small size of the crystals.
- mocha stone** (a variety of chalcedony). After Mokha, a port on the Arabian coast of the Red Sea.
- moldavite** (a member of the tektite group). After the Moldau River, Czechoslovakia, where it was first found in 1787.
- morganite** (a variety of beryl). After J. Pierpont Morgan, the famous American financier, in recognition of his contribution to mineralogy and gemology in presenting his unrivaled gem collection to the American Museum of Natural History.
- morion** (smoky quartz). From the old Roman word for this variety, *mormorion*.
- myrickite** (quartz or opal with cinnabar). After an early and prominent Nevada prospector, "Shady" Myrick.



- natrolite**. From the French *natron*, meaning *soda*, in allusion to its sodium content.
- nephrite**. Lapis nephriticus was the Latin translation of the early Spanish *pedra de los rinones* (stone of the kidneys), *nephros* being the Greek word for kidney. It was believed that the stone would cure ailments of this organ if worn next to the skin. Eventually (1739), *nephriticus* was shortened to the present spelling of the word.
- noselite** (a member of the sodalite group). After a K.W. Nose, German geologist.
- novaculite**. From the Latin *novacula*, meaning a *sharp knife*, in allusion to the material's use as a whetstone.



- obsidian**. The Romans called this natural glass *obsianus*, since it had the same appearance as a stone discovered in Ethiopia by a citizen of Rome named Obsius. In all of the early editions of Pliny's *Natural History* the name appeared as *obsidianus*, and eventually it was shortened to its present spelling.
- odontolite** (fossil bone or tooth). From the Greek *odonto*, meaning *tooth*, and *lite*, meaning *stone*.
- oligoclase** (a species of the feldspar group). From the Greek *oligos* and *klasein*, meaning *little cleavage*, because it was thought to have less perfect cleavage than albite.

oneginite (sagenitic quartz). After Lake Onega, north of Leningrad, USSR, a source of the material.

onyx (a variety of chalcedony). Through the Latin from the Greek *onyx*, meaning, in the mineralogical sense, *a veined gem*.

oolitic agate. From the Greek *oion* (an egg) and *lite* (rock), in allusion to its rounded grainlike structure.

opal. Through the Latin *opalus* from the Greek *oplios*, which itself comes from the Sanskrit *upala*, meaning *precious stone*.

orthoclase (a species of the feldspar group). From the Greek *orthos*, meaning *at right angles*, and *klasis*, meaning *fracture*, in allusion to its right-angle cleavage.



padparadscha (a variety of corundum). After the Singhalese word for *lotus flower*, an allusion to the color of the variety.

painite. After A.C.D. Pain, a British gemologist, who discovered the mineral in 1957 in Upper Burma.

paulite (a variety of hypersthene). After its occurrence on the Island of St. Paul, off the coast of Labrador.

pectolite. From the Greek *pektos*, meaning *compacted*, because of the compact masses in which it usually occurs.

pelhamine (a variety of serpentine). After Pelham, Massachusetts, where it is found.

periclase. From the Greek *peri* and *klan*, meaning *to break around*, in allusion to its one direction of perfect cleavage.

peridot. From the French *péridot*, from the Old French *peritot*. The origin of the word, however, is uncertain.

peristerite (a variety of albite feldspar). From the Greek *peristera*, meaning *pigeon*, in allusion to its colors.

petalite. From the Greek *petalon*, meaning *leaf*, because of the foliated, cleavable masses in which it usually occurs.

petoskey stone (coral replaced by calcite). After Petoskey, Antrim Co., Michigan, one of its sources.

phenakite. From the Greek *phenakos*, meaning *deceiver*, because it is so similar in appearance to quartz.

phosphophyllite. From the Greek *phyllon* (leaf) and *lite* (mineral), in allusion to the common crystal color.

picotite (a variety of spinel). After a Picot de la Peyrouse, a French botanist.

picrolite (a variety of serpentine). From the Greek *pikro*, meaning *bitter*, in allusion to the mineral's magnesium content.

piedmontite (a variety of epidote). After Piedmont, Italy, where it is found.

pistacite (a variety of epidote). From the German *pistazit*, meaning *pistachio*, in allusion to the color of this nut.

plagioclase (a series of feldspar minerals). From the Greek *plagios* (oblique) and *klasis* (a breaking), because its cleavage angle is very close to 90°.

pleonast (a variety of spinel). From the Greek *pleonastos*, meaning *abundant*, in allusion to the additional faces that replace the solid angles of the octahedron.

pollucite. The mineral was originally called *pollux* and another mineral, now called petalite, was named *castor*, because they were always thought to occur together in lithium-rich pegmatites, just as the twin brothers of Greek mythology, Pollux and Castor, were inseparable.

prase (a variety of chalcedony). From the Greek *prasios*, meaning *leek green*, in allusion to the color of the variety.

prehnite. After Dutch Colonel von Prehn, who discovered it in 1774.

proustite. After the French chemist J.L. Proust (1754-1826).

pseudophite (a mineral of the chlorite group). From the Greek words meaning *false* and *like a serpent*, because of its resemblance to serpentine.

psilomelane chalcedony. From the Greek *pslio* (bare) and *melas* (black), because psilomelane itself occurs in smooth, botryoidal, massive or stalactitic forms.

pyrite. From the Greek *pyrites lithos*, meaning *stone that strikes fire*, because of its ability to emit sparks when struck by steel.

pyrope (a species of the garnet group). From the Greek word meaning *fiery eyed* or *firelike*, in allusion to its deep-red color.

pyrophyllite. From the Greek *pyro* (fire) and *phyllon* (leaf), because the application of heat will cause it to exfoliate (cast off flakes or scales).

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quartz. An old German mining term that has been in general use in all languages since the 16th century.

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rashleighite. After Philip Rashleigh (1729-1811), a mineralogist of Cornwall, England, where the mineral was discovered in 1948.

retinalite. (a variety of serpentine). From the Greek *rhetine* (resin) and *lite* (rock), in allusion to its waxy or resinous luster.

rhodochrosite. From the Greek *rhodo*, meaning *rose* and *chrosis*, meaning *a coloring*, in allusion to its usual rose-red hue.

rhodolite. (a species of the garnet group). From the Greek *rhodo*, meaning *rose*, and *lite*, meaning *stone*, in allusion to its color.

rhodonite. From the Greek *rhodozein*, meaning *to be like a rose*, because when a piece of the mineral is subjected to the flame of the blowpipe, a red color is imparted to the flame.

rock crystal (quartz). From the Greek *krystallos*, meaning *clear ice*, for the Greeks believed that the mineral was ice in permanent, solidified form.

rogueite (jasper). After Oregon's Rogue River, where it is found.

rubellite (tourmaline). From the Latin *rubellus*, meaning *red* or *reddish*, in allusion to its color.

ruby (a variety of corundum). From the Latin *ruber*, meaning *red* in allusion to its color.

rutile. From the Latin *rutilus*, meaning *red*, referring to the color sometimes displayed.

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sagenite (quartz). From the Latin *sagena*, meaning *large net*, in allusion to the inclusions of needlelike crystals.

samarskite. After a Colonel Samarski, a Russian mining official.

sanidine (a variety of orthoclase feldspar). From the Greek *sanis,-ides*, meaning a *board*, in allusion to the tabular crystals commonly assumed by the orthoclase species.

sapphire (a variety of corundum). From the Greek *sappheiros*, meaning *blue*, in allusion to the color often assumed by this variety.

sard (a variety of chalcedony). Through the Latin from the Greek *Sardis*, which was the capitol of Lydia in Asia Minor.

saussurite. After H.B. Sasseur (1740-1799), the Swiss naturalist.

scapolite. From the Greek *skapos*, meaning *shaft*, in allusion to its prismatic crystals.

scheelite. After Karl Wilhelm Scheele (1742-1786), the Swedish chemist.

schorl (a variety of tourmaline). From an old German mining term of the same spelling, which was formerly applied to a number of dark-colored minerals.

scorodite. From the Greek *scorodon*, meaning *garlic*, in allusion to its odor under the blowpipe.

scorzalite. After an E.P. Scorza, a Brazilian mineralogist.

selenite (variety of gypsum). From the Latin form of the Greek *selene* and *lithos*, meaning *moonstone*, because the cleavage planes of crystals often have a pearly, moonstonelike luster.

sepiolite (the mineralogical name for meerschaum). From the Greek *sepia*, meaning *cuttlefish*, because the bones of this fish are similarly light and porous.

serendibite. From the ancient Sanskrit *Sinhala* (Ceylon), where it is found.

serpentine. From the resemblance of the green-and-white mottled or veined type to the skin of some snakes.

shattuckite. After the Shattuck Copper Co., Cochise Co., Arizona, the principal source.

siberite (a variety of tourmaline). After the country of Siberia, where it has been found.

sillimanite. After Benjamin Silliman (1779-1864), one-time professor at Yale University.

simponite. After Dr. E.S. Simpson (1875-1939), former mineralogist of Western Australia, where it was first found.

sinhalite. From the ancient Sanskrit word *Sinhala* (Ceylon), one of its sources.

skutterudite. After Skutterud, Norway, one of its sources.

smaltite. The word *smalt*, referring to a blue pigment made from the powdered mineral, is derived from the Italian *smalto*.

smaragdite. From the Latin *smaragdus*, meaning *emerald*, in allusion to its color.

smithsonite. After James Smithson (1754-1829), founder of the Smithsonian Institution, Washington, D.C.

sodalite. In allusion to its sodium content.

spessartite (a species of the garnet group). From Spessart, Bavaria, where it has been found.

sphalerite. From the Greek *sphaleros*, meaning *treacherous*, because of its similarity to more easily smelted ores.

sphene. From the Greek *sphen*, meaning *wedge*, because of the flattened, wedge-shaped orthorhombic crystals in which it occurs.

- spinel.** Origin uncertain. Perhaps from the Latin *spina*, meaning *thorn*, in allusion to its sharply pointed crystals; or from the Greek meaning *spark*, in allusion to the red or orange color of some crystals.
- spodumene.** From the Greek *spodumenos*, meaning *burnt to ashes*, in allusion to the ashy color of the crude, nongem crystals when the gem was first known.
- staurolite.** From the Greek *stauros*, meaning *cross* in allusion to the interpenetrating twin crystals in the form of a 90- or 60° cross.
- steatite.** Through the Latin from the Greek *steatos*, meaning *tallow*, in allusion to its greasy or soapy feel.
- stibiotantalite.** In allusion to the antimony (Latin *stibium*) and tantalum in its composition.
- stichtite.** After Robert Sticht, a Tasmanian mining engineer.
- stilbite.** From the Greek *stilbein*, meaning *to glitter*, in allusion to its pearly luster on cleavage surfaces.
- succinite** (amber). From the original Latin word for amber, *succinum*, which itself was taken from the word meaning *juice*.
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- taaffeite.** After Count Taaffe, an Irish gemologist, who first described it in 1945.
- tachylyte.** From the Greek *tachy* (quick) and *lyein* (to dissolve), because the mineral is decomposed by acids and is readily fusible.
- talc.** A French adaptation of the Old Latin *talcum*, which, in turn, came from the Arabic *talq*.
- tecali** (onyx marble). After Tecali, Puebla, Mexico, one of its principal sources.
- tektite.** From the Greek *tektos*, meaning *molten*, in allusion to its supposed meteoric origin.
- thaumasite.** From the Greek *thaumazein*, meaning *to wonder*, because of its complicated chemical composition.
- thomsonite.** After a Thomas Thomson, a Scottish chemist.
- thulite** (a variety of zoisite). After Thule, the ancient name of Norway.
- topaz.** Derivation uncertain. From *Topazios*, an island in the Red Sea (meaning *to guess*), because it was often obscured by fog and difficult to find. Another theory holds that the name is derivative of the Sanskrit word *topas*, meaning *fire*.
- topazolite** (a variety of andradite garnet). In allusion to its resemblance to topaz.
- tourmaline.** From the ancient Singhalese *turmali*, meaning *mixed precious stones*.
- travertine** (massive calcite). Through the Italian *travertino* from the Latin *Tiburtinis* (from Tibur, an ancient city of Latium, now Tivoli).
- tremolite** (a member of the amphibole group). From Tremola, a valley in the Alps, where it was discovered.
- triphane** (spodumene). From the Greek meaning *appearing threefold*, named by Haüy, the French mineralogist (1743-1822), in allusion to his idea that the crystals are divided by three planes with nearly equal ease.
- turquoise.** First used in the 13th century, the name is thought to have come from the French *Pierre turquoise*, meaning *Turkish stone*, probably because the gemstone first reached Europe by way of Turkey. The Persian word for turquoise is *ferozah*, which means *victorious*.

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ulexite. After the German chemist George Ludwig Ulex (1811-1883).
unakite (a rock composed of epidote and feldspar). From the Unaka Mts. (the Great Smokies), on the border of North Carolina and Tennessee.
uvarovite (a species of the garnet group). After a Russian Count, S.S. Uvarov (1786-1855), who was president of the St. Petersburg Academy and an ardent amateur mineral collector.

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variscite. After Variscia, the ancient name for the Voigtland district of Germany, where the mineral was first found.
vermeil. From the Old French *vermilion*, meaning *red*, usually applied to garnet but also to spinel or zircon.
vesuvianite (idocrase). After Mt. Vesuvius, Italy, where the mineral is found.
viluite (a variety of vesuvianite). After the Vilui River, Yakutsk, Siberia, where it is found.
violane (a variety of diopside). From the violet-blue color of the variety.
viridine (a variety of andalusite). From the Latin *viridis*, meaning *green*, in allusion to its color.
vivianite. After a J.G. Vivian, an English mineralogist.

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wagnerite. After F.M. von Wagner (1768-1851), a German mining engineer.
wardite. After H.A. Ward (1834-1906), an American mineralogist.
wernerite (a member of the scapolite group). After A.G. Werner (1750-1817), the eminent German geologist.
whewellite. After William Whewell (1794-1866), English mineralogist and philosopher.
willemite. After William I, King of the Netherlands, in 1830.
withamite (a variety of epidote). After a Henry Witham of Glencoe, Scotland, where it is found.
witherite. After W. Withering (1741-1799), an English mineralogist.
wollastonite. After W.H. Wollaston (1766-1828), an English chemist and physicist.
wulfenite. After Franz Wulfen (1728-1805), an Austrian mineralogist.

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