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FALL 1968

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The Serpentine Mineral Group

by

H. Lawrence McKague
Assistant Professor
Department of Geology
Rutgers University

(Editor's note: Each year for at least the past five, we have encountered more serpentine in our laboratories for testing. Professor McKague, formerly on the GIA staff, where he has encountered many serpentine carvings, has studied this interesting mineral group for a number of years. His findings are therefore of particular interest to gemologists.)

Serpentine is the most common jade substitute. Although the name serpentine, as used in gemology, implies a single mineral, it is actually the name of a mineral group. The serpentine group consists of three minerals: antigorite, lizardite and chrysotile. Because of their nearly identical chemical composition $(\text{Fe, Mg})_3\text{Al, Si})_2\text{O}_5(\text{OH}_4)$, they have similar physical properties (Table I). This classification of serpentine-group minerals was proposed by Whittaker and Zussman (1956), and is based on X-ray diffraction and electron-microscope studies. The term *serpentinite* is applied to a rock consisting primarily of serpentine-group minerals.

Before the advent of X-ray crystal analysis, a number of varieties of serpentine were proposed. Faust and Fahey

(1962) list 29 names that were applied or thought to apply to serpentine-group minerals. Johannsen (1928) lists three additional varieties. Some of the more common varietal names, along with a description, are given in Table II. Most of the varieties have been shown to be: (1) nonserpentine minerals, (2) mixtures of the three recognized serpentine-group minerals, or (3) slight variations in texture or color of the recognized minerals.

The serpentine-group minerals have a sheetlike structure (Fig. 1). Each sheet consists of a layer of SiO_4 tetrahedra and a second layer of $\text{Mg}(\text{OH})_2$ octahedra (Fig. 1). For serpentine of stoichiometric composition $(\text{Mg}_3\text{Si}_2\text{O}_5(\text{OH})_4)$, the octahedral layer is larger than the tetrahedral layer (Fig. 2). Corresponding dimensions are $a = 5.3 \text{ \AA}$, $b = 9.2 \text{ \AA}$ for the octahedral layer and $a = 5.0 \text{ \AA}$, $b = 8.7 \text{ \AA}$ for the tetrahedral layer (Deer, Howie, and Zussman, 1962). These differences in size of the two layers cause strain to develop in the serpentine structure. This strain can be relieved in three different ways: (1) curvature of the sheets into tubes with the smaller tetrahedral layer on the

inside of the tube (*Fig. 3*), (2) limit the development of the crystals to an extremely small size, and (3) by slight changes in the chemical composition, so that the two layers become more nearly equal in size. The easing of the strain by these various methods results in the different minerals of the serpentine group.

When the strain is relieved by rolling the sheets into hollow tubes, chrysotile results (*Fig. 3*). The tubular structure is suggested by the fibrous habit of chrysotile. Individual tubes have an average outer diameter of 340 Å and an average inner diameter of 80 Å (Huggins and Shell, 1965).

When the strain between the layers is not relieved, as the crystal grows, a point is reached where the accumulated strain becomes so great that it inhibits further crystal growth (Deer, Howie, and Zussman, 1962). Very fine-grained platy lizardite is the result. Crystals of lizardite average about 750 Å in diameter (Deer, Howie, and Zussman, 1962).

The substitution of larger ions for Si^{+4} in the tetrahedral layer (Al^{+3} , for example), and/or smaller ions for Mg^{++} in the octahedral layer (such as Fe^{+3}) does not permit the strain to develop. Such substitutions may require a second substitution, to maintain electrical neutrality within the crystal. These substitutions cause a better fit of the octahedral and tetrahedral layers. The result of such substitutions is antigorite, which forms much larger crystals than either chrysotile or lizardite (*Fig. 4*). The varieties of serpentine minerals used for gem and ornamental purposes (i.e., bowenite, williamsite and yu-yen-

stone), consist chiefly of antigorite (Faust and Fahey, 1962). The large crystal size is an important factor in contributing to the desirability of antigorite. In addition, serpentinites consisting of chrysotile and lizardite are brittle and only about one-fourth as strong as serpentinites consisting of antigorite (Robertson, 1964).

Serpentinites have two rather distinctive origins. One group originates from the alteration of igneous rock, consisting of ferromagnesium (Fe- and Mg-bearing) minerals. The second group results from the alteration of carbonate sedimentary rocks; i.e., Mg-rich limestones and dolomites. Serpentinites of these two groups correspond to the Class A and Class B serpentinites, respectively, of Faust, Murata and Fahey (1956).

The relative abundance of Class A and Class B serpentinites has never been established. Certainly, more research has been done on the Class A serpentinites.

Most Class A serpentinites originate from igneous rocks that were originally composed of olivine, with lesser amounts of pyroxene and accessory amounts (less than 1%) of chromite and magnetite. The ultimate origin of such rocks is still in doubt. However, at temperatures below 500° C., the olivine and pyroxene react with any water vapor that is present to form serpentine minerals. The first serpentine-group mineral to form is chrysotile, mixed with some lizardite (*Fig. 5*). Accompanying the formation of chrysotile and lizardite is the development of finely disseminated magnetite. The combination of the fine-grained chrysotile and

lizardite with the fine-grained opaque magnetite results in a brittle, opaque, unattractive, greenish-black serpentinite. In some serpentinites this is the final stage of serpentinization. In others antigorite develops, commonly in close relation to shear zones within the rocks or near podiform chromite lenses. These locations may represent either zones along with moved solutions carrying the chemical components necessary for the transformation of chrysotile and lizardite to antigorite, or they may represent zones of increased pressure, the increased pressure effecting the transformation. They may represent some combination of the two. In these areas, the early-formed serpentine minerals may be completely replaced by antigorite (*Fig. 6*). Complete transition from serpentinite composed chiefly of chrysotile and lizardite to serpentinites composed almost completely of antigorite can be found. As the antigorite content increases the magnetite content decreases. The magnetite that remains becomes concentrated into a few large scattered grains. Possibly, some of the Fe aids in the formation of the antigorite structure. The development of antigorite and the concomitant decrease in the number of magnetite grains results in a serpentinite that is often dark green and semitransparent, but may become a transparent, rich, medium green (williamsite). The green color may be the result of the presence of iron.

Considerably less research has been done on Class B serpentinites. The alteration of carbonate sedimentary rocks to serpentinites is identical to that that has formed talc deposits in many areas, the development of talc being one ad-

ditional step beyond the development of serpentine minerals. Engel and Wright (1960) describe many talc deposits originating in carbonate sedimentary rocks. They point out that silica (SiO_2), magnesia (MgO) and water would have to be added. The amount required would depend upon the initial composition of the carbonate. Thus, a dolomite with numerous chert layers would require the addition of lesser amounts of silica and magnesia than would a pure limestone. The water-rich solutions containing silica and magnesia could be derived from igneous or metamorphic sources or recirculated groundwater (Engel and Wright, 1960). These same general conditions would be necessary for the conversion of carbonate rocks to serpentinites. Most Class B serpentinites are yellow-green. Again, those varieties that have been used for gem and ornamental purposes (bowenite, yu-yen stone) consist chiefly of antigorite (Faust and Fahey, 1962).

In summary, regardless of the origin, only those serpentinites that consist chiefly of antigorite have the requisite durability and beauty for gem purposes. Such rocks consist of relatively large antigorite crystals, with only a few scattered, opaque magnetite grains or other accessory minerals. Those serpentinites originating from the alteration of igneous rocks have a medium- to dark-green color. This is probably a result of their higher iron content (Faust and Fahey, 1962, *Table 7*). Class B serpentinites have a yellow-green color, possibly reflecting their lower iron content.

The author would like to thank Dr. Thomas F. Bates and the Mineral Con-

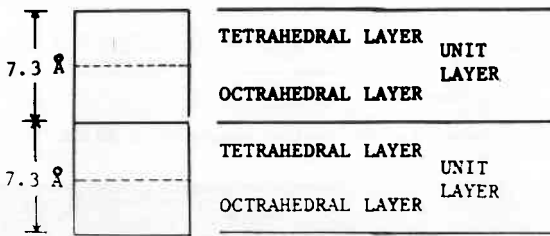


Figure 1

Stacking of SiO_4 tetrahedral layer and $\text{Mg}(\text{OH})_2$ octahedral layer to form a unit layer of serpentine-group minerals. Two unit layers are shown.

Figure 2

Showing the amount of mismatch between the two layers. The matching of the four corners produces strain within the serpentine mineral-group structure.

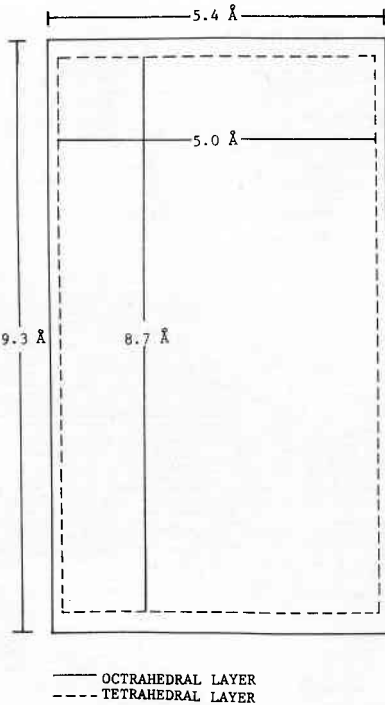


Figure 3

The tubular nature of chrysotile fibers. The light area down the center of the tube (at arrow) indicates its hollow nature. X 47,600.

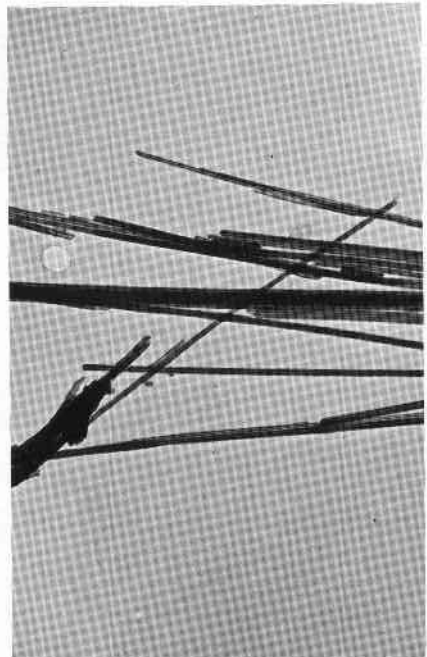


Figure 4

The platy nature of antigorite is apparent in this electron micrograph. X 30,800.

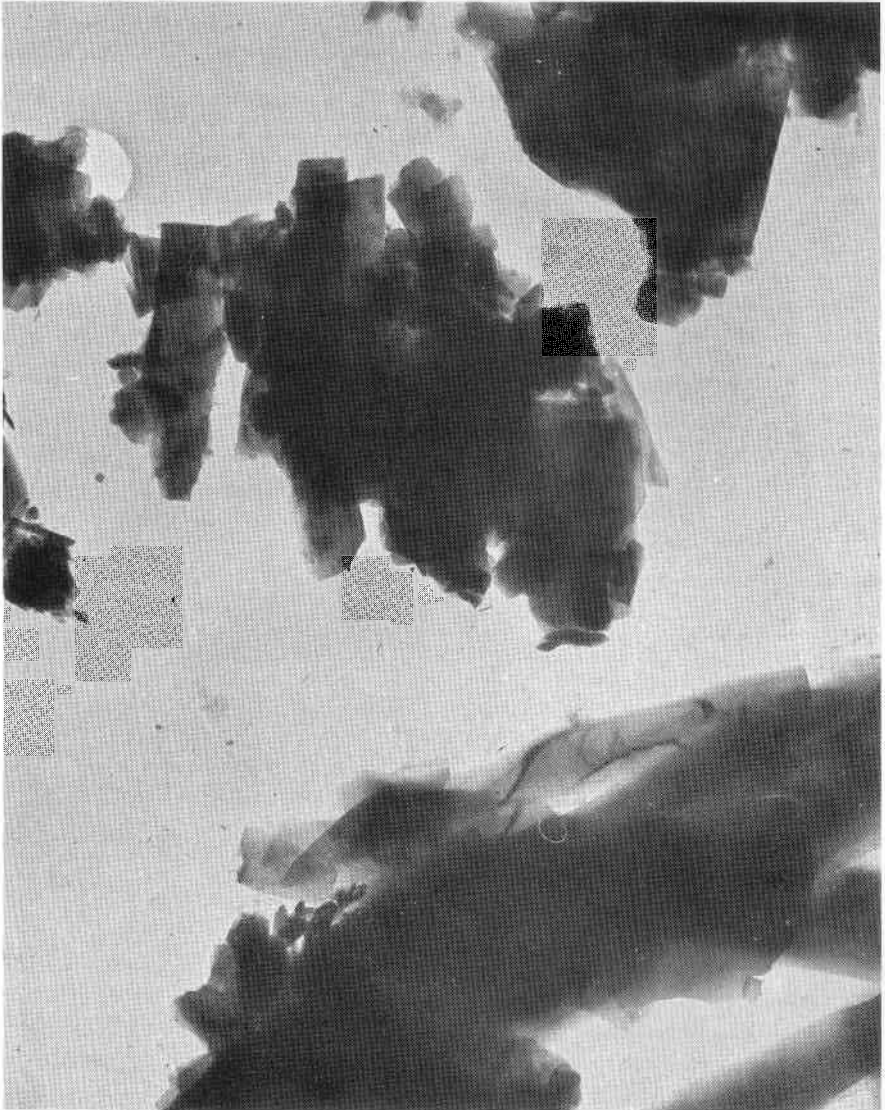


Table I. Physical and optical properties of the serpentine-group minerals (after Deer, Howie, and Zussman, 1962).

<u>Index of Refraction</u>	<u>Chrysotile</u>	<u>Lizardite</u>	<u>Antigorite</u>
N _s	1.532-1.544	1.538-1.554	1.558-1.567
N _β	---	---	1.565
N _δ	1.545-1.556	1.546-1.560	1.562-1.574
Birefringence	0.013-0.024	0.008-0.022	0.004-0.016
Optic sign	Biaxial —	biaxial —	biaxial —
Density	≈2.55	2.55	2.6
Hardness	2½	2½	2½-3½

Table II. Description and mineralogy of some of the more common varieties of serpentine-group minerals.

<u>Name</u>	<u>Description</u>	<u>Mineralogy</u>
Bowenite.	A massive, fine-grained, greenish-white to apple-green variety. Hardness 5 to 6. (1).	Antigorite. (2).
Marmolite.	A thin foliated variety. (1).	Lizardite with some chrysotile. (2).
Picrolite (also Baltimorite).	A fibrous variety, which may be transparent in small pieces. (1)	Antigorite with lizardite. (2).
Retinalite.	A honey-yellow to light-green variety with a waxy or resinous luster. (1)	Chrysotile with some lizardite. (2).
Williamsite.	A translucent to transparent medium-green variety. (1)	Antigorite with a little chrysotile. (2).
Yu-Yen Stone.	A massive, pale greenish-gray translucent variety. (2).	Chiefly antigorite. (2).

(1) Johannsen, 1928

(2) Faust and Fahey, 1962

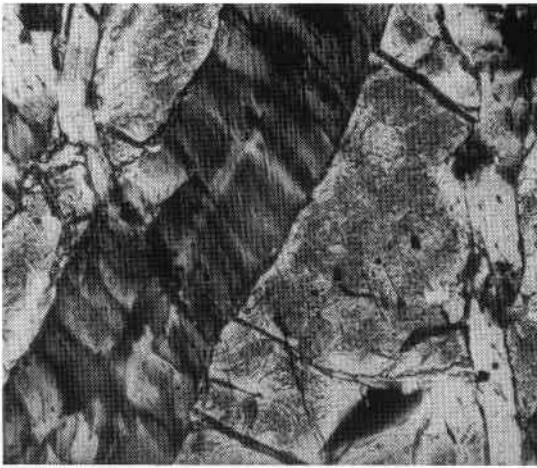


Figure 5

Chrysotile (C) replacing olivine (O) along a cleavage. Note small scattered grains of magnetite (M) in chrysotile. X 145.

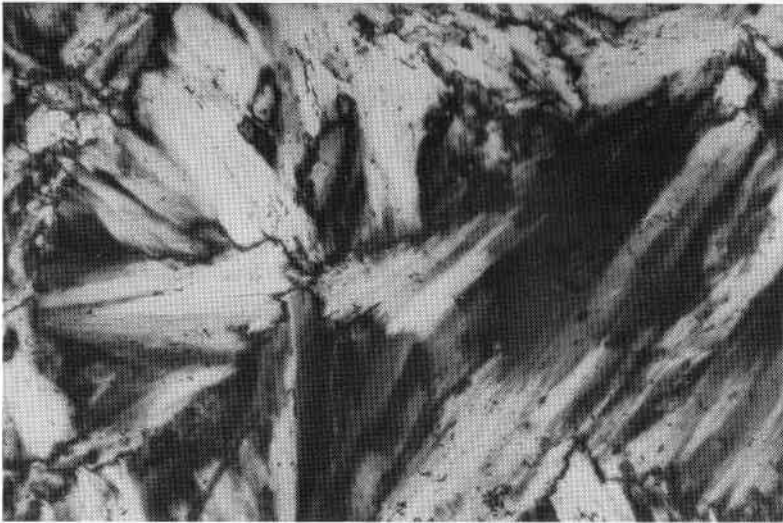


Figure 6

Large plates of antigorite typically found in most gem-quality serpentine. X 145.

stitution Laboratories of the Pennsylvania State University for supplying the electron photomicrographs used in *Figures 3 and 4*, and Dr. Thomas A. Vogel of Rutgers University for reviewing the manuscript.

(continued on page 356)

A Descriptive Catalog of the Drift Diamonds of the Great Lakes Region, North America

by

Christopher B. Gunn

(Continued)

No. 45. 1897. One stone, 6 carats. White. Octahedron, with markings. Found by two small daughters of a J. R. Taylor of Milford, Clermont County, in or near a kettle moraine. It passed to a Herman Keck of Cincinnati in 1899, and subsequently to the collection of The University of Cincinnati, who possessed it in 1961. Cut into a brilliant. Mentioned by Hobbs (1899); Sinkankas (1959); Vierthaler (1961a, 1961b).

NEW YORK

No. 46. 1905. One stone, possibly between 10 and 15 carats (estimate). Found while quarrying gravel in a pit on the south side of Syracuse. It was sold for \$1,700 at Springfield, Mass. Reported in the Syracuse Herald, December 24, 1905. Mentioned by Sinkankas (1959). Reported by Kunz (1905).

No. 47. 1909. One stone, no details. Found near Grass River, near Massena, St. Lawrence County. Men-

tioned only by Sinkankas (1959), and is open to doubt.

No. 48. 1920 or 1921. One stone, very small. Transparent, white. Found in a peridotite dike near Syracuse by a Frank Brainerd, a graduate student at Syracuse. Mentioned by Blank (1935); Sinkankas (1959). (This is not a drift diamond).

ONTARIO

No. 49. Undated (some time before 1929). One stone, 33 carats. Rough, broken, of little value as a gem.

Found while digging a railway cut between Ottawa and Toronto, apparently near Peterborough. It was sold to a jeweler who showed it to G. F. Kunz about 1920. Mentioned by Kunz (1931); Blank (1935).

Acknowledgment:

This work was carried out with the assistance of a Geological Survey of Canada grant. This support is most gratefully acknowledged.

DRIFT DIAMOND REFERENCES

- Bell, Robert, (1906). The Occurrence of Diamonds in the Drift of Some of the Northern States. *Jour. Can. Min. Inst.*, v. 9, pp. 124-127.
- Blank, E. W., (1935). Diamond Finds in the United States. *Rocks and Minerals*, v. 10, pp. 147-150, 163-166, 179-182. v. 11, pp. 7-10, 23-26, 39-40.
- Blatchley, W. S., (1902). Gold and Diamonds in Indiana. 27th Ann. Rept. of Ind. Dept. Geology and Nat. Res., pp. 11-47.
- Brown, R. T., (1883). Geology of Morgan Co. 13th Ann. Rept. Ind. Dept. Geology Nat. Hist., pt. 1, pp. 71-85 (1884).
- Cox, E. T., (1878). Eighth, Ninth and Tenth Annual Reports of the Geol. Survey of Indiana Made During the Years 1876-78. 542 pp., Indianapolis (1879).
- Gunn, C. B., (1967). The Origin of Diamonds in the Drift of the North Central United States. Discussion. *Jour. Geology*, v. 75, pp. 232-233.
- Hartwell, J. W., and Brett, B. A., (1958). In *Minerals Yearbook*, U.S. Dept. of the Interior, Bur. of Mines, Washington.
- Hobbs, W. H., (1894). On a Recent Diamond Find in Wisconsin and on the Probable Source of This and Other Wisconsin Diamonds. *Am. Geologist*, v. 14, p. 31.
- (1899). The Diamond Field of the Great Lakes. *Jour. Geology*, v. 7, pp. 375-388.
- Kunz, G. F., (1890). *Gems and Precious Stones of North America*. Scientific Publishing Co., New York.
- (1905). *Minerals Yearbook*, U.S. Dept. of the Interior, Bur. of Mines, Washington, D.C.
- (1931). Diamonds in North America (abstract). *Geol. Soc. America Bull.*, v. 42, pp. 221-222.
- Schwarcz, H. P., (1965). The Origin of Diamonds in the Drift of the North Central United States. *Jour. Geology*, v. 73, pp. 657-663.
- Sinkankas, John, (1959). *Gemstones of North America*. Van Nostrand Co., Inc., New York.
- Smith, C. H., (1950). Diamonds in the Great Lakes Area—a Geological Enigma. *Can. Min. Jour.*, v. 81, no. 7, pp. 52-53.
- Sterrett, D. V., (1911). *Minerals Yearbook*. U.S. Dept. of the Interior, Bur. of Mines, Washington, D.C.
- Vierthaler, A. A. (1961a). Wisconsin Diamonds. *Gems & Gemology*, v. 10, pp. 210-215.
- (1961b). There are Diamonds in Wisconsin. *Lapidary Jour.*, v. 15, pp. 18, 20, 22, 26.
- Wade, F. B., (1949). Another Rough Diamond Found in Indiana. *Gems & Gemology*, Winter 1949-50, pp. 249-50.

Developments and Highlights at the

Gem Trade Lab in New York

by

Robert Crowningshield

Convincing Turquoise Imitation

One of the most convincing imitation turquoise stones we have encountered is illustrated in *Figure 1*. The areas of matrix and natural-appearing cavities, combined with the fact that the stone "sweat" oil when a hot needle was brought close to it, all suggested a normal wax- or oil-treated turquoise. However, the refractive index varied from approximately 1.57 in one area to 1.60 in other areas. No absorption spectrum was noted, but the stone charred when touched with a hot needle. Magnification failed to disclose the usual mosaic pattern of compressed imitations, but a drop of clear hydrochloric acid became yellow when left on for several minutes. X-ray diffraction showed that no turquoise was present and that it was indeed a compressed imitation.

Pressed Glass

Another quite convincing imitation consisted of six intaglios in a bracelet that were pressed glass cemented to flat chalcedony backs. The carvings had been "sharpened" to appear carved instead of molded. The bracelet must

have been made in a time when carved stones were more appreciated than now.

Fingerprint in Grossularite

Figure 2 shows a fingerprint inclusion in a 4-carat pear-shape green grossularite garnet. The color of the stone was a yellow-green of medium intensity, somewhat like the green of chrysoberyl. No chrome lines were visible in the spectroscope; in fact, no distinct absorption spectrum was seen.

Bearded Girdle

Figure 3 illustrates the fact that a round diamond with a frosted girdle and no inclusions or blemishes may rate a flawless clarity classification, whereas light polishing of the girdle will expose the typical "bearding" resulting in a VVS classification.

Horn (?) Snuff Bottle

Occasionally, the Laboratories are asked to identify materials that are not quite what could be termed gem material. Snuff bottles are perhaps the best example. Frequently, these bottles are not identifiable by gem-testing methods or even with destructive mineralogical tests. However, they are challenging and we frequently spend more time

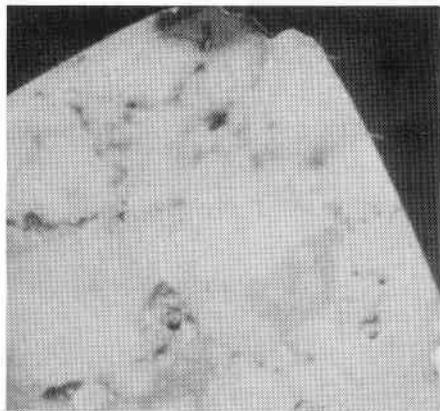


Figure 1



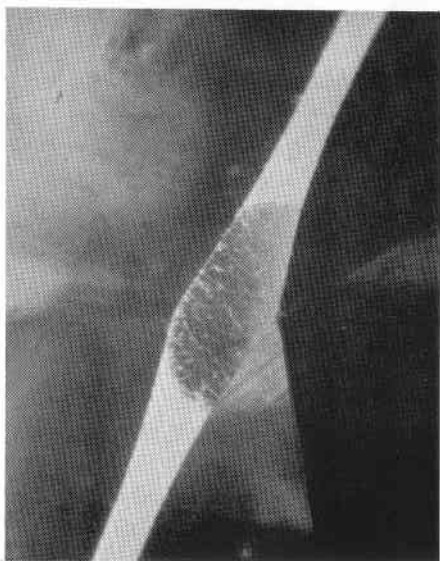
Figure 2

Red Inclusions in Rock Crystal

Figure 5 was taken because the inclusions in the rough piece of rock crystal were a brilliant red and resembled strands of seaweed or kelp. We once saw similar intense red inclusions in a carved amethyst.

Abraded Old-European Cut

Figure 6 shows very unusual abrasion of a 1.35-carat old-European-cut diamond worn for 40 years as an engagement stone.



than we can justify. Figure 4 is a close-up of a section of a beautifully carved snuff bottle that had the odor of burning hair when touched with an electric needle. We had to indicate in the identification report that it was probably horn and undoubtedly of organic origin.

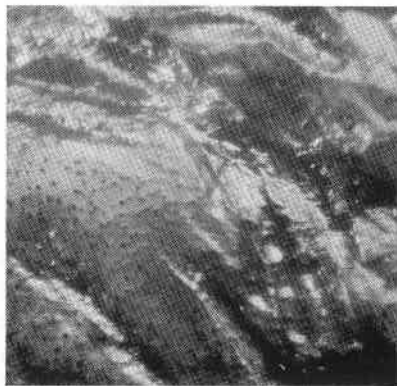


Figure 4

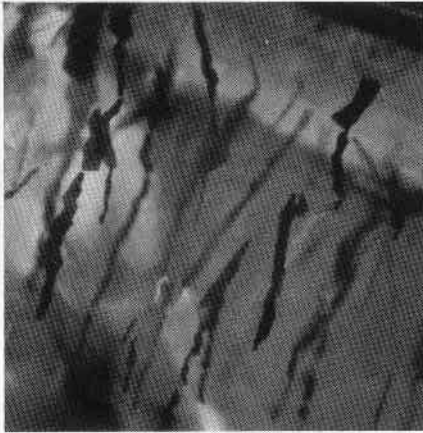


Figure 5

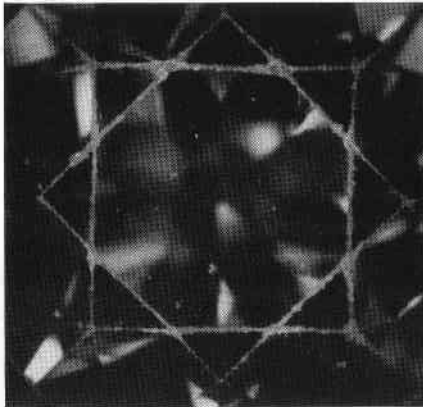


Figure 6

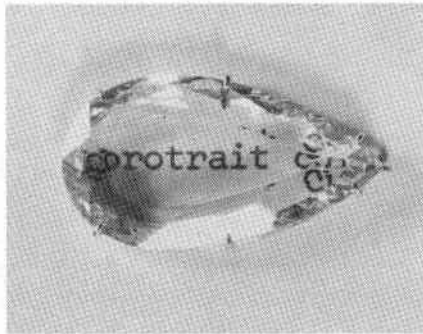


Figure 7

Portrait Diamond

A 20-carat pear-shape portrait-cut diamond we examined was so clear it transmitted the poor typing of your columnist who quickly mistyped the words "portrait cut" for *Figure 7*.

Synthetic-Emerald Inclusions

A 3-carat synthetic emerald, believed to be of French manufacture, had a specific gravity of 2.73; R. I., 1.565-1.570; very weak fluorescence in long-wave ultraviolet, with blade-shaped inclusions fluorescing yellow. Under magnification several odd inclusions were noted. *Figure 8* shows a 2-phase flux inclusion. *Figure 9* shows the blade-shaped flux inclusions and the layered color zoning of the stone. *Figure 10* is of the more familiar wispy veils one expects in flux-grown synthetics.

Tanzanite

The introduction of transparent blue zoisite under the name *Tanzanite* has caused quite a bit of comment. A few callers have wondered about the choice of name. We have stated that there is good precedent for naming minerals for a locale; e.g., the californite variety of idocrase, the amazonite variety of microcline, and labradorite. Honoring a new country by naming a beautiful new gem after the country seems to us to be both mineralogically sound and commercially acceptable. Before proposing the name, a check was made with the international nomenclature commission for minerals.

Inclusions in Zoisite

We have been very pleased to see several more large cut zoisites, one of more than 80 carats in weight. Most have been without inclusions, other than a minor fracture. In fact, few of



Figure 8

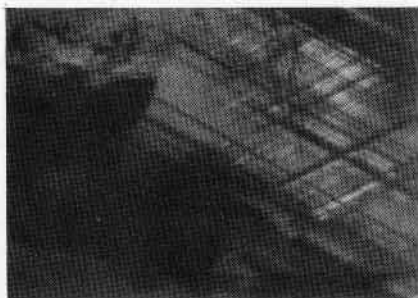


Figure 11

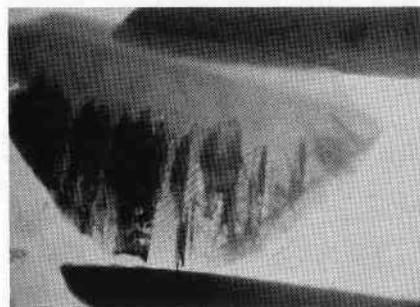


Figure 9

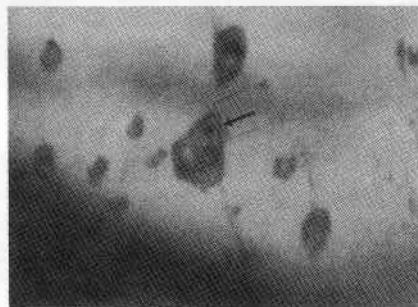


Figure 12

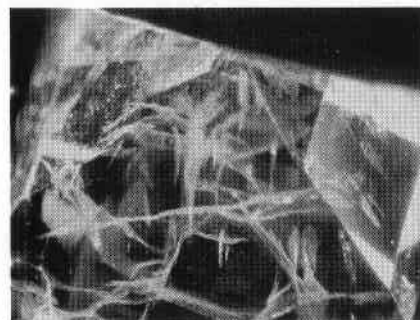


Figure 10

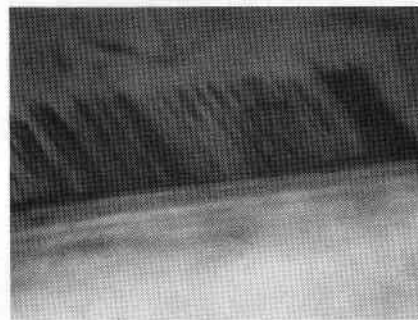


Figure 13

the rough pieces of cutting quality we have examined had inclusions specific enough to photograph. One piece in our collection does have intersecting needle-like inclusions, which are shown in *Figure 11*. Another specimen has num-

erous two-phase inclusions, with here and there what appears to be 3 phases. *Figure 12* shows one of the latter with the small black spot (arrow). The same stone had an area of needlelike inclusions in one direction only (*Figure 13*).

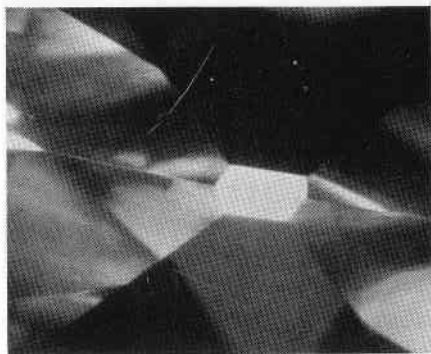


Figure 14

Double-Culet Effect

The staff in the New York Lab was interested to see the double-culet effect mentioned in the last Los Angeles Lab. column, since it is the first of this type of cutting we had seen, until that afternoon when a flawless and colorless 18-

carat marquise was in for examination. It had the same type of culet faceting, which would certainly be preferable to a single large facet (Figure 14).

Synthetic Scheelite

Several requests for information regarding brown scheelite prompted us to ask the assistance of Dr. Kurt Nassau, of Bell Telephone Laboratories, who kindly loaned us a series of synthetic "pulled" crystals and fragments for study. Because synthetic brown scheelite has been offered for sale as natural material recently in Europe and other colors have been cut and reached collectors, it was thought desirable to have on record the absorption spectra of the various colors of synthetics. Many of the crystals we studied had no recognizable inclusions under magnifi-

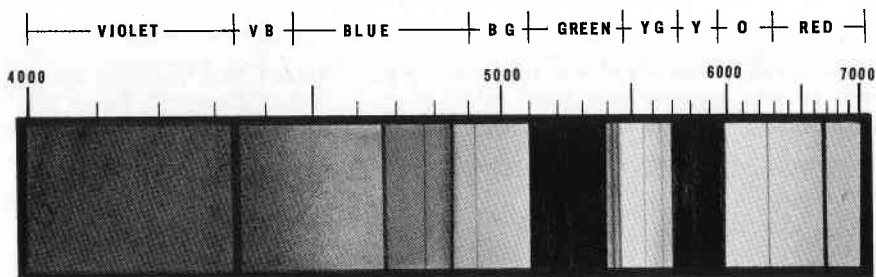


Figure 15

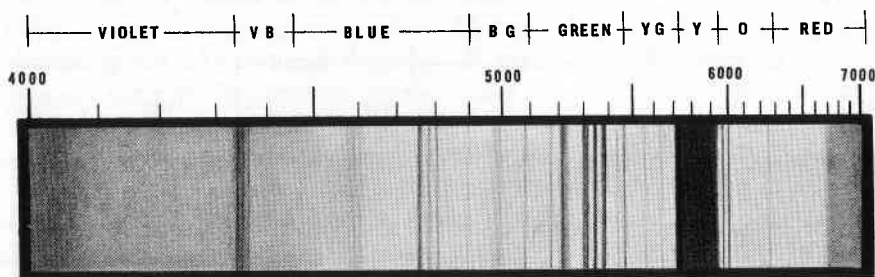


Figure 16

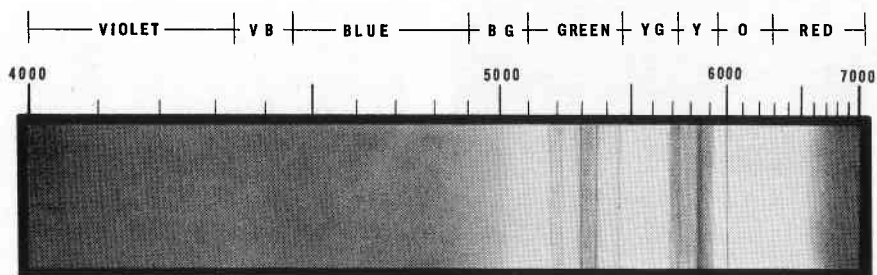


Figure 17

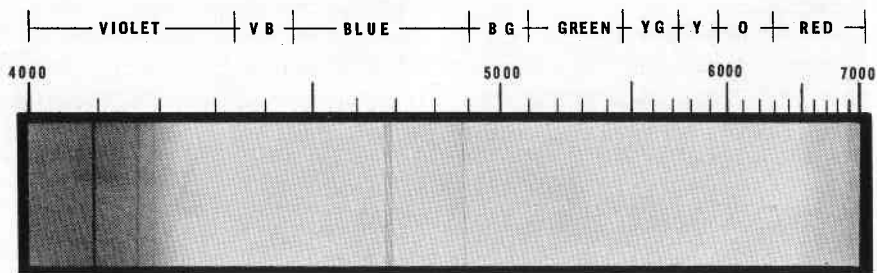


Figure 18

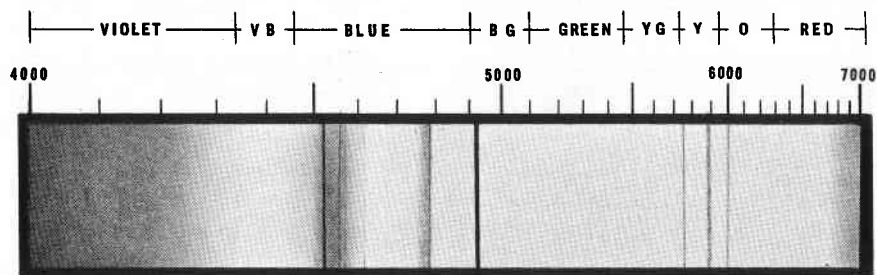


Figure 19

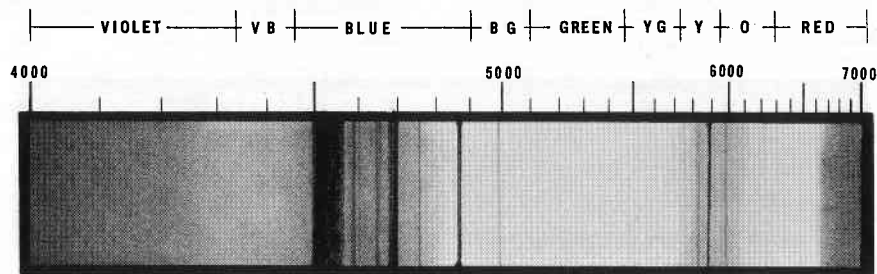


Figure 19-a

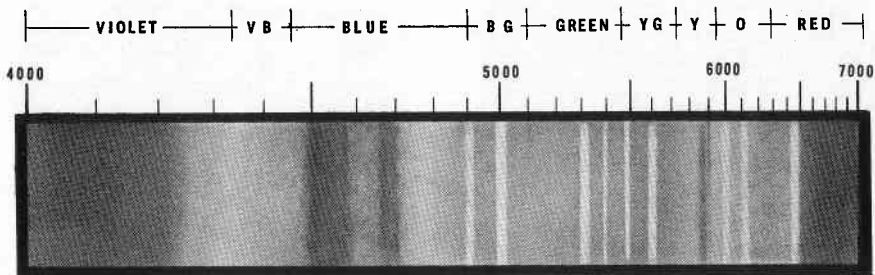


Figure 19-b

cation. *Figure 15* shows one of the most startling absorption spectra we have yet encountered. The crystal was a rich purple, reminiscent of freshly mined kunzite. A paler stone had a similar but less pronounced spectrum (*Figure 16*). The absorption spectra of much paler lavender and lavender-blue stones were shown in the winter issues of *Gems & Gemology*, both 1963-64 and 1964-65. *Figure 17* shows the absorption spectrum of a rich red-brown fragment, the color of which resembles fine topaz. It was surprising to note that a yellow-brown crystal gave no absorption lines whatever, and a very dark garnet-red crystal showed no recognizable lines. A pale-yellow fragment gave the spectrum recorded in *Figure 18*. *Figure 19* is the absorption spectrum of a pale-green piece resembling green spodumene in color. A very dark yellow-green piece resembling the color of fine demantoid gave no recognizable spectrum. Many different impurities are involved in the coloration of these synthetic scheelites, with the rare-earth metals perhaps responsible for the most striking. Colorless and sulphur-yellow specimens, along with a pale, almost gray piece, gave no absorption characteristics.

Figure 19-a and *Figure 19-b* are the absorption spectra of beautiful faceted pale-green synthetic scheelite by analyzing different directions of light. *19-a* is the absorption spectrum in direct transmitted light, whereas *19-b* is the result of analyzing diffused light. This brings to mind the reversible lines due to fluorescence shown by ruby. This particular scheelite fluoresced a brilliant pink under short-wave ultraviolet. Most of the other colors fluoresced various tones of blue and bluish white only under short wave. One very handsome, rich, peridot-green stone (which had no recognizable absorption spectrum) fluoresced a dull brick- or orange-red in only one-half the stone under long-wave ultraviolet.

Figure 19-c shows typical gas bubbles that may occur in any of the colors, although they are frequently absent. However, a "batch" may be spoiled by their presence in such great numbers as to make the crystal semitranslucent. *Figure 19-d* and *19-e* are inclusions of rhodium or iridium from the growth vessel; they may be found in any color but are not always present. These photos were taken under 500x. We are indebted to Dr. Nassau for all the inclu-

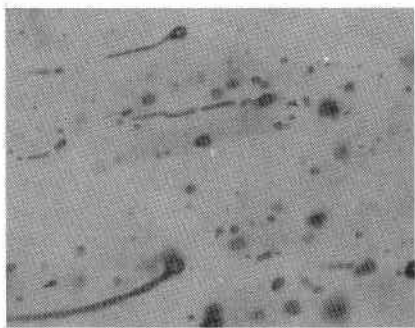


Figure 19-c

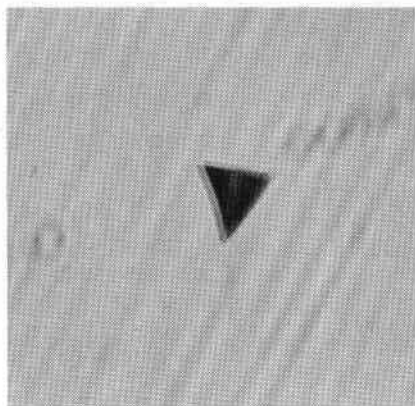


Figure 19-e

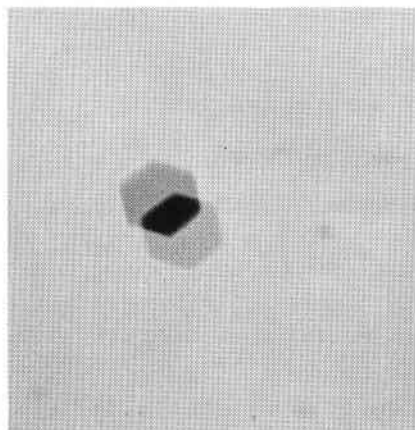


Figure 19-d

sion photos.

Rare Cat's-Eye Opal

A small cat's-eye opal in the possession of Bill Collison, gem dealer and ex-GIA instructor, caused much comment at the American Gem Society Conclave in Atlanta several years ago. We are happy to show (*Figure 20*) three black opals with good chatoyancy shown to us by George Bruce, Atlanta stone dealer. The largest is a rich blue with a nearly emerald-green eye.

Strontium Titanate Doublets

We have heard of many attempts to improve the surface resistance of both synthetic rutile and strontium titanate. One method was advertised as "sapphirizing" in the 1950's. A West Coast lapidary made doublets of synthetic sapphire tops and strontium-titanate backs. These never reached the market in quantity, probably because of labor costs and the lack of suitable bonding agents. Recently, doublets of synthetic spinel and strontium titanate have been introduced, with the claim that they were not cemented but fused. Under magnification we could see no gas bubbles in the joining plane, which was at the girdle. The stones withstood steam and an overnight bath in concentrated hydrochloric acid. In an attempt to determine if the claim of fusing were true, one stone was set in a 14K yellow-gold engagement ring and the shank sized by welding without any protection for the stone. The joining plane turned brown near the point of prong contact and an arborescent, or fern-like, pattern developed throughout (*Figure 21*). It is assumed, therefore, that a cement is involved. Another stone

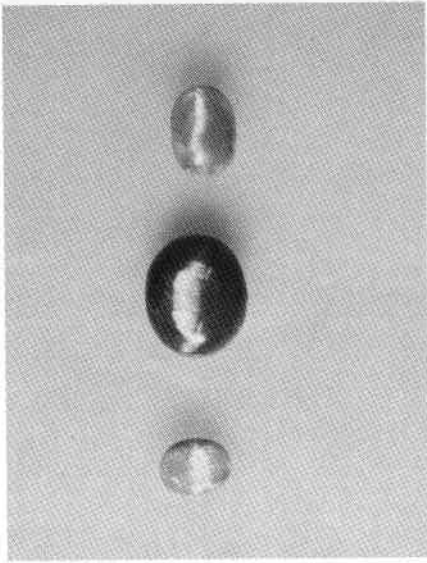


Figure 20

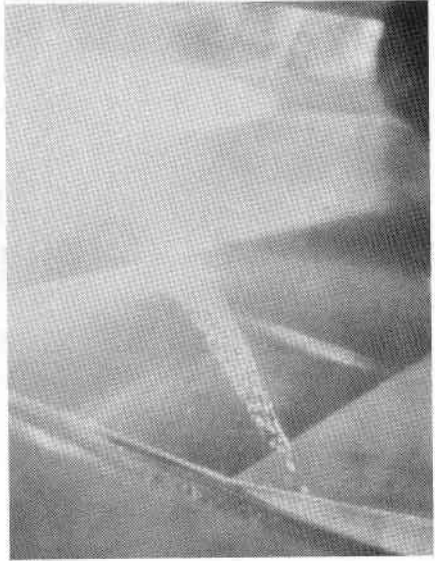


Figure 22



Figure 21

set in an engagement ring and properly protected during sizing did not alter in appearance. It would seem that these

doublets accomplish the desired ends of reducing the fire of the strontium titanate while making a more durable stone. In appearance, the round brilliants are very diamondlike. One of the doublets we examined recently contained a very natural-appearing fingerprint inclusion in the strontium titanate (*Figure 22*).

Acknowledgements

We are indebted to Mr. Barnett Robinson, stone dealer of New York, for a selection of many stones for use in student study sets.

From an anonymous donor we have received one of the most important gifts of stones for study sets in recent years. Among the several thousand stones were synthetics, natural and assembled stones. The gift will greatly augment our efforts to widen the availability of stones for correspondence students.

Developments and Highlights at the Gem Trade Lab in Los Angeles

by

Richard T. Liddicoat

A Variety of Interesting Inclusions

On several occasions recently we have encountered chalcedony containing little spherules as inclusions. *Figure 1* shows under rather high magnification (about 45x) a number of round inclusions in a pale-green chalcedony. *Figure 2* shows a number of spherules in a greenish chalcedony, another stone encountered a week or two ago. In *Figure 3* we see some green spherules in another green chalcedony — these seem to be perfectly spherical. In addition, this stone contained some interesting crystallites, which are seen faintly in the upper right-hand corner. *Figure 4* shows a nearly circular inclusion in a diamond. From its rounded outline and low relief, we assume the inclusion to be diamond. An excellent, seemingly spherical bubble in diamond is pictured in *Figure 5*. From its outline and high relief, it seems likely that this is a negative crystal.

We have seen so many square patches of cottony inclusions recently in diamonds that we photographed one under 200x, using a metallurgical microscope (*Figure 6*). The same inclusion

enlarged to 450x is shown in *Figure 7*. In *Figure 6*, the two elongated black areas are small cleavages, and a vague cross may be seen going from point to point.

Ultraviolet as an Illuminant

Figure 8 depicts a very flawed fluorescent diamond photographed under long-wave ultraviolet illumination. It is interesting to see the extent to which

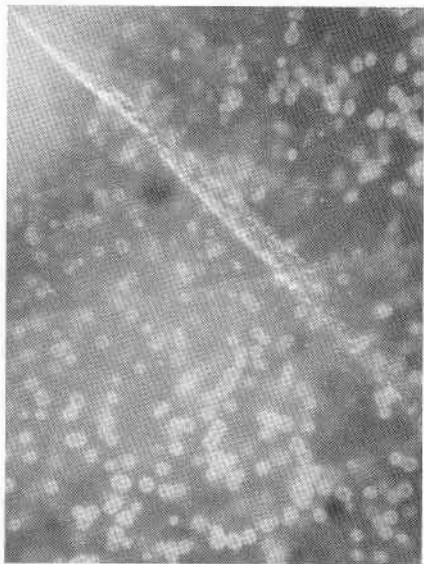


Figure 1

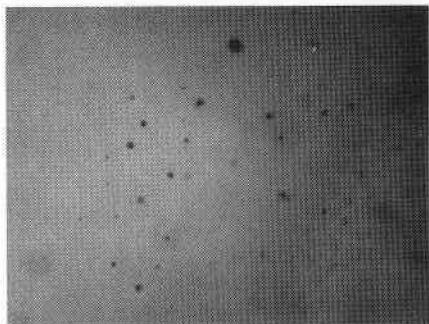


Figure 2

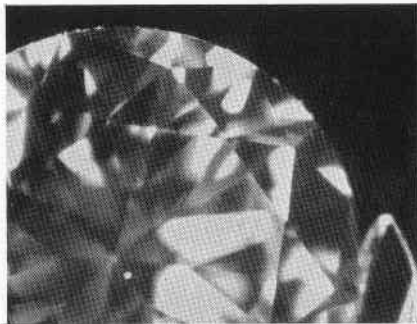


Figure 5

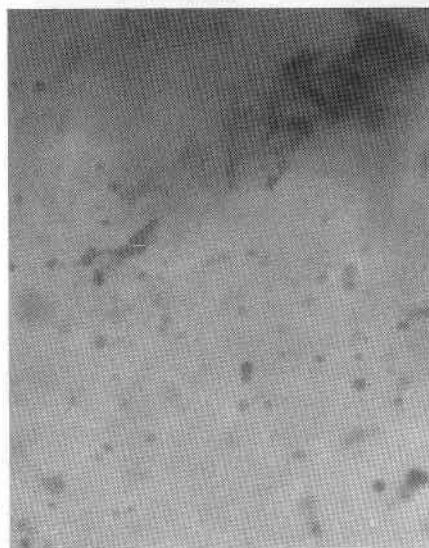


Figure 3

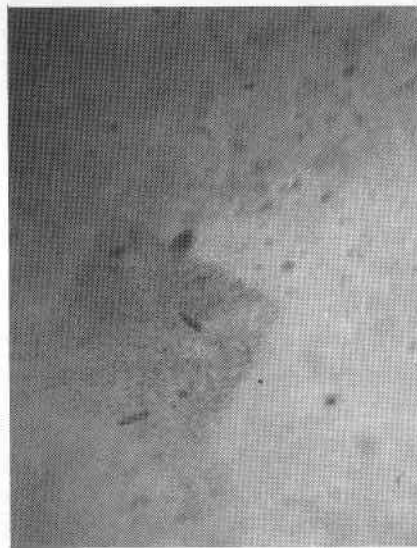


Figure 6



Figure 4



Figure 7



Figure 8

feathers in the stone are revealed as black spots against the soft glow of the ultraviolet-induced fluorescence in the diamond.

YAG

Recently, we have seen several stones cut from the synthetic so-called YAG, an acronym for yttrium-aluminum garnet. This material has a garnet structure but does not contain silica. We were told that these had been sold as demantoid. They were attractive green

stones but the color was not the chrome green of demantoid. Both had an absorption spectrum similar to that shown in Figure 9. The inclusions were very interesting (Figure 10). They included not only gas bubbles, but a rather irregular-appearing fingerprint inclusion (top of the photograph at left center). In addition to a few spherical inclusions that were somewhat akin to what one would expect in synthetic corundum,



Figure 10

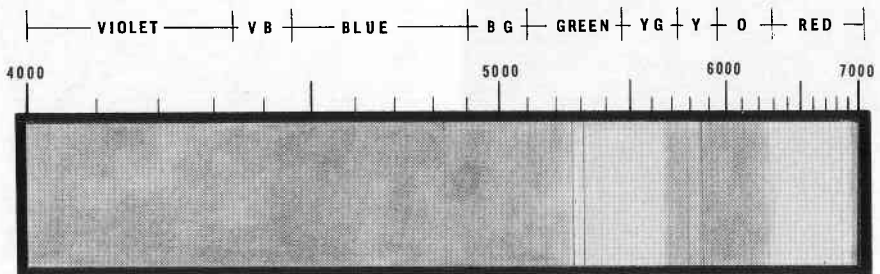


Figure 9

there were tubelike inclusions reminiscent of those of synthetic spinel.

Since the last Lab report, we have encountered a number of interesting inclusions and surface characteristics in diamonds. *Figure 11* shows a pair of feathers that resembled the wings of an eagle, with the body centered at the culet of the stone.

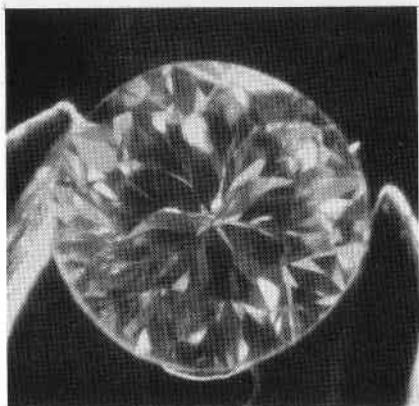


Figure 11

Figure 12 illustrates the irregular surface of the table of a diamond that very much resembles the meanders of the surface of a cultured pearl when viewed under high magnification. This photograph was taken under approximately 60x.

A series of strong percussion marks on the crown of a large treated green diamond is shown in the center and left side of *Figure 13*.

A very interesting "washboard" effect on the otherwise very smooth girdle surface of a diamond is illustrated in *Figure 14*. We assumed that this girdle had been turned mechanically, rather than holding the stone by hand. We have seen traces of this effect in the past, but never so strongly developed.

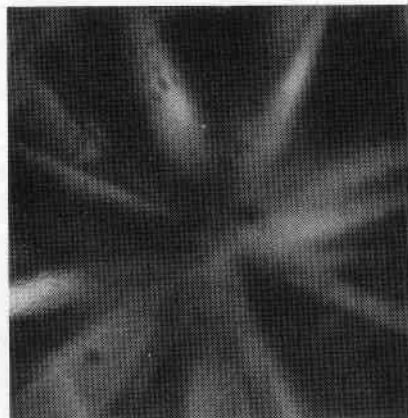


Figure 12

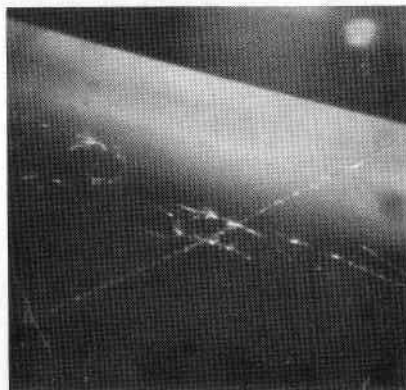


Figure 13

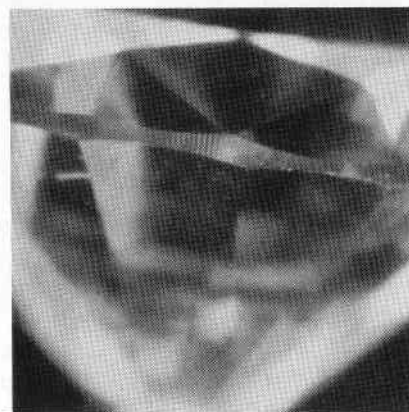


Figure 14

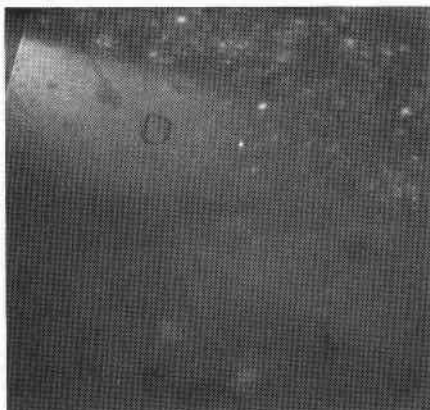


Figure 15

Figure 15 shows an inclusion with a square outline in the garnet portion of a garnet-and-glass doublet encountered in the Los Angeles Laboratory recently. Because the crystal did not reach the surface, we were unable to determine its composition; but since square outlines in garnet inclusions are rare in our experience, we photographed it.

One of our Graduate Gemologist's, Werner Frischknecht of St. Gallen, Switzerland, who studied in Los Angeles for several months, sent us a photograph of an "Apollo space vehicle" he found captured in an amethyst (Figure 16). Since the shape is somewhat irregular, we were unwilling to hazard a guess as to the nature of the inclusion.

Not long ago we examined a low-property green zircon that had very intriguing inclusions. We have seen somewhat similar inclusions before in low-property zircon, but these were so well developed that it was decided to photograph them (Figure 17).

Figure 18 shows an interesting black calcareous concretion with a structure that is evident below the bright reflec-

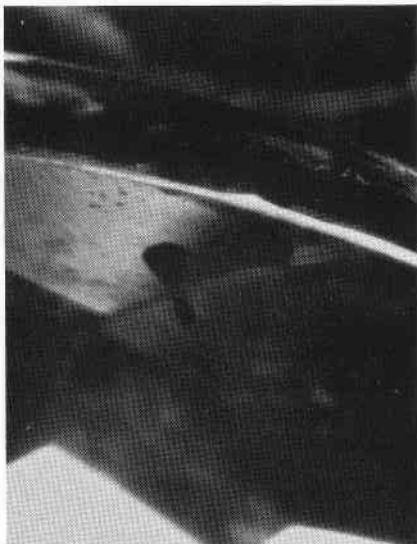


Figure 16

tion from the illuminator. We do not know the origin of the concretion, but suspect that it came from a mollusc. If any of our readers are familiar with

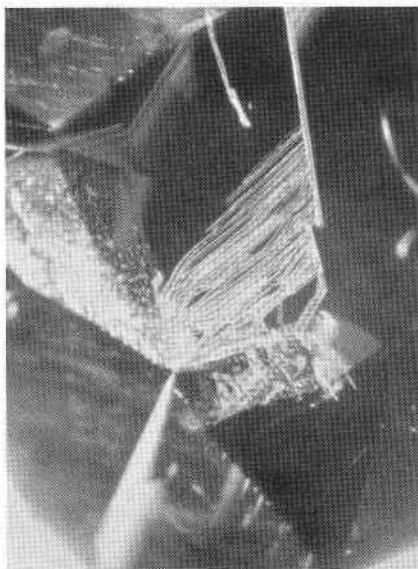


Figure 17

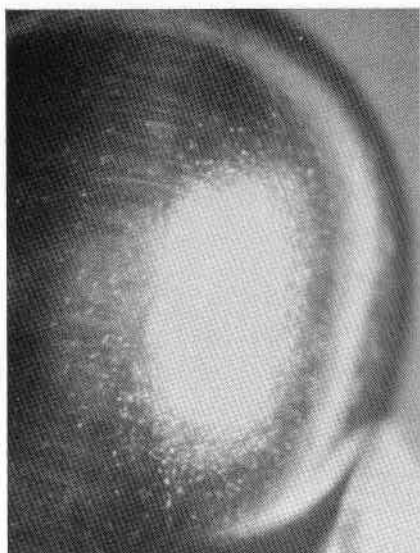


Figure 18

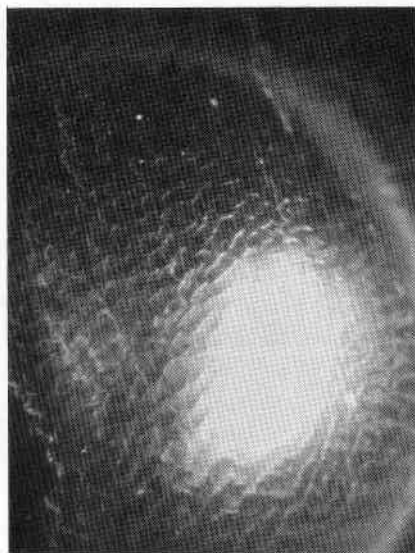


Figure 19

concretions of this kind, we would like to learn their origin.

Along the same lines, we have encountered on two occasions black concretions of a noncalcareous nature that are organic in nature, as shown by the fact that they give a burnt-hair odor when a hot point is applied. They also have a characteristic structure that varies somewhat with direction. The origin seems to be somewhere in Mexico, probably near La Paz in Baja, California. They have been polished. The refractive index is about 1.53 and the specific gravity near 1.31. The end view of their structure is shown in *Figure 19*, and the side view is illustrated by *Figure 20*. All of those we have studied had been shaped and polished.

Opal-In-Ironstone Matrix

Figure 21 shows the almost metallic reflection from an opal-in-ironstone



Figure 20

matrix in reflected light. This photograph was taken with light reflecting directly from the surface of the matrix. The darker areas showed the good play of color one would expect from opal, whereas the ironstone showed the almost metallic reflection.

Mangled Diamond

The diamond illustrated in *Figure 22* must have been put through a crusher. It is hard to conceive of a situation that would so completely have destroyed the original symmetry of the round brilliant cut. It would seem one could take a hammer to a diamond on an anvil and hardly achieve such damage as was encountered here. No exceptional strain was noted when the stone was examined in the polariscope, so we could only assume that it had been subjected to great abuse.



Figure 21

Rose-Cut Fraud

From time to time we encounter the often-described mounting in which a very thin rose-cut diamond is set in a gypsy mounting so that the entire girdle area is covered. The mounting is made in such a way that "facets" are impressed in the metal on its flat bottom. There is a large air space between the flat base of the rose cut and the metal "facets." Usually, when such a stone is examined from above under magnification, reflections of the facets on the top surface give a doubling effect, such as seen in *Figure 23*. When this diamond was removed from the mounting, it was found to have a total depth of not much more than 2 mm., even though the girdle diameter of the stone was in excess of 14.3 mm. Later, the man who had brought it to us for identification told us that he had removed the stone from the setting, and that it was not much thicker than a fingernail. It weighed just over two carats. By formula for a brilliant cut, if such a diamond with a 14.3 mm. diameter weighed $2\frac{1}{2}$ carats, its depth would be only 2 mm. at the deepest point.

Unusual Opal

A woman who is an X-ray technician owned an opal set in a ring. Over a period of time she noticed that the stone had whitened and lost its play of color. She thought this must have been caused by exposure to X-rays, which she believed could have occurred during her daily duties. Obviously, such an explanation seemed exceedingly remote, in that the regulations for X-ray technicians are so stringent that they are exposed to no more radiation than the man on the street. Examination of

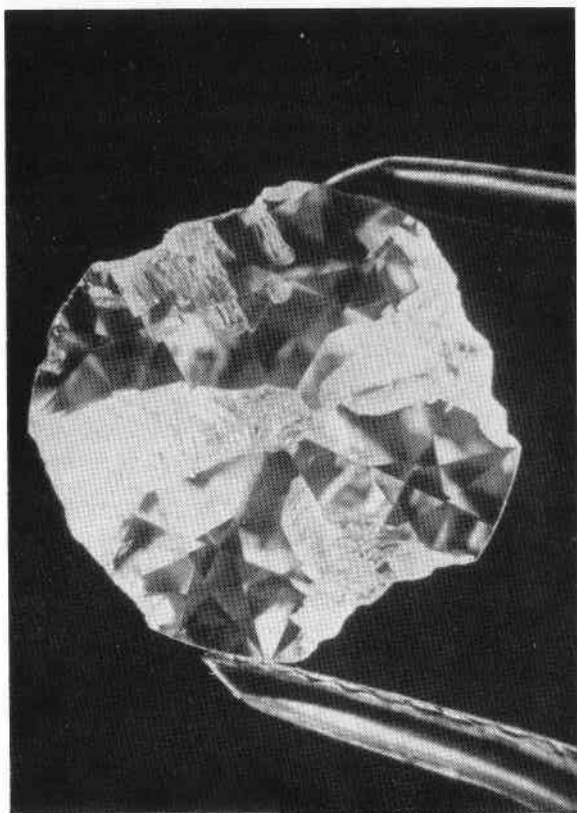
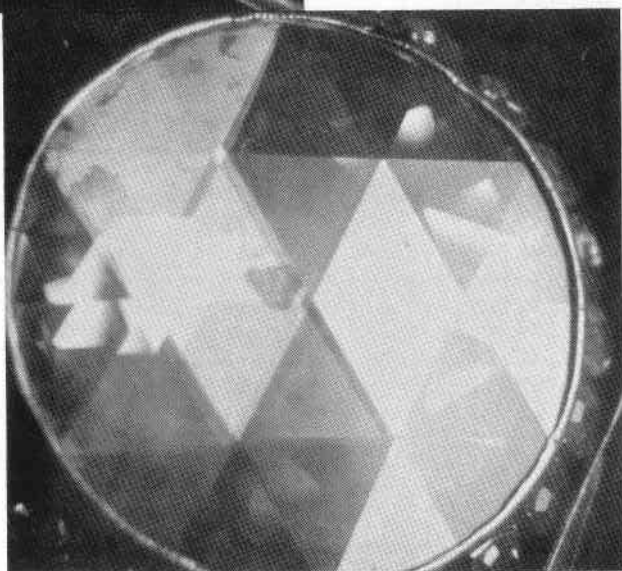


Figure 22

Figure 23



the stone led Charles Fryer to suspect that it was hydrophane, so he soaked it in water over a weekend. When we examined it the following Monday, it was again translucent and had a very attractive play of color.

Acknowledgements

We wish to express our sincere appreciation for the following gifts:

To *Martin Ehrmann* for one faceted zoisite, a phenacite and one faceted sphalerite. Also, he donated several mineral specimens, such as herderite, rhodonite, azurmalachite, grossularite, sphene, morganite and a quartz-crystal aggregate.

To *Ben Gordon* of Gordon's Jewelry, Houston, Texas, for his gift of assorted stones for Gem Identification students.

To *Robert S. Jacoby* of Vancouver, Canada, for three beautiful nephrite specimens.

To *Richard H. Toyoshiba* of Honolulu, Hawaii, who donated many samples of coral.

To *George F. Harvey* of Denver, Colorado, who sent us an assortment of stones.

To *Robert E. Smith* from Las Vegas, Nevada, for aquamarine crystals.

To *Jerry Ellinger* for his gift of a lovely diamond.

To *Paul Johnson*, Paul Johnson Jewelers of Phoenix, Arizona, for his large gift of test stones.

To *Rosenzweig's Jewelers* in Phoenix, Arizona, for stones donated for use in our Gem Identification sets.

To *Herb Walter* of Craftstones, Ramona, Calif., for his gift of sodalite and two kinds of garnet for use in our student test sets.

To *William Grupe* for his gift of assorted stones.

To *Arnold Baron* of Baron's Jewelers, Billings, Montana, for his gift of emerald crystals for a study by the laboratory.

To *Rene Vauges* of Los Angeles, for his gift of assorted stones to be used in the Gem Identification sets.

To *Dr. M. W. Conway* of Santa Ana, California, for his gift of various rough stones for use in the Gem Identification class.

Book Reviews

OPALS & SAPPHIRES, by Ion L. Idriess. Published by Angus & Robertson, Ltd., London, England, 1968. 231 pages. Clothbound. Illustrated with black-and-white pictures and line drawings and eight color photographs. Price: \$5.50.

"This book," Mr. Idriess states, "was written for three kinds of prospectors: the man intending to prospect for opal and sapphire as a means of earning a living; the man who wants to spend a few months in a pleasant way, with the chance of a lucky strike to bring in payment for his time; and for the family holidaymaker with less time but with the same object in view."

The author, who has had many years of practical experience in the Australian gem fields, seems to have accomplished these aims very well. More than two-thirds of the book is devoted to opal: prospecting, mining, classifying, cutting, and buying and selling. The section on sapphire is treated in a similar manner. Also discussed is the geological setting for these gems, their history of discovery and association with the great and the rich, the legends they have inspired, the renowned collections throughout the world, and the record of soaring values. All aspects of Australia's two most important gems have been thoroughly covered, with the exception of the more technical information.

As a practical and readable guide for the gem hunter who sets out, either in earnest or for fun, on such an adventure, *Opals & Sapphires* will undoubtedly prove valuable.

MINERALS & MAN, by Cornelius S. Hurlbut, Jr., Ph.D. Published by Random House, Inc., New York City, 1968. 304 pages. Clothbound. 8½x11" format. Profusely illustrated with 67 black-and-white photographs and line drawings and 160 color plates. Price: \$15.

Minerals & Man has much to recommend it. First, the book has instant eye appeal, because of its impressive size, its attractive layout and design, and the wealth of outstanding color plates, all superbly engraved. The color photography and reproduction rank among the best to be encountered in a book of this kind. Secondly, it is written in a highly readable and nontechnical style, making it equally well suited for the novice, the connoisseur, the student and the specialist. The author deserves special recognition for his knowledgeable handling of the text. Thirdly, it is authoritative: Dr. Hurlbut is an eminent American mineralogist and a distinguished professor of mineralogy at Harvard.

Hurlbut calls attention to man's increasing dependence on minerals and the neglect by many writers of a fascinating chapter in earth science: the origin, occurrence, association and uses of mineral commodities. He points out that the number of familiar objects whose manufacture requires the use of minerals is staggering: from a minute transistor to a powerful engine, from wedding rings to crown jewels, from the hardest abrasives and cutting tools to baby's talcum powder. Individual chapters discuss the early use of min-

erals, physical properties and identification, rocks that make up the earth's crust, the beautiful zeolites and related minerals associated with lava flows, the discovery and exploitation of borax in the American Southwest in the 1880's, the ancient tin mines of Cornwall, a single gypsum crystal as large as a skyscraper girder, the ornamental stones preferred by sculptors, minerals from the sea and from land-locked lakes, the commercial importance of ore minerals, the breathtaking beauty of fluorescent minerals, the amazing array of minerals at Franklin Furnace, New Jersey, and the minerals needed for atomic energy. Other sections consider the precious metals—gold, platinum and silver—and, of particular interest to gemologists, two chapters on gemstones. A bonus for gem enthusiasts is the illustration of both rough and cut gemstones in the many superb color plates throughout the book, together with special emphasis on the importance of pegmatites as a source of large and well-formed gem crystals of many species. An appendix of the physical properties of some of the more common minerals, followed by an index, complete the book.

Minerals & Man is possibly the most refreshing and exciting approach to economic mineralogy yet written. It is for all those who want to know more about an aspect of the natural world vital to mankind. Dr. Hurlbut has written a distinctive and significant book on this branch of the earth sciences.

VAN NOSTRAND'S STANDARD CATALOG OF GEMS, by John Sinkankas. Published by D. Van Nostrand Co., Princeton, New Jersey, 1968. 286 pages. Softbound. Illustrated with black-and-white line drawings and photographs. Price \$5.95.

It is difficult to review a book that contains thousands of specific facts, because it is easy to find fault with a number of figures in such a book. We can find dozens of discrepancies very easily in this work, and we will mention a few of them in this review. However, we must express our admiration for the care with which John Sinkankas has researched his subject.

Sinkankas has a thorough knowledge of the value of the less-expensive gems and ornamental stones, even of many of the expensive stones in the rough, and he has the advantage of being a very careful writer who does his best to present a completely accurate picture of anything he undertakes. As a result, he has several outstanding books to his credit. His preliminary section on the orientation of rough in cutting is superlative, and his diagrams and drawings are exceptional.

In this book, we find fault mainly with the higher prices he quotes, feeling that perhaps he did not find suppliers who handle the ultimate in quality from which to extract his information, or that his information was not quite up to date in a rapidly rising market. We did find that he is quite low on a number of prices in the top qualities of rubies, sapphires, cat's-eyes, emeralds, and even synthetic emeralds. Probably he consulted dealers with whom he was acquainted who gave him information on the finest stones they had handled; unfortunately, however, these were sometimes far from top-quality stones.

For example, he lists a top retail price for a 10-carat blue sapphire of \$1600 a carat. Those who have priced the finest Kashmir sapphires recently would realize that the jeweler would have to pay appreciably more than this. This holds true also for the finest ruby, for which he quotes a top price of \$10,400 per carat; we have seen prices to the jeweler in excess of \$20,000 a carat. His quotations on melee diamonds are particularly unfortunate, because the prices listed are appreciably below wholesale for fine, well-made stones. This is an area that is likely to be of interest to a majority of readers, whereas exceptional prices for rubies, emeralds and sapphires are seldom encountered. In the other direction, the value he gives for golden cultured pearls in relation to rosé is far above reality, for the golden color commands only a fraction of the price of fine rosé.

Despite these drawbacks, which could be corrected in future editions, Sinkankas has done a remarkably able job, so it will have a value far beyond its low cost for

those who purchase it. We recommend it enthusiastically.

THE BOOK OF PEARLS, by Joan Younger Dickinson. Published by Crown Publishers, Inc., New York City, 1968. 248 pages. Cloth-bound. Illustrated with black-and-white photographs and line drawings and one color plate. Price: \$6.95.

Joan Younger Dickinson has followed her previous book, *The Book of Diamonds* (Crown Publishers, Inc., 1965, \$5.95), with a comprehensive and thoroughly entertaining account of the pearl. As with the diamond book, this one fills an obvious gap in the literature of the pearl, for no important, popular work has been published on this subject for many years.

Mrs. Dickinson's story covers a wide span of time, from the role of pearls in the shell cult of antiquity and the early pearl fisheries of the Persian Gulf to the development in Japan of the cultured pearl of today. She tells how these lustrous gems were revered in the East, as in the 9th century, when the bride of the Caliph Almunum of Bagdad wore to her wedding a headdress of 1000 magnificent pearls; how Henry VIII of England had robes, mantles, coats, hats and even shoes adorned with pearls; and how Mary Queen of Scots, upon her betrothal to Francois II of France in 1559, received six ropes, each consisting of 25 stunning purplish Oriental pearls, the finest of this color ever seen.

When Christopher Columbus reached Margarita Island off the Venezuelan coast on his third voyage, he found that the American Indians were well aware of the beauty and value of pearls. He named Margarita the

"Isle of Pearls." Over the years, both salt- and fresh-water pearls of the Americas were exported in competition with the Oriental product. During the late 19th and early 20th centuries, a profusion of pearls was purchased and worn the world over as symbols of status and splendor.

In a chapter entitled *The Discovery of the Oyster's Secret*, the author describes the frustrating search for a method of inducing the mollusc to produce a lustrous concretion — the success story of the cultured pearl. Another chapter, *Cultured Pearls Today*, is illustrated with a number of pictures from Japan, depicting the step-by-step method involved in pearl culturing.

In addition to discussing the history, lore and romance of pearls and pearling, the book has a very practical aspect, since it serves as a guide for anyone who owns or is contemplating buying pearls. Described is the evaluation procedure for size, shape, luster, orient, flawlessness and color, and how to choose pearls for fashion and sentiment. Also illustrated and described are the various lengths and styles of necklaces: choker, matinee length, opera length, sautoir, bib, dog collar, etc. The author tells who wears what pearls—and where.

The Book of Pearls is exceptionally well illustrated with many old engravings of pearl fisheries, photographs of museum paintings, pearl antiques, cultured-pearl production techniques, and exquisite jewelers' offerings: necklaces, bracelets, earrings, rings, hairpieces and others.

Everyone who has an appreciation for pearls should find this book an enjoyable and valuable reading experience. Many jewelers will consider it a worthwhile gift for good customers.

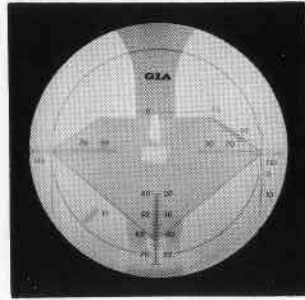
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BIBLIOGRAPHY

- Deer, W. A., Howie, R. A. and Zussman, J., *Rock-Forming Minerals*, Vol. 3. John Wiley and Sons, New York, 1962.
- Engel, A. E. S., and Wright, L. A., *Talc and Soapstone in Industrial Minerals and Rocks*. Am. Inst. Min. Met. and Pet. Eng., 835-850, 1960.
- Faust, G. T., and Fahey, J. J., *The Serpentine-Group Minerals*, U. S. Geol. Sur. Prof. Paper 384-A, 1-92, 1962.
- Faust, G. T., Murata, K. J., and Fahey, J. J., *Relationship of Minor-Element Content of Serpentinities to Their Geological Origin*. Geochim. et Cosmochim. Acts, 10, 316-320, 1956.
- Huggins, C. W., and Shell, H. R., *Density of Bulk Chrysotile and Massive Serpentinite*. Am. Min., 50, 1058-1067, 1965.
- Johannsen, A., *The Serpentinities of Harford County, Maryland*. Md. Geol. Sur., 12, 197-287, 1928.
- Robertson, E. C., *Strength and Elastic Moduli of Serpentinite from Mayaguez, Puerto Rico, in a Study of Serpentinite*. Ed. C. A. Burk, Nat. Acad., Sci., Pub. No. 1181, 118-125, 1964.
- Whittaker, E. J., and Zussman, J., *The Characterization of Serpentine Minerals by X-ray Diffraction*. Min. Mag. 31, 571-574, 1956.

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The new GIA ProportionScope sells diamonds as no other instrument can. This instrument will help you sell every stone in your inventory, regardless of make. It demonstrates positively the quality of a diamond's cut... beyond the shadow of a doubt. It brings you a convincing, professional method for showing and explaining diamond proportions to customers.

The diamond's silhouette is projected on the ProportionScope screen for comparison with the detailed outline of the ideal diamond. Customers can immediately see the significant part proportion plays in determining a diamond's price.

The ProportionScope lets you quickly and positively grade the proportions of diamonds. It easily compares facet angles, crown height, girdle thickness, pavilion depth, and all details of a gem's make with proportions calculated to give maximum brilliancy and fire. The ProportionScope is excellent for determining the re-cutting of old-miners and damaged stones.

The handsome, professional ProportionScope will bring new prestige and customer confidence to you and your store. It will give you a new competitive advantage... and you'll *sell more diamonds!*



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11940 San Vicente Blvd., Los Angeles, California 90049