# Gems & Gemology

GIA

SUMMER 1976

ISSN 0016-62X

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# gems & gemology

VOLUME XV NUMBER 6

SUMMER 1976


IN THIS ISSUE

# A Pleochroic Variety of Gem Labradorite From the Rabbit Hills Area, Lake County, Oregon*

By **ERNEST H. CARLSON**
Associate Professor of Geology
Kent State University

and

**MICHAEL A. KIRCHER**
Geologist and Gemologist
Marcus, Ohio

### Introduction

Labradorite rarely is considered to be a gemstone. One important but poorly known occurrence is found about 22 miles north of Plush in east-central Lake County, Oregon *(Figure 1)*. It lies in the northwest part of the Rabbit Hills NE quadrangle map of the U.S. Geological Survey. The material is called sunstone locally, and the site of the occurrence is designated as the "Sunstone Area" on this map.

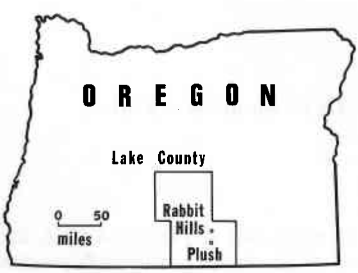


*Figure 1. Gem labradorite locality in the Rabbit Hills area, Lake County, Oregon.*

The Rabbit Hills area lies within the southern portion of an extensive province of volcanic rocks that passes north and east into Washington and Idaho. Stewart, and others (1966, p. 178-180) note that labradorite occurs as phenocrysts in porphyritic lava flows in the vicinity of the Rabbit Hills. They described crystals as large as 86 x 26 x 8 mm.

A parcel of cut stones and rough material from the Rabbit Hills area was investigated by the writers. Transparent gem quality stones as large as 13 x 7 x 5 mm were examined. The discovery of some previously undescribed properties led to the work upon which this report is based. The assistance of James Pettit, Assistant Manager of J.R. Rodgers, Ltd., Sherman, Oregon, who supplied all the specimens, is gratefully acknowledged.

*Department of Geology, Contribution No. 134.

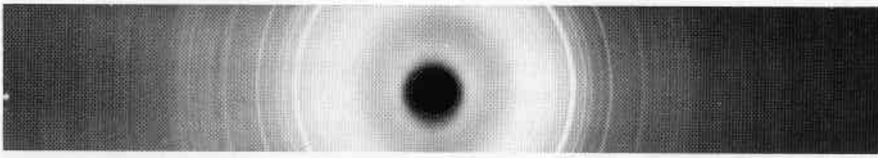

*Figure 2. Debye-Scherrer x-ray diffraction photograph of labradorite from the Rabbit Hills area, Oregon.*

Previous work on the properties of gem labradorite from southern Oregon is scant. Aitkens (1931, p.8) noted the occurrence of a labradorite that is remarkably similar to the material described here, from an unspecified locality in southern Oregon. Bank (1970, p. 134-136; 1973, p. 58-59) described similar feldspars (bytownite, labradorite) from an unspecified pegmatite locality near Plush. Gem labradorite from the Rabbit Hills locality has been noted recently by Rodgers (1976, p. 120).

## X-Ray Diffraction

Positive identification was made from a powder sample, using a Debye-Scherrer camera of 114.7 mm diameter, and a filtered copper radiation source. The resulting pattern is shown in *Figure 2.* Twenty reflections were measured and the corresponding d-spacings are listed in *Table 1.* Intensities were estimated visually on a scale of 10. The pattern is typical of plagioclase and no reflections due to impurities were recognized.

The structural state of the plagioclase was determined by accurately measuring the $2\theta_{\bar{1}31} - 2\theta_{131}$ spacing with a Norelco diffractometer. The spacing was found to be 2.10 degrees. From the determinative curve given by Bambauer, and others (1967, p. 342), a high structural state for the plagioclase is indicated. This result is consistent with a volcanic origin.

**Table 1. Intensity and measured d-spacing for labradorite from the Rabbit Hills, Oregon**

| Indices | Intensity | d-spacing (Angstroms) | Indices | Intensity | d-spacing (Angstroms) |
|---|---|---|---|---|---|
| 0$\bar{2}$1 | 1/2 | 4.68 | 131 | 2 | 2.82 |
| $\bar{2}$01 | 3 | 4.03 | $\bar{1}$32 | 1 | 2.64 |
| 1$\bar{1}$1 | 1/2 | 3.88 | $\bar{2}\bar{4}$1 | 4 | 2.51 |
| $\bar{1}$30, 111 | 3 | 3.75 | 2$\bar{4}$1 | 2 | 2.13 |
| 130 | 2 | 3.62 | 151 | 1 | 2.09 |
| $\bar{1}\bar{1}$2 | 1/2 | 3.47 | $\bar{4}$22, $\bar{4}$22 | 1/2 | 1.92 |
| $\bar{1}$12 | 1 | 3.35 | 333, $\bar{2}$60 | 1 | 1.87 |
| 040, $\bar{2}$02, 002 | 10 | 3.19 (broad) | 400 | 1 | 1.83 |
| 1$\bar{3}$1 | 1 | 3.02 | 113 | 1/2 | 1.79 |
| 0$\bar{4}$1, 0$\bar{2}\bar{2}$ | 3 | 2.93 | $\bar{2}$04 | 1 | 1.77 |

### Refractive Indices and Specific Gravity

Refractive indices were determined in sodium light using a Duplex II refractometer. From eleven determinations, $n\alpha$ ranged from 1.560 to 1.563, averaging 1.562, and $n\gamma$ ranged from 1.569 to 1.570, averaging 1.570. The average birefringence was 0.008.

Specific gravity determinations were made using an Ainsworth, double pan, analytical balance, and toluene as the displacement fluid. For seven determinations, the specific gravity averaged 2.713, ranging from 2.711 to 2.717. The accuracy of the determinations is estimated to be $\pm$ 0.010.

The composition of the plagioclase, in terms of the percent albite (Ab) and anorthite (An), can be determined from its structural state, refractive indices and specific gravity. Using the determinative curves of Barth (1969, p. 159) and Smith (1958, p. 1189), the composition was found to be calcic labradorite ($Ab_{32}$–$An_{68}$). All of the above data is in close agreement with the results of Stewart and others, (1966, p. 182-185), seeming to indicate that their material and ours correspond.

### Color and Pleochroism

Colors of varying tone and intensity were observed in the labradorite from the Rabbit Hills. The variations in color, as observed in diffuse south daylight during January, are given in *Table 2.* The color descriptions used follow standard North American gemological nomenclature. In addition, the color was noted to vary slightly with the source of illumination – a red-orange color being more predominant under incandescent light, and a bluish-green predominating under fluorescent light.

One of the most unusual properties of the labradorite is its pleochroic character. This pleochroism, which is weak in the pale yellow material, increases in strength with depth of color. In more deeply colored specimens the strong pleochroism imparts a multicolored effect that can be seen

**Table 2. Color and pleochroic character of labradorite from the Rabbit Hills, Oregon.**

| Color of Stone | Pleochroism |
|---|---|
| yellow | colorless; light yellow |
| red-orange and blue-green (multicolored effect) | bluish-green; light red-violet; reddish-orange or orange |
| bluish-green | bluish-green; light orange; colorless |
| red-orange | orange; light reddish-purple |
| yellowish green | bluish-green; light orange |
| orange | orange; reddish-orange |
| bluish-green and violet (parti-colored) | red-violet; reddish-orange; bluish-green |

*Figure 3. Saucer-shaped clustered inclusions (x25).*

without the aid of a dichroscope or polariscope as the stone is rotated. This effect is similar to that observed in transparent andalusite. The data given in *Table 2* were obtained from a gem dichroscope with the base of an Illuminator Polariscope serving as the light source. The pleochroism undoubtedly is due to a unique combination of the high transparency, deep coloration and relatively large size of the crystals of the Rabbit Hills material.

The labradorite lacked fluorescence in both short- and long-wavelength ultraviolet radiation. No characteristic absorption spectra were recognized with a Rayner Prism Spectroscope.

**Inclusions**

Inclusions of microscopic size are common in the Rabbit Hills labradorite. With the unaided eye, the presence of inclusions in some specimens is indicated by an aventurescent effect similar to that of sunstone. As viewed with dark-field illumination under magnification, the inclusions are seen to reflect light strongly and to be oriented in planes. The distribution of the inclusions is irregular and they often occur in clusters (see *Figure 3**). The inclusions sometimes appear as a series of minute, parallel streaks that form a zigzag pattern when viewed along an edge (see *Figure 4**). When rotated from this position, reflective surfaces of the inclusions appear, indicating a plate-like habit (see *Figures 5*, 6*,* and *7**). The size of the

*Figure 4. Zigzag patterns viewed on edge (x25).*

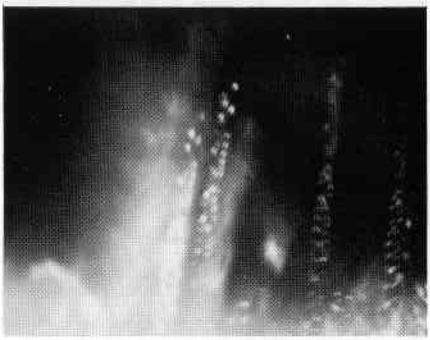

*Figure 5. Reflections from plate-like inclusions (x100).*

*Figure 6. Reflections from plate-like inclusions (x25).*

inclusions is approximately the same in a given plane, but may vary between adjacent planes and from specimen to specimen. In one specimen of rough material, sheets of inclusions were seen to lie parallel to a prominent direction of cleavage. This cleavage was established to be the {001} direction since it was cut by broadly spaced albite twin lamellae. It was not possible to identify the platy inclusions with the available equipment. The strong doubling effect under magnification, which is readily apparent in the photomicrographs, increased the difficulty of resolution.

In one stone, a solitary inclusion was resolved at 100 power magnification *(Figure 8*).* This inclusion has the equant habit and color that are characteristic of pyrite, and is obviously protogenetic in origin. Noting the size of other inclusions in this photograph, one clearly can see why this particular specimen presented a cloudy appearance under low magnification.

## Gem Potential

The limitations to the use of this gemstone in jewelry stem from its low hardness relative to other gem materials and its ability to cleave easily in two directions. Similar factors have been overcome in other gemstones with careful attention to the type of mounting used, and by exercising care in setting the stone. Examples of

*References to magnification refer to the original size of the negative (24 x 36 mm)., All photographs were taken under dark-field illumination.

*Figure 7. Strong reflections from inclusions viewed perpendicular to plates (x25).*

*Figure 8. Large solitary inclusion surrounded by minute inclusions (x100).*

gemstones of a similar nature are kunzite and opal, both of which are used widely in jewelry.

The quantity of better material that is potentially available is unknown at the present time. Since there may be a limited supply of quality stones, probably the appeal will be restricted. The high degree of transparency and the unusual pleochroism displayed by the Rabbit Hills material, however, combine to form an exceptional gemstone for the collector or other discriminating individual.

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# On the Naming of New Man-Made Crystals

By K. NASSAU, Ph.D.
Bernardsville, N.J.

The well-established names of gemstones give direct information about their composition. Thus diamond refers to carbon in a cubic form, sapphire is $A1_20_3$ in a trigonal arrangement, spinel is cubic $MgA1_20_4$, and so on. Yet carbon can also exist as hexagonal or rhombohedral graphite; a cubic form of $A1_20_3$ (called gamma-alumina or gamma-corundum) has been synthesized; and spinel in its synthetic form has a wide range of composition (from about $Mg0 \cdot A1_20_3$ to about $Mg0 \cdot 5A1_20_3$) without any change in structure. These matters are well covered in Hey's Index.[1]

Many man-made crystals are now used in technology and are finding their way into the gem field. Naming these compounds can be a problem. An example occurs with "yttrium aluminate." This designation implies a composition containing both yttrium oxide ($Y_20_3$) and aluminum oxide ($A1_20_3$). Now in the $Y_20_3$-$A1_20_3$ phase diagram,[2] there are two such compounds. The first is $3Y_20_3 \cdot 5A1_20_3$ or $Y_3A1_50_{12}$, also called "YAG," "yttrium aluminum garnet," "yttrogarnet,"[2] "diamonaire," and other trade names. The second compound is $2Y_20_3 \cdot A1_20_3$ or $Y_4A1_20_9$ which has no other name. When the term "yttrium aluminum oxide" is used by itself, one cannot be sure which compound is intended except from the context.[3]

Similarly, the designation "strontium titanate" for the man-made gem material $SrTi0_3$ ("fabulite," etc.) has been a satisfactory name only because other "strontium titanates" do not appear to have been grown in crystal form. The $Sr0$-$Ti0_2$ phase diagram[2] in fact shows four strontium titanates: $Sr_3Ti0_5$, $Sr_2Ti0_4$, $Sr_3Ti_20_7$, and $SrTi0_3$!

How then should such materials be designated so that all ambiguity can be avoided? The most obvious way would be to continue to use whichever popular designation is current, but always to append the chemical formula. For example: strontium titanate – $SrTi0_3$; YAG – $Y_3A1_50_{12}$ *or* yttrium aluminum oxide – $Y_3A1_50_{12}$. In some cases the same chemical formula composition can exist in different crystal forms. If separate names do not exist, then the formula would have to be followed by the crystal system. Thus yttrium oxide would be $Y_20_3$– cubic, $Y_20_3$– hexagonal, or $Y_20_3$– monoclinic, just as $Pb0$ could be either the dimorphous minerals litharge or massicot (tetragonal and orthorhombic, respectively). In this way both present and future confusion can be avoided.

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1. Hey, M., "An Index of Mineral Species and Varieties Arranged Chemically," 2nd Edition 1955 (Appendices 1963, 1974), British Museum, London.
2. Levin, E. M., C. R. Robbins and H. F. MacMurdie, "Phase Diagrams for Ceramists," 1964, Supplement 1969, p.96, American Ceramic Society, Columbus, Ohio.
3. Crowningshield, R., Fall 1975 *Gems & Gemology* 15, p. 92, Figure 9; the accompanying text clearly mentions YAG.

# Gemology—Now You See It, Now You Don't

by MABEL STERNS
Washington, D.C.

The word "gem" stems from the Latin *gemma*, so you might think that "gemology" had been around a long time. Not so, apparently; at least the references we think of as authorities don't substantiate it. The earliest I have found is a reference to lithology in 1811, which shows the word "gemmology."

*Webster's New International Dictionary*, 1909 edition, seems to be the first of that series to show "gemmology." The third edition, 1971, gives both the single and double "m" plus several related words.

*Webster's Universal Dictionary*, 1908, and *Webster's Imperial Dictionary*, 1909, fail to include any such term. *Webster's New American Dictionary*, 1958 and 1965, prefers the American spelling.

*Century Dictionary and Cyclopedia* did not show the word in 1911, nor did *The Universal Dictionary of the English Language* and *The New Century Dictionary*, both in 1952. *Funk & Wagnall's New Standard Dictionary*, 1921, includes "gemmology," and in 1960, gives two spellings, but its *Standard Dictionary International Edition* in 1974 omits "gemology." The *Oxford English Dictionary*, 1931, followed the Latin derivation, and added "gemmosity." In 1972, the *Supplement* recognized "gemmologist."

As early 1937, the *Gemmologists' Compendium* used the British term based on the Latin spelling. The *Dictionary of American English*, 1940, had not caught up with the word, but did define "gem pan." *Chambers's Mineralogical Dictionary*, 1948, shows neither spelling; *Chambers's Twentieth Century Dictionary* included "gemmology" in 1956.

*Cassell's French-English, English-French Dictionary*, 1951, came up with "gemmed," and "gemmiform," which are its closest approaches to our present topic. "Gemmology" and "Gemmologist" appear in the *Britannica World Language Dictionary* for 1954. *The American College Dictionary* still omitted the term as lately as 1961. Even in 1966, *A Comprehensive Etymological Dictionary of the English Language (Ernest Klein)*, was not comprehensive enough to recognize either spelling.

*The Random House Dictionary of the English Language*, 1966, contains both spellings of the word in question, as well as "gem(m)ologist" and "gem(m)ological." Oddly, "gemmology" appears in *A Dictionary of Difficult Words* in 1969. By 1971, *The World Book Dictionary* gave "gemology"; in 1974, it added the British form.

Additional research in encyclopedias indicated that although *Encyclopedia Americana*, 1960, omits "gem(m)ology," it does include "gemologist." As recently as 1974, *Encyclopedia Britannica* ignored the whole thing. *McGraw-Hill Encyclopedia of Science and Technology*, 1960, 1966, 1971, gives the American orthography. *The Harper Encyclopedia of Science*, 1963, fails to acknowledge gem(m)ology but does discuss gemstones very clearly.

From the above research, it appears that "gemology" has been stumbling into the English language for about 165 years.

# Developments and Highlights at GIA's Lab in Santa Monica

By RICHARD T. LIDDICOAT, JR.

### One of the Rarer

In a very recent issue we discussed blue coral, stating that it was a material that had been mentioned in the GIA course for years but never seen before in my memory at GIA Los Angeles. Just a short time later we had a parallel experience. Jerry Call, a former GIA instructor, came in to visit us while on a trip from his home in Brazil. After showing us several interesting stones, including a lovely greenish-blue euclase of about 8 carats and a large (over 50 carat) petalite, he mentioned another petalite of well over 100 carats that had gone to a museum. Almost as an afterthought, he brought out a star chrysoberyl. Star chrysoberyl is often listed among those very rarely encountered stars of an almost once-in-a-lifetime type. In *Figure 1* we see the strong ray of the usual chrysoberyl cat's-eye but with a very distinct ray at 90°, giving a very excellent four-rayed star in an otherwise nondescript chrysoberyl. The color of the stone was not particularly attractive; the ordinary cat's-eye effect extending the long way on the cabochon was not all that exciting, and the stone was not particularly transparent. However, the ray at right angles to the usual eye was so pronounced and sharp that it made this a very rare and really exciting star chrysoberyl.

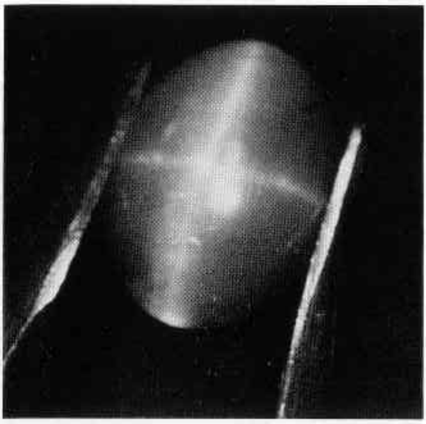

*Figure 1.*

### Inclusions in Natural Ruby

Another very unusual group of inclusions was encountered in a natural ruby. These are shown in *Figure 2* at 126x. Three irregular cavities appeared

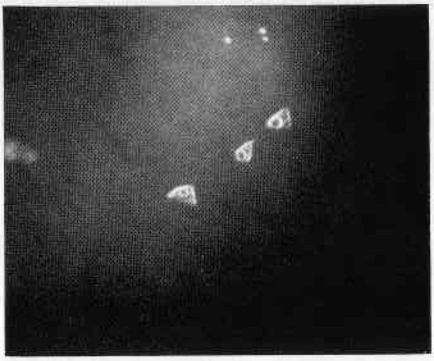

*Figure 2*

to be filled with a liquid and gas. In each of the inclusions there appears to be a bubble in a liquid. This is an unusual situation for a natural ruby.

### A Novel Cut

One of GIA's consultants in the optical field, Helio Associates of Tucson, designed an unusual cutting style without facets. They cut an example in glass. It looks like a facetless round brilliant with a buff top. The pavilion is a 41° cone and the crown appears to be a section of a sphere with a large radius. It is a highly efficient reflector, but, of course, has no scintillation. *Figure 3* shows a side view.

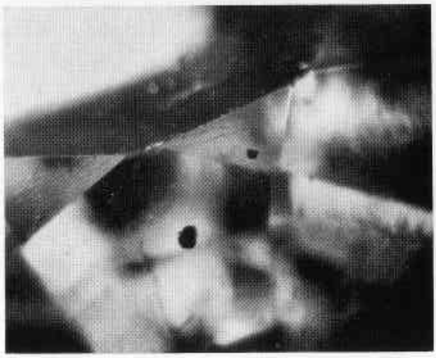

*Figure 4*

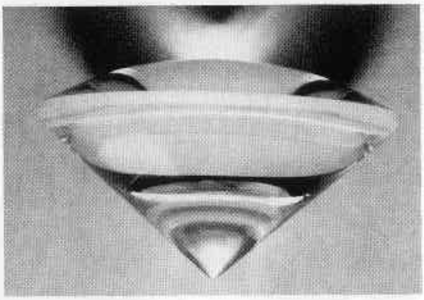

*Figure 3*

### Unusual Inclusions in Flame-Fusion Synthetics

*Figure 4* shows some opaque, angular inclusions in a Verneuil synthetic ruby. There were spherical gas bubbles elsewhere in the stone and curved striae. These did not look like the blobs of partially melted powder occasionally seen in synthetic ruby, but were dark and opaque. Some unusual dendritic inclusions in a synthetic sapphire are seen in *Figure 5*. It, also, had other factors, such as curved color banding which identified it.

### Cyclotron Treated Diamond

Today, one seldom encounters cyclotron-treated diamonds, and

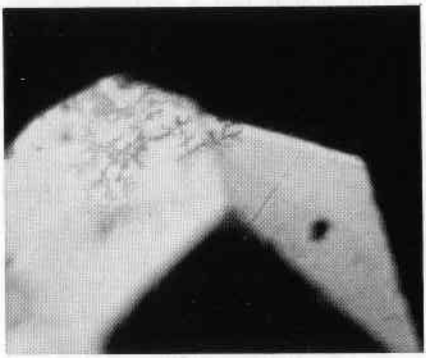

*Figure 5*

Figure 6

emerald cut cyclotron-treated stones are especially rare. The emerald cut shown in *Figure 6* was treated from the culet to a green color and remains a green color today – not having been heat treated to a canary color. The streak shown in the center of the photograph represents the culet of the stone and, near the top, the dark shadow going off to the left, represents a corner pavilion facet.

### A Rhodolite Pink Diamond

We had a 0.44 ct. diamond in for testing which had a body color that was almost a medium tone of slightly reddish-purple. It was very reminiscent of a good rhodolite color. The spectrum was very interesting; it had a moderately strong line in the red at 6390, a faint line at 6190 and a very faint line at 5960 Angstrom units and a fluorescent line at 5768 which is reversible to a faint dark line. The spectrum tended to be directional. The stone had a strong orange fluorescence

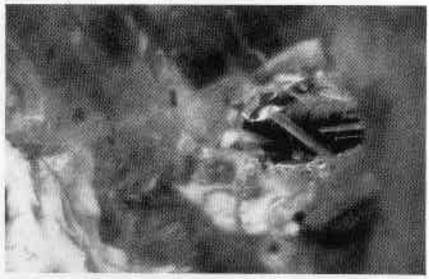

Figure 7

to long-wave ultraviolet and slightly less strong, of approximately the same color, to short-wave. It fluoresced to X-ray, but had no phosphorescence. It was not a conductor. This is a classic spectrum for treatment in a pink diamond. A 0.44 carat is large for a treated pink diamond.

### Negative and Positive Crystals

A short time ago, we received a broken star sapphire sent to us by a client as a horrible example of what could happen on the repair scene. In

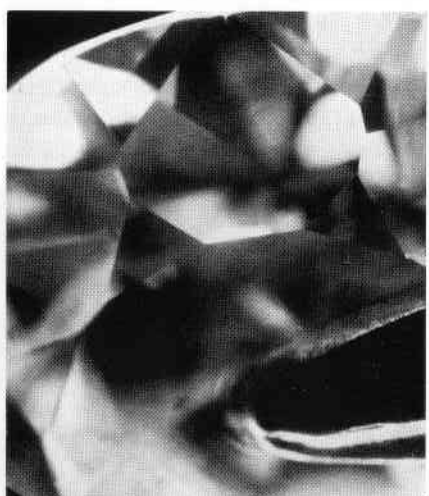

Figure 8

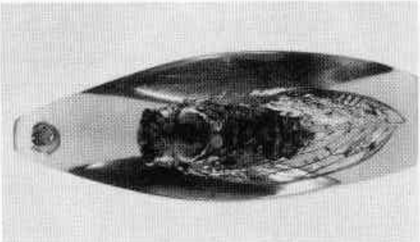

*Figure 9.*

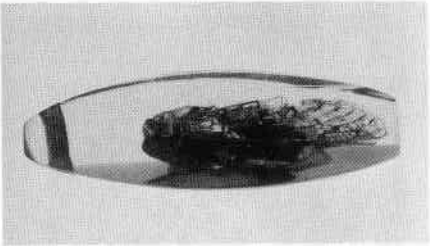

*Figure 10.*

the middle of the larger of the two pieces was a large negative crystal opening to the fracture surface. In the negative crystal were needlelike crystals growing from one side. These are clearly seen in *Figure 7.* We did not attempt to identify them.

**Incredible Cutting on a Diamond**

We received a stone for grading not long ago that was so poorly cut that the star facets failed to meet at the table by about the same length as their total width at the table. Pictured in *Figure 8* is a bezel facet that does not have the usual four sides, but ten - count them - ten.

**Cicada in Amber? No!**

*Figure 9* shows a top view of a cicada that was imbedded in a material resembling amber. The material turned out to be plastic, rather than amber. It had been built in layers and the colored layer shows well in *Figure 10*

**Odd Diamond Natural**

Bob Klippel of Ben Erlich Company in Los Angeles, donated to GIA a 0.05 ct. diamond which, when we first examined it, we thought had the first perfectly smooth, conchoidal fracture we had ever seen in a diamond. Since that didn't make sense, we studied it much more closely and realized that it was a natural. It is shown in white in the upper left side of *Figure 11.*

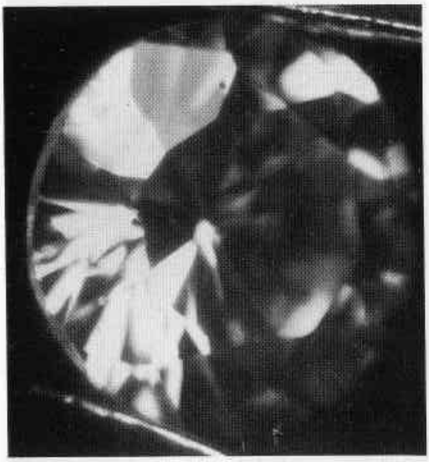

*Figure 11.*

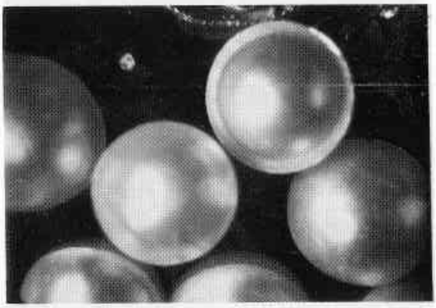

*Figure 12.*

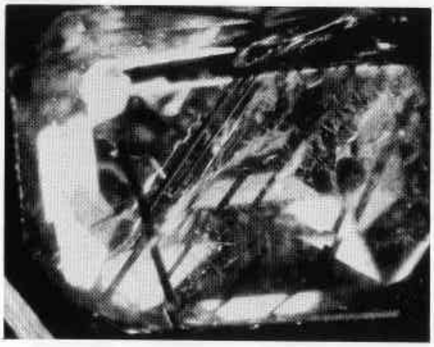

*Figure 13*

### A Mabe with an Unusual Center

*Figure 12* shows one of a pair of earrings set with numerous 4 mm. Mabe pearls. The one with the top missing had an imitation pearl center. This feature is new to us.

### Rutile in Emerald

Recently received for identification was an emerald with some relatively large needlelike inclusions. The inclusions were really larger than any needlelike inclusions we had encountered in emeralds for some time. In examining the stone, the near metallic luster and the squarish cross sections of the needles led Charles Fryer to the conclusion that these might be rutile needles. They are shown in *Figure 13.*

### Interesting Crystals in Opal

Graduate Gemologist Loreen Haas of Crown Gems brought in a number of Mexican opals in which two specimens had visible crystal inclusions. Two different crystals are shown in *Figures 14* and *15.* In *Figure 14* we couldn't really see enough of the crystal to be sure into what system it crystallized, but in *Figure 15* we were satisfied that it had crystallized in the monoclinic system.

### Flux Synthetic Ruby on a Flame-Fusion Synthetic Seed

*Figure 16* shows a rather thin flux

*Figure 14.*

*Figure 15.*

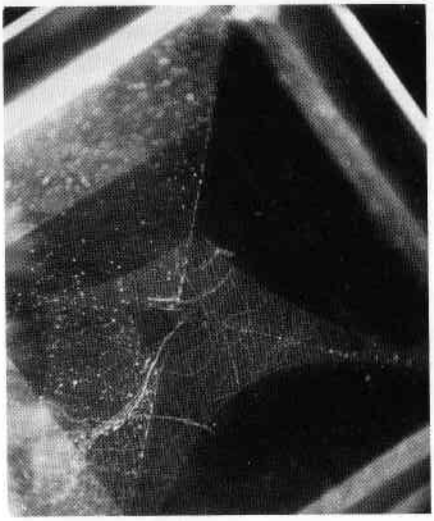

*Figure 16.*

growth near the culet of a combination flame-fusion and flux-melt synthetic ruby of which the larger portion was that formed by the flame-fusion method. This looks very much like the appearance of a Lechleitner synthetic emerald overgrowth on natural beryl, only in this case, it is flux-melt synthetic ruby on a flame-fusion synthetic ruby base.

Curved striae were readily visible in the flame-fusion portion and flux inclusions were visible elsewhere in this material in the flux-melt portion. In addition, there was a distinct purplish dividing line between the two portions of this synthetic ruby.


### Acknowledgements

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

To *Dr. Abraham Aronowicz,* G.G., from Berlin, Germany, for an interesting beryl triplet, to be used in the reference collection.

To *Joe Akers,* Hopkinsville, Kentucky, for numerous corundum crystals for our Colored Stone course.

To *Association of Japan Gem Trust,* Tokyo, Japan, for a collection of 12 synthetic star corundum of various colors, which will be used in the Resident Gem Identification classes.

To *Shonn Atkinson,* G.G., Fredericton, New Brunswick, Canada, for a collection of loose beach-tumbled peridot and obsidian from Hawaii for reference and class use.

To *Craig Beagle,* C.G., R.J., Chantry Square Jewelers, La Habra, California, for an assortment of rough and cut stones including opal, quartz, chalcedony, malachite, pearls and pyrite in matrix, for reference and class use.

To *Chappell Jewelers, Inc.,* Wilmington, Delaware, for an interesting natural blue sapphire weighing 1.17 carats, which will be put to good use in our Resident Colored Stone courses.

To *Thomas Chatham,* Chatham Created Gems, Inc., San Francisco, California, for a cluster of Chatham's new synthetic blue sapphire weighing 39 carats, for our new display case and reference collection.

To *Rock Currier,* G.G., Jewel Tunnel Imports, San Marino, California, for a gift of a faceted natrolite and an unusual transparent faceted smithsonite, for our reference collection.

To *Dobie Jewelers,* Royal Oak, Michigan, for a selection of natural opals, zircon, onyx, synthetic star

sapphire, garnet and glass doublets, to be used in our Gem Identification classes.

To *Felco Jewel Industries,* through the good offices of Mr. Morton A. Lippman, President, Rio Rancho, New Mexico, for a donation of a large number of rubies and sapphires that will enable GIA to teach Colored Stone-Grading and Appraisal in classes. The rubies and sapphires have a value of over $25,000.

To *Loreen Haas,* G.G., Crown Gems, Sherman Oaks, California, for a large amount of plastic treated turquoise, to be used in Resident and Correspondence test sets.

To *Mark Hal Jacobi,* ex-student, Casa De Verde Jewelers, Atascosa, Texas, for a very generous gift of miscellaneous rough material including: chalcedony, shell, lapis-lazuli, nephrite, tiger-eye, calcite, chrysoprase, red and black coral, opal in rhyolite matrix and chrysocolla in quartz, and cut stones including synthetic corundums and spinels, opal, glass, chalcedony, pearls, obsidian and other materials, for use in class identification stones and our Correspondence Course test sets.

To *Harry Levitch,* Student of GIA, Harry Levitch Jewelers, Memphis, Tennessee, for two colorless zircons and numerous broken pieces of peridot, apatite, and natural emerald for Resident Gem Identification Student test sets.

To *Dr. Donald Marchbanks,* Created Gem Imports, Salina, Kansas, for a generous selection of Gilson synthetic emerald and turquoise (with and without matrix) for use in our Resident Program and Correspondence courses as well as for our reference collection and traveling demonstration sets.

To *Irving Michaels and Company,* New Haven, Connecticut, for an assortment of synthetic spinels, synthetic sapphires, citrine, quartz, and synthetic spinel triplets, as well as other gem materials to be used in our Gem Identification classes.

To *William Mosandl,* Pasadena, California, for a specimen of dumortierite and other rock specimens, for our reference collection.

To *Naomi Muramatsu,* G.G., Los Angeles, California, for a tortoise shell bracelet, a cabochon of dyed pink tiger-eye quartz, faceted glass mounted in a pendant, and a specimen of faceted glass mounted in a ring, for class identification stones.

To *Edward Oran,* Jubilee Products, Los Angeles, California, for two samples of Gotham Created Rubies, for our reference collection.

To *Pennsylvania Gem Company,* Pittsburgh, Pennsylvania, for an assortment of natural stones consisting of quartz, amethysts, rose quartz, chalcedony and garnet for our student test sets.

To *Dean Shur,* GIA Student, Lincoln, Nebraska, for five rock crystal "Herkimer Diamonds," for use in our Gem Identification classes.

To *Marcus Switzer,* GIA Student, Switzer Faceting School, Manhattan Beach, California, for a faceted round brilliant 0.80-carat strontium titanate and part of the boule. Also, eight spinels of various colors and other miscellaneous stones from Burma and Ceylon gem gravels. This material will be put to good use by our students in the Gem Identification classes.

To *Wetzel and Truex,* Norfolk, Nebraska, for an assortment of cut stones including glass, bloodstone (heliotrope), natural opal and several agates, for class identification and reference use.

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**EDITORIAL NOTE** concerning an amendment to the "Internal World of Gemstones" by Dr. E. Gübelin.

Dr. Gübelin had a recent opportunity to acquire several small hessonites from Ceylon, all excelling in that well known granular look caused by a dense dissemination of minute guest minerals, which offered the welcome chance of carrying out a more careful and accurate examination of these mineral inclusions. Several of the guest minerals in each hessonite were subjected to an electron microprobe analysis, and in each case the mineral inclusions were identified as being *apatite.* This result causes an amendment to be made in his book, and Dr. Gübelin invites readers to alter the caption of the center right illustration on page 166 so that it reads:

"Hessonites from Ceylon are recognizable by their 'granular' appearance which is provided by grains of apatite" (instead of "diopside or zircon" as thought previously).

# An Easy Method of Measuring the Depth of a Mounted Transparent Stone in a Closed-Back Setting

By JOSEPH O. GILL, C.G., F.G.A.
Boston, Massachusetts

Those who deal with estate and antique jewelry have always found it necessary to remove a stone mounted in a closed-back setting in order to obtain its weight. Stones where the pavilion is accessible may be measured directly and a formula can be used for a fairly accurate weight estimate. These formulas are obtainable through the GIA and are very simple to use with only a small amount of practice.

I was recently asked if there was any way to obtain an accurate depth for stones in a very valuable antique sapphire necklace and bracelet, where the sapphires were set in a closed-back bezel setting. From direct vision there was absolutely no way to even guess at the depth. Only the length and width could be measured; and without the depth, the stones would have to be removed from their fragile old settings to be weighed. The settings would be damaged and this is, of course, out of the question when you are buying and handling other people's property.

I recalled the "Herbert Smith Memorial Lecture"(1) given by Mr. Basil Anderson, F.G.A., in London in 1955. Mr. Anderson spoke on "The Refractometer and Other Refractive Index Methods." He discussed the Duc de Chaulnes' method of using the microscope to obtain the refractive index of any transparent stone, no matter how high or low its refractive index. Briefly, by measuring the depth by direct measurement and dividing that by the apparent depth, one can easily calculate the refractive index. The apparent depth is found by measuring the difference in microscope position between focusing on the culet, or bottom of the stone, and focusing on the surface of the table (or highest point on a cabochon).

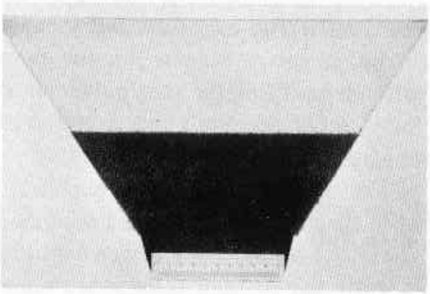

*Figure 1. Table gauge with millimeter measurements set in microfilm. Accuracy in a range of ±.05mm.*

Mr. Anderson briefly mentioned that by measuring the apparent depth of a flaw or inclusion and multiplying that by the refractive index, one can obtain the real depth of the inclusion. This method would be helpful in recutting a stone and is now used in the precise location of dark inclusions in a diamond to be lasered.

Closer to our needs, in July, 1973, Mr. Harold Oates, F.G.A., discussed the Duc de Chaulnes' method in great detail.(2) Briefly, he explained the benefits of the dial-type depth gauge in arriving at an accurate measurement of the apparent depth. At the end of his detailed article he made a short note concerning diamonds mounted in closed-back settings. He said that by multiplying the apparent depth by the refractive index you get the true depth of the mounted diamond.

Oates' paper indicated that by using the Duc de Chaulnes' method for diamond but substituting the appropriate refractive index of any given stone, and multiplying that by the apparent

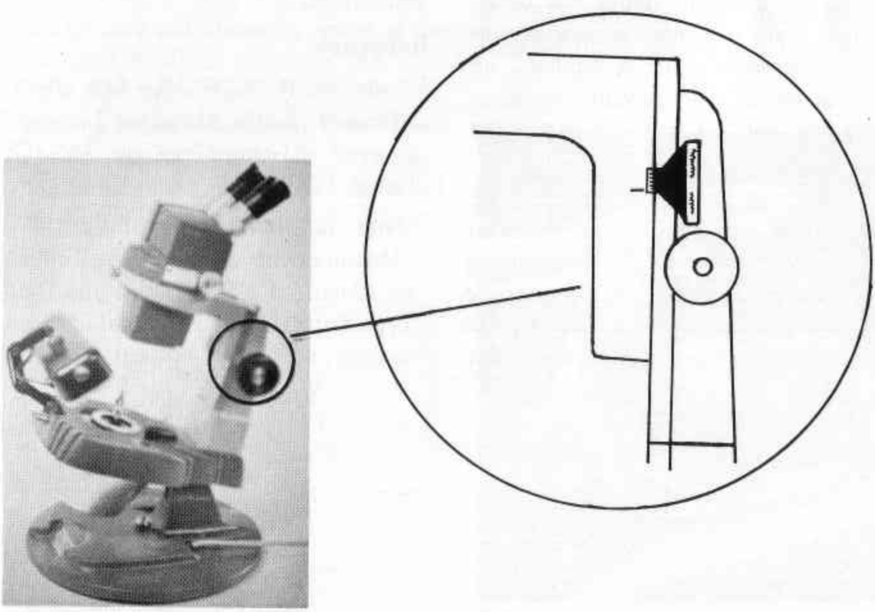

*Figure 2. Gemscope microscope with 40X magnification and stone holder.*

depth, one could obtain a relatively accurate reading of the real depth.

This sounded good in theory but had to be tested in practical application.

The table gauge *(Figure 1)* was taped to the stationary side of the Gemscope just above the adjustment knob, and the measuring bar of film was positioned parallel to and just over the edge. Then the stone was inserted in the stone-holder in a workable position and the Gemscope run down to focus on the culet. By placing a small mark on the moving side of the Gemscope, opposite the zero on the table gauge, a zero point was established (see *Figure 2*). From this zero point adjustment knob was turned until the focus was moved from the culet up to the table of the stone. Then, by reading the point on the gauge opposite the new position of the mark, the apparent depth was determined. Only one mark is necessary as each successive stone is adjusted up and down in the movable tweezers until the culet is in focus while the zero point is in place.

Using this very simple method, fifteen loose stones of several different species were tested. By multiplying the apparent depth by the appropriate refractive index I found that I came within .05mm every time. The thicker the stone examined, the more accurate the results. The culet was always used as the zero point because it is the more difficult point of the two on which to focus. Mr. Anderson's speech, referred to earlier, agreed with this point.

For even better, more reliable results than the quick method described above, I am sure that a device could be constructed to hold a leveridge gauge in the appropriate position to substitute for the awkward table gauge which can be read accurately only with a 10X loupe.

The results are as close as an estimation can be and the process is extremely easy. This formula will give accurate refractive index readings well above or below the range of the refractometer and will help in calculating weight estimation.

I feel that this method will prove to be a very helpful tool to the practical gemologist.

**References**


[1] Anderson B. W., F.G.A., July, 1955, "Herbert Smith Memorial Lecture," *Journal of Gemmology*, pp. 166-178 (see p. 176).

[2] Oates, Harold A., F.G.A., July, 1973, "Measurement of Refractive Indices By Means of a Microscope and Dial-Type Depth Gauge," *Journal of Gemmology*, pp. 270-274 (see p. 274).

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

By ROBERT CROWNINGSHIELD

### Some Diamond Inclusions

In the course of cutting a 50-carat rough diamond one imaginative cutter decided to eliminate a central cloudy area by cutting a cube in which the cube-shaped dark cloud can be seen to enclose a cross. The combination of unusual appearance together with the unexpected reflections by virtue of the diamond medium combines this 8.55 carat specimen one of the most intriguing we have ever seen. (See *Figure 1*). In *Figure 2* we see a roughly hexagonal white cloud with a six-rayed cross which was photographed in a fancy natural brown diamond. While mentioning inclusions in diamond we would like to thank the firm of J. C. Keppie Co., Pittsburgh, for a beautifully cut round brilliant containing a bright green inclusion which we believe to be chrome enstatite – though possibly chrome diopside. Also we wish to thank Gem Trade Laboratory

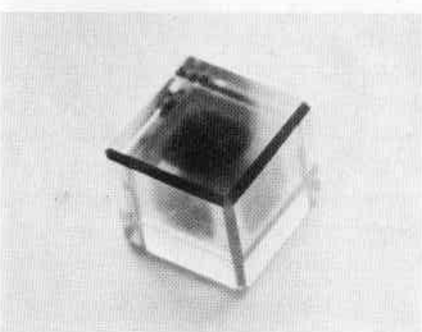

*Figure 1.*

*Figure 2*

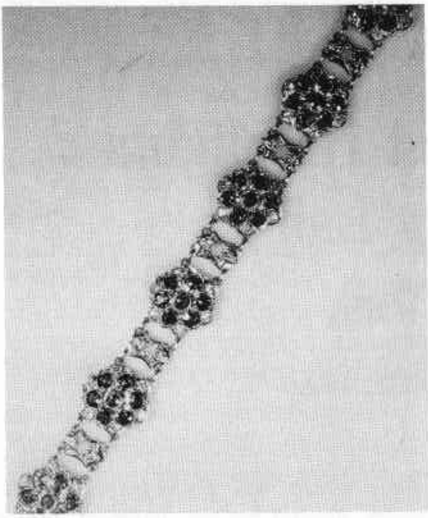

Figure 3.

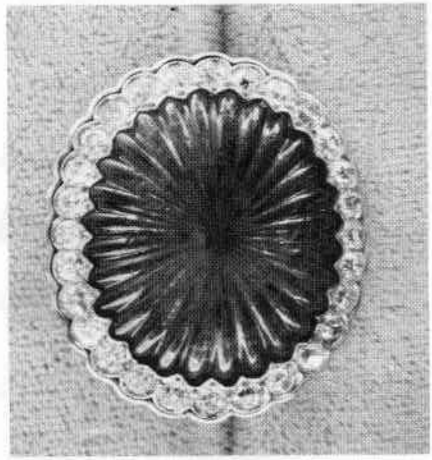

Figure 4.

member John Schupf, New York for another round brilliant cut diamond for our collection which contains a most unusual and indescribable inclusion.

### Rarely Seen Matched Spinels

In *Figure 3* can be seen part of a platinum and diamond bracelet containing natural red spinels of superb quality – so fine, the client wanted to know if they were natural or synthetic rubies. Similar fine red spinels have been shown to the staff in recent months under the term "soft rubies."

### Lapidary Art Rescues An Indifferent Emerald

Undoubtedly the natural emerald shown in *Figure 4* would have been unsaleable if it had been faceted or even cut into a normal cabochon. It was heavily included and not particularly dark in color. However, by melon cutting the cabochon the inclusions were effectively disguised and the jeweler designed the setting to harmonize with the fluted edges to produce a most happy result.

### GGG In The News

In March, the New York District Attorney called to alert us to a fraudulent practice that had been reported to his office. It seems that a neatly dressed man has been visiting jewelers for the purpose of selling an engagement ring with what appears to be by estimation a diamond of 0.75 carats. Presumably, a broken engagement prompts the sale and the confidence man does not claim the stone to be a diamond. Only after the jeweler parts with from $250 to $350 removes the stone from the setting and finds that it weighs twice his estimate does he become suspicious.

### A Diamond Color Mystery

Recently the laboratory had a telephone call from a consumer in New

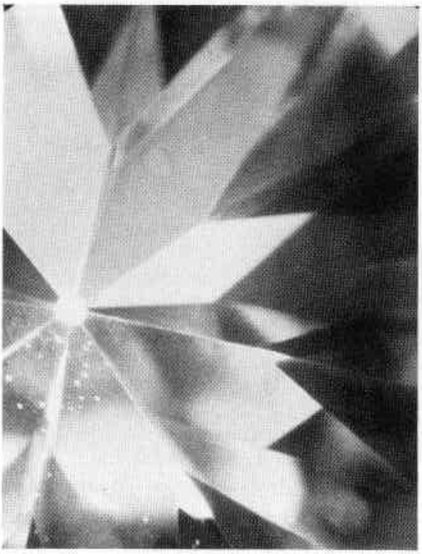

Figure 5.

England who had noticed that his wife's engagement diamond was becoming yellow in color. The jeweler to whom he took the ring steamed it as well as exposing it to ultra-sonic to no avail. The jeweler suggested that he call us. On a hunch I asked the gentleman about the quality of the water they use. "Funny," he said, "the stone only became noticeably yellow the past eight months following our move to our present home. You would be amazed to read the water analysis report on our well." He sent the ring to us and we repeated the jeweler's attempts again to no avail. In the microscope we noticed a yellow-brown build up under the prongs and decided to dip the ring in concentrated hydrochloric acid. Presto! The stone came out sparkling clean and colorless. Some years ago a jeweler in Chicago told the writer of a similar experience which prompted the thought that local water was the culprit in this case too.

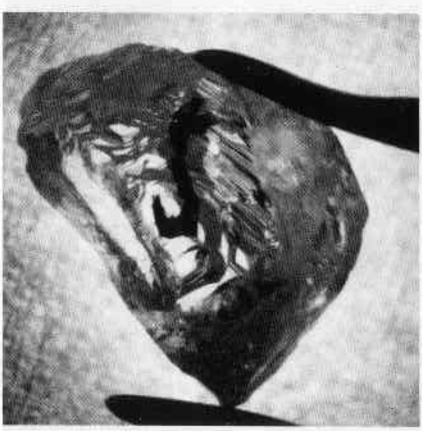

Figure 6.

**Follow-Up On A Blue-Gray Diamond**

The painted blue-gray diamond described in the last issue of *Gems & Gemology* was returned by other clients a number of times. The last time we were able to photograph an oval spot where the coating was thin *(Figure 5)*.

**Diamond Inclusion Oddities**

A 7.76-carat irregular rough diamond crystal was shown to us by Lazare Kaplan & Sons because of a striking black "S" lying in the mid-plane of the stone. It was not possible to determine if it were an impurity along a separation plane or an actual plane of black inclusions *(Figure 6)*. In *Figure 7* we captured two nearly ideal "bubbles" lying near some small fractures. We have never seen such sphericity in diamond inclusions.

**Diamond Shapes**

Occasionally we have to invent

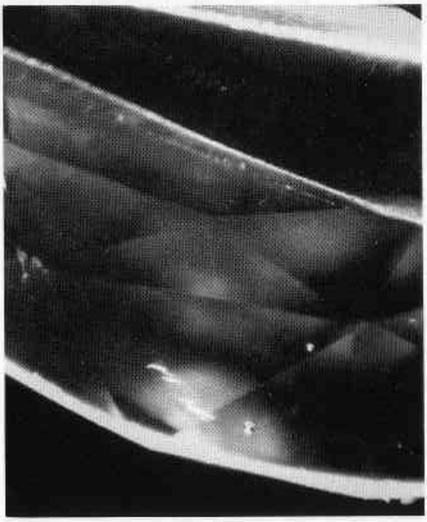

Figure 7

names for shapes and cuts of diamonds that have not been common enough to enter the literature or dictionaries. One shape for which a name seems in order is that in which the stone is neither an oval or a marquise *(Figure 8)*. We would like to propose a term we have occasionally used – "marquise oval." We have found it to be generally well understood and readily visualized.

**True Antiques and Reproductions**

*Figure 9* illustrates what is pur-

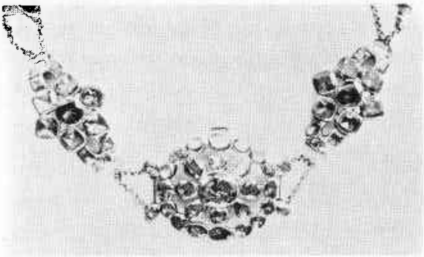

Figure 9

Figure 8.

ported to be part of a necklace consisting of silver gilt metal and thin foil-backed almandite garnets belonging to Martha Custis before her marriage to George Washington – if the moldering documents accompanying the jewelry are to be believed. The cross shown in *Figure 10* is clearly a reproduction in spite of the fact that it too is silver gilt with true diamond chips and synthetic blue sapphire.

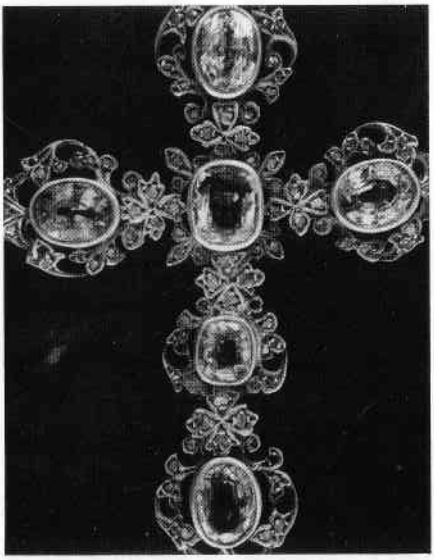

Figure 10

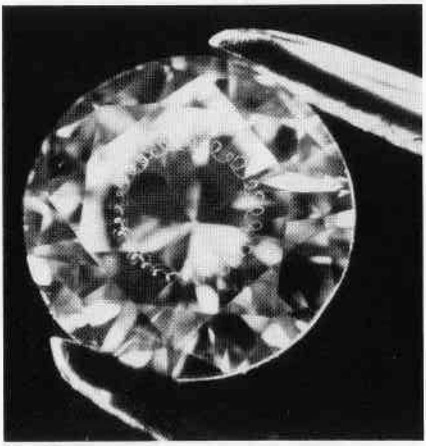

*Figure 11*

## What Did It?

For the life of us we are unable to come up with the answer to the cause of the complete spiral scratch on the table of the diamond in *Figure 11* Because it is so regular it seems almost too complete to be intentional. Could it be due to a faulty tool or technique?

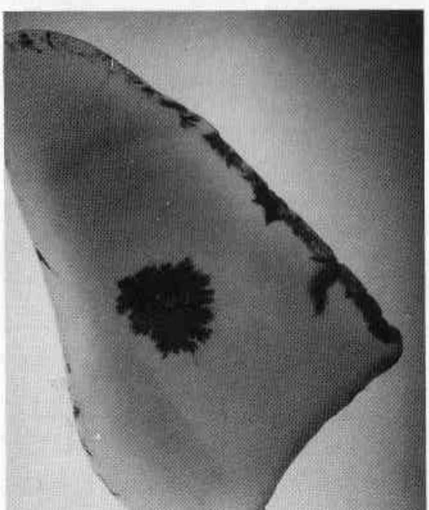

*Figure 12.*

## How Did He Do It?

The slab of pale dyed green chalcedony given to the writer on a recent trip to California by Leon Trecker, G.G. of Laguna Hills, contained a very natural looking moss-like inclusion. Presumably, it is an artificially precipitated copper inclusion. The guess is that it has occurred as the result of an electrical application *(Figures 12 and 13).*

## Imitation Opal

According to Mr. John Slocum, whose imitation opals were described in the Winter 1974-1975 issue of *Gems & Gemology,* the product has entered the market by way of mineral and gem dealers and gem and mineral shows where both cut and rough material has been readily accepted. In addition to stones which resemble both white and black opals, Mr. Slocum has manufactured some stones with a pink body color and others with blue and orange body colors. Some stones have also been faceted. In most of the stones the color seems to

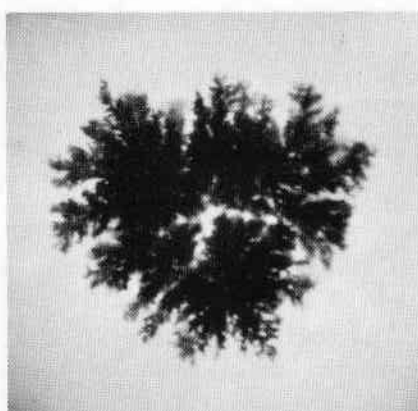

*Figure 13.*

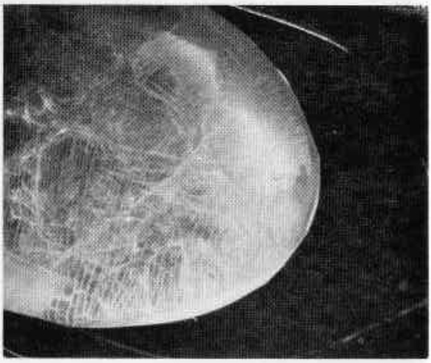

*Figure 14.*

come from thin plates or flakes suspended in the colored (or colorless or milky) mass. *Figure 14* shows a mosaic of thin flakes in an orangy-bronze stone with peculiar fingerprint or cob web-like inclusions.

**Dyed Quartzite**

In *Figure 15* is shown a group of green to variegated green and white cabochons submitted for testing. The physical tests indicated quartz but the only clue to the origin of color was the presence of a broad absorption band at 6700 Å in the hand spectroscope. There was no fluorescence and no color filter reaction. Also, there was no reaction to color by hydrochloric acid. However, a short heating in the acid completely destroyed the green color leaving the stone nearly opaque and black (the darker stone in *Figure 16)*. The identification was written: "Dyed Quartzite."

**Unusual Diamonds**

We have encountered several novelty cuts of diamond recently. One consisted of apparently a normal round brilliant into which notches were cut to make a 6-pointed star.

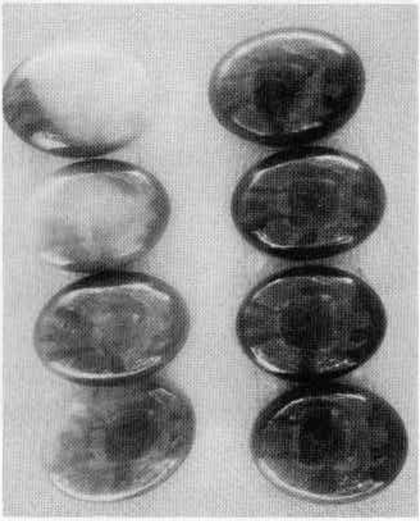

*Figure 15.*

With the 8-fold symmetry of the round brilliant, the 6-fold symmetry of the star does not "jibe" and the whole looks haphazard. More recently we have been seeing some 6-pointed stars with 6-fold symmetry. The notches appear to be faceted the way

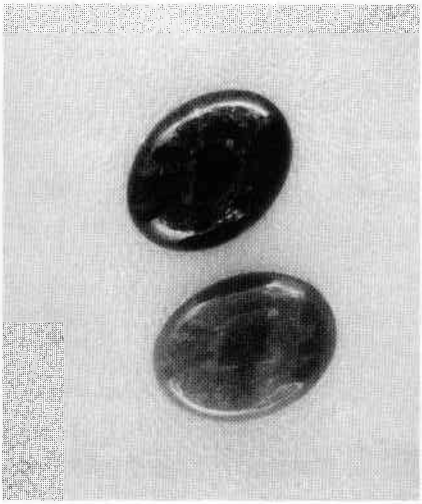

*Figure 16.*

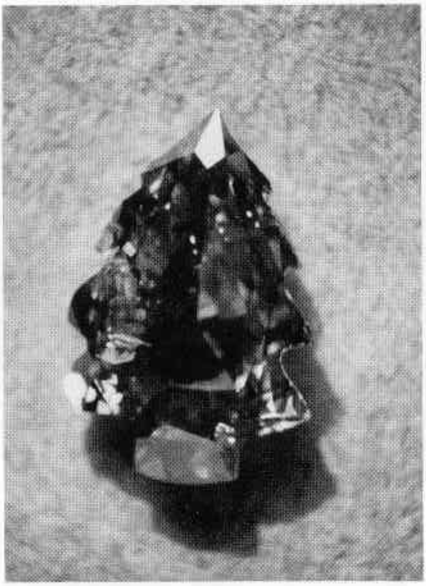

*Figure 17*

the notch is put into a heart-shaped stone. An adaptation of the same technique was evidently responsible for the treated blue-green Christmas tree-shaped stone seen in *Figure 17.* It was evidently made from a former pear-shaped brilliant.

Laymen and some jewelers are often unaware of the fact that diamonds can break. When a stone is damaged in an engagement ring, it is a traumatic experience and in his or her frustration the owner frequently lashes out at the jeweler for selling him a "bad stone." In *Figure 18* we see such a broken stone. A blow on the girdle has split off a typical portion of the stone which eliminated the culet. *Figure 19* shows that the stone had a normal crown angle and medium girdle. Whether or not the unpleasant lawsuit could have been avoided by giving the buyer the information about diamond's durability and the need for insurance in the rare case that it is broken is hard to say. Perhaps it would not be wise to bring home the point by showing the customer *Figure 20* which is a normal marquise broken during the course of repairing it or *Figure 21* which is a 3.80 fine round brilliant that completely shattered while the brillianteerer was putting the final shape to the lower girdle facets! We are indebted to Gem Trade Laboratory member Goldberg-Weiss for the latter stone which now graces our collection.

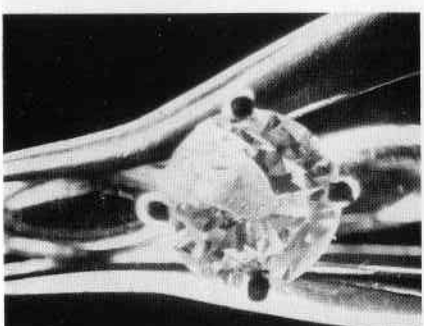

*Figure 18*

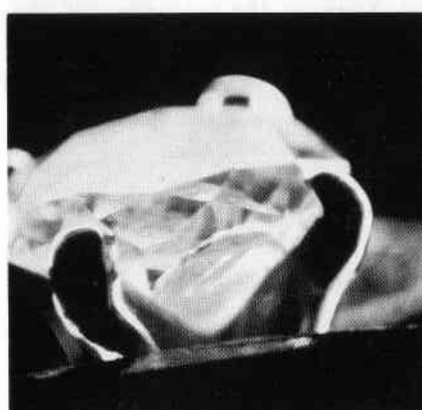

*Figure 19*

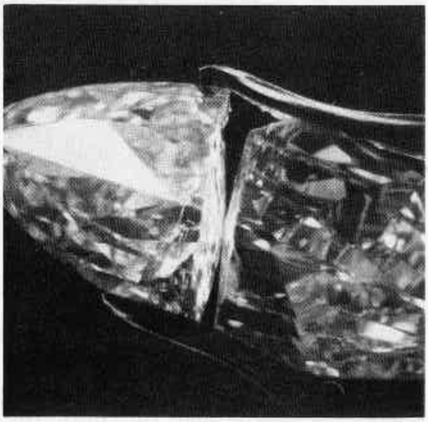

*Figure 20*

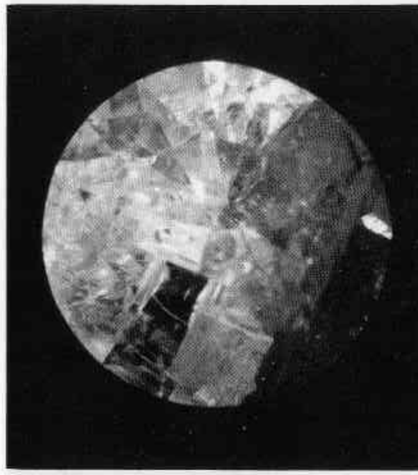

*Figure 21*

We mentioned unusual shapes of diamonds in the last issue such as a "marquise oval." In *Figure 22* we see what we feel is best described as a cushion antique step or emerald cut. In *Figure 23* we are shown a number of small distorted octahedra on which from one (a ducut) to 5 (a Prinz cut?) facets were polished. We have been told that a family of diamond cutters tried to popularize a simple 5 polished facet octahedron under the name Prinz Cut. Some of the octahedra (of the type used in glazers tools) were so bright naturally, that by merely putting one facet on the stone (the table) a quite respectable looking product was produced. It was named the Duke Cut (maintaining the royal sound of the family name). Later as these simple stones were accepted they became known as "ducats," "ducuts" or merely "dukes." Needless to say, under Federal Trade Commission Rules

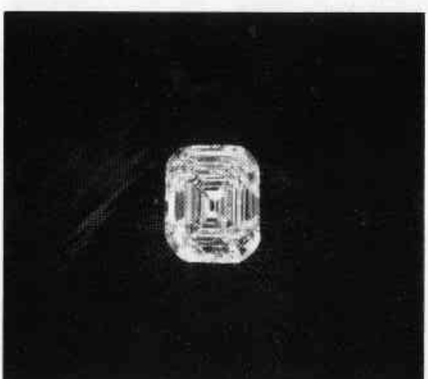

*Figure 22*

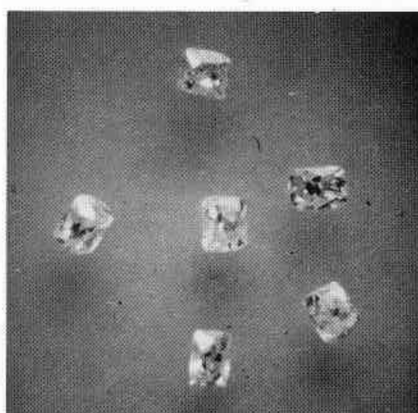

*Figure 23*

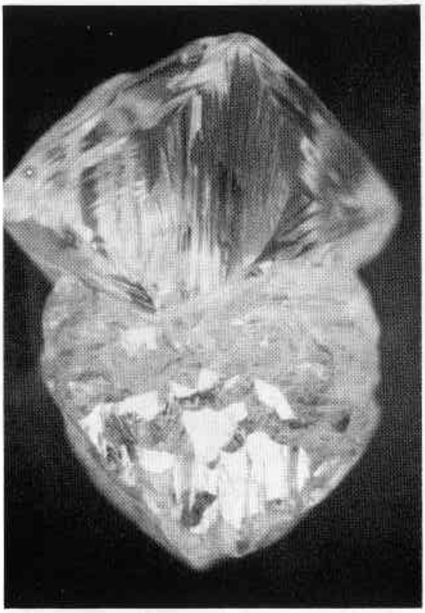

*Figure 24*

the name must be used since under the rules no diamond with fewer than 17 symmetrically placed facets can be called diamond alone.

We are indebted to Mr. Paul Kaplan, grandson of famed Lazare Kaplan, for his continued interest in bringing unusual rough diamonds to our attention. *Figure 24* is one such stone. How two widely dissimilar octahedra could have intergrown is a mystery. We are also indebted to Paul for a fine presentation and demonstration of cleaving for our New York full-time resident class. Included was a 3-minute movie of his grandfather and father cleaving the Jonker diamond.

**Acknowledgements**

We wish to express our sincere thanks for the following gifts and courtesies:

To *Ellyn Fine* of Fortunoff, Westbury and New York City, for an important donation of many hundreds of stones both synthetic and natural with many being broken examples of the latest types of hoops and bangles. These will find good use in our sets. Among the more unusual stones in this gift is a fractured but very good example of a 12-ray black star sapphire in which alternating rays are blue and brown.

To our old friend, *Joe Dattoli,* for a handsome specimen of Sicilian sulphur which now graces the new mineral and gem cabinet in the full-time resident classroom.

To *Bill Larsen* and his staff for a fine round "Himalaya" pink tourmaline which has the typical color of stones from this mine.

# Book Reviews

*HOW TO INVEST IN GEMS, by Benjamin Zucker. Published by Quadrangle/The New York Times Book Co., New York, 1976. 120 pages. Hardbound with numerous illustrations. Price: $12.50*

To come to the point quickly – there are reservations about the book. The premise: Gemstones in the reviewer's opinion are *not* an investment.

Consider what is involved:

This reviewer has lectured on gems for the past 40 years. A leading question always asked: "Are gems an investment?" My answer – frankly, no!

Since everything revolves around the mighty dollar, the comments made in this review are based on prices as of now. For gemstones, they are skyhigh.

A case in point: During October, at Parke-Bernet auction galleries, a 44.61-carat sapphire was sold for $290,000 – a new high for a gem, *Ceylon* sapphire.

In this instance, investment was not an angle. Ownership of a superb sapphire was!

To continue: About 10 years ago, a magnificent Oriental pearl necklace was sold for $50,000. It had been purchased from Tiffany & Company in the 1920's for $600,000. Keep in mind that in those years, a dollar was worth a dollar!

An investment? Hardly.

Next, take the case of the Nassak diamond. Flawless and "D" in color. The famous, historical emerald-cut diamond weighing 43.37 carats was appraised in 1969 for $1,000,000.

This reviewer working with the diamond received an offer of $500,000. The owner, a Britisher, turned the offer down.

Shortly thereafter the Nassak was sold at auction for $400,000.

Had the diamond been auctioned in London, at the time a British pound was worth $2.84, consider what the situation would be today, with the pound valued at $1.66. "Investment" in gemstones can be a precarious business.

A Richard Burton might conceivably have paid $1,000,000 for a diamond of this size, and bought this famous diamond for his then equally famous wife. With his resources, getting his money back in full would not be a matter of concern to Richard Burton!

Turning to the text, one finds on page 23 a statement to the effect that "I advise you (the reader) to purchase your gems from a fine, retail establishment, even though you admittedly pay a retail mark-up."

An amazing statement from one who is a wholesaler in the jewelry industry and one who is trying to interest the reader in investing in gems!

Frankly, a retail jeweler could be hurt in a situation of this kind. For example:

A customer purchasing a diamond ring from Cartier or Tiffany for $500,000 is going to be shocked to learn what he or she would be offered for the stone, if at some later date the decision was reached to dispose of the diamond.

In the chapter on rubies, Zucker discusses stones of Burma, Siam, Ceylon and African origin. He makes this observation (speaking of color): "Unfortunately, color differentiation isn't all that simple."

This reviewer has seen Siam rubies which rivalled the finest Burma gems in color. It doesn't happen very often, but it does occur.

Zucker next comments on sapphires, and continues with a chapter on emeralds. Here he discusses stones of Muzo, Chivor, Sandawana and those of Brazilian origin.

The reader will find his chapter on diamonds informative. Gleaned from many sources, Zucker's material is combined in a few short pages.

The book would not be complete without mention of prices. The reader is directed to Table 1 on page 80. Titled: "Current Prices of Colored Stones and Diamonds of Fine Quality" (at prices per carat). Zucker does not state that the figures are wholesale, but if you are in the stone business, you know that they are.

A feature of the book covers: "Investment Portfolio for Gems in the $5,000, $20,000, $100,000 and $1,000,000 range."

The 120-page publication contains a collection of carefully chosen photographs. The plates enhance the text.

The book is favorably priced at $12.50. Buy it and judge for yourself.

*A. E. Alexander, Ph.D.*