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SUMMER, 1972

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UNUSUAL QUARTZ INCLUSIONS IN NORTH CAROLINA EMERALD

By
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Quartz inclusions have often been noted in the common varieties of beryl and P. W. Johnson *(Journal of Gemmology, 1961)* has documented their presence in the emerald variety of beryl from the Chivor gem mines. Inclusions of quartz, in emerald, which have an equant form, bear numerous mono – or poly-phase inclusions and are characteristic of an entire deposit can, however, be considered rather unique. Not only do such characteristic inclusions fingerprint the material from that specific deposit or area, but they can also become important as tools in unravelling the genesis of the deposit.

Figure 1 – Emerald matrix with numerous quartz inclusions, randomly spaced and oriented. Quartz healed fracture in upper portion. X-nicols. 5 x 8 mm.

Recent work on emeralds from the Little Switzerland, North Carolina emerald mine has shown that quartz inclusions occur in the emeralds at all levels of the mine workings – from surface outcrop to the present 150 foot depth. A very small number of the emerald crystals taken from the mine contain a large number of quartz inclusions such as the specimen illustrated in *Figure 1.* Some contain from a few to a moderate concentration. The majority of the emerald crystals, however, contain no – or very few – quartz inclusions. All quartz inclusions are dispersed through the emerald crystals at random. If one were to express the concentration as zones, they would have to be

described as rather nebulous zones roughly parallel to the base or to one side of the emerald crystals. There appears to be no zonation of quartz bearing emeralds in the deposit.

The quartz inclusions are unoriented with relation to the crystallographic axis of the emerald matrix *(Figure 1)*. Polarization further reveals random crystallographic orientation of the quartz crystal inclusions relative to themselves *(shown in Figure 2)*. No incipient or established crystallographic zonal patterns could be ascertained.

Variations in the concentration of quartz inclusions within the emerald matrix is well recorded in *Figure 1*. In this single crystal, heavy, medium, and light concentrations of inclusions occur while some portions of the emerald matrix are completely void of any quartz inclusions. A correlation between the concentration of quartz inclusions – in any single emerald crystal – with other more "normal" emerald inclusions (the more normal emerald inclusions are here defined as acicular tubes parallel to the C axis, pyrite, and other single, or poly-phase inclusions) was found to exist throughout the emerald content of the deposit. When quartz inclusions were present in heavy-to-moderate concentration, no other inclusions occurred in the emerald matrix. As the concentration of quartz inclusions dropped below moderate levels,

Figure 2 – Pseudo-isometric and rounded quartz inclusions showing in turn a variety of mono-phase inclusions. X-nicols. 0.2 mm. from face to face of the pseudo-iso shaped quartz crystal.

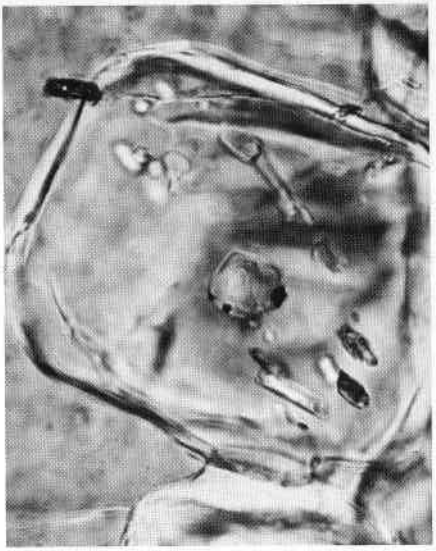


Figure 3 – Quartz inclusion of pseudo-isometric form showing in turn numerous elongate-shaped mono-phase inclusions. Grain contact is apparent, not real. X-nicols. 0.2 mm. from face to face of quartz crystal.

"normal" inclusions began to appear in the emerald matrix and as the emerald matrix became free of quartz inclusions, the "normal" inclusions could rise to high concentration of jardin. (The modifying word "could" is used because many emeralds – nearly clear of any type of inclusion – were encountered.)

Although the photomicrographs would, at first glance, seem to indicate contact of the quartz inclusions *(Figures 1, 2 and 3),* the author could find no contact except in vein fillings *(upper portion of Figure 1)* where the filling consisted of nonoriented contact grains. Thick sections as well as whole emerald crystals were immersed in oil media and used for study, so the apparent contact is simply the result of grain overlap caused by a large depth of field. Further, what appear to be large inclusions in some cases, are simply a number of close overlapping quartz inclusions with the same or nearly the same crystallographic orientation *(Figure 1).*

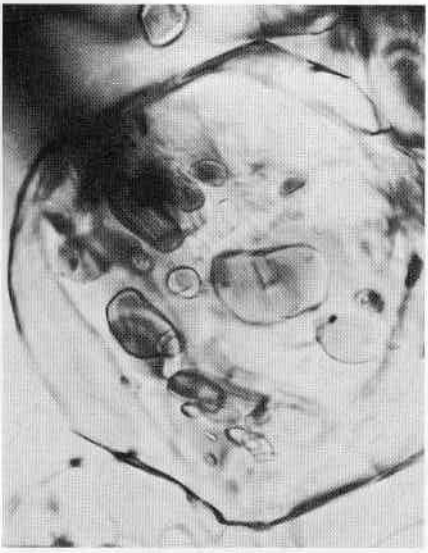
Morphology of the included quartz grains varies greatly in any emerald crystal and this variation is apparently random. Hexagonal quartz forms are encountered but these are quite rare. Irregular to irregularly-rounded grains predominate, but scattered among these are a large number that possess pseudocubic *(Figures 2 and 3)* or pseudotetragonal-appearing forms with moderately rounded corners. The presence of this type of form for a hexagonal inclusion in a hexagonal matrix certainly raises questions. It is hoped that with more study, these variations may shed some light on the genesis of the emerald crystals.

Because of the closeness of refractive index values for quartz and emerald, the quartz inclusions are not readily apparent. Immersion in a liquid of refractive index close to either mineral and crossed polarization, however, accentuates the difference, especially under magnification *(Figures 1, 2, 3 and 4).*

Unless the quartz inclusions are very abundant, the color of the matrix is not lightened appreciably.

Because emerald is more brittle than quartz, a fractured surface of emerald containing quartz inclusions has a characteristic pebble-grained

Figure 4 – Irregular, rounded (possibly hexagonal) form of quartz inclusion showing in turn numerous irregular, flat included crystals of mica. X-nicols. Approximately 0.2 mm. across face of quartz crystal.



effect with the nonfractured quartz grains standing out in relief from the emerald surface. On polished surfaces, however, because of the differential hardness, the quartz grains assume a negative relief on the emerald matrix surface. This is evident as light is reflected from the surface and is accentuated by the difference of refractive index and reflective qualities of the two materials involved.

Outside the external morphology of the quartz inclusions, their own content of numerous and varied inclusions is also quite unique. The author encountered only single-phase inclusions in this study. Because two or more phase inclusions are normally encountered in quartz crystals, however, it is possible they might be present in the quartz inclusions of this study. If so, lack of resolution at high magnification may be one reason for not recognizing them. What appear to be two-phase inclusions in the illustrations are only apparent. They are simply single-phase inclusions that overlap in space and reflect the depth of focus in the thick section of crystal. As the microscope focus is raised or lowered, it can be seen that they are separate and discrete inclusions in the quartz matrix.

Mica (muscovite) crystals predominate as inclusions in the quartz grains *(Figures 2, 3 and 4).* Their morphologic outline is irregular-to-rounded, except when viewed perpendicular to their C axis when they are tabular in form. A planar arrangement is evident and is probably coincident with the basal plane of the quartz structure. Other transparent crystals occur that have recognizable hexagonal, cubic, acicular or nondescript shapes and reflect a variation of optic properties. Minor opaque inclusions occur in either regular, to irregular elongate or cubic forms. A further study of the inclusions in quartz and the genetic implications is in progress.

Although many inclusions similar to those found in the emeralds of other deposits and locations occur in the Little Switzerland emerald, the quartz inclusions discussed in this article would seem to be characteristic enough for the possible recognition of the Little Switzerland, North Carolina material.

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Developments and Highlights at GIA's Lab in Los Angeles

by

RICHARD T. LIDDICOAT, JR.

A Very Unusual Ruby

In testing, one gets used to problems that involve the detection of synthetics. Perhaps it is less common to encounter natural stones that have been altered to improve their appearance other than by dyeing or heat treatment. Recently, we found a rather attractive natural ruby that had characteristics quite unlike those we had encountered in the past. *Figures 1, 2 and 3* show some of the characteristics that we saw in this unusual stone.

Figure 1

Apparently, the ruby had been subjected to some form of damage somewhere in its history – probably a long history. In order to fill out a damaged outline, someone had added what we assumed to be epoxy resin to bring its shape back to a symmetrical one. The edge, which had been epoxied and brought back to a normal outline, is shown nicely in *Figure 1.* Gas bubbles in the epoxy are also visible in this illustration. There were several other spots in the ruby that had been filled in by epoxy. Two of them are shown in the brightly reflecting pair of facets in which two areas of lower luster are apparent. Arrows pointing to these areas can be seen in *Figure 2.* A third photograph showing a zone of epoxy, with its lower luster going across a bezel and an upper girdle facet, is illustrated in *Figure 3.*

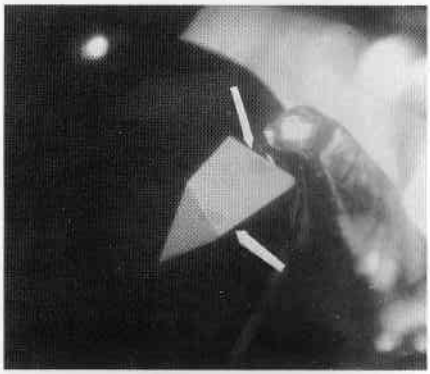


Figure 2

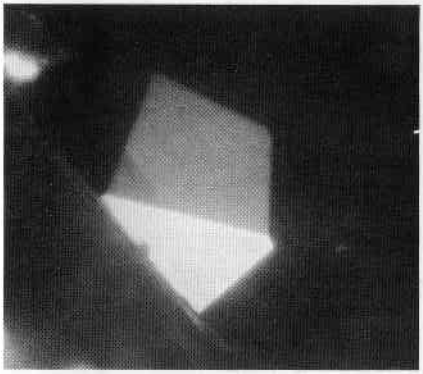


Figure 3

A New Synthetic

One of our recent identification problems involved a very large cabochon with a light-pink color that showed refractive indices of 1.762 to 1.770, and which appeared to be an attractive pink sapphire. Upon examination, we found all of the characteristics of corundum including a chromium absorption spectrum. But, despite many inclusions that had a very angular nature, we found a large bubble near the surface *(shown in Figure 4)*. There is no question but that this was a synthetic material, but one quite unlike anything we had seen.

We had encountered very large synthetic pink sapphires made by the Airtron Division of Litton Industries

Figure 4

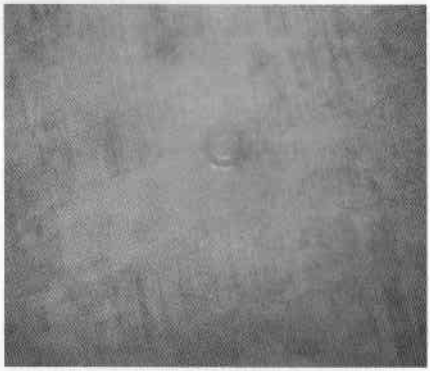
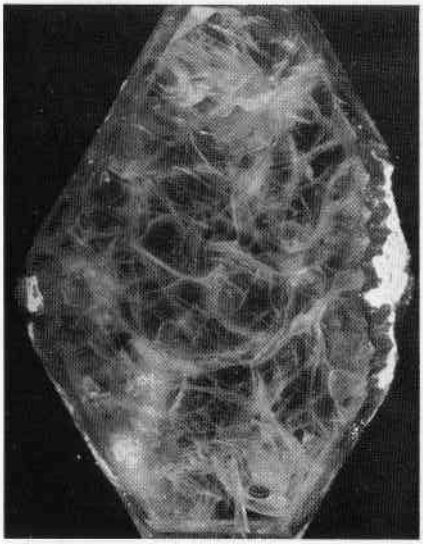


Figure 5



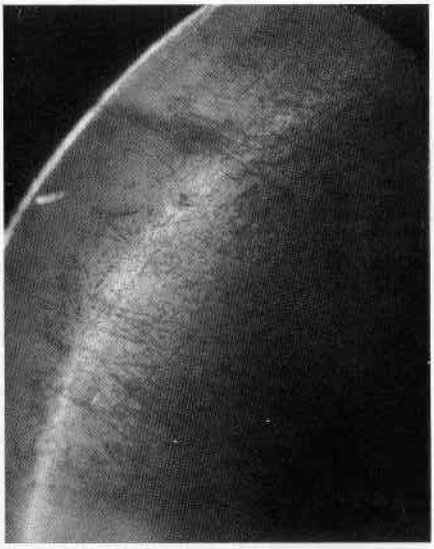
in New Jersey, but the inclusions in this cabochon were considerably different from anything that we saw in their product. Their product shows, *in Figure 5,* a variety of inclusions of the veillike nature that were reminiscent of flux-fusion synthetic emeralds made by both Chatham and Gilson. In this material, there were many parallel inclusions that gave it a natural appearance. These parallel inclusions in rows are quite visible in *Figure 4.* We do not know who is making this new synthetic, but feel it is something to guard against in the future.

Figure 7

Rhodolite Variations

We usually give a set of property values in refractive index for rhodolite from about 1.75 to 1.78. Recently, we had in for an identification two different garnets – with a rhodolite color – that had properties distinctly different from these figures. One had a refractive index appreciably above the 1.78 figure, at 1.79+. The other one, however, had enough differences in properties for its appearance to be of particular interest to us. It had a refractive index of 1.731 and showed a weak almandite absorption spectrum, with a pale-pink color that would characterize rhodolite. We assume that it was largely pyrope.

Figure 6



Unusual Opal

We had in for identification an opal that was fairly normal in appearance with a slight preponderance of blue play-of-color, but which seemed quite transparent for the vividness of the play-of-color shown. When we used

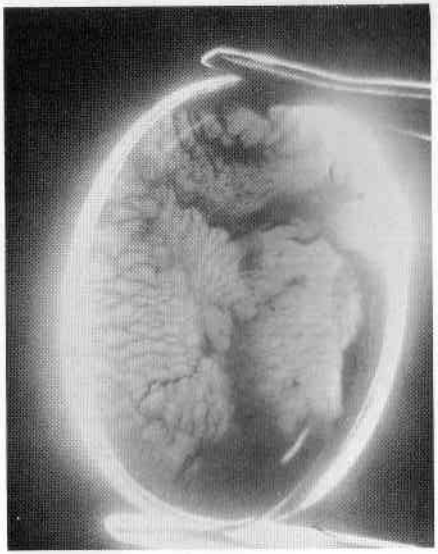


Figure 8

dark-field illumination, we noticed a preponderance of black spherules throughout, some of which were arranged in the interesting patterns shown in *Figure 6.*

Figure 7 shows a portion of another black opal with a play-of-color visible in reflected light. This transparent opal in dark-field illumination appeared as is seen in *Figure 8.* It had a brownish body color and the play-of-color was no longer visible. This is not unusual, but the transparency of the black opal was greater than that seen in most such stones, and the pattern in dark-field illumination was slightly unusual.

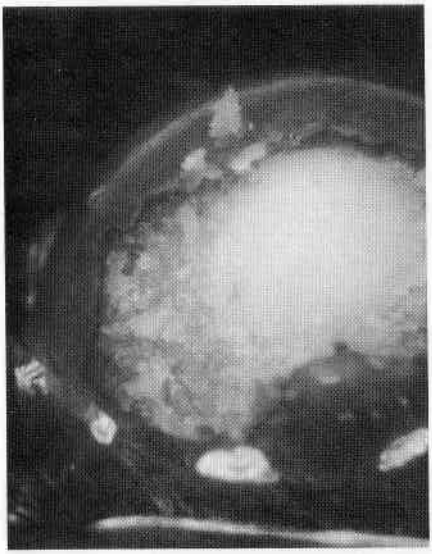
A Blue Mabe

In *Figure 9* is shown a blue mabe pearl in which the blue color is a result of coating the inside of the nacreous portion of the assembled piece with a pitchlike substance. This imparts a blue color to the overall mabe, when it has been cemented to a bead. Interestingly, the bead was not flat, but spherical. It had been liberally coated with an adhesive before the pitch-lined exterior mabe (which had been sawn from a host shell) had been cemented onto the spherical bead. The pitchlike material can be seen as a blackish rim under the irregularly-broken mabe outer skin. The spherical bead is seen as the whiter area in the right portion of *Figure 9;* the greyish portion represents the cement.

A Large Black Diamond

We had an opportunity to examine an approximately 30-carat black

Figure 9



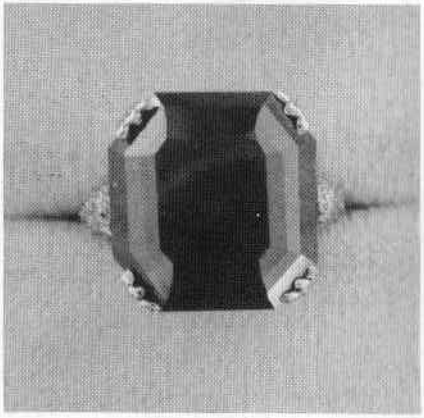


Figure 10

diamond which is shown in *Figure 10.* As can be seen from the photograph, the stone looked megascopically to be a uniform black. When examined under dark-field illumination, at higher magnification, it is seen in the next photograph *(Figure 11)* to be something less than opaque. It was a diamond with a tremendous number of inclusions that gave it a uniformly-black appearance to the unaided eye.

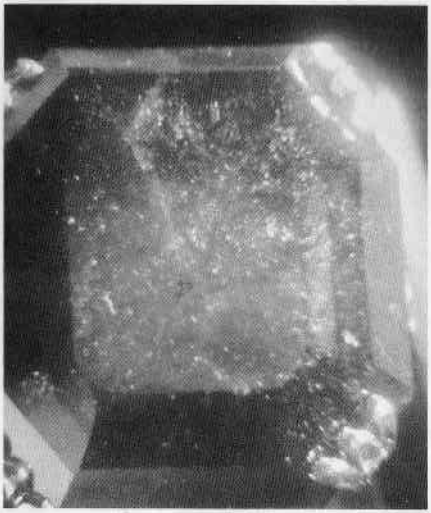


Figure 11

Interesting Growth Marks

The next photograph *(Figure 12)*

Figure 12

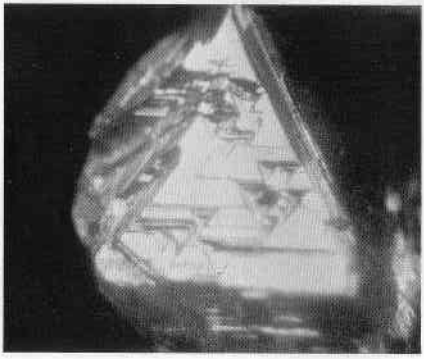
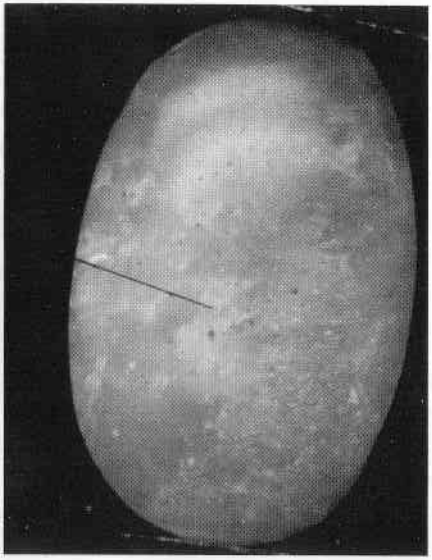


Figure 13

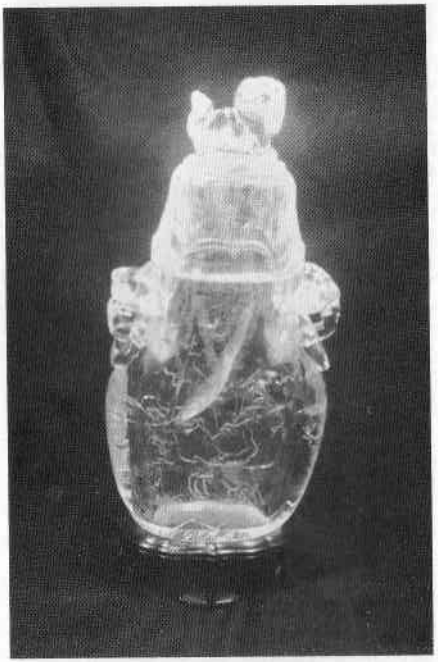


shows a crystal which – for practical purposes – resembles a diamond octahedron, because of the growth marks visible on the octahedral face. This actually was a dark-green octahedron with a refractive index of about 1.79, and showing absorption bands about 4350, 4650, and 5200 Å. The specific gravity was on the order of 4.5. We were able to identify the stone as a member of the spinel group, even though in this photograph it so closely resembles a diamond crystal.

An Incomplete Opal

The purchaser of a rather attractive opal cabochon wondered about certain characteristics it showed, which did not seem to fit with his idea of what an opal should have. Upon examination under magnification (and, as a matter of fact, by unaided eye) it was apparent that something had been added to the back of the opal to make it a symmetrical cabochon. The pointer in *Figure 13* shows a bubble which was included in the plastic coating. A filler had been applied to the back of the opal to make it a complete cabochon. This was a relatively-thin piece that had some rather deep grooves in the back, into which – for strength and a better appearance – had been added what we assumed to be an epoxy resin. Apparently, the person who applied the backing to the stone felt that it made it a much more saleable item, and thus, made this application. Apparently, the seller had not commented about it in the sale of the stone.

Figure 14



Huge Vase

We had the opportunity to examine a tremendous vase that had been bought as glass. Its measurements were 4 1/4 inches deep by 9 inches wide by almost 20 inches high *(Figure 14)*. In testing, the huge vase proved to be rock crystal quartz. It also had a wooden base which added about 3 inches to its height. It was a very imposing piece and remarkable in both size and beauty.

Alexandritelike Sapphire

We are called upon frequently to

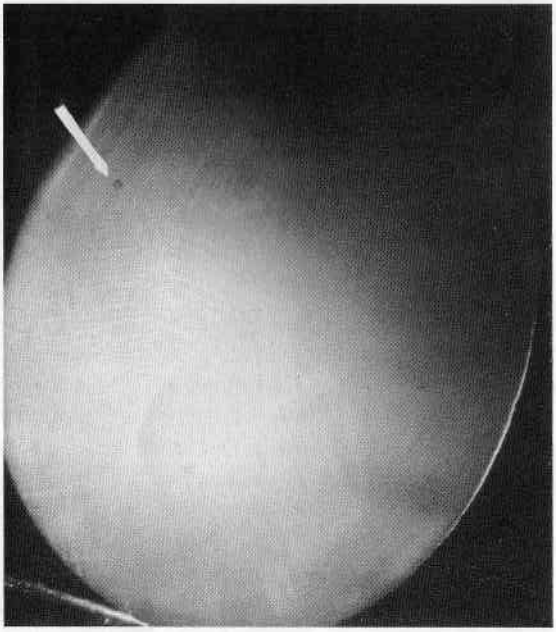


Figure 15

identify synthetic alexandritelike sapphires, with their typical amethystine color under incandescent lights and greyish-blue color under daylight. Recently, we have been called upon to identify a number of stones, each of which proved to be natural sapphire with an alexandritelike color change. A change from purple to blue in alexandritelike sapphires is certainly not too rare, but one encountered recently had a color change so similar to that of natural alexandrite that it was hard to believe. The color change was not that of the finest of alexandrites, but more akin to that typically seen in the industry, with a change from a brownish-red to a brownish-green. The color change was very strong, and the material in appearance certainly very strongly resembled a natural alexandrite. However, when it proved to be uniaxial and had a refractive index of 1.762 – 1.770, there could be no doubt that it was actually a natural alexandritelike sapphire.

Jade Substitute

Recently, we have been encountering, more and more frequently, a jade substitute being sold under a variety of names. By normal testing, the material proves to be glass. Bubbles are visible under magnification, along with a complex pattern of angular inclusions. We had

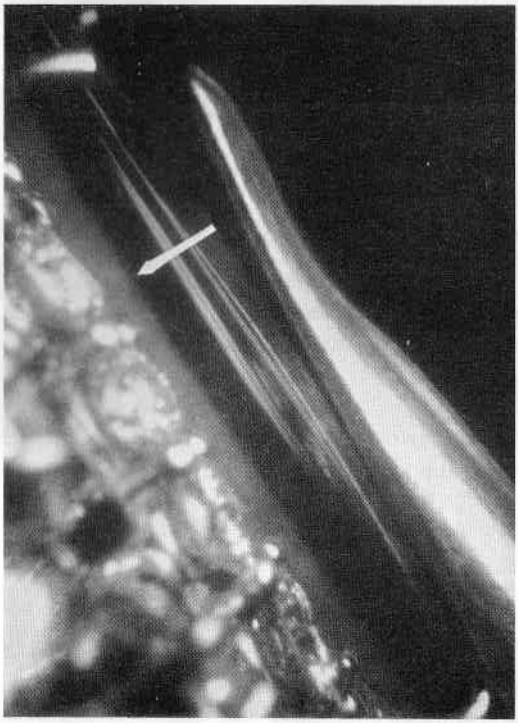


Figure 16

occasion, not too long ago, to test one of these by X-ray diffraction. We found that it gave a fluorite pattern. Under magnification, a dendritic pattern of crystals is readily apparent, as shown in *Figure 15*, but bubbles are also apparent (see arrow). The refractive index is about 1.51. For want of a better term, we call this material imitation jade, even though we are satisfied that it is a form of glass.

Not A Doublet

Not infrequently, we see rather thin pieces of very attractive opal that, when encountered by jewelers, are assumed to be opal doublets. Such a stone is shown in *Figure 16*. The black-to-gray color division across the stone (above the single-cut diamonds in the setting), which appears so like the line of demarcation in a doublet, is actually a line between the background material and the natural color-bearing opal that is of gem quality.

Acknowledgements

We wish to express our sincere

appreciation for the following gifts:

To **R.G. Fergoda**, J. Herbert Hall Co., Pasadena, California, for a much needed smoked opal that will supplement our collection nicely and be put to good use by our students as well.

To **Glenn Vargas**, Thermal, California, a dealer in rare faceting materials, for nine green crystals and crystal fragments of gahnite.

To **Sallie Morton**, Morton Jewelers Inc., San Jose, California, for a moonstone cabochon that will be put to good use in our gem identification course.

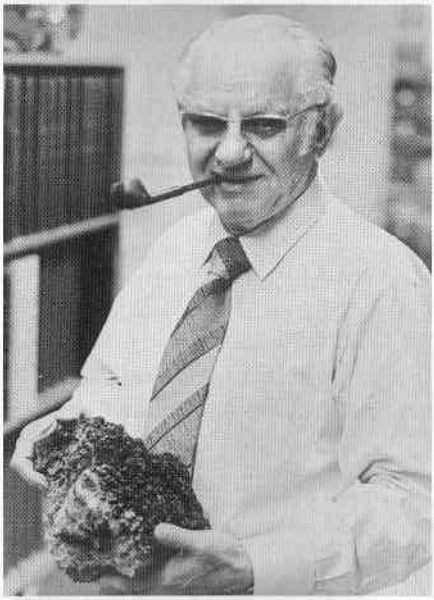
To **Marianne Shale**, recent Resident Graduate, Shale's Gems & Minerals, Los Angeles, California, for several pieces of rough transparent grossularite from Lalatema, Tanzania.

To **Bill Kerr**, gem cutter from Long Beach, California, for a piece of chrysocolla-stained quartz. This fine specimen will be useful in our classes.

To **Marcus R. Switzer**, Manhattan Beach, California, for two faceted opals which have been placed in our display case.

To **Larry Breckenridge**, student, Anaheim, California, for an assortment of cabochons to be used in our resident classes.

A Memorial Tribute to Martin L. Ehrmann



For many years, GIA shared – with major museums and mineralogy departments the world over – the pleasure of too-infrequent visits from Martin L. Ehrmann. His legion of friends and admirers were greatly saddened to learn of his death on May 18th, 1972.

Martin was a remarkable man in many ways. He dedicated himself to furnishing museums with gem and mineral specimens and traveled all over the world buying minerals, acquiring collections and important gems. His exceptional knowledge, experience, and ability made it possible for him, from the beginning, to find financial backers for his travels and purchases. Martin Ehrmann probably had more influence on the collections in the major museums than anyone other than their curators.

Mr. Ehrmann was working on a book concerning his life with gems and minerals. The next few paragraphs were written by him for the dust jacket of the book he was trying to finish before his death.

Martin L. Ehrmann was brought up in Kiel, Germany, and emigrated to the United States in 1923.

A keen interest in mineralogy and gemology acquired early in his life, furnished him the incentive to establish a mineral and gem business in New York City, which flourished prior to World War II. He was instrumental

in arranging for the acquisition of many important gemstones by museums throughout the United States, including the famed "De Long Star Ruby" by the American Museum of Natural History in New York City and the "Star of Asia" by the Smithsonian Institution in Washington, D.C. He was also responsible for bringing the famous Calvert Collection from England to this country.

In the late 1930's, he commenced experimentation with off-color diamonds, using the cyclotron at Harvard University in conjunction with the late Dr. Harry Berman as well as the cyclotron at Columbia University. Results of this experimentation and research were published in an article entitled "Bombarded Diamonds" which appeared in the Summer, 1950, issue of Gems & Gemology. *His business and the cyclotron project were interrupted by the outbreak of World War II. Though over age, he volunteered for service with the United States Army and received a direct commission.*

His knowledge of mineralogy, together with his excellence in the German language and knowledge of the European terrain, prompted the military to send him on several special missions to occupied France to obtain tourmalines desperately needed for use in sensitive measuring devices in a number of critical projects. During his military service, he achieved the command of the United States Army Bomb Disposal School at Aberdeen Proving Ground, Maryland. Subsequently, he was again called to serve to assist in liberating several of the great German rocket scientists away from the Russians and into American hands. Upon his discharge, he was decorated with the Legion of Merit.

After the war, he moved to Los Angeles where he reestablished his mineral and gem business. He authored many articles on minerals and gemstones; and in collaboration with the late Dr. Herbert P. Whitlock, Curator of Mineralogy at the American Museum of Natural History, wrote the book, THE STORY OF JADE. *He continued his practice of world travel and made a number of trips to Burma, the Orient, Australia, Africa, Europe and South America, in search of fine gems and minerals.*

Mr. Ehrmann's comments for the book add to a very brief and modest summary of the high spots of a remarkable career. There is much more that he could have added.

Martin was a modern-day Marco Polo or Tavernier. We, at GIA, looked forward to each return to Los Angeles from his wide travels. Whenever he encountered something new or different, he made it a point to let us see it. Usually, he made sure that GIA was well supplied with whatever new material he had found, or items he had, that he knew or suspected we might need.

Martin was well conditioned to the unexpected, and anything out of the ordinary always intrigued him. His was a keen and inquisitive mind – witness, for example, his pioneering in diamond irradiation.

At the GIA, we always looked forward to his visits. Not only was Martin's enthusiasm contagious, but he shared with us, the ideas and excitement that surrounded his work. To know that he will no longer call on us is indeed a sad prospect.

All of us – at GIA – feel a deep, personal sense of loss. Martin L. Ehrmann . . . a man who unselfishly contributed so much for so many . . . a man who was respected and admired by the many who knew him . . . will be long remembered.

Felix S. Y. Chang

Felix S. Y. Chang, President of the China Development Corporation, Taipei, Taiwan, and Graduate Gemologist, passed away on April 7th, 1972.

Mr. Chang traveled widely all over the world. He had many friends in every country he visited. Every time his agenda took him to Los Angeles – when his heavy schedule would permit a visit – he called on us at GIA.

Over the years, Felix Chang endeared himself to our entire staff. He will be missed.

Developments and Highlights at GIA's Lab in New York

by

ROBERT CROWNINGSHIELD

Jadelike Minerals

We have recently encountered a number of jadelike stones which suggests to us that increased trade with China may be responsible. Several carved stones and two actual-sized

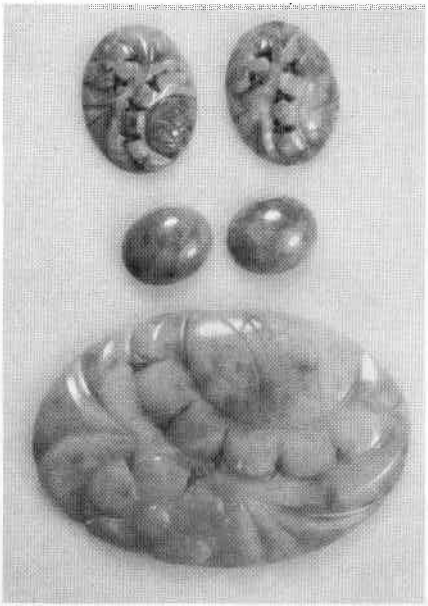


Figure 1

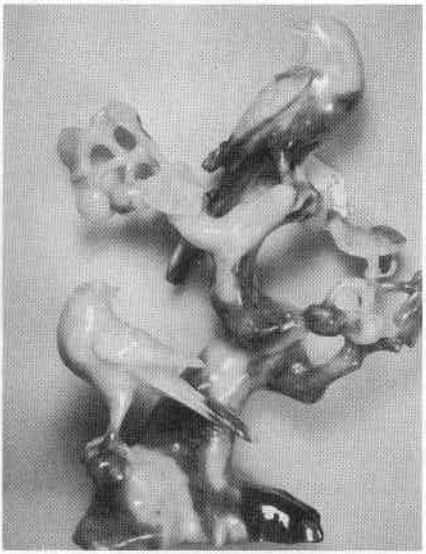


Figure 2

cabochons – *shown in Figure 1* – are as nearly like jade as we have ever seen. They proved to be a mixture of grossularite and idocrase with possibly hydrogrossular too. We are indebted to Mr. George Babakian, of Art Craft Jewelry, for these specimens. Also seen recently, but not pictured, are

Figure 3

strings of beads of the same material.

Figure 2 illustrates a fairly common-type carving mostly featuring birds. The material – a combination of serpentine and zoisite – is the same as that discussed in the Spring, 1972 issue of *Gems & Gemology.*

Another jade substitute – which we were unable to photograph – proved

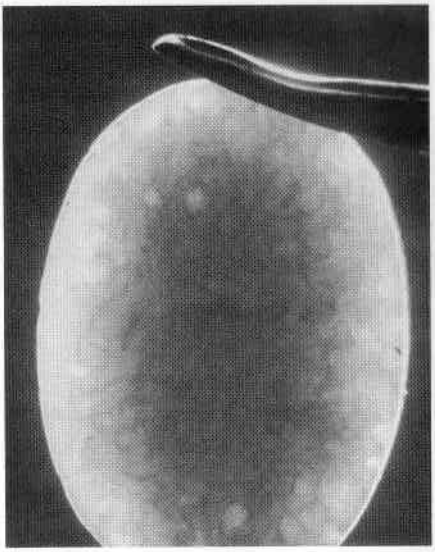
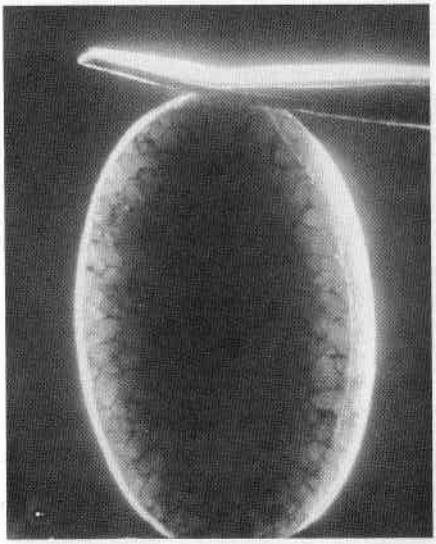


Figure 4

to be a large bowl with a fish motif handle. Limited gem tests indicated serpentine for the main bowl but the

Figure 5



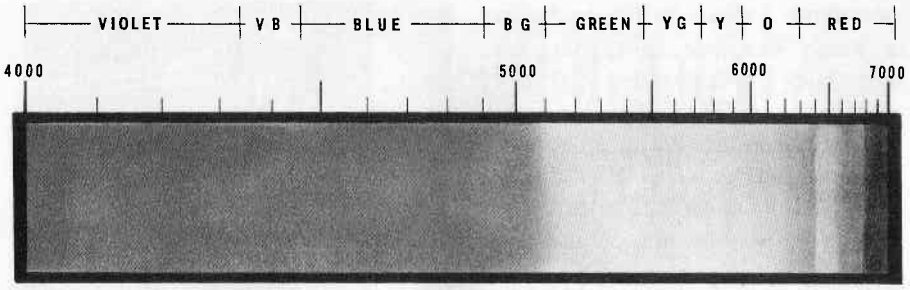


Figure 6

head of the fish seemed to give all indications of nephrite so that the whole was actually a mixture.

Figure 3 is a photograph of two stones from a large lot of quite nice green stones that proved to be a natural color green quartzite. Initial magnification strongly suggested a dyed stone *(Figure 4).* However, boiling in concentrated sulphuric acid did not attack the color but did blacken or alter impurities in the spaces between the mosaiclike structure of the quartzite, as illustrated in *Figure 5.* The absorption spectrum of the material *(Figure 6)* indicates chromium.

Recent Emerald Find

We are indebted to Mr. E.F.M. Wolff, of London, England, for allowing us to study some quite attractive emeralds from the Marua district of Mozambique. They are found in a pegmatite area that is

Figure 7

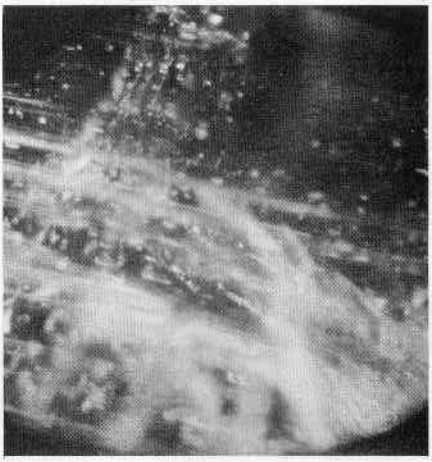
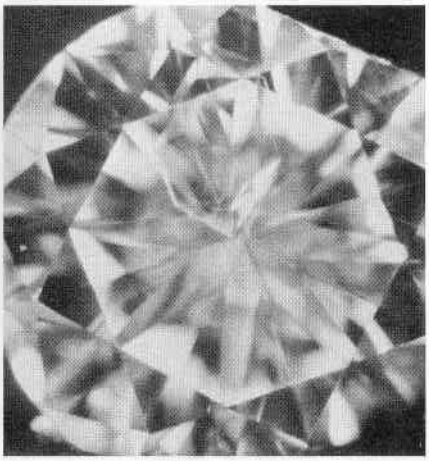


Figure 8



currently mined commercially for mica, tantalite and beryl, though the emeralds are in a zone of schist sometimes 20 feet in thickness. Although Mr. Wolff doubted that any truly large or spectacular stone would be found, the stone we examined was of pleasing color, though quite heavily flawed. We tried to photograph the

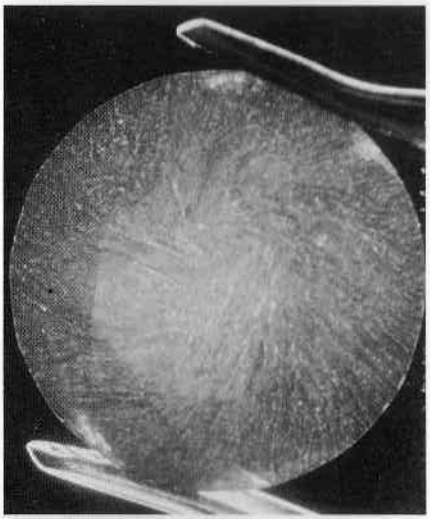


Figure 9

main characteristics of the inclusions – *shown in Figure 7* – and would say that they are mainly needlelike parallel inclusions with squarish two-phase inclusions; although several of the stones had what we often amongst ourselves term "nondescript garden."

Diamond In Diamond

An otherwise very fine diamond is pictured in *Figure 8.* Fine, except for a very large included-diamond crystal, complete with trigons on the octahedral faces.

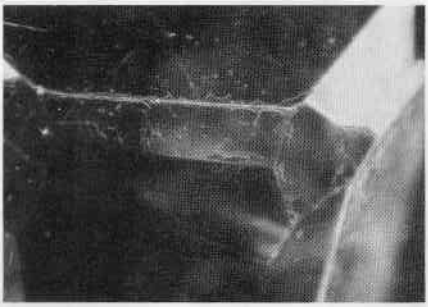
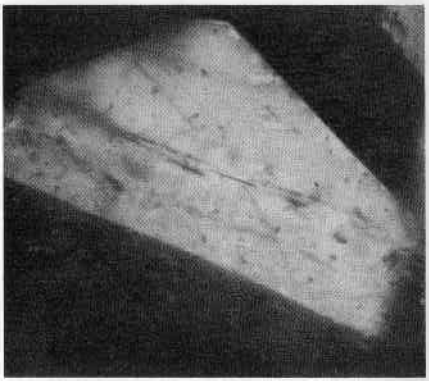


Figure 10

Emerald-Green YAG

A very striking round brilliant when viewed with the unaided eye proved to owe its sleepy-green color to a myriad of tiny gas bubbles, oriented in an unusual manner, as seen in *Figure 9.* It is possible that the flaws were purposely introduced in order to give the green synthetic a more emeraldlike appearance.

Figure 11



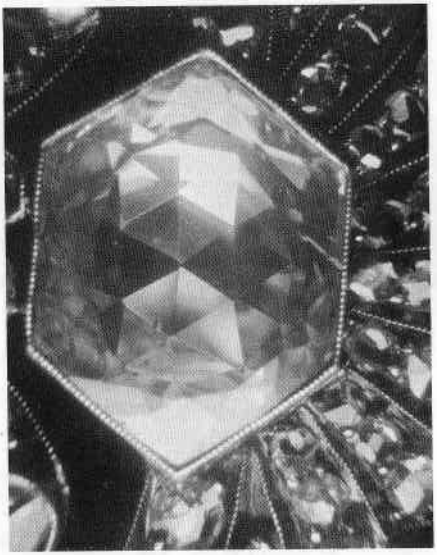
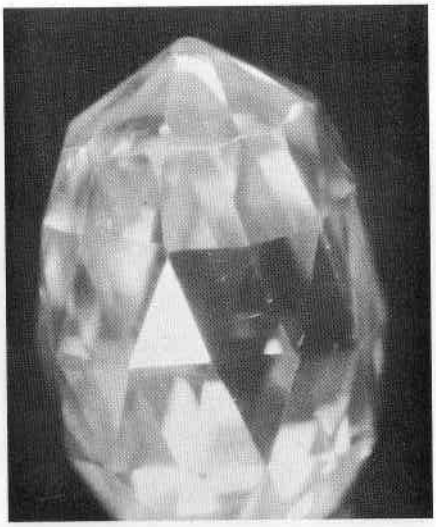


Figure 12

Coated Beryl

A green plastic coating on beryl beads is something we have encountered occasionally. However, to see it on a faceted stone is new to us. (Note peeling at facet edges in *Figure 10* and luster differences in *Figure 11.)* The stone showed no chromium in the absorption spectrum, but was a very good green color due to the intense green plastic coating.

Figure 13



Unusual Diamonds

We have occasionally reported round rose-cut diamonds – set over crimped foil pavilions – making a potential customer believe the stone to be much larger than it is. *Figure 12* illustrates a long hexagon rose cut, similarly mounted, and set in an ornate brooch with numerous unbacked rose cuts.

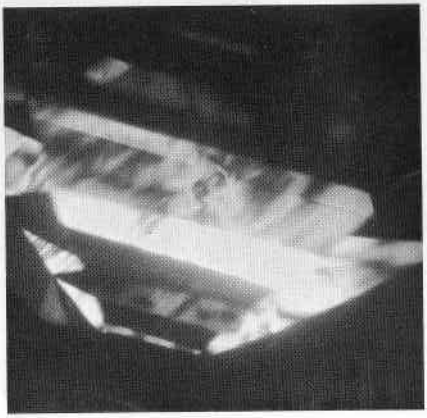


Figure 14

We were puzzled by the great amount of wear on a beautiful briolette diamond set as a stick pin (shown in *Figure 13).* It was our feeling that it must have originally

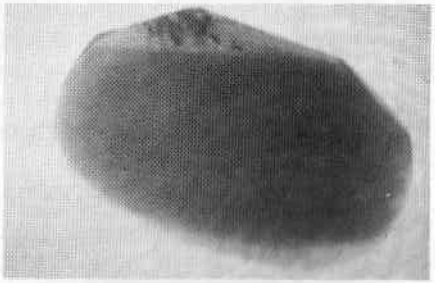


Figure 15

been set in jewelry which allowed it to strike other diamonds. Surely, it would not be exposed to such wear in a man's tie.

A beautiful, large emerald-cut brown diamond of the type that is green in transmitted light had a transparent colorless-diamond inclusion which was responsible for an unusual degree of strain in polarized light. It is shown in *Figure 14.*

Another Flux-Grown Synthetic Ruby

We examined an attractive cushion antique synthetic ruby which had obvious flux-fingerprint and coarse-flux inclusions. In addition, it had curved striae. This would not have been considered unusual as it has been recorded for Mr. Chatham's better quality synthetic rubies. However, under immersion we noted that the curved striae were subparallel, precisely like those of Verneuil flame-fusion synthetics, and confined to a darker zone. The flux inclusions were confined to a lighter color zone outside the dark area. A Plato test disclosed strain along the optic axis, which was nearly 80° from the plane of the table. This strongly suggested that a Verneuil seed had been used to initiate growth. Subsequent conversation with the manufacturer confirmed this *(Figure 15).*

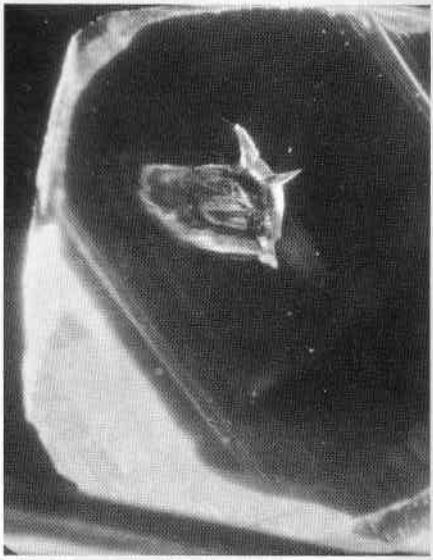
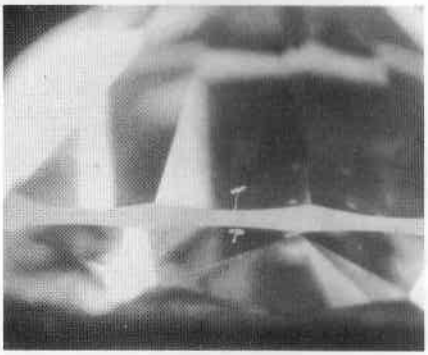


Figure 17

Figure 16

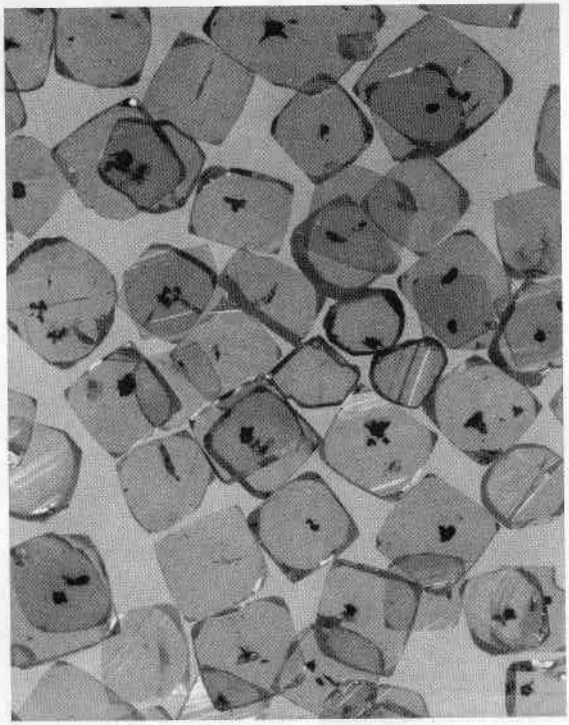


Laser-Drilled Diamonds

Most information about laser-drilled diamonds implies that the stones so treated were imperfect originally. That such is not the case was brought home forcibly to us recently, when we graded some twenty diamonds averaging approximately 1.00 carat each. Of the twenty stones graded, two were found to have been drilled and the lowest grade we could imagine would be VS_2 – even imagining that the now-white imperfections were dark. One of the stones is pictured in *Figure 16.* The drill hole is finer than any we have seen in a cut stone, and appears to have just reached the crystal-shaped inclusion. In another stone – not pictured – a fine drill hole through the girdle failed to reach a black "light trap."

A "light trap" may be defined as an internal separation of the structure which causes light to be reflected, resulting in a black silhouette of the area. Sometimes the "light trap" radiates from an included crystal, resulting in the imperfections most frequently misidentified as a "carbon spot." *Figure 17* illustrates a black-appearing inclusion of this type, which is in a section sawed from a

Figure 18



crystal. It is one of many *(Figure 18)* loaned to us for study by a cutter. In order to remove the black inclusions, two saw cuts are made and the section removed becomes little more than crushing bort, perhaps worth less than $10 per carat. The economics of laser drilling is readily apparent if one realizes that instead of removing the sections, they can be left in a finished stone, and then, improved in appearance by laser drilling. Already, for many cutters, the use of laser drilling is becoming an accepted advancement in the field of diamond cutting.

Acknowledgements

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

To **Tom Mariner**, GIA Graduate, of Linde Air Products, for a complete selection of all the colors currently being manufactured of Linde synthetic star sapphires and rubies.

To **Owen J. Boylan, III**, GIA student, of W.D. Webb Company, Greenwich, Connecticut, for a fine example of an old-mine cut pear-shape diamond.

Book Reviews

GEMSTONE & MINERAL DATA BOOK by John Sinkankas. Published by Winchester Press, New York, 1972. 346 pages. Clothbound. Price: $8.95.

One of the really remarkable people in the gem field is John Sinkankas. A former Navy Captain, John spent his spare time, in the Navy, cutting as a hobby and investigating the gem field in a way that was amazingly comprehensive. Everyone who is acquainted with gemology knows his many fine books. For sheer research effort, Sinkankas' latest work, *GEMSTONE & MINERAL DATA BOOK*, has greatly outdone anything he has done in the past. This is a book that must be an essential to anyone who maintains any sort of a gem library. The effort that has gone into this publication can only be described as monumental.

We know John Sinkankas to be a man who gets by with about four hours sleep a night. It is obvious that the waking hours for the last several years have gone into gathering the data that went into his book. The detail is so incredible that it is really hard to believe that any one individual could find enough time to gather the information that he has accumulated for the preparation of this book. We find it amazing and can only bow to Mr. Sinkankas' efforts.

There are a few minor criticisms we could make, mainly in the fact that there is no index in the book, but in view of the tremendous effort that went into it, we can only bow to John and give him an "unbelievably well done."

Perhaps a better idea of the extent of his efforts could be given by outlining the "Table of Contents." Since this table does contain page numbers, it has to serve as the only index for the book. The first section is "Weights, Measures, Conversions, and Mathematical Formulas;" the second, "Chemicals, Useful Miscellaneous Materials, and Formulations;" the third, "Lapidary Equipment;" the fourth, "Abrasives, Polishing Agents, Buffs and Laps, and Their Uses;" number five, "Metals and Jewelry Data;" number six, "Coloring Gemstones and Minerals;" number seven, "Physical Properties of Minerals and Gemstones Aiding in Identification;" number eight, "Chemical Testing of Minerals;" nine, "Mineralogical Miscellany;" ten, "Cleaning Mineral Specimens;" eleven, "Nomenclature;" and number twelve, "Optical Properties of Minerals and Gemstones."

It takes much more explanation than this to really give an idea of the comprehensiveness of the book. For example, under Chapter Seven, "Physical Properties of Minerals and Gemstones Aiding in Identification," there is a section of cleavages arranged by system and type. In this, Mr. Sinkankas has arranged all of the cleavages to be found in any system by crystallographic relationship and also by the cleavage surface quality. For instance, under the orthorhombic system, he lists every gemstone or mineral that has prismatic, pinacoidal or pyramidal cleavage. The same is done for hardness, refractive indices and specific gravities for all minerals; e.g., every gem or mineral that could have an index of 1.59 or any other number, is listed – the same is done for the other properties. It is hard to conceive of the amount of time and

effort that went into the gathering of the information necessary to compile such a table.

In all our years of looking over new books in the gem field, I can't recall any that is more impressive from the viewpoint of research entailed in its compilation than John Sinkankas' *GEMSTONE & MINERAL DATA BOOK*. At $8.95, it must be the best buy of the book year.

GREAT TREASURES OF THE KREMLIN by David Douglas Duncan. Published by Harry N. Abrams, Inc., New York. 187 pages. Clothbound. Profusely illustrated with 105 full-color photographs.

This exquisite work is the quintessence of three lengthy years of study and reflection by an internationally famous photographer and veteran journalist. David Douglas Duncan opens our Western eyes, permitting us a glimpse of the mystery and beauty from the past grandeur of old Russia to the present reality of the Soviet Union.

The text entwines legend, temperament, resources and history to weave a picture of Russian rulers and artisans responsible for the creation of some of the worlds most incredible riches. Included are photographs of Monomakh's Cap of gold, Ivan the Terrible's jewel-encrusted Book of Gospels, the Diamond Crown of Peter the Great, the long-lost Cloth of Christ, and the Golden Easter Egg executed by Peter Carl Fabergé. As if these treasures were not enough to stagger the imagination, Duncan also describes and includes the places, ceremonial rooms, and cathedrals that house them. Noteworthy is the following passage describing the Granovitaya Palato (Palace of Facets): "... The name Palace of Facets originated from the prismatic appearance of its outer walls which resembled the surface of a facet-cut gem. Its outstanding architectural feature is the single, central, majestically arched stanchion which supports the entire vaulted ceiling of the Throne Room." "... The fresco illuminations found here today are XIXth century versions of those painted during the era of Boris Godunov, at the end of the XVIth century."

Equally descriptive passages accompany every photograph, completing in precise detail, pertinent facts the reader would wish to know. For the scholar and historian, a bibliography is included along with an exceedingly technical "Research Supplement," outlining historical data, romantic lore and dimensional aspects of each work of art contained in the book.

GREAT TREASURES OF THE KREMLIN is one of those rare works that permits the viewer and reader equal footage. We offer only our highest praise and stamp of approval to its brilliant writer.

THE STUDIO HANDBOOK OF MINERALS by Hellmuth Boegel. Edited and revised by John Sinkankas. Published by the Viking Press, Inc., New York, 1972. 304 pages. Clothbound. Well illustrated with 102 line drawings and 48 pages of beautiful color plates by Claus Caspari. Price: $8.95.

"As an amateur handbook," Mr. Sinkankas states, "this one makes no pretense at being a textbook. Only enough information is given in the preliminary theoretical portion to acquaint the reader with the essentials of crystallography, chemistry, and crystal structure."

THE STUDIO HANDBOOK OF MINERALS was written in 1968 by Hellmuth Boegel in Germany. In 1972,

a revised and edited English version appeared by John Sinkankas. The eminently qualified authors have given the reading public a book that has much to recommend it.

The first section covers general mineralogy with simplified and clear definitions on the structure and composition of minerals and the basics of mineral formation. Also included are sensible suggestions for planning, storing and categorizing a mineral collection.

The practical section that follows is the essence of this colorful work, containing the description of over 250 important and common minerals. The minerals are divided into eight classes – based on chemistry and atomic structure – and each class is further subdivided, partly by detailed chemical composition and partly by structure. Cultural and historical concepts are injected with each mineral, along with deposit location information indicating increasing specimen quality by the use of an increasing number of exclamation points with parenthesis, e.g., (!), (!!).

Concise and orderly tables fill the final 42 pages, listing the minerals in ascending order on the Mohs scale, starting with the nonmetallic and ending with the metallic.

The outstanding feature of this work is the color illustrations by Claus Caspari. These are watercolors that will enable the neophyte collector to sight-identify rough crystals. The artist's palette can capture delicate nuances of surface luster and characteristics of crystal form and growth markings that a camera could not. It is an impressive book.

THE STUDIO HANDBOOK OF MINERALS is a group effort of excellent blending into an invaluable work that should serve its intended purpose in the field and library.

COLORFUL MINERAL IDENTIFIER by Anthony C. Tennissen, Ph.D. Published by Sterling Publishing Co., Inc., New York, 1972. 224 pages. Clothbound. Well illustrated with 120 full-color photographs. Price: $3.50.

Dr. Anthony C. Tennissen, Associate Professor of Geology at Lamar University in Beaumont, Texas, has compiled a remarkably convenient and compact book. Small in size, it may accompany a mineral collector in the field; vast in detail, it includes concise information on color variation, streak, luster, hardness, specific gravity, crystal system and primary source.

For the specimen collector, Dr. Tennissen also indicates in which deposits the finest crystals can be located.

Each of the 120 minerals listed is accompanied by a full-color photograph of superior quality and exacting detail to further expedite mineral identification.

The minerals in this book are classified chemically. Thus, the chapter headings are as follows: Elements; Sulfides and Sulfosalts; Halides; Oxides and Hydroxides; Carbonates; Sulfates; Chromates, Tungstates, Molybdates; Phosphates, Arsenates, Vanadates; and Silicates. For quick reference, an index is included, preceded by a streak and hardness chart.

Indeed, the *COLORFUL MINERAL IDENTIFIER* – both basic in scope and precise in detail – will offer sound, informative aid to the amateur as well as advanced mineral collector.

PRACTICAL GEMSTONE CRAFT by Helen Hutton. Published by The Viking Press, Inc., New York, 1972. 104 pages. Clothbound. Well illustrated with 66 line drawings and 52 photographs (9 in color). Price: $8.95.

With the art of lapidary increasing in popularity, the author has recognized the need for a comprehensive book on the subject. This book sets out to cover the general interest of the lapidary while creating a balance between the geological background of minerals, then descriptions, and cutting and polishing techniques.

PRACTICAL GEMSTONE CRAFT is amply detailed where needed, with simplified and practical explanations of everything needed to inform and teach even the young student of gemstone craft.

Eight chapters comprise the book: The Nature of Rocks and Minerals, Rocks and Pebbles for Collecting and Tumbling, Quartz and its Varieties, Descriptions of Gemstones and Decorative Stones, Lapidary Equipment and its Uses, Tumble-Polishing, Cutting a Cabochon, What to do with Stones. Appendices, a bibliography, a glossary and an index complete the book.

One of the more useful sections of Helen Hutton's book is Appendix III, which gives localities mainly concentrating on the British Isles. Also included is an excellent map.

The author, Helen Hutton, has been a collector since childhood, and has recently made a world tour studying the sources of decorative stones.

We recommend *PRACTICAL GEMSTONE CRAFT* to anyone who wishes to develop or begin an interest in the mineral kingdom.

INDIAN GEMMOLOGY by Raj Roop Tank. Published by Dulichand Tank, Jaipur, India. 171 pages. Clothbound. Illustrated. Price: $4.00.

Raj Roop Tank's *Indian Gemmology* is a unique combination of Indian culture with gemology. To simply describe this book as out-of-the-ordinary or most unusual would be insufficient. The author uses a totally different approach by giving his readers an overwhelming experience of the timelessness of Eastern culture – merging the past with the present – in a manner that very few have been able to achieve.

There are numerous books in the market today, dealing specifically on the subject of gemstones, with excellent guides for both the experienced gemologist and layman as well. *Indian Gemmology* does not pretend to match these books already in print that give detailed accounts of modern scientific investigations or accounts of the physical and chemical properties of all the stones. Instead, Raj Roop Tank covers a total of 84 stones and classifies them according to their utility under the following categories: "(1) those suitable for jewelry; (2) those required for medicinal purposes; (3) those considered efficacious for propitiating adverse planets; and (4) those required for the manufacture of mortar, toys, etc."

Indian Gemmology takes us back, in ancient times, to society in India, when by classical law, a division of the human activities was organized. There was an intellectural class, namely of Brahmins or the learned, to give advice on religious, spiritual and political matters. Then, there was the warrior class of the Kshatriyas, which guarded the social structure against outside aggression and inner dissensions. The trader class of Vaishyas carried on various occupations in the field of exchange of commodities, and lastly, there was the service class – known as the Shudras – that carried on small occupations of service to the society.

At that time this division was not rigid. Gems, having a close relationship and influence on human affairs, came to be distributed according to the professions under the four classes:

Brahmins, Kshatriyas, Vaishyas and Shudras. The author picks gems that are the most commonly in use and groups them throughout his book at various places under what he terms "the Four Established Varnas." This is one of the many things in *Indian Gemmology* that is so different from what we expect that any reader in the West is sure to find it very fascinating.

It is difficult to say when the use of gems came into vogue in the civilized world and many people have written biblical stories on gemstones which have always been and continue to be of interest to readers. In this vein, Tank is no exception but he does cover various fascinating accounts in his introduction.

Raj Roop Tank's book is certain to be quoted as a "one-of-a-kind" publication. As stated previously, *Indian Gemmology* covers 84 stones. He takes the most important ones and arranges them in the sequence of the week days – astrologically! His first chapter begins with "Manikya (Padmarag) Ruby" – ruby to be worn in the morning at sunrise on Sunday. Tank's second chapter deals with pearl – to be worn on Monday in the evening – ending with Rahu (Dragon's head) – hessonite – and ketu (Dragon's tail) – cat's-eye – with each appropriate gem governed by their respective planets.

A brief account of the remaining stones arranged in Hindi alphabetical order comprises the remainder of the book. Each stone contains items of interest from a purely gemological viewpoint as well as many more from the human interest point of view. For example, under hessonite the section entitled "Medicinal Utility" reads as follows: "Hessonite is crushed and powdered finely in rose, 'Keora,' or 'Bedmushk' water and then taken by mouth. It is indicated in acute gastritis, piles, fever with cough, foul breath, rheumatism, suicidal tendencies, rheumatic tumours, swelling of the uterus and constipation." One can imagine how effective the latter information could be over the counter in selling hessonite.

The following are partial excerpts taken from Raj Roop Tank's first chapter on ruby:

MANIKYA (PADMARAG)
RUBY

"Ordinarily the Gem stone (of the corundum family) which possesses the brilliance of lotus petals, is crystal clear and transparent, is free from spots, stains, cracks, striations (the lines seen on the surface of crystal), and dullness of colour, which has got the smooth and delicate lustre of the clarified butter, which is solid, of high specific gravity, of blooming colour, is of a regular shape and appears to be flattening out in a circular fashion, is free from bends and fissures and is not uneven, such a Gem is known as an excellent Ruby."

"Ruby is a Gem of the Sun. Just as the Sun occupies the foremost place amongst the nine planets, so also Ruby finds precedence among the nine most important jewels. It is of scarlet red colour resembling the seeds of the 'Kandhari' promegranate, blossom of the 'tesu' red lotus, or the beak of the parrot. Delicate rosy colour, like that of the eye of a living 'chakravak' (goose) and cuckoo, is also to be found in Ruby (of the finest quality). It is a Gem of the corundum family, and is a compound mainly of aluminium and oxygen. Its red tint is derived from a light combination of iron and chromium."

"In a specimen of Ruby we look for: transparency, clarity and strength of colour, the clear, bright, dark crimson called 'pigeon blood.' "

(A section entitled "*Flaws of Ruby*" follows, giving 14 steps where blemishes may be detected in the specimens of ruby. Then, a helpful

guide is given in the "*Varieties of the Native Mineral or Rough of Ruby*" where essential facts in determining the proper use of the rough stone is discussed. In addition, there are sections entitled "*Identification of Real or Genuine Rubies,*" and "*Ruby Mines*" which are fascinating.)

Grouping of Rubies According to The Four Established Varnas

"Brahmin (the learned class)

Rubies having the colour of rose petals.

Kshatriya (the fighting or the governing class

Rubies of blood red colour or of the colour of red lotus.

Vaishya (Commercial or the trading class)

Rubies of crimson colour resembling that of the seeds of Kandhari pomegranate or the pigeon's blood.

Shudra (the serving class)

Rubies having the mixed colour of bluish or dirtish tinge with the red."

When To Wear The Ruby Gem

"According to the astrologers Ruby is worn in the phase of the Sun. It is put on the neck, arm, or ring finger, with due regard to the vocation the wearer is following or to the group to which he belongs, in the morning at sunrise on Sunday."

Medicinal Utility

"Very finely powdered Ruby, and Ruby ash are both utilized for the preparation of medicines to be taken by mouth with suitable vehicles or combinations of drugs for specific diseases. Ruby is prescribed for loss of blood, gastric troubles, headache, diseases of the heart, diminished vision, indigestion, prolonged fevers, loss of appetite and various mental troubles.

"The flaws of Ruby do not count in the preparation of medicine. A specimen of fine colour and fire and water needs to be selected.

"It may, however, be noted that it is only the Burma Ruby which has been found to be useful for medicines."

In addition to ruby, Raj Roop Tank's book covers – in similar fashion – pearl, coral, emerald, white or golden sapphire, diamond, blue sapphire, hessonite, cat's-eye, and tourmaline, with a brief account of seventy-five stones (previously mentioned) given in Hindi alphabetical order.

Upon opening *Indian Gemmology*, one journeys from West to East – experiences yesterday with today, in eye-opening fashion – and obtains a knowledge of gemology en route. Raj Roop Tank has certainly written a most unusual publication. It is a fascinating book that should be of interest to all.