# Gems & Gemology

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FALL 1973

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# gems & gemology

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# Some Interesting Aspects of Gem Testing

By ROBERT WEBSTER, F.G.A.

There appears to be no end to the varying nature of objects which are submitted to laboratories for identification, many of which are, to say the least, somewhat outside the normal work of a gem laboratory. Such objects may be fairly obvious and easy, especially if they have been seen before, but if they are something outside the common orbit, such pieces can be really difficult and tests for them need thinking about. This article details a few such items, some of which had humorous overtones and some of which were just plain nuisances but all of which had to be identified.

A necklace of baroque white beads were submitted for confirmation that they had been made from "the milk teeth of a young animal." If they were teeth, they were then in fact ivory, and one test for ivory would be to grind down thin sections which would show under the microscope the typical structure of ivory. This would take time, so knowing that teeth consist chemically of calcium and phosphate with some organic matter, microchemical tests for calcium and for the phosphate radical were made. Scrapings from the bead were placed on a microscope slip and a drop of dilute hydrochloric acid added to the scrapings; this was followed a little later by a drop of dilute sulphuric acid. After a few minutes the slide was examined through the microscope, and typical radiating crystals of calcium sulphate were seen *(Figure 1)*. This indicated that the material contained calcium. Another glass slip was cleaned and

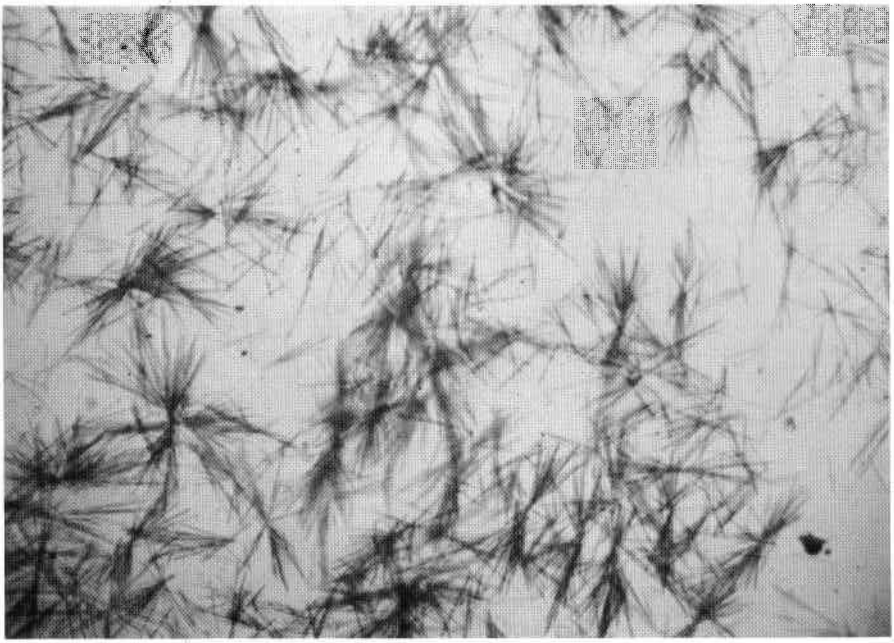

*Figure 1. Radiating crystals of calcium sulphate formed when calcium is present in the sample.*

further scrapings from a bead were placed on it. To this group of scrapings was added a drop of nitric acid and then a drop of an aqueous solution of ammonium molybdate and the slide slightly warmed. No action was seen when the slide was examined microscopically. A "blank test" with the same reagent, using a scraping from a piece of known ivory, gave the characteristic yellow precipitate which, under microscopic enlargement (about 60 to 80 times) showed up as yellow octahedra which were often in groups of four *(Figure 2)*. This proves the presence of the phosphate radical in the ivory, but was not present in the beads under test, so the beads could not be teeth. To obtain further information a bead was removed from the necklet and its density taken. This was found to be 2.82, which, of course, was in the range of ivory, but could also be the value of the shell of a mollusc. To confirm this, an X-ray Laue diffraction picture was taken which gave a pattern reminiscent of fibrous aragonite, that is reminiscent of a cultured pearl picture. From the above evidence the beads were deducted to have been .cut from the thick central pillar of a spiral shell.

Another problem occurred when a white spherical object was sent in for identification. A preliminary "eye inspection" brought forth the suggestion

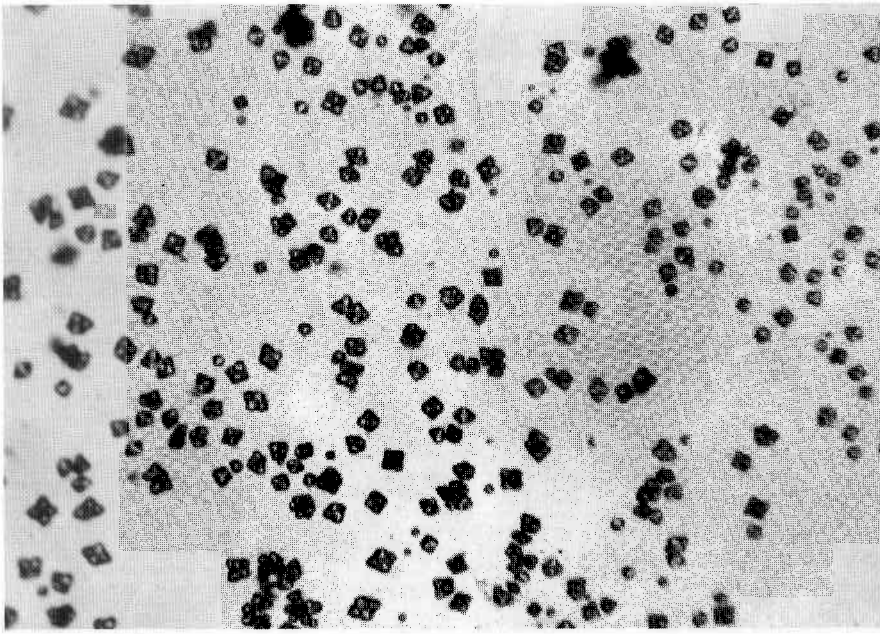

*Figure 2. Groups of yellow octahedral crystals formed when the phosphate radical is present in the substance.*

that it was a flint nodule, a notion which was not accepted by others. A density determination produced a value of 2.33. This did not convince the "flint nodule" advocate that it was not a flint and suggested that the object had a cavity in it. An X-ray picture showed that this was not so. When the "think tanks" got going, it was realized that 2.33 was the density of porcelain (china), but who wanted a china ball? At this time a chemist friend of one of us was visiting the laboratory and saw the "ball." That evening the writer met him again in a club, and he asked if we had identified the object. Laughing, he then said that the object was a porcelain ball which was used in a "ball mill" for grinding fine powders. This was confirmed when the object was taken to a manufacturer of such things who confirmed it as a ball from a ball mill.

A slave bangle made of a black material joined with an engraved silver sleeve produced a problem, for nothing like it had been seen previously. The surface of the black rod-like material, which was about 6 mm in diameter, was marked with what appeared to be weave marks. One end of the bangle had come away from the silver sleeve, and as no reliable density was possible and the refractive index, taken by the Lester Benson spot method, gave only a value of 1.55,

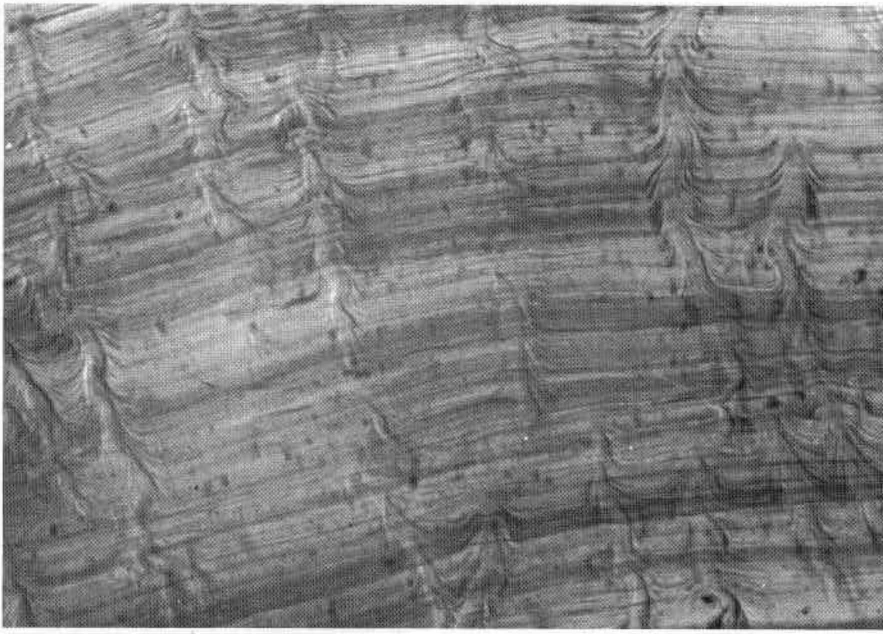

*Figure 3. Photomicrograph of a thin section of Hawaiian black coral (transverse section).*

which conveyed little, it was decided to cut off a piece from the end and make thin sections. When this was done, it was seen that there was a central glistening core to the black rod. This gave the impression that the material could be made from a piece of single core electric cable – with the woven appearance of the surface and the glistening central core – but it was realized that the hacksaw used in cutting off the end did not "bite" as it would have done if the rod had a metal core. The glistening core was later found to be caused by a wax filling to a hollow central cavity. A transverse and a longitudinal thin section were ground and examined under the microscope. The picture seen immediately gave the answer, for the pattern was that of black coral, a substance which the writer had earlier reported upon[1] *(Figures 3 and 4).* What puzzled us at the time was how a branch of black coral could be bent into a circle. Reference to literature soon told us how.[2, 3] The bangle was black coral.

(Ed. Note: A method of shaping black coral into jewelry is given in the addendum on page 222.)

Two necklaces of black beads were submitted for identification. The first consisted of 81 round black beads whose surface seemed to be striated

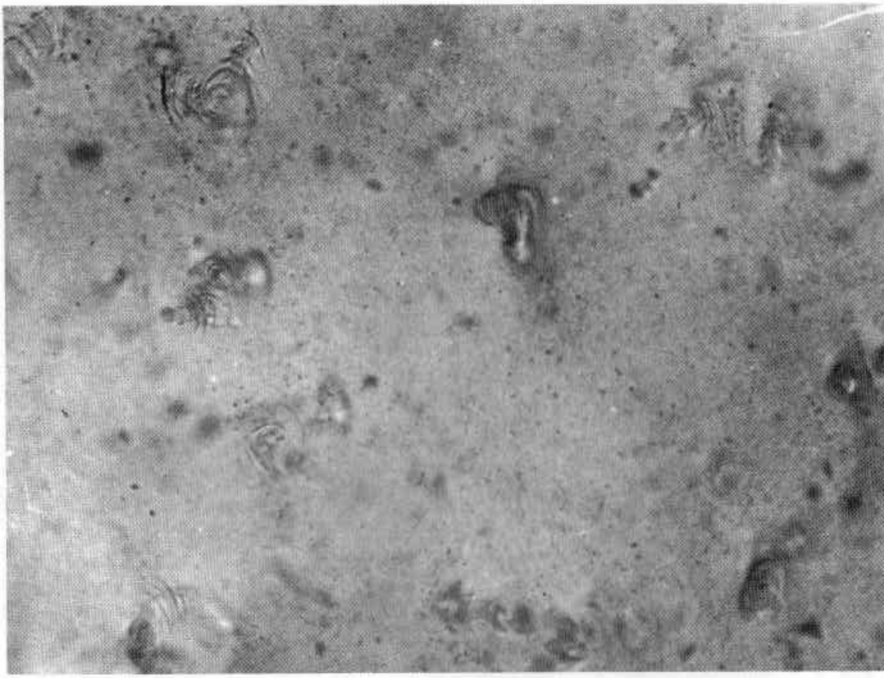

*Figure 4. Photomicrograph of a thin section of Hawaiian black coral (longitudinal section).*

parallel to the drill canal. The first notion explored was that the beads might be dyed vegetable ivory, but the low density of 1.286 tended to discount this. Could the beads be some kind of hardwood? Thin sections were made of one of the beads, and a number of sections were made of various woods. There was little agreement; the wood showing definite plant structures while the unknown had a peculiar structure of its own and, when examined between "crossed polars," showed fairly strong "polarization colours" which were not seen in the wood sections. So it seemed that wood could be ruled out. The effect of a white-hot platinum wire placed on the cut surface of the bead used for making the thin section was that there was a strong smell of burning hair. Could it be horn? Thin sections of known horn were made, and these confirmed that the substance of the beads was indeed horn. It was not considered necessary to take the time and trouble to chase up the type of animal from which the horn came, but as no artificial staining could be proved by the use of solvents, it was considered that the horn was naturally black in colour.

The other necklace tendered at the same time again consisted of black beads. This time the outward appearance seemed to show that they were made of some sort of berries which had probably been lacquered. One of the beads was cut through by a sharp scalpel which immediately revealed the object to have the typical inside structure of a plant seed pod, and indeed reminiscent of some rose hips. The black colour, however, appeared to be natural, as no stain came off when swabs of cotton wool impregnated with solvent were rubbed over the surface of the beads. The beads were then reported as *botanical seed pods,* but no identification of the plant was attempted.

The final problem which the writer is reporting concerned a black oval-shaped stone set in a signet ring. This was submitted for investigation in view of the possibility of Court proceedings over the misnaming of the stone, which should have been black stained chalcedony, usually called "black onyx." The refractive index was found to be about 1.55, a value which is never too helpful, but did preclude jet, which was one of the suggested possibilities; jet has a refractive index about 1.65 and was ruled out. The stone could be cut with a knife blade, which certainly put black onyx out of the question. Examination of the underside of the stone showed peculiarities, in that it had a channel running across the long diameter. The writer recognized that the stone had been made out of part of a cigar tube which had been ground and polished to produce a suitable stone for the ring. A similar tube had been in the possession of the writer for many years and was at first thought to be black amber. For some reason or other, this notion was changed, and the material was considered to be another hydrocarbon, an unusual asphalt called *albertite.* Albertite has rather similar constants to amber. A "hot-wire" test gave a "coaly" smell with an underlying aromatic odour. As there seemed to some doubt about the matter, a spectrophotometer curve was obtained and compared against curves for albertite and amber. This showed the curve to be more like amber than albertite, but short of an elaborate chemical analysis, the problem is not really satisfactorily resolved, although amber seems to be the more likely answer; amber which had been "loaded" by staining with carbon. The material was certainly not black onyx, which was all the Court would have needed to know.

In this short article it is hoped to show that not all tests are straightforward, routine matters.

*References:*


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2. Kraus, P. D. *Cutting & polishing of Hawaiian black coral.* Lapidary Journal. pp. 494-5 (July 1965).
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# Developments and Highlights at GIA's Lab in Los Angeles

By RICHARD T. LIDDICOAT, JR.

We encountered a diamond recently with a rather unusual reaction to ultraviolet light. Under longwave ultraviolet radiation, the diamond was inert. Usually, diamonds are more strongly fluorescent under longwave than under shortwave, but in this case, the diamond that was inert to longwave fluoresced very strongly in a pink-to-apricot color under shortwave. Under X-ray, the fluorescence was bluish in color as might be expected, but in this case definitely on the purplish side. The diamond phosphoresced in a bluish-green color. We had never encountered a gem diamond that reacted in this fashion.

### Interesting Emerald Cuts

The great upsurge in GIA's Diamond Course enrollments that occurred in 1973 created a situation which forced us to buy several hundred diamonds to be graded and used in the home study diamond grading and appraising portion of the Diamond Course. Some of these were emerald cuts. The cutting on some of the emerald cuts was hard to believe. For example, *Figure 1* shows an emerald cut with the corner facets cut close to 90° to the girdle. The angle of even the row of facets closest to the table must be in excess of 70° to the girdle plane. In *Figure 2* we see the unusual situation of an emerald cut with the crown so high and steeply angled that the culet is seen reflected in the crown facets on each side of the table. This is something which is usually seen only on the bezels of a round old-European cut.

Perhaps the most unusual of all of the rather odd emerald cuts was one which showed a modern bow tie *(Figure 3)*. By modern bow tie, we refer to the very large bow so popular recently. I believe this is the first time anyone at our Laboratory had encountered a bow-tie effect in an emerald cut. The stone had a depth of over 70% of the narrow girdle diameter.

### A Natural at the Culet

It is very unusual to see a natural on a diamond at the culet. In *Figure 4* a number of trigon growth markings are visible on the culet of a marquise. Because trigons are characteristic of an octahedral face, it is almost certain that this marquise was cut from a macle, so the culet was preserved from the surface of what would have been an octahedral face if no twinning had been present. The culet represents one of the pair of large faces on the twinned form called a macle.

### Ghostly Cross

The cross in the center of the table of the diamond shown in *Figure 5* appears to be surrounded by a ghostly halo. Such inclusions are seen occasionally but this is better developed than most.

### A Kaleidoscopic Mirror

When a round brilliant diamond has an inclusion near the culet, it is usually

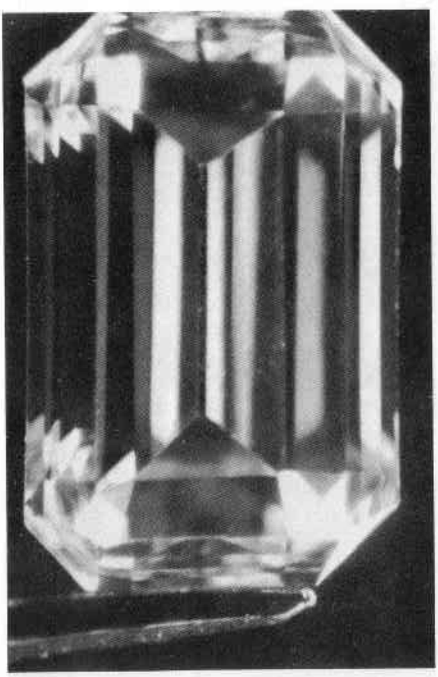

*Figure 1.*

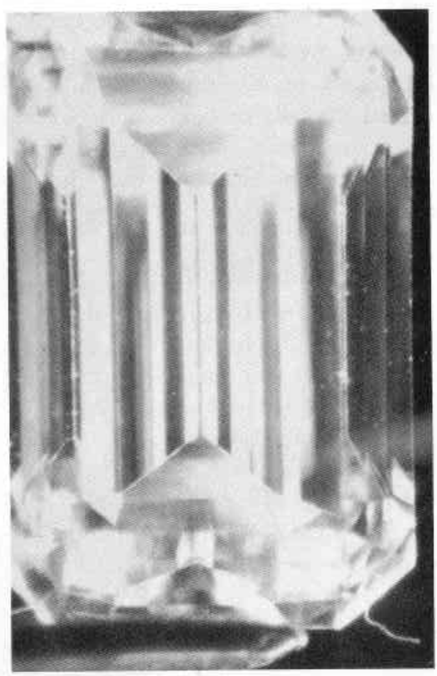

*Figure 2.*

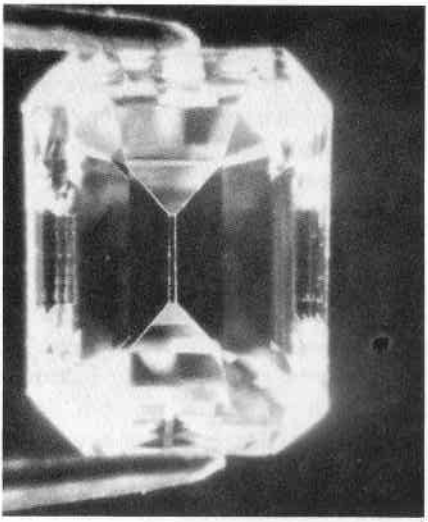

*Figure 3.*

*Figure 4.*

reflected all over the diamond. Such a diamond brilliant is usually called a reflector. Perhaps the most spectacular reflector we have ever encountered is illustrated in *Figure 6.* A large included crystal, probably of diopside, just to the right of the culet, is visible one or more times in almost every crown facet.

### Interesting Cameo

A cameo received for identification showed a certain amount of color banding that was reminiscent of onyx marble. The features of the nose, eye, forehead and cheek were a cream color in the lower layers. As the carving of the head from the cheek bone to the ear and the hair involved removing less material, the final surfaces were in higher layers, and appreciably darkening to a dark brown was evident. Closer examination showed that this was not onyx, as suggested by the

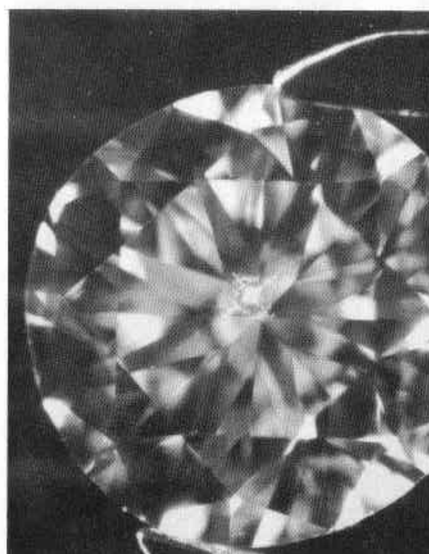

*Figure 5.*

banded appearance shown below the ear in *Figure 7.* Closer examination seen in *Figure 8*, particularly in the lips and the cheek behind the lips and the lower portion of the nose, showed a strongly banded structure which had a certain amount of slightly brighter reflections that are seen in such shell as the giant *Tridacna* clam. The banding is much more evident in *Figure 9,* which is taken of the back of the cameo. Note the faint perpendicular row of banding near the top of the photograph.

### Lovely Stone Cameo

A green beryl cameo was so attractive that we decided to photograph it. It is shown in *Figure 10.* The carving was exceptionally good and the lighting made for a rather dramatic photograph.

### Alexandrite Glass

An attractive piece of jewelry received for identification proved to be glass. Glass is usually not particularly interesting, but this had a distinct alexandrite-like color change. It was more reminiscent of alexandrite-like sapphire than of true alexandrite in that it had a daylight or fluorescent color of a steely blue, and under incandescent light the color was amethystine. An interesting feature in the glass was the presence of many tiny crystallites shown in *Figure 11* under 63X. We do not know the nature of the crystallites. We have been informed that this glass has been around

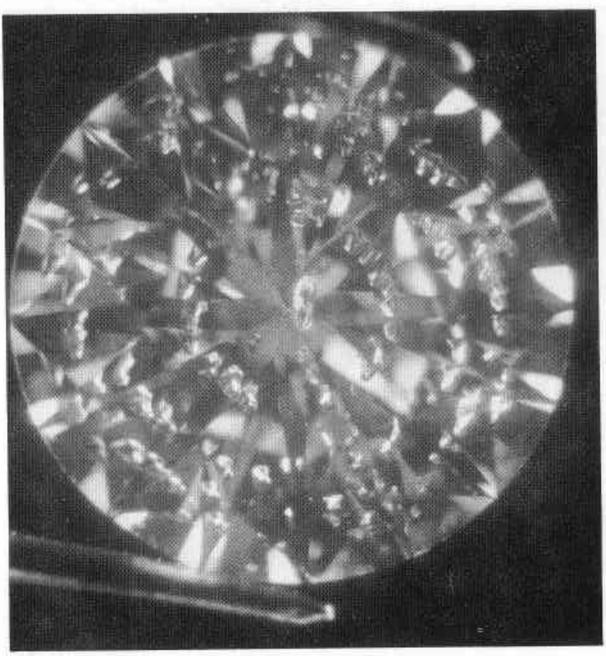

*Figure 6.*

Figure 7.

Figure 8.

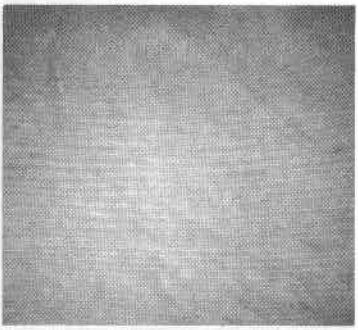

Figure 9.

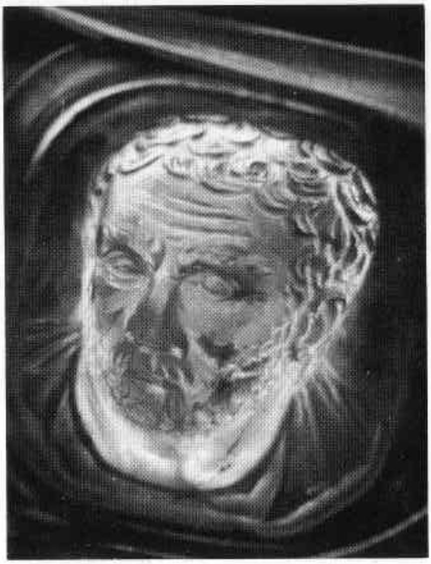

*Figure 10.*

*Figure 11.*

in quantity since the late 1800's. It is called alexandrite glass and is used in vases and other ornamental pieces.

**Venetian Blinds in a Natural Sapphire**

A very interesting group of inclusions was noted in a natural sapphire submitted for identification. A series of steps in echelon was noted that was assumed to be related to repeated twinning. The sapphire also showed rather strong color banding which may be noted both to the left and to the right of the repeated inclusions which run from top to bottom in the photograph. *Figure 12* was taken at approximately 25X.

**Another Case of Silicification**

In the Summer issue of *Gems & Gemology,* we showed a picture of a coral which was partially silicified. By coincidence, we encountered another more recently in which a silicification has not proceeded quite as far so that we were able to take a photograph that better delineated the situation. In

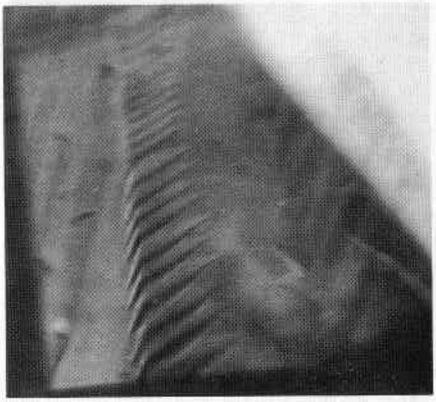

*Figure 12.*

the first photograph, *Figure 13,* we see at rather low magnification the cabochon with the general structure. A drop of acid on the back of the cabochon caused heavy effervescence and the area attacked is somewhat darker than the surrounding area. This is illustrated in *Figure 14.* In this photograph, the quartz areas stood out and the calcite areas were lower because of their lower hardness. The acid etching added to the relief of the quartz grains rather well. In taking the refractive index by the spot method, only the 1.54–1.55 of quartz was evident – the high birefringence of the calcite was not in evidence because the refractometer was in contact only with the grains that stood higher. Rotation of a polaroid plate in front of the eyepiece did not show the shift that would be expected from calcite.

**Attractive Combination**

We received for identification a cabochon of a dark but attractive deep green, semi-translucent material that appeared to be nephrite but with many brighter and lighter green inclusions. The main mass of the material appeared to be nephrite with the brighter green inclusions obviously harder, because they stood above the surface in the polishing of the nephrite. We were able to see that the inclusions had a considerably higher refractive index than the nephrite.

By scraping the edge of the area of the darker material and running an X-ray diffraction analysis, Chuck Fryer was able to obtain a nephrite pattern. On the brighter green inclusions, scraping and X-ray diffraction analysis showed a pattern corresponding to grossularite. Since the

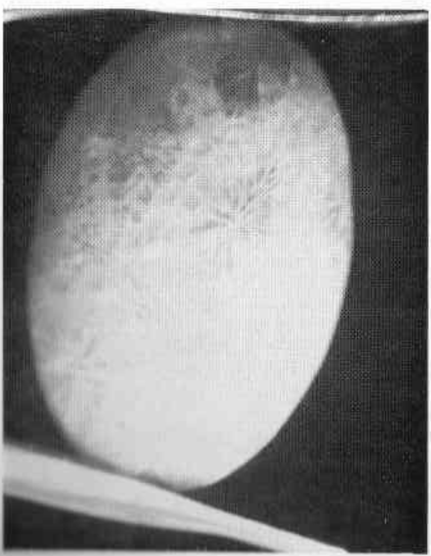

*Figure 13*

*Figure 14.*

refractive index on the order of 1.78 is high for grossularite, we assumed that a certain amount of the andradite molecule was represented in the garnet inclusions. Probably some chromium was present to give the inclusions their bright green color. It made a very attractive cabochon. The material was said to have come from British Columbia.

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

To *Carroll F. Chatham,* Chatham Created Gems, Inc., San Francisco, for four nice pieces of Chatham Created Ruby faceting rough.

To Graduate Gemologist *Dr. Edgar F. Borgatta, Ph.D.,* Gempro Distributors, Rupert, Vermont, for yet another very generous donation of 569 miscellaneous, much-needed cabochons for use in our student practice sets. This most useful gift included various jades, lapis, turquoise, chrysocolla, variscite and shattuckite.

To *Ben Gordon, G.G.,* Gordon Jewelry Co., Houston, Texas, for another of many donations to GIA for class use, consisting of numerous foilbacks, lapis, nephrite, coral, marcasite, synthetic star ruby, and star sapphire cut stones. This is a most welcome gift for our gem identification classes.

To *Donald L. Marchbank, M.D.,* student, Salina, Kansas, for a Gilson synthetic turquoise which will be put to good use in our gem identification classes.

To *Clifford Millsap,* Millsap Jewelry Co., Kansas City, Kansas, for a large assortment of rough, cabochons, and faceted imitations for class use in gem identification sets.

To *Ernest Penner, G.G.,* Ernest Penner, Inc., St. Catharines, Ontario, Canada, for a Brazilian opal cabochon which will make an important addition to our laboratory reference collection.

To *Edward R. Swoboda,* Jewels by Swoboda, Los Angeles, California, for two large assortments of jadeite jade and idocrase baroques. These will be put to good use as spectroscopic test specimens in our gem identification course.

To *Glenn Vargas,* dealer in rare gem materials, Thermal, California, for a generous gift of a large collection of rare and unusual gem material rough consisting of benitoite, sphene, datolite, zincite, hexagonite, sphalerite, smithsonite, fluorite and a number of other specimens for use in our resident gem identification classes.

# Hornbill ~ Ho-Ting

BY ARGIMIRO SANTOS MUNSURI

Reprinted courtesy of *Boletin del Instituto Gemologico Español,* Noviembre-Diciembre 1972.

Ed. Note: There are many strange and wonderful forms in the bird world, but none attracts so much attention to the gemologist and artisan as the Hornbill. They are large in size, shy and uncommon, grotesque in appearance, and most have strange nesting habits. But above all, only the Helmeted Hornbill, *Rhinoplax vigil,* from Southeast Asia and Borneo, is unique in that its casque is made of solid ivory-like material which is coveted by artisans the world over for ornamental carving. It is remarkable that this bird has not been exterminated since it has been persecuted for years by hunters wanting the Hornbill ivory. Today, the importation of recent carvings to the U.S. of Helmeted Hornbill is illegal; however, antique pieces are allowed.

Gemology is not only the study of precious stones, but it also deals with certain materials which we could call gemological materials, since they are used to make beautiful and treasured objects (true jewels). Thus, such materials as pearl, coral, ivory and its different varieties, bone, amber and jet are studied.

Although there are various texts which include these materials, such as *Gemologia* by Sra. Cavenago or *Gems* by Robert Webster, it has always seemed strange to me that none discusses Hornbill or Calao Ivory or Ho-Ting, as the Chinese call it, or golden jade. This material is more noble, rare and expensive than ivory; therefore, I consider this unique material of such importance and interest to write this article.

On the islands that surround Borneo lives a bird the size of a large goose, the Calao *(Rhinoplax vigil),* possessing a wing spread of 1.5 meters and a large black and red tail *(Figure*

*Figure 1. Idealized portrait of the Helmeted Hornbill* (**Rhinoplax vigil**). *Adapted from D. G. Elliot's* **A Monograph of the Bucerotidae.**

*Figure 2. Skull of the Helmeted Hornbill showing the whole casque carved* in situ. *Carving shows the workable portion of the bird's head with its golden-center and red to crimson-edged outer layer. From the collection of Kenneth Brown, Inc., La Jolla, California. (Photo courtesy San Diego Zoo.)*

*Figure 3. Exquisitely carved art objects of Hornbill, illustrating the skillful use of the bi-colored casque. A superb Chinese double belt buckle, snuff bottle, and earring are shown. From the collection of Kenneth Brown, Inc., La Jolla, California. (Photo courtesy of San Diego Zoo.)*

*1).* The material that we are dealing with here is found on the males of the helmeted variety only. It consists of a protuberance (casque) of horny (chitinous) origin that appears on the top of the beak next to the cranium *(Figure 2).* Other varieties of this species exist in Africa and some parts of Asia, but they do not produce gem quality material, but rather, their material is spongy and uncarvable. Only the helmeted variety of the Malayan archipelago possesses the precious material. This species lives in virgin forests between 500 and 1000 meters in altitude and nests in the tops of large trees where the females live in virtual captivity until their young can fly. In spite of their great weight, these birds can fly distances of 300 or 400 meters, producing an infernal noise by the flappings of their wings. Since these birds are extremely cautious, it is difficult to catch them. Only the Punans of west Borneo are capable of catching the male birds. When the males leave to gather food for females in the nest, they are shot with arrows launched from blowguns. Furthermore, it often takes weeks or even months of tracking, and the men must take advantage of the least slip-up in vigilance on the part of the male bird. Thus, the difficulty of its capture, together with its rarity, make the Hornbill a most treasured and appreciated material.

Its carving into valuable objects is very ancient; some pieces have been found in a Neolithic tomb in Borneo. Over 2000 years ago, local tribes held the helmeted bird to be magic, and it was used as the symbol of power and virility. Some Dayak tribes believe that they descended from the "man bird," which is apparently this very bird (Harrison). The poetry and songs of this tribe often allude to this bird. Also, the Kennyalis, the Njadjus, and other peoples in the area often mention this bird in their songs and legends.

However, it was not until the Hornbill became known to the Chinese that it became truly appreciated, when it began to be carved into earrings, finger rings, pendants, belt buckles, but, above all, into much sought after snuff bottles *(Figure 3).*

During the Tang dynasty a large trade developed between China and Southeast Asia. From that time on, the Indochinese and Malayans became intermediaries between hunters and consumers.

Hornbill is also mentioned in later dynasties. During the Ming dynasty, for example, a piece of this material was evaluated as 1000 coins according to tax regulations. Furthermore, the center yellowish area (the cranium of the Calao), called Chin-Mo-Ho-Ting, was differentiated from the outside carmine-colored area, which was more in demand *(Figure 2).*

Hornbill, in China as well as among the Dayaks, was used only by men, and, among the men, only chiefs or those belonging to the aristocracy wore it. Members of the court or high military leaders wore buckles to fasten their large belts and long, narrow strips of very fine leather, which indicated the rank of the wearer. Some very finely carved and polished loop-shaped examples of these buckles exist,

*Hornbill Snuff Bottle, Nineteenth Century. Valuable snuff bottle carved in "calao ivory," decorated with birds and flowers.*

several in the form of Buddha (from the Ming dynasty), and ovals (Tching dynasty), all carved from a single piece.

One of these buckles, dating from the 18th century, 10.2 cm long, is carved on one side with the magnificent characters of the symbol "Chow" (longevity) and on the other side with the symbol "Fou" (felicity). This work of art, of incredible beauty, belongs to Mr. R. H. Palmer, Berkshire. There are examples of the helmet (casque) together with the beak, totally carved on the exterior into figures or landscapes and the cranium furnished with artificial eyes and plumage. A very finely carved complete helmet of the Calao may be seen in the British Museum.

During the Chieng-Lung period (also 18th century), bottles or flasks for snuff began to be carved from Hornbill. Soon after, almost the entire supply of this noble material was used to make only these particular objects. Three snuff bottles may be carved from one "helmet." Finger rings were also made from Ho-Ting to protect the thumbs of aristocratic archers. In the 18th and 19th centuries, the Japanese, too, used this material to carve "netsukes" of great beauty and fine craftsmanship.

The helmet, or casque, the usable material of the Hornbill's cranium, is located on the top of the bill *(See Figure 2).* It has a form somewhat like a loaf, about 5 to 6 cm in length, and is almost square, since it is approximately the same measurement in depth. The interior is a golden yellow color, somewhat yellowish-orange in the center, and the whole mass is surrounded by an outer layer of very beautiful carmine color.

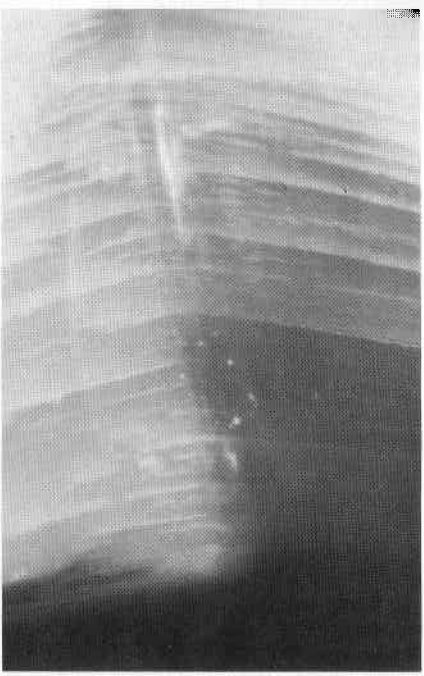
Ho-Ting is a dense material, but it doesn't seem heavy since the carved objects are almost always hollow (snuff bottles, for example) or are very lacy.

Hornbill's refractive index is approximately 1.54. It is harder than ivory, of chitinous character, and has a luster after carving somewhat better than amber. It should not be called Calao Ivory, which it has sometimes been designated, as for example by Dr. Schuyle Camman, a celebrated investigator, who said about this material:

"Among all the very rare substances which have been worked by the artists of the Far East and of India, the strangest and least known perhaps would be Calao Ivory." (Sarawak Museum Journal 1:393).

On examining Hornbill under a microscope, we observe fibers – but irregular ones – which have a tendency to come together and separate like whirlwinds. One of the most difficult problems is to determine the age or antiquity of a piece of Calao. The great collector Tom Harrison, a true specialist in this rare substance, says:

. . ."if the helmet was taken from an old male, one would find it split, cracked and displaying brittleness. However, one must take into account that some helmets were kept by the capturers for a few or for many years. This allowed them to deteriorate, something which would become evident upon carving them."



*Photomicrograph of Hornbill (calao ivory) showing its typical structure. (90X.)*

Nevertheless, once Hornbill was in the hands of Chinese artisans, it could be improved by treatment, the nature of which we unfortunately do not know. The result of this treatment was a more luminous material with a better carmine color. The artist's treatment and care of this material could give it the appearance of greater age than it actually had, or the reverse – it could rejuvenate and enrich the material, giving it the brilliance and freshness of material obtained from young males and used soon after their death.

Recently-captured Hornbill produces a material without cracks or fibers, full of freshness and color, and if it is cleaned and cured adequately these properties will last indefinitely. The only exceptions to this are the helments of old birds.

As with everything in this world, this material has also been the object of imitation or faking, although even in the Ming dynasty laws existed which made this fraud punishable.

Without any doubt, the most notable substitute comes from the inner part of the horns of a deer native to India. These imitations are extremely rare and thus in a way more valuable than the authentic pieces. The previously-cited collector Harrison announced that he had with pleasure traded a buckle made from authentic Hornbill for a fake made from the above-mentioned deer's horn. At first glance these copies are easily confused with Calao, since they possess a rich yellow-orange color. But microscopic examination will separate them easily, since ordinarily on examining a section, the horn exhibits concentric fibers (indicating growth). In the genuine material, however, the fibers appear without any order, as previously discussed, and are not evident on the surface. Plastic imitations are so easy to detect that it is not worthwhile to concern ourselves with the separation. The characteristic magnificent luster, color and freshness of Ho-Ting makes the separation of plastic from the genuine material a very simple matter.

As an item of curiosity, we must also mention that cases were known in China of yellow jade with red areas being carved and called "Calao Ivory." This is not a case of faking in the strictest sense of the word, since one can readily see that he is confronted with a stone, but it is indeed testimony to the profound admiration and appreciation the Orientals felt for Hornbill, that they would "copy" it with the gem which enjoys their greatest appreciation.

*Photomicrograph of deer horn imitation of Hornbill ivory from India, showing concentric and orderly structure indicating growth. (30X.)*

*Photomicrograph of elephant ivory, illustrating the "lines of Retzius" or engine-turning effect seen only in ivory from elephants. (30X.)*

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

By ROBERT CROWNINGSHIELD

### Fade Tests on Gamma Irradiated Topaz and Quartz

In the Lab Column last issue we mentioned that we had not conducted any fade resistance tests with either brown irradiated topaz or smoky quartz. We now have some information about them. *Figure 1* shows a cleavage section of topaz which was originally colorless. After a short exposure to gamma rays about one half of the section became a dark reddish-brown color. The line of demarcation is almost die straight, indicating that an undetermined difference in structure allowed the coloration of only part of the stone. Longer exposure seems not to be the answer. Half the piece was covered with black tape and placed on a sunny window for a period of two weeks. Note that the dark part was unchanged. The exposed part of the colored zone faded to less than half the original intensity. In addition, the color became merely smoky instead of brown – the first truly smoky topaz we have seen.

It occurred to us that if a pale yellow topaz were irradiated instead of a colorless stone, would the reddish-brown color superimposed on the yellow produce a more realistic color than the brown treated stones we have been seeing? We are indebted to Graduate Melvin Strump of Superior Gem Co. for loaning us several small so-called "Imperial topazes" as well as a large pale yellow stone. After short exposures to gamma radiation, all the stones took on a beautiful orange color which was quite exciting to see. However, after a very few days on a sunny window the stones faded to their original colors.

A large selection of cut rock crystals was exposed to gamma radiation

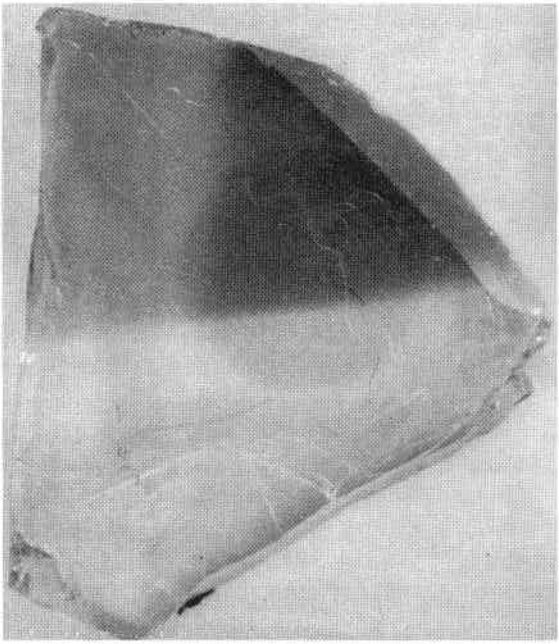


*Figure 1.*

with the result that most became smoky. A few that did not color evenly with zones of color reminded us of the zoning in many amethysts. A few pale amethysts were exposed also. Although most became darker in color, the color was smoky and the treatment did not improve them commercially. *Figure 2* illustrates two cabochons on the smoky treated quartz. One has been on a sunny window for two weeks while the other (the one with the chip in the girdle) was in the safe as a control. The stone in the window has faded perceptibly; mainly it is less smoky and more yellowish. We still have to test the irradiated and heat-treated citrines and blue cultured and irradiated pearls for fade resistance.

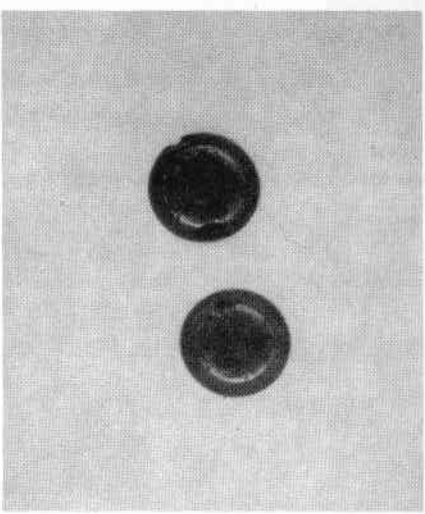


*Figure 2.*

**Southwest Indian Jewelry**

In recent months silver and turquoise jewelry manufactured in the

American Southwest has become increasingly popular – particularly in the sophisticated, high fashion shops and salons. We have been asked to examine several pieces and in most cases have found the turquoise to be rather pale in color, usually with matrix and with no evidence of treatment. However, recently we tested an example of this type of jewelry in which the turquoise was definitely dyed – not just oiled or paraffin treated *(Figure 3)*. The color was too intense to be natural, and it had penetrated the stones quite irregularly. We have rarely encountered turquoise with a penetrating dye treatment. More often it is merely painted and then lacquered with a colorless coating.

**More About Lavender Jadeite**

Until a year or two ago we never saw violet or lavender jade with any real depth of color. In most cases it is quite light in color tending toward grayish, though some are a delicate and quite attractive light violet color. Recently, as readers have learned, very dark purple to blue-purple stones have been seen. Some are obviously treated by virtue of the fact that the dye can be detected under magnification. Others do not show the dye under magnification but do fluoresce an unnatural reddish-orange (like fluorescein) under ultraviolet. Still others, purchased from dealers as dyed stones and for a small price, show no evidence whatsoever of the color origin.

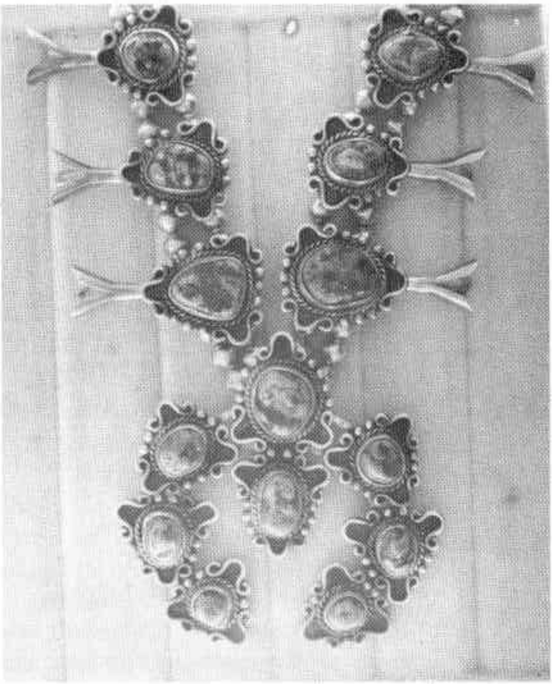


*Figure 3.*

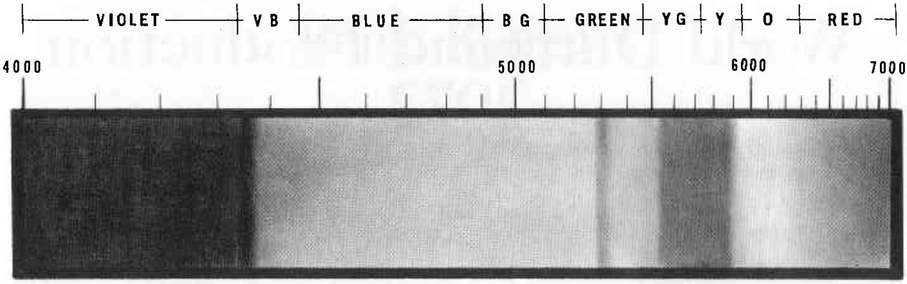



*Figure 4. Color treated lavender jadeite (nature of dye unknown).*

This has unfortunately meant that there are stones for which no Laboratory report about their color origin can be issued. Recently in New York we encountered two further examples of dyed stones which do not fit the examples mentioned above. *Figure 4* is a drawing of the absorption spectrum of one intense violet stone in which no dye could be seen under the microscope. Since we identified this stone, we have seen several other examples, some with a more believable color than the first one. Another stone with stronger color than we like to think possible in nature did not have the absorption spectrum shown above, nor did it show dye in the cracks when observed in the microscope. Under ultraviolet there were areas of very weak reddish fluorescence which could readily be dismissed as meaningless. However, in the dark room with no other source of illumination than long-wave ultraviolet, we could see dye fluorescing deep within the stone, proving that the stone was not of natural color.

Another avenue of investigation into the possible source of color in treated violet jadeite occurred to the writer mindful of the glass which turns violet with exposure to sunlight. Perhaps atomic bombardment would cause a color change. A translucent white cabochon was exposed to fast neutrons in an atomic reactor. The color was virtually unchanged, though perhaps grayer. However, it became highly radioactive so that it could not be released. The chances of an artificially induced color being due to sub-atomic bombardment seems remote. However, it is planned to subject other white jadeites to gamma radiation.

# World Diamond Production 1972

(Ed. note: Reprinted from Mineral Trade Notes, U.S. Dept. of the Interior, Bureau of Mines, Vol. 70, No. 11, November 1973.)

As shown in the following table, total world production of diamond (natural) increased over 2 million carats entirely within the industrial diamond segment. The Republic of the Zaire continued to be the principal source for industrial diamond, and South Africa, the U.S.S.R., South-West Africa, and Angola were leaders in the output of gem diamond.

**Diamond (natural): World Production, by country**[1]

(Thousand Carats)

| Country | 1971 | | | 1972[p] | | |
|---|---|---|---|---|---|---|
| | Gem | Industrial | Total | Gem | Industrial | Total |
| Africa | | | | | | |
| Angola | 1,810 | 603 | 2,413 | 1,171 | 391 | 1,562 |
| Botswana | 82 | 740 | 822 | 360 | 2,043 | 2,403 |
| Central African Republic | 288 | 149 | 437 | 346 | 178 | 524 |
| Ghana | 256 | 2,306 | 2,562 | 266 | 2,393 | 2,659 |
| Guinea [e] | 22 | 52 | 74 | 25 | 55 | 80 |
| Ivory Coast | 130 | 196 | 326 | 131 | 199 | e330 |
| Lesotho [2] | 1 | 6 | 7 | 1 | 8 | 9 |
| Liberia | [3]532 | [3]277 | [3]809 | 532 | 278 | [e]810 |
| Sierra Leone [4] | 715 | 1,220 | 1,935 | 609 | 1,038 | 1,647 |
| South Africa: | | | | | | |
| Premier mine | 609 | 1,828 | 2,437 | 613 | 1,841 | 2,454 |
| Other DeBeers Co. [5] | 2,162 | 1,769 | 3,931 | 2,291 | 1,874 | 4,165 |
| Other | 398 | 265 | 663 | 466 | 310 | 776 |
| Total | 3,169 | 3,862 | 7,031 | 3,370 | 4,025 | 7,395 |
| South-West Africa, Territory of | 1,566 | 82 | 1,648 | 1,516 | 80 | 1,596 |
| Tanzania | 419 | 418 | 837 | 365 | 365 | [4]730 |
| Zaire, Republic of the | 1,250 | 11,270 | 12,520 | 980 | 12,380 | 13,360 |
| Other areas: | | | | | | |
| Brazil [e] | [r]150 | [r]150 | [r]300 | 155 | 155 | 310 |
| Guyana | 19 | 29 | 48 | 20 | 29 | 49 |
| India | 16 | 3 | 19 | 17 | 3 | 20 |
| Indonesia [e] | 12 | 3 | 15 | 12 | 3 | 15 |
| U.S.S.R. [e] | 1,800 | 7,000 | 8,800 | 1,850 | 7,350 | 9,200 |
| Venezuela | 114 | 385 | 499 | 141 | 315 | 456 |
| World total | 12,351 | 28,751 | 41,102 | 11,867 | 31,288 | 43,155 |

e Estimate

p Preliminary

r Revised

1 Total diamond output of each country is actually reported except where indicated to be an estimate. The detailed separate reporting of gem diamond and industrial diamond represents Bureau of Mines estimates in the case of all countries except Lesotho, Liberia (1971), and Venezuela where sources give both total and detail. The estimated distribution of total output between gem and industrial is conjectural based on unofficial information of varying reliability.

2 Exports originating in Lesotho; excludes stones imported for cutting and reexport.

3 Exports for year ended August 31 of that stated.

4 Exports

5 All company output from the Republic of South Africa except for that from the Premier mines; also excludes company output from the Territory of South-West Africa and from Botswana.

# Book Reviews

*MINERALS OF BRAZIL* (Minerais Do Brasil) *by Ribeiro Franco, Alsedo Leprevost, João José Bigarella, and Aurélio Bolsanello. Published by Edgard Blücher, Ltd., São Paulo, 1972, 3 volumes, 426 pages profusely illustrated with 96 color plates. Price $50.00.*

*Minerals of Brazil* is a bilingual text in Portuguese and English, compiled and authored under the direction of Rui Ribeiro Franco, Coordinator of the Central Geoscience Institute, University of Brasília, with the assistance of Alsedo Leprevost, João José Bigarella, and Aurélio Bolsanello. The book is essentially a visual exploration into the vast realm of Brazilian minerals and their localities.

The format of the book arranges the minerals primarily according to the standard mineralogical classification; i.e., as to elements, oxides, phosphates, silicates, etc. Initially, a very general introduction to mineralogy and summary of the numerous physical and chemical properties of the various mineral classes are given as a short preliminary introduction. Reserves and production figures are also given for most of Brazil's strategic, critical and essential minerals. Chemical formulae, locations, and English names accompany each photograph. An indication of specimen size is usually given in the metric system. Thus the book is not a mineralogy text in the classical sense, but rather it can be considered a pictorial introduction to the field of descriptive mineralogy. To quote from the author's preface, "our idea was to assemble the largest possible number of good quality photographs of Brazilian minerals, gems, and rocks." Further, it was intended to include ". . . a relatively short preliminary text to introduce the reader to the field of mineral study, giving him a new vision about many of the problems related to the subject."

Brazilian mineral species are colorfully and profusely illustrated, so that the varieties of quartz are portrayed 116 times and tourmaline 26 times. Apart from the general good quality of the mineral photographs, some of the cut stone photographs leave much to be desired. The use of solid color makes excellent background for showing the minerals to best advantage. Photograph IX-280, depicting orthoclase from Santa Rita, Minas Gerais, and photograph IX-287, illustrating albite and rubellite from Lavra da Barra, Minas Gerais, appear to be strikingly similar specimens. They seem to be the same specimen except for having been apparently reversed in the reproduction process. Otherwise, in the great majority of color plates, reproductions are amazingly accurate and of good quality.

Amateur and professional mineralogists alike will find *Minerals of Brazil* a fascinating "viewing," as the many diverse minerals of Brazil are put into perspective. Because the complete text is given in both Portuguese and English, there is no difficulty in understanding the descriptions. Consequently, collectors and importers of rough and finished material will find the book invaluable. *Minerals of Brazil* will make a useful and decorative addition to any mineral and gem library.

*R.A.P.G.*

*MAN-MADE CRYSTALS, by Joel E. Arem. Published by the Smithsonian Institution Press, Washington, D.C., 1973. Publication Number 4830. 112 pages. Well illustrated with 23 full-color plates plus numerous black and white photographs and line drawings. Price: $5.95 Paperback.*

The field of synthetic crystal growing has made a quantum jump in its development since the latter part of the 1800's. *Man-Made Crystals* is a broad overview of the field of synthetic crystal technology. The author has picked key developments and materials to explain their importance to industry and society. The book explains why synthetic crystals are important and how they fit into the general picture of materials science, a rapidly growing field in modern technology. Topics covered include an introduction to crystals, which gives lucid definitions and descriptions of what a crystal is, the difference between natural, synthetic, and imitation, and the importance of crystals to our everyday life. Other chapters include a historical retrospect of the crystal-growing art, transistors, lasers, and "bubbles," (phenomena observed in certain types of magnetic materials), and specific case histories of organic and inorganic crystal syntheses. Also included is a view looking toward the future of synthetic crystals. Arem predicts that the day may not be far off when only synthetics will be available to the average person and that it will probably be difficult, if not impossible, to distinguish natural from man-made gems without the most sophisticated laboratory analysis.

A very useful appendix includes acronyms for various synthetics as well as precise definitions of technical terms used in the industry, and a tabulation of many of the trade names used for diamond imitations. From a purely gemological point of view, the book has much to offer, especially the chapters discussing "Techniques for Growing Crystals" and "Man-Made Gems." In fact, the section on crystal growing techniques is one of the best general treatments available on the subject.

The author stresses the importance of differentiating *natural, synthetic,* and *imitation* crystals. *Natural* crystals are those found in nature – and are minerals, which are naturally-occurring chemical compounds with a characteristic crystal structure and a composition that varies within defined limits. *Synthetic* crystals are manufactured from simple or complex components and are chemically, physically, and structurally identical to its natural counterpart. The only difference is that the synthetic was made by man, rather than by nature. Because the growth method generally introduces characteristic defects, inclusions, or other visible features, identification of a synthetic is possible. An *imitation* is a material with properties that mimic or simulate those of a different, more costly material.

The chapter discussing techniques for growing crystals is well written, informative, and extremely interesting. Joel Arem has done an admirable job of describing how crystals grow and takes the reader in a lucid step-by-step progression through crystal growth while defining the complex technical terms into understandable language for the lay-person. The author uses well chosen line drawings to clarify the text material. Besides describing the more common methods of synthetic crystal growth such as the Verneuil and Czochralski techniques, growth from solution, hydrothermal growth, and flux growth, Arem clearly describes natural crystal growth and other methods not too common to the gemologist.

Among the numerous crystal growing techniques is the Bridgman-Stockbarger method. It is most interesting because it is a useful technique for growing single crystals of exceptionally high purity and enormous size. The largest to date are crystals of sodium iodide and cesium iodide nearly a yard across and weighing more than a ton. This is a vast improvement over Fremy's early attempts of synthesis of ruby crystals in 1877 which were only about 1/2 inch in diameter. Unfortunately, rubies and other important gem materials have not as yet been synthesized by this method. A variation on the Czochralski crystal pulling method is the Kyropoulos technique. It differs from the Czochralski technique in that instead of the crystal being pulled out of the melt, the temperature of the melt is lowered from the seed crystal downward. This technique produces good single crystals having a larger diameter compared to height in contrast to the Czochralski method which is best suited for crystals much longer than they are wide. These systems are completely automated and computerized so that the length and diameter of the crystals can be controlled.

Growth from solutions includes gel growth, in which chemicals in solution diffuse through an inert gel. Where the solutions meet, a reaction occurs and crystals grow as the reaction product. This technique is good for growing relatively insoluble compounds.

The chapter on man-made gems is of special interest to the gemologist but rather superficial. However, it does cover synthetics such as diamond, ruby, sapphire, spinel, quartz and beryl in a very readable and interesting manner. Curiously, the recent developments of synthetic turquoise and opals by Pierre Gilson of France are not covered in this book.

All the illustrations are clear and the information on the coloring agents used in the manufacture for all stones is interesting. The quality of the colored photographs is superb and the subjects depicted are both educational and aesthetically pleasing. *Man-Made Crystals* is a useful, practical, easy-to-understand book. It is highly recommended to gemologists and anyone who wishes to develop or begin an interest in synthetic crystals.

*R.A.P.G.*

# The Gem Line

## Dr. Gübelin Honored

A new gemological section (De Beers Laboratory) was established in the Geological Department of the University of Stellenbosch, South Africa, on October 29, 1973.

At the end of the inauguration ceremony Prof. J.N. de Villiers, Rector of the University of Stellenbosch, awarded Dr. Edward Gübelin the title of "Honorary Professor" in recognition of his valuable contribution towards gemological research and successful promotion of gemology throughout the world.

Needless to say, we are all delighted with this honor although Dr. Gübelin considers this not so much his personal reward but more that this is the first academic award of its kind ever to be bestowed upon a gemologist, in the narrow sense, and consequently to the science of gemstones, in a wider sense. We are happy that through this tribute gemology has been elevated into the ranks of academic dignity.

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## New Magazine From India

The Gem & Jewellery Information Centre of India, Publisher of *Journal of Gem Industry, Gem & Jewellery Year Book,* and *Weekly Bulletin on Import Licenses* for the last 10 years, plans to publish very shortly a bi-monthly magazine called *Diamond World,* India's only news magazine on diamonds. The first issue is expected to reach readers before the end of 1973. The yearly subscription is 16 Rupees or U.S. $6.00. For more information, contact The Manager, *Diamond World,* Gem & Jewellery Information Centre of India, A-95 Journal House, Janta Colony, Jaipur 302004, India.

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## 2nd Gemmological Symposium in Australia Announced

The Gemmological Association of Australia's 26th Conference and 2nd Gemmological Symposium will be held in Melbourne on April 27 and 28, 1974. Visitors are welcome. For information please write to: Mr. C.R. Stott, G.P.O. Box 5133AA, Melbourne, Victoria, 3001, Australia.

Symposium Theme: Diamonds, General Topics and Discussions.

"Synthetic Diamonds"
Professor H.C. Bolton, B.Sc., Ph.D. (London)
Department of Physics, Monash University, Melbourne

"Marketing of Diamonds"
Mr. B. Corcoran

"Industrial Uses of Diamonds"
Mr. Gellie, Anglo American Agencies

"Russian Diamond Fields"
Dr. G. Troup, D. Sc.

"Reciprocal Influence Between Gemmology and Lapidary"
Mr. J. S. Taylor, F.G.A.A.

"Further Work on Zoisite"
Dr. D. Hutton

"Electron Microscope"
Mr. Dawson, C.S.I.R.O.

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## Largest Russian Diamond Found In Siberia

Recently, Siberian miners reportedly discovered a 232-carat diamond, the largest ever found in the Soviet Union. The stone was unearthed in the diamond fields of Mirnyy in the Yakutskaya region of Siberia.

The new diamond has been named "Fifty Years of Aeroflot" in commemoration of Soviet Aviation Day, according to Sovietskaya Latvia.

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**ADDENDUM**

# Shaping Black Coral Bracelets

BY CAPT. GIRVIN B. WAIT

Reprinted courtesy of *Lapidary Journal,* June 1973

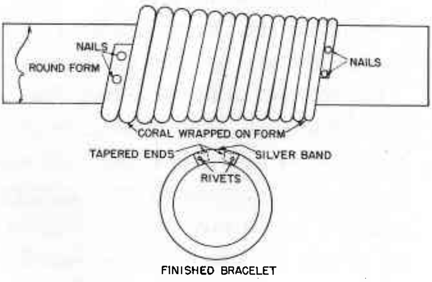
*(Ed. note: The following article has been added to describe the method of shaping black coral into jewelry.)*

Black coral from the Hawaiian Islands has become very popular for jewelry items. This particular coral grows in bush form up to three feet in height, with branches as thick as one inch at the base.

Black coral jewelry is also manufactured in the Philippine Islands from a different variety. The coral used for these items, which include bracelets and circular earrings, grows in tall slender stalks, fifteen or more feet in height and about 3/4 inch in diameter at the base, tapering to a point at the tip.

The tools used in making the Philippine black coral jewelry are simple. They consist of a buffer using tripoli, a hacksaw, a torch for soldering and heating the coral, and various shapes for chasing a design on the connecting silver band.

The method of shaping the coral is as follows: A piece of black coral, eight to ten feet long, with the desired thickness, is cut from a long stalk. A round wooden form is available about a foot long and 2-3/8 inches in diameter, or the inside diameter of a bracelet. One end of the coral is nailed to the wooden form; then as the coral is heated by the blowtorch, it is wrapped around the form. The application of the heat is somewhat critical; it must be of sufficient heat to allow the coral to bend, but not so hot that the coral will melt. The final end is then nailed to the wooden form. This operation is shown in the diagram.




Unlike true precious coral, which is composed of calcium carbonate, black coral is organic, consisting primarily of conchiolin. Calcareous coral resists bending; however, black coral when fixed on a wooden mount can be shaped into many different forms. The wooden form with the coral attached is put aside for three or four weeks to allow the molecules to set in the new position.

After this lapse of time, the coral is removed from the form. A saw cut is made separating each circlet. A small tubular connecting piece of silver is bent to the shape of the circular coral. It is then fitted to the slightly tapered ends of the coral and riveted in place. A design is chased into the connecting piece; the whole thing is then polished very gently with tripoli, and there you have the finished bracelet.