

Gem Trade LAB NOTES

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AMBER, Plastic Imitation

A large translucent-to-opaque orange, white, yellow, and brown piece of rough was submitted to the West Coast laboratory for identification. The piece measured approximately $28.7 \times 20.5 \times 28.0$ cm. Our client reported that it had been represented as amber when he purchased it in Tahiti; he was told that it had been found floating offshore there.

The appearance of the piece was rather unusual. One side had a thin white coating over a brown area where a few broken sections revealed a third layer that was orangy brown. The other side (figure 1) had some of the white coating plus what appeared to be stamped impressions. In addition to numerous gas bubbles, this side also had a broken portion that revealed a dark yellow interior.

In general, the piece resembled slag material from a plastics factory. Because of its size and the rough surface, we could not get either a specific gravity (although the "heft" test indicated it was very low) or a refractive index. However, a thermal reaction tester produced the slightly acrid odor that is typical of many plastics. An infrared spectral analysis performed by the GIA Research Department confirmed that the material was indeed plastic. The IR



Figure 1. This $28.7 \times 20.5 \times 28.0$ cm plastic imitation amber shows numerous gas bubbles and unnatural stamped depressions.

spectral curve closely matched a standard curve for polyvinyl chloride. RK

DIAMOND

With an Almandine-Pyrope Garnet Inclusion

While grading a 1.25-ct diamond recently in the West Coast laboratory, we noticed the unusual appearance of a transparent crystal inclusion. As evident in figure 2, when the diamond is viewed face-up, the crystal appears to be half black and half orange. Because of the high refractive index of diamond, the color of included crystals may sometimes be masked, either partially or entirely. In this case, when the diamond is tilted, one can see that the entire crystal is actually orange (figure 3).

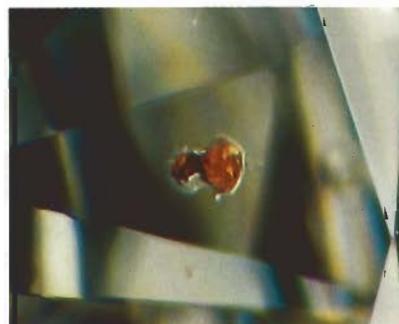
This inclusion, approximately

0.55 mm at its longest point, appears to be a reddish orange almandine-pyrope garnet, similar to published descriptions (see, e.g., *Photoatlas of Inclusions in Gemstones*, by E. J. Gübelin and J. I. Koivula) of compar-

Figure 2. When the host diamond is viewed face up, this included crystal appears to be half black and half orange. Note also the dodecahedral face. Magnified $35\times$.



Figure 3. When the diamond in figure 2 is tipped slightly, the true orange color of the entire included crystal becomes visible. Magnified $27\times$.



Editor's Note: The initials at the end of each item identify the contributing editor who provided that item.

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Figure 4. The light yellow tips and near-colorless center give this 0.69-ct marquise-shaped diamond the distinctive appearance of a true bicolor.



Figure 5. When exposed to long-wave U.V. radiation, the light yellow tips fluoresce a very strong chalky yellow, while the near-colorless center fluoresces a very strong blue.

ble stones, which would place the origin of this diamond in the eclogitic suite of kimberlites. Of course, since the inclusion does not break the surface of the diamond, it is impossible to prove the composition conclusively without damaging the host.

Typically, diamond imposes its own crystal structure on inclusions. Consequently, the faces visible on an included crystal are actually negative diamond faces, not those characteristic of the included mineral. (The term *xenohedral* is used to describe a crystal inclusion bounded by faces of its host mineral.) In this case, however, we cannot tell if the dodecahedral face visible in figure 2 belongs to the garnet or is imposed by the diamond's structure, because both belong to the cubic system.

The study of included crystals in diamond enables scientists to determine what elements are present deep within the earth where the diamonds crystallized. If there are no breaks between the surface of the diamond and the inclusion, then scientists know that the inclusion has remained compositionally unchanged since its creation more than 150 km deep in the earth's crust.

Holly Baxter

Bicolored

The West Coast laboratory recently studied a most unusual 0.69-ct mar-

quise-shape brilliant-cut diamond that was truly a bicolor (figure 4). The center portion was near colorless (approximately an H on the GIA color-grading scale), and both tips were light yellow (in approximately the T to U range on the same scale).

When the diamond was exposed to long-wave U.V. radiation, we observed a distinctly zoned fluorescence: the center portion a very strong blue, with both tips a very strong chalky yellow (figure 5). The zoned fluorescence appeared to correspond directly to the near-colorless and light yellow portions seen in visible light. When the long-wave lamp was turned off, the entire diamond exhibited a very weak chalky yellow phosphorescence that lasted approximately 10 seconds. Interestingly, the phosphorescence did not appear to be zoned. The fluorescence to short-wave U.V. radiation was essentially the same as to long-wave, except that the intensity was moderate rather than very strong. Although the diamond did phosphoresce after exposure to short-wave U.V. radiation, the phosphorescence was extremely weak and very short lived.

The absorption spectrum of this stone was examined at room temperature using a spectroscope unit equipped with a Beck "hand-held" type of prism spectroscope. The near-colorless portion exhibited a

strong, sharp 415-nm line, but the rest of the "Cape series" lines at 423, 435, 452, 465, and 478 nm were very weak. The light yellow tips of the marquise cut did not show any absorption lines or bands. When the diamond was placed over the strong light source from the opening of the iris diaphragm on the spectroscope unit, the near-colorless center portion showed a strong blue transmission luminescence. However, the light yellow areas did not show any transmission luminescence.

When the diamond was examined under the microscope with diffused lighting, both in air and while immersed in methylene iodide, no line of demarcation was observed between the light yellow and near-colorless areas.

Although we occasionally see diamonds that are strongly and irregularly zoned yellow and near colorless, this is the first one that possessed a symmetrical bicolor appearance to the unaided eye.

RK

With a Color-Change Garnet Inclusion

The West Coast laboratory recently received a 0.58-ct diamond for quality analysis. This diamond was found to contain a very unusual inclusion, a color-change garnet, which was red-purple in incandescent light (fig-

ure 6, left) and saturated green in fluorescent light (figure 6, right).

The included crystal, approximately 0.25×0.30 mm, was partially exposed on the surface of the pavilion. Using X-ray fluorescence analysis, Dr. Emmanuel Fritsch of the GIA Research Department determined that magnesium, aluminum, and silicon were present, with a trace of iron and chromium, but found no indication of any manganese. This suggests that the crystal is a color-change pyrope garnet.

The diamond contained other wholly included crystals; one near the table showed a very faint change of color. One should always examine colored inclusions in diamond with both incandescent and fluorescent light to see if there is a color change.

Soheila Jalali

Radium Treated

The East Coast laboratory recently encountered a green pear-shaped diamond (approximately $9.70 \times 8.00 \times 3.70$ mm) that was bezel set as an accent stone to a 6-ct fancy light yellow round diamond (figure 7). When examining green diamonds to determine origin of color, we routinely use a Geiger counter to test for radioactivity. This stone turned out to be radioactive, probably as a result of having been treated with radium salts earlier in this century.

Although encountered infrequently today, artificial coloration of gemstones by treatment with radium was first reported in 1909. In 1916, Sir William Crookes, reportedly the first to experiment with laboratory irradiation of diamonds, presented a small blue-green octahedron to the British Museum that he had treated with radium salts in 1914 (see *Gems & Gemology*, Summer 1950, p. 317).

The pear-shaped diamond we examined was medium dark green in color and showed no luminescence when exposed to either long- or short-wave U.V. radiation. Although the setting restricted our observations with the hand spectroscope, we did see a pair of lines at 498 and 504



Figure 6. This inclusion in diamond appears red-purple in incandescent light (left) and green in fluorescent light (right). Magnified $25\times$.

nm. Because the stone was dark and the heavy gold setting covered an unusually large portion of it, we could not see the tell-tale green "mossy" patches that result from radium treatment until we illuminated the diamond with a FiberLite. We then noted a few very subtle green stains on the pavilion (see p. 164 of the Fall 1987 issue of *Gems & Gemology* for a photo of such stains). Mr. John Haynes, who has treated diamonds with another type of radioactive salt, americium, reports that green diamonds treated by his method do not show these mossy patches (pers. comm., 1989).

To rule out the possibility that the reading from the Geiger counter of

two millirems per hour was from the setting, we wrapped the green diamond with lead foil and again checked the entire ring with the radiation detector. The significant reduction in detectable radiation proved that the source of the original reading was the green diamond.

Although this stone did not have as high a level of residual radiation as has been reported in other radium-treated diamonds, we would not advise using it in jewelry.

Tom Moses

Treated Crystal

In recent months, the laboratories on both coasts have received a greater-than-normal number of fancy color diamonds for examination. With this trend, we have also encountered more treated diamonds. Particularly rare is an irradiated rough diamond crystal submitted for examination to the East Coast laboratory. Although we have seen two such crystals in the past, this is the first we have had an opportunity to photograph and report.

This 2.95-ct well-formed bluish green octahedron was low in clarity and lacked the natural green irradiation stains usually seen on the surface of natural-color green diamond crystals. More significantly, as is evident in figure 8, the coloration was very superficial and was concentrated along the crystal edges. This was most likely the result of electron or alpha-particle treatment.

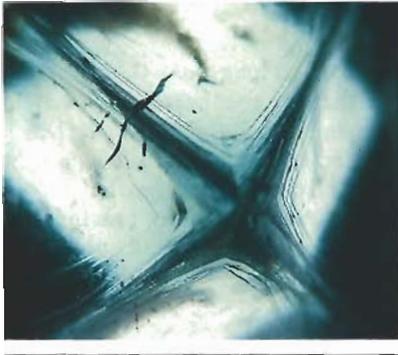
The diamond did not luminesce to either long- or short-wave ultraviolet

Figure 7. The green pear-shaped diamond seen here as a side stone to the 6-ct fancy yellow diamond at the bottom was found to be radioactive.



radiation. The absorption spectrum, observed with a GIA spectroscopy unit, showed a line at 415.5 nm, a pair of lines at 498–504 nm, and a weak, but sharp, line at 594 nm, a spectrum that is commonly observed in treated diamonds. Tom Moses

Figure 8. A magnified view (10×) of this treated diamond crystal shows that the color has very shallow penetration and is concentrated along the edges of the crystal.



Impregnated JADEITE JADE

Our West Coast laboratory learned that a new type of treatment was being used in the Orient to improve the appearance of some jadeite jade. Four sample beads, each measuring approximately 9 mm in diameter, were loaned to us for examination. As can be seen in figure 9, the center pair of beads looks quite different from the outer two. We were told that the center two slightly yellowish green beads are representative of the material after treatment, whereas the outer two darker brownish green beads represent the untreated material.

With magnification we noticed that the "treated" material appeared to be more homogeneous in structure; few of the tiny cracks that are usually present in jadeite jade were visible. The "untreated" beads showed numerous cracks that seemed to be filled with iron stains, thus giving the beads their brownish appearance. However, the area



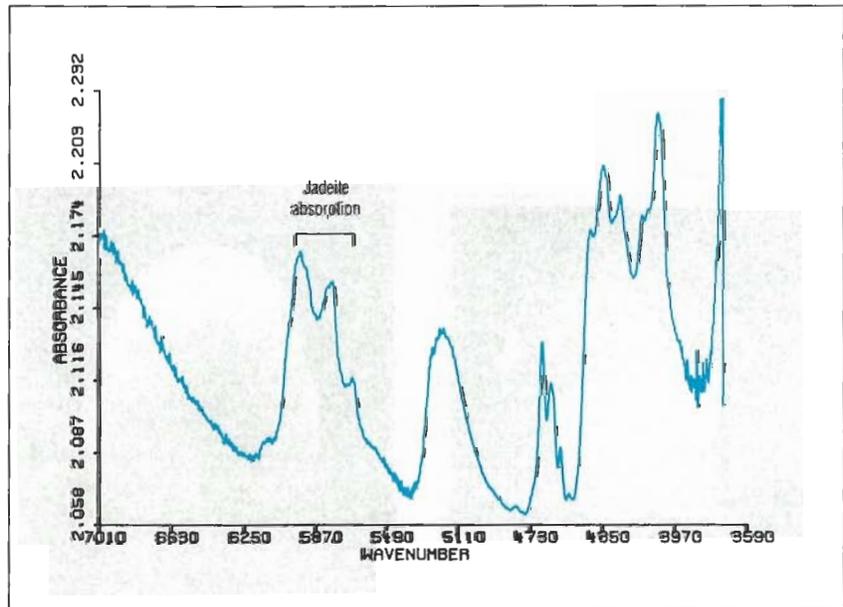
Figure 9. Although all four of these 9-mm jadeite beads were impregnated with plastic, the treatment was more successful on the inner pair than on the outer two.

within and around the drill holes of both types of beads showed a foreign colorless material. When touched lightly with the hot needle of the thermal reaction tester, the very soft material started to flow and give off an acrid odor. This indicated that both types of beads had actually been impregnated with a plastic. We concluded that the lighter colored beads had been treated more successfully,

with the iron-stained cracks masked to improve the overall color appearance of the material.

Using a Nicolet 60SX-FTIR spectrometer, Dr. Emmanuel Fritsch was able to record the infrared spectrum of the treated beads (figure 10). The peaks in the area of approximately 6200 to 5500 wavenumbers are those of jadeite jade; all others can be attributed to a plastic. Bob Rosen-

Figure 10. Only the peaks in the 6200–5500 wavenumber range of this infrared absorption spectrum of one of the beads in figure 9 can be attributed to jadeite; all of the others represent a plastic.



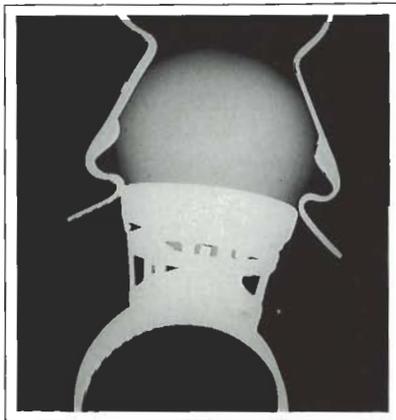
thal, of Nicolet Instrument Corporation, reported that the plastic is probably a mixture of different polyacrylates, although a definite conclusion is not possible without destructive testing. KH

Assembled PEARL

In most cases, identification of mounted pearls does not present a problem. The X-radiograph in figure 11, taken at the East Coast laboratory, shows a large (approximately 18.75 × 17.30 mm) half-drilled slightly baroque pear-shaped pearl that was set in a yellow metal ring. Although this X-radiograph seemed to indicate natural origin, it was not conclusive. After several more X-radiographs were taken, all with unsatisfactory results, we asked the client to remove the pearl so that we could examine it unmounted.

We were surprised to find that the unmounted pearl actually was assembled (figure 12), a fact that had been carefully concealed in the gallery work of the setting. Neither section fluoresced to X-rays, and a subsequent X-radiograph proved that both sections were of saltwater natural origin. The fact that both pearls had slightly flared outlines near the

Figure 11. This X-radiograph of a large (18.75 × 17.30 mm) mounted pearl suggests, but does not conclusively prove, natural origin.



union suggests that they were worked from blister pearls. If it went undetected, such an assemblage would appear to be an important pearl because of its large size. Our report concluded: "Assembled pearl consisting of two sections of natural pearl or blister pearls cemented together." Tom Moses

CULTURED PEARL, Treated Black

The West Coast laboratory had the rare opportunity to see the interior of a cultured pearl that had been treated to give it a black color. A jeweler from Texas discovered that a triple strand of cultured black pearls, which had been represented to him as being of natural color, were actually artificially enhanced. He sent us a few loose brownish black pearls from the necklace together with one that he had cut in half for research purposes.

Figure 13 shows one of the loose pearls, which measured approximately 9 mm in diameter, next to half of the cut pearl. The striated grayish bead nucleus and a brownish black nacreous layer approximately 2-mm thick are readily visible. When

Figure 12. When the pearl shown in figure 11 was unmounted, it became readily apparent that it had been assembled, possibly from two blister pearls.



Figure 13. When a companion to the 9-mm treated black cultured pearl at the left was sawed in half, it revealed a rim of black nacre, evidence that the pearl had been dyed.

exposed to long-wave U.V. radiation, neither of the pearls showed the brownish red fluorescence that is characteristic of natural-color Tahitian black cultured pearls; instead, both remained inert, proving that they had been artificially enhanced.

The GIA Research Department has been studying the chemistry of the nacreous layers in black pearls by means of X-ray fluorescence. XRF analysis of these two pearls showed the presence of a high amount of silver in both, indicating that they had been dyed, probably with a silver nitrate solution. Comparative analyses have shown that natural-color black pearls do not show any traces of silver. KH

Damaged "Burma" RUBY

Recently the East Coast laboratory had the pleasure of identifying an attractive untreated ruby that was mounted in an older yellow and white metal lady's ring set with old-mine-cut brilliants, single cuts, and Swiss cuts. The stone displayed the patches of short rutile needles and irregular "treacle" color zoning that are characteristic of Burma rubies. In addition, it luminesced strongly to both long- and short-wave U.V. radiation. The stone appeared to be in exceptionally fine condition.

Several weeks later the stone and ring, which we recognized imme-

diately, were returned to us for a damage report. The ruby was now so badly fractured (figure 14) that it could not be repaired.

We examined the fractures in question using an overhead light source and a high-magnification contrast-interference microscope. The fractures lacked undercutting and polishing drag lines where they reached the surface, thus proving that they had occurred after the stone was last polished and, therefore, were not inherent. The nature and extent of the fractures indicated that the damage was probably the result of a rapid temperature change.

While examining the mounting, we noticed new metal at the end of a pitted prong next to one of the diamonds, a sign that it had been re-tipped. This was probably the cause of the damage. Why the ruby was subjected to the heat of re-tipping the prongs and not removed from the setting first is the real mystery.

DH

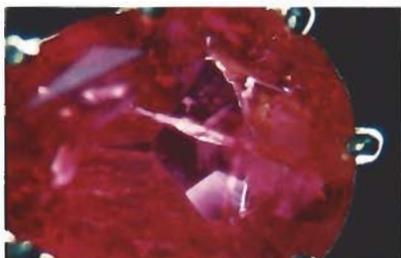


Figure 14. The numerous fractures in this natural ruby (8.60 × 6.20 × 3.80) probably resulted when the stone was heated during a re-tipping of the prongs. Magnified 10×.

Large Purple SCAPOLITE

Although scapolite occurs most frequently in colorless to yellow transparent crystals, it is also found in other colors; purple is one of the most popular. An unusually large (17.61 × 16.36 × 15.20 mm) transparent purple oval mixed-cut scapolite recently came to the attention of the East Coast laboratory (figure 15). This

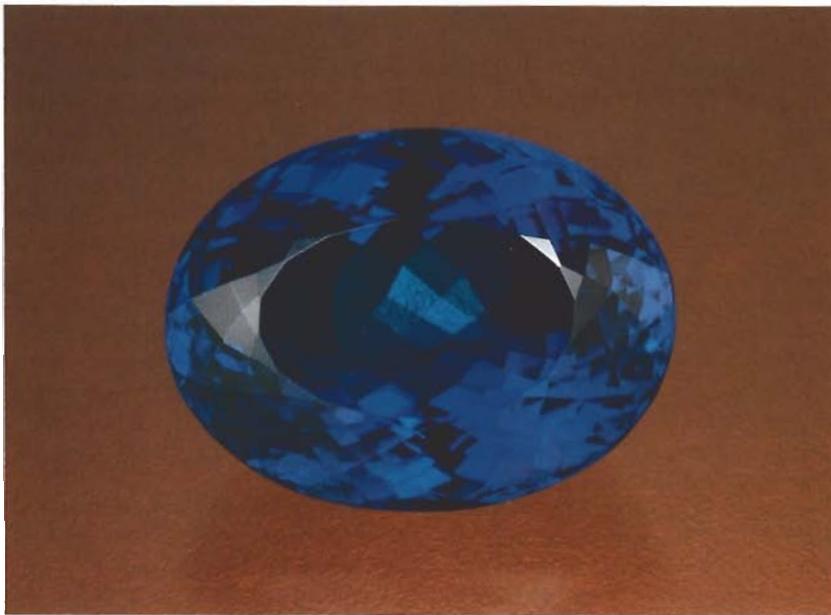


Figure 16. This magnificent 15.18-ct dark violetish blue tourmaline is from the newly discovered São José da Batalha mine, in Paraíba, Brazil.

26.11-ct stone was reportedly from Burma. The largest cut scapolite, also from this locality, is believed to be the 288-ct colorless stone reported in the January 1978 issue of the *Journal of Gemmology*. However, fine-color purple scapolites in sizes over a few carats are not common.

Scapolite also occurs in a fibrous and translucent form that may display chatoyancy when cut *en cabochon*. A 52.92-ct cat's-eye scapolite

Figure 15. This 26.11-ct purple scapolite is unusually large for such a color.



was reported by our West Coast laboratory in the Summer 1985 *Gems & Gemology*.
Nicholas DelRe

Blue TOURMALINE from Brazil

In recent months, laboratories on both coasts have seen a number of tourmalines from the new locality in Paraíba, Brazil. The East Coast laboratory examined two tourmalines from this locality of a fine "sapphire" blue color, known in the trade as "indicolite," the larger one weighing 5.71 ct. The samples tested had the normal gemological properties for tourmaline.
DH

The West Coast laboratory received for identification an extraordinary 15.18-ct oval modified brilliant cut, dark violetish blue tourmaline (figure 16) that was reported to be from this same locality. When viewed table up with standard "daylight equivalent" illumination, the stone somewhat resembles a fine tanzanite. This color is unlike any previ-

ously reported for blue tourmalines (particularly in this size range).

As mentioned in the Gem News section of the Fall 1989 issue of *Gems & Gemology*, faceted stones from this new Paraíba find (more precisely known as São José da Batalha) are usually less than 1 ct. To the best of our knowledge, this is the largest fine faceted violetish blue tourmaline reported from that locality to date.

Identification of the stone as tourmaline was confirmed by standard gemological testing. It was determined to be uniaxial negative and to have refractive indices of 1.620 and 1.640, with a corresponding birefringence of 0.020; a specific gravity of 3.07 was determined by the hydrostatic method; very strong pleochroism was obvious to the unaided eye. With a calcite dichroscope, we observed strongly dichroic colors of dark blue-violet parallel to the c-axis and medium greenish blue perpendicular to the c-axis.

The visible-light absorption spectrum was examined with a GIA Gem Instruments spectroscope unit with a Beck prism spectroscope at room temperature. This unusually colored tourmaline had a very interesting absorption spectrum. Parallel to the c-axis there were only two major areas where light was transmitted: one in the violet, violet-blue, blue, and part of the blue-green; and the other in portions of the blue-green and green regions. Within the violet, violet-blue, and blue transmission areas we observed a moderately strong diffuse band centered near 453 nm and a thinner diffuse band of moderate intensity at approximately 461 nm. We also noted, in the green region, a strong sharp line slightly above 539 nm, with a vague emission (bright) line at around 538 nm. In addition to these areas, there was a broad strong absorption area blocking out all of the red and most of the orange (approximately 605 to 700 nm) as well as a general, moderate to weak, absorption from around 500 to 540 nm and a somewhat narrower strong dark absorption in the violet

from approximately 400 to 428 nm.

The spectrum observed perpendicular to the c-axis was very similar, except for the absence of the line slightly above 539 nm and the fact that the lines at 453 and 461 nm were weaker. As reported in the Gem News section of this issue, preliminary work by the GIA Research Department indicates that the color of this stone is probably caused by the presence of Mn^{3+} together with Cu^{2+} . European researchers have reached a similar conclusion based on like-color material from this locality (E. Gübelin, pers. comm., 1989).

To insure observation of even the weakest fluorescence, we exposed the stone to both long- and short-wave U.V. radiation in a darkened room, placing it within a few inches of the ultraviolet lamp. The tourmaline showed no visible fluorescence to either source.

We also checked the stone for color zoning by immersing it in sesame oil (R.I. of 1.47), which was chosen because it is nontoxic. When the stone was viewed over diffused illumination, the overall blue coloration as seen with the unaided eye was even. However, there was a very subtle zone, moderate in size, of faint purple arranged in a "Y"-shaped pattern oriented parallel to the c-axis that appeared to extend throughout most of the stone. The "Y" shape was reminiscent of the growth features that run down the c-axis of some Brazilian "imperial" topaz.

Examination of the stone with a microscope and darkfield illumination revealed subtle, straight parallel growth features throughout most of the interior. In addition, a few small needles and minute white crystals were observed in random orientation. RK

Imitation CUBIC ZIRCONIA

By definition, an imitation is fashioned to closely resemble a more valuable gem. Many diamond imita-



Figure 17. These 5-mm "zirconia" earrings were found to be foil-backed glass.

tions, for example, are familiar to jewelers and consumers alike. At the East Coast laboratory, however, we were surprised to encounter glass imitations of cubic zirconia, which in itself is a relatively inexpensive material and certainly not a gem.

The earrings shown in figure 17 were offered as an incentive to attend a real estate sales presentation. These 5.00-mm round brilliants were labeled *zirconia*. A trained observer would immediately notice the molded appearance and the lack of the dispersion that is characteristic of true CZ. The pavilions of both stones were coated with a reflective substance (foil backed) to give them the appearance of having more brilliance than the low refractive index (1.57) would provide. DH

FIGURE CREDITS

Figures 1, 4, 5, and 16 are the work of Shane McClure. Holly Baxter took figures 2 and 3. The two views in figure 6 were taken by Robert E. Kane. David Hargett provided the pictures in figures 8, 14, and 17. Nicholas DeRe supplied figures 7, 12, and 15. Robert Weldon is responsible for figures 9 and 13. The infrared absorption spectrum chart shown in figure 10 was produced by Dr. Emmanuel Fritsch. The X-radiograph in figure 11 is the work of Tom Moses. John I. Koivula took the photomicrographs in the "Historical Note" section.

A HISTORICAL NOTE

Highlights from the Gem Trade Lab 25, 15, and five years ago

WINTER 1964

The New York laboratory reported on their examination of the famous 43.48-ct Nassak diamond, which is of top color and flawless. Additional notes referred to Brazilian emeralds without chromium, pressed amber, odontolite, and some rare-earth synthetic crystals.

A pink pearl that was sawed in half to make a pair of earrings was seen in the Los Angeles laboratory. Large knots in diamond, "pigeon's eye" nephrite, and needles in quartz that were identified by X-ray diffraction as tourmaline were also discussed. The American Gem Society's definition of *flawless* was mentioned and illustrated with photos.

WINTER 1974

Synthetic opal, Slocum stone, and a number of other opal imitations were compared with natural opals in the report from the New York laboratory.

The Los Angeles laboratory discussed at length a new pulled synthetic alexandrite. Its transparency to short-wave ultraviolet light was compared with that of flux-grown synthetics and natural alexandrite. Photos showed that the pulled material was more transparent than its flux-grown counterpart, which in turn was more transparent than the natural stone. Different types of coral were mentioned, including

black from Hawaii and a calcareous type of a rare blue color that was from an unknown source.

WINTER 1984

A very small (0.02 ct) single-cut diamond was seen to have a unique diamond crystal inclusion. Because it was loose in a cavity that was open to the surface, the included crystal actually protruded above the table of the host diamond when the host was

inverted. Other items of interest were a color-change spinel, natural pale color corundum beads with red dye that was visible in the drill holes, and illustrations to help separate oolitic opal from sugar treated. To someone who is not familiar with the appearance of these two opal types, separation can be difficult. The comparison photomicrographs are repeated here to help clarify the difference.

Circular black spots identify the natural structure of oolitic opal. Magnified 20×.

In sugar-treated opal, shown here at 45×, the small black irregular concentrations of dye appear only in the interstices and cracks of the opal.

