GEM TRADE LAB NOTES

Clarified AMBER Beads

While we were working on the mystery of the fading amber cabochons described in the Summer 1993 Lab Notes section (pp. 122–123), we received a necklace of baroque amber "nuggets" (figure 1) that had many of the characteristics of the previously described specimens. Specifically, the "nuggets" also fluoresced orange to long-wave U.V. radiation in the brown areas and blue in the near-colorless areas. A few beads had planes of tiny bubbles near the surface, and many showed heat-induced "sun spangles." As with the cabochons, the color of these beads also appeared to be confined to the surface, although wherever a stress "spangle" broke the surface, the brown color had penetrated it, contrasting markedly with the colorless appearance of those spangles that were completely enclosed (figure 2). Because the fluorescence, near-surface bubbles, and stress spangles are typical of clarified material, it would appear that the original material from which most, if not all, of the beads were fashioned was cloudy.

Figure 1. Prolonged exposure to strong light did not change the color of the amber beads (largest is 2.4 × 15.25 × 7.80 mm) in this 40-cm (16-inch) long necklace of amber beads.

Figure 2. The heat-induced "spangles" that reach the surface of this amber bead are dark; those that are totally enclosed within the bead are not.

Since these beads had properties similar to those of the cabochons described in the last issue, which faded when exposed to light, we fade tested one by placing it about 7.5 cm (3 inches) from the bulb of a 12-watt Tensor lamp for seven days. (Neighboring beads were carefully shielded from the light.) The selected bead failed to fade, which indicates that the material was not surface treated in the same manner as were the cabochons described in the Summer issue.

At the time we tested the "fading" amber cabochons, we also exposed one each of five pairs of closely matched, untreated Dominican amber cabochons to the Tensor lamp for a seven-day period. The control sample of each pair was kept in the dark during the exposure period. All but one of the exposed cabochons actually *darkened*. This reaction was not unexpected, since untreated amber typically darkens with time due to oxidation. Exposure to strong light apparently accelerates the process.

GRC

DIAMOND

Brown-Pink Diamond with "Green Graining"

"Green graining" (colorless or brown graining that appears green because of transmission luminescence) is most commonly associated with brown, orange, and yellow diamonds, and has been seen in some green and near-colorless stones. Recently, the West Coast lab received a 0.52-ct brown-pink round brilliant for grading and determination of its color origin. Magnification showed green graining

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

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Figure 3. This 0.52-ct natural-color brown-pink diamond is unusual because it exhibits brownish pink graining that luminesces green. Magnified 15×.

throughout the pavilion; when used in conjunction with fiber-optic illumination, it revealed that the green graining was actually brownish pink graining that was luminescing green (figure 3).

When examined with fiber-optic illumination, the diamond also exhibited a moderate overall green transmission luminescence. With a desk-model spectroscope, we observed absorption lines at 498 and 504 nm (but no 594-nm line), which is typical of stones that exhibit green graining. We also observed an absorption line at 415.5 nm, as well as the weak bands centered at about 500 and 580 nm that are commonly seen in natural-color pink diamonds. The observed spectrum, plus the presence of pink graining, proved that the stone was of natural color. Such "green graining" is extremely rare in natural-color pink diamonds.

Patricia Maddison and RCK

Light Violet-Gray Diamond

Figure 4 shows the unusual color of a 27.89-ct pear-shaped diamond next to a 7.14-ct D-color stone for comparison. This internally flawless, light violet-gray diamond—cut by a New York dealer from a 60+-ct piece of South African rough—exhibited some unusual characteristics.

During routine examination with the DiamondLite (the stone positioned table down), we noticed two well-defined zones of gray. One was wedge shaped and located toward the head of the stone; the other was more rectangular and in the center, just below the culet. When we viewed the diamond (still table down) parallel to the girdle plane and in the direction of the length, we saw a pale pink color that was even more apparent in the pointed end of this pear-shaped stone when it was examined table up.

Testing for electrical conductivity revealed a weak conduction, with the zones of conductivity correlating to the gray areas—thus indicating that they are type IIb. The diamond did not react to long-wave U.V. radiation, but it fluoresced weak orangy red to short-wave U.V., with phosphorescence of the same color lasting about three minutes. This is consistent with some other type IIb diamonds.

No absorption features were visible with a desk-model prism spectroscope. Nor did the U.V.-visible spectrum recorded with a Pye Unicam SP8-400 spectrometer show any distinct features. The mid-infrared spectrum, recorded with a Nicolet 510 FTIR spectrophotometer, showed features associated with both type IIb and IIa diamonds. The absence of any spectral features that would indicate treatment, together with the electrical conductivity of this stone, proved that it was natural color. In addition, type IIa natural-color pale pink diamonds have been documented by the GIA Gem Trade Laboratory many times, as well as reported in the literature (see, e.g., *Journal of Gemmology*, Vol. 20, No. 6, 1987, pp. 358–361).

The violet-gray color can be explained as an optical combination of the gray and pink zones. Although this is a good example of the mixture of two diamond types, it is the first of this combination (IIa and IIb) that we have recorded. (For more information on diamond types, see, e.g., *Gems & Gemology*, Spring 1992, pp. 38–39.)

Ilene Reinitz and TM

Strain Phantom in Diamond

Phantom crystals are one of the more interesting internal features in gems. Although generally associated with single-crystal quartz, they are also encountered in other materials, including diamond. In the latter, they are typically defined by clouds of pinpoint inclusions and/or various types of graining, both of which usually can be resolved with darkfield illumination.

Recently, the West Coast lab was asked to determine origin of color for a 3.01-ct modified emerald-cut light-yellow diamond. Microscopic examination with darkfield conditions revealed nothing unusual. However, when crossed polarizers were used in

Figure 4. Note the subtle color difference between the light violet-gray 27.89-ct pear-shaped diamond on the right and its D-color 7.14-ct counterpart on the left.

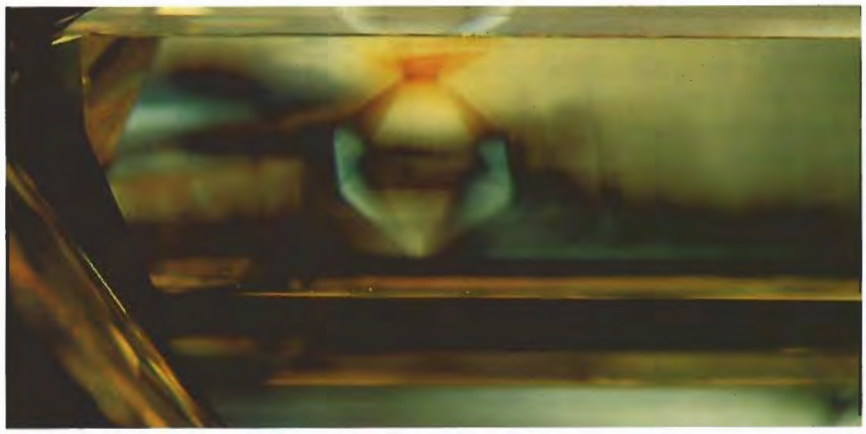


Figure 5. Crossed polarizers clearly reveal a "strain phantom" in this 3.01-ct light-yellow diamond. Magnified 8×.

conjunction with magnification, we were surprised to see a well-formed phantom with a distinctive octahedral shape that was very clearly defined by first-order interference colors (figure 5). Although such phantoms are not unknown in diamond, this one is exceptional for the sharpness of its delineation. *RCK*

Synthetic Yellow Diamond Crystal

Last summer, the East Coast laboratory received a 0.74-ct orangy yellow crystal for routine identification. Measuring 4.83 × 4.75 × 3.62 mm, the crystal displayed a predominantly cubic form with minor octahedral and dodecahedral faces.

Magnification revealed fairly large inclusions with metallic luster; when suspended by a thread, the crystal was attracted to a magnet, actually attaching to it. With magnification, we also noted a square pattern of ultraviolet fluorescence and color zoning centered roughly in the middle of the crystal's base. This fluorescence was a moderate green to short-wave U.V. radiation and a weaker green to long-wave U.V.

Infrared spectroscopy helped further characterize the specimen, showing it to be essentially type Ib with some IaA character. In the visible range, we noted rising absorption from 400 to about 480 nm, with distinct, sharp absorptions at 495, 628, 637, 648, and 659 nm. Weaker features were seen at about 609, 615, 618, 630, 642, 651, 684, 711, and 733 nm.

The crystal morphology, metallic inclusions, magnetic reaction, color zoning, and stronger reaction to short-wave than long-wave U.V., clearly identified the crystal as synthetic diamond. The absorptions at 659 and 733 nm, and a weak feature in the mid-infrared at about 1050 cm^{-1} (attributed in the scientific literature to Ni-related defects), are also consistent with synthetic diamond that has been grown in a Ni-containing metallic flux. The absorption at 637 nm suggests that the crystal had been subjected to annealing. We noted with interest that some of these properties are slightly different from those observed in yellow gem-quality synthetic diamonds produced by General Electric, Sumitomo, or De Beers (see, e.g., related articles in the Fall 1984 [pp. 146–158], Winter 1986 [pp. 192–208], and Winter 1987 [pp. 187–206] issues of *Gems & Gemology*). However, all features are consistent with those of some Russian yellow synthetic diamonds currently being studied by GIA Research and the GIA Gem Trade Laboratory (see the Gem News section of this issue; a detailed report on these investigations is also scheduled for an upcoming issue of *Gems & Gemology*).

Soon after receiving the above crystal for examination, the lab was asked to identify, first, a predominantly red round brilliant-cut stone and, some weeks later, a predominantly red radiant cut. These items, described elsewhere in this issue (pp. 182–190), were also determined to be synthetic diamonds, with features similar to those of the Russian synthetics we have examined. The color was the result of irradiation followed by annealing.

TM, RCK, and Emmanuel Fritsch

Treated Green Diamond with a Blue Color Zone

Determining origin of color for some light green diamonds still poses a great challenge for the gemologist. The green color is usually caused by irradiation, but the source of the radiation may be either natural or the product of a laboratory. The criteria used to identify the sources of radiation remain few, but over the years we have documented certain characteristics in known treated stones that do reveal laboratory enhancement. One identifying characteristic is a small blue zone close to the culet (see, e.g., E. Fritsch and J. E. Shigley, *Gems & Gemology*, Summer 1989, pp. 95–101). This feature was very obvious in a 0.75-ct oval, brilliant-cut diamond sent to the West Coast lab for an origin-of-color report. The stone was an attractive light bluish green. No green or brown radiation stains were visible that could impart the green color; nor were there any prominent internal features, except for some graining that appeared brown. In addition, the stone appeared to have a brownish body color when viewed table down in the diamond tray. The visible absorption spectrum did not reveal any distinct lines other than a faint smudge around 500 nm that is usually seen in brown diamonds. The diamond fluoresced a weak yellowish green to both long- and short-wave U.V. radiation.

However, when the stone was viewed table up over a diffused light source, a bluish zone on only one side

Figure 6. A small blue color zone, present on only one side of the culet of this 0.75-ct oval diamond, not only strongly influences the stone's faceup color, but also proves that it has been treated.

of the pavilion became visible (figure 6). (We have found that a white color-grading tray placed above the light well in a microscope can make color zones stand out quite prominently.) Although this blue zone at the culet proved (with immersion in methylene iodide) to be quite small and appeared on only one side of the pavilion, its location was such that it imparted enough blue color to make the otherwise light brown diamond appear bluish green. We also noticed on the table of this stone a feature that we had never before encountered on *any* diamond: a whitish, irregularly shaped "coating" of unknown origin (figure 7). *KH*

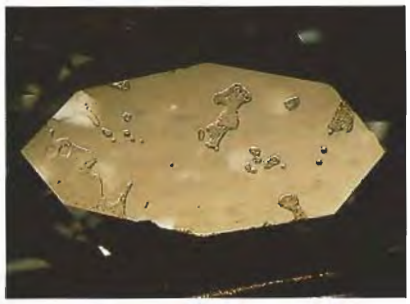


Figure 7. The unidentified "coating" on the table of the stone in figure 6 is the first such feature encountered on a diamond in the GIA Gem Trade Laboratory. Magnified 8×.

Devitrified GLASS, Resembling Actinolite

Among the less commonly seen gem imitations are devitrified glasses. These result from the alteration of a substance from a glassy, noncrystalline structure to one of partial or total crystallization. The trade is probably most familiar with the green devitrified glasses, which are used as jade simulants and marketed under such trade names as "Meta jade" and "Imori stone." The lab has also examined a cobalt-bearing black partially devitrified glass represented as dyed black "onyx" (Lab Notes, Summer 1986, p. 108). Other devitrified glasses reported in *Gems & Gemology* include those that resemble lapis lazuli (G. Bosshart, "Cobalt Glass as a Lapis Lazuli Imitation," Winter 1983, pp. 228–231) and one that was reminiscent of the distinctive blue pectolite from the Dominican Republic (Gem News, Winter 1990, p. 309).

Recently, the West Coast lab received for identification the 12.25-ct tapered, somewhat trapezoidal, tablet shown in figure 8. The dark green color, low diaphaneity, and prominent, eye-visible planes of coarse fibers reminded us of similar features seen in masses of actinolite crystals. Gemological testing revealed a refractive index of 1.60 and a specific gravity of 2.72. Examination with a desk-model spectroscope showed strong absorption increasing toward both ends of the spectrum, with a transmission window from about 540 to 580 nm. Magnification revealed a roiled or swirled effect throughout, as well as the fern-like structure typical of devitrified glass. Our client subsequently told us that this unusual material had been found in a rock quarry in Michigan, where it occurred as irregular lumps. How this manufactured glass got there is not known. *RCK*

Figure 8. This unusual 12.25-ct tablet, which is reminiscent of a mass of actinolite crystals, proved to be devitrified glass.

Bleached/Polymerized JADEITE Update

Both figures 1 and 3 of the article "Identification of Bleached and Polymer-Impregnated Jadeite" (*Gems & Gemology*, Fall 1992, pp. 176–187)

Figure 9. The beads (8.7–10.0 mm) in this variegated jadeite necklace are representative of the quality of most of the bleached and polymer-impregnated jadeite seen thus far in the East Coast laboratory.

Figure 10. This fine 34.82 ct (39.36 × 17.52 × 6.20 mm) jadeite pendant also proved to have been bleached and polymer impregnated.

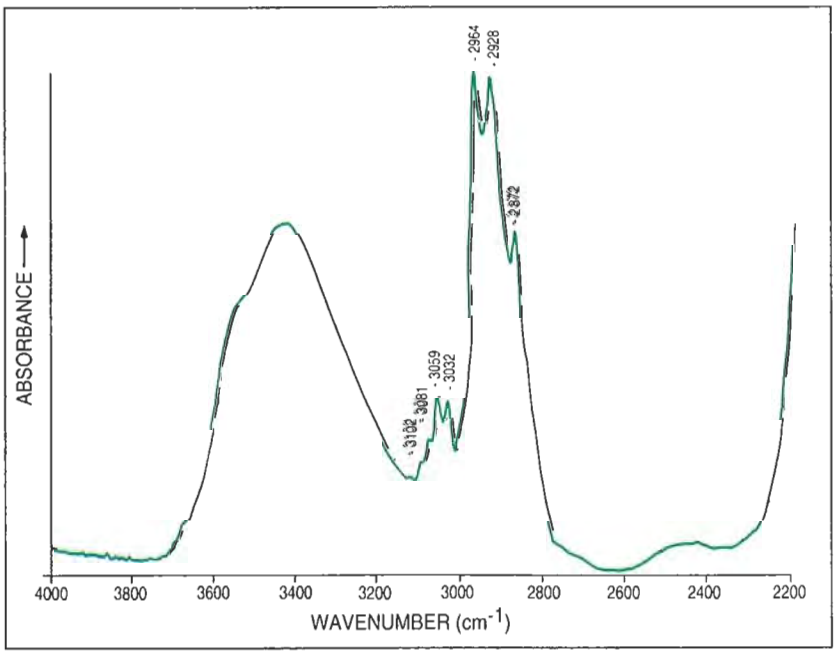
showed high-end treated jadeite. In the months after that article appeared, however, only variegated material (figure 9; similar to the mottled necklace of "B-jade" pictured in the same article) was seen in the East Coast lab.

Recently, however, a New York dealer submitted carvings suitable for pendants (see, e.g., figure 10), stating that he had been informed that the stones had had "the treatment." However, because he had not seen this quality and color for many years, he needed to know if color had been added as well. We were happy to assure him (based on the visible spectrum) that the green color was natural, although there were enormous polymer peaks in the infrared region of the spectrum (figure 11).

By coincidence, we received a jadeite ring and matching earrings at the same time that we were testing the pendants. To the unaided eye, they appeared to be equal in quality to the pendants, but they did not show the presence of any polymer.

GRC

Figure 11. The infrared absorption spectrum of the pendant in figure 10, produced with a Nicolet 510 DX infrared spectrometer, shows strong peaks in the mid-infrared range that are diagnostic of a polymer.



PEARLS

Cultured Pearl, Unusual "Twin"

Throughout history, pearls with unique shapes occasionally have been used creatively in jewelry to simulate flora or fauna. First popularized during the Renaissance era, these were particularly prevalent in jewelry from the late 1800s and early 1900s (see, e.g., Dirlam et al., "Pearl Fashion Through the Ages," *Gems & Gemology*, Summer 1985, pp. 63–78). These unusual shapes were made into *objets d'art*, a practice that continues today.

The East Coast lab recently received for identification a gray pearl that was set in a brooch with a bird motif (figure 12). Not only did X-radiography prove this to be a cul-

Figure 12. This brooch (approximately 29.0 × 25.4 × 6.7 mm) is set with a natural-color cultured pearl that was found to contain two beads.

Figure 13. An X-radiograph of the brooch in figure 12 proves that the pearl is cultured and has two separate beads.

tured pearl, but it also revealed two beads (figure 13). It was not so readily apparent from the X-radiograph whether this was one whole piece or a doublet. However, closer inspection, with a binocular microscope, revealed a continuation of nacreous structure between the head and the body. In addition, the brown-orange long-wave U.V. fluorescence, which is diagnostic of natural color (similar to pearls from French Polynesia), was uniform over the pearl—further proof that it was not an assemblage but rather one piece, essentially a twin cultured pearl. *Nicholas DelRe*

Eroded Cultured Pearls

Figure 14 shows a section of a relatively old (as suggested by the small nuclei and the amount of wear evident) double-strand cultured pearl necklace received by the East Coast lab. Note the area of each pearl that eroded, leaving a "cap" at either end, after repeated contact with the wearer's skin. This erosion affected the first dozen or so pearls at both ends of each strand, where they would be in constant contact with the neck. It would appear that this necklace did not receive proper care, that is, wiping with a damp cloth after each wearing. *GRC*

Figure 14. The central areas of these pearls (5.6–10.4 mm in diameter) have been eroded by contact with the acidic skin of the wearer. Magnified 10×.

Color-Zoned Pink QUARTZ

Last year, a gem dealer from Teófilo Otoni, Brazil, showed us some curious faceted colorless quartz with vivid pink banding, reportedly from the Araçuaí region of Minas Gerais. Later, at the February Tucson gem shows, we saw limited quantities of this gemological curiosity in the form of faceted stones weighing up to a few carats.

More recently, the West Coast lab inspected a highly transparent 4.55-ct modified brilliant-cut oval stone that, face up, appeared to be a fairly uniform vivid pink (figure 15). However, further examination showed color zoning—densely packed thin pink bands in an otherwise colorless stone (figure 16). The gemological properties were consistent with those of quartz.

Although identification of the species was straightforward, the stone presented a nomenclature problem. Should a recognized variety name (i.e., rose quartz or amethyst) be used? To help answer that question, additional testing was carried out at GIA Research.

EDXRF analysis revealed—besides silicon—only traces of iron. Yet U.V.-visible absorption spectroscopy showed absorption features more similar to those of amethyst (color produced by iron) than of rose quartz, which suggests that the coloring agent might be iron.

Still, it did not seem appropriate to call the material amethyst, as it was clearly not purple. In addition, the color banding was very unlike the rhombohedral color zoning typical of this variety. Although the hue was closer to that of rose quartz, rose quartz is usually semi-transparent at best; this stone was more transparent than any specimens of rose quartz we

Figure 15. Table up, this 4.55-ct oval-cut quartz appears a fairly uniform, vivid pink.

Figure 16. Examination at 10× magnification reveals that the pink color of the stone in figure 15 is confined to densely packed bands.

have previously encountered. Also, we have not seen such color zoning in rose quartz. Therefore, we identified the stone simply as "quartz," including the unusual color in its description.

RCK and Emmanuel Fritsch

SYNTHETIC RUBY

Another Imitation Ruby "Crystal"

GIA Gem Trade Laboratory staff are periodically asked to identify what at first glance appear to be natural gem crystals. Gemological testing, however, has exposed a number of these as clever fakes, including cubic zirconia fashioned to resemble diamond octahedra (see, e.g., Lab Notes, Winter 1988, p. 241), flame-fusion synthetic corundum fashioned to imitate natural corundum crystals (Gem News, Winter 1989, pp. 249–250), a glass imitation of tourmaline (Gem News, Summer 1992, pp. 138–139), and irregular pieces of synthetic ruby that have been misrepresented as natural waterworn rough from Vietnam (Gem News, Winter 1991, p. 260). This last imitation appears to have become endemic in the gem trade.

Figure 17. This 10.85-ct imitation of a waterworn ruby crystal is fashioned from melt-grown synthetic ruby.

One of the cleverest such imitations ever encountered in the West Coast lab is the 10.85-ct "crystal" shown in figure 17, which resembles a somewhat distorted hexagonal pyramid with a polished base. The "natural" appearance was further enhanced by the waterworn look of the ersatz prism faces, which also exhibited irregularly spaced, parallel "striations," apparently sawn across their widths.

The gemological properties of this specimen, including R.I. and absorption spectrum, were typical of ruby, either natural or synthetic. However, examination of the specimen's interior through the polished base revealed a network of fractures typical of synthetic corundums that have been quench-crackled to give them a less perfect and more "natural" look. Also noted, near the intersection of some fractures, were minute, highly reflective inclusions that were only tentatively identified as gas bubbles. As these data were inconclusive in proving natural or synthetic origin, the specimen was further examined by GIA Research using EDXRF analysis. This revealed a trace-element composition typical of a melt-produced synthetic ruby.

RCK

Figure 18. Synthetic rubies (the largest is 1.5 × 1.8 × 2.3 mm) were used in the labor-intensive "invisible" settings of these earrings.

In "Invisible" Mountings

The setting of gemstones so their mountings are "invisible" is an uncluttered and attractive way to use many small stones in a single piece of jewelry. In this process, square-cut (usually) stones are fitted into a gallery of metal tracks. So the stones can "snap" precisely into the metal framework, parallel grooves must be polished on their pavilions (see., e.g., Lab Notes, Spring 1993, p. 48). This labor-intensive "mystery" setting was made popular in the 1930s by Van Cleef & Arpels (see D. Federman, "Invisible Setting," *Modern Jeweler*, February 1993, pp. 51–53).

Until about 10 years ago, virtually all the invisible-mounting ruby-and-sapphire pieces submitted to the lab carried the Van Cleef & Arpels signature and were set with fine-quality natural stones. Over the last decade, however, we have seen a proliferation of lower-quality rubies and sapphires mounted by this costly fabrication method. In general, these pieces do not rival the signature pieces in the workmanship of the mountings or overall quality, but it appears that the execution is cost effective.

Nevertheless, we were quite surprised to determine that the stones set by this labor-intensive process in a pair of flower-motif earrings (figure 18) sent to the East Coast lab were

Figure 19. This asteriated doublet (approximately 13.5 × 11.0 × 7.6 mm) is composed of a synthetic ruby top and an unidentified natural base material.

actually flame-fusion synthetic rubies. Because of the repeated cutting and repolishing necessary to fit the stones in place, the curved striae were difficult to see, although they were visible in most stones when diffused lighting was used. In addition, high magnification with fiber-optic illumination revealed numerous tiny telltale gas bubbles. The stones also fluoresced a strong red to short-wave U.V. radiation, a characteristic of flame-fusion synthetic rubies.

Dan Campbell and TM

As the Top Stone in an Asteriated Doublet

Because the identification of loose assembled stones is usually straightforward, it is not surprising that many of the composite gems seen in the lab are mounted in jewelry. The two types we encounter most often are opal assemblages (including doublets and triplets) and doublets of natural and/or synthetic corundum (occasionally in various combinations with natural or synthetic spinel). On rare occasions, we have also encountered assembled stones that display asterism (e.g., a star sapphire and sapphire doublet, as reported in this section in the Fall 1985 issue, p. 171).

Recently, the West Coast lab received for identification a transparent red cabochon, bezel set in a man's yellow metal ring, that displayed a six-rayed star (figure 19). The spot R.I. reading, characteristic absorption spectrum, and (as seen with magnification) presence of curved striae identified the crown as synthetic ruby. Magnification also revealed numerous round and oval gas bubbles in the cement layer. The reddish purple, semi-translucent base of the cabochon showed pronounced hexagonal growth zoning, partially healed fractures, yellowish brown (limonitic?) staining in fractures, and negative crystals. Although these features are proof that the base is a natural gem material, the mounting prevented a definitive identification. The features noted, however, are consistent with the typically low-transparency, silk-rich natural corundum that is sometimes called "mud ruby" in the trade. The use of such material for the base would also explain the asterism exhibited by the assemblage, as no silk was noted in the synthetic ruby top.

Because we could not conclusively identify the base, the report read "a doublet consisting of a synthetic ruby top with an unidentified bottom, held together with cement," and indicated that the stone would have to be removed from the mounting to identify the bottom material. *RCK*

PHOTO CREDITS

The photos used in figures 1, 2, 4, 9, 10, 12-14, and 18 were taken by Nicholas DelRe. Photomicrographs in figures 3, 5, and 7, and the macro photograph in figure 6, were by John I. Koivula. Maha DeMaggio supplied figures 8, 17, and 19. Ilene Reinitz produced the spectrophotometer curve in figure 11. Shane McClure provided figures 15 and 16.