Gem Trade LAB NOTES

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AZURITE

The West Coast laboratory recently had an opportunity to examine several collection-quality specimens of azurite, the theme mineral of the 1991 Tucson Gem & Mineral Society Show. These fine specimens came from several different localities.

Azurite is a copper carbonate hydroxide, with the chemical formula $Cu_3(CO_3)_2(OH)_2$. Its name, in allusion to its color, is from the Persian word *lazhward*, which means blue. Azurite is soft, with a Mohs hardness of 3 1/2 to 4. Its specific gravity normally ranges from 3.77 to 3.89, although some porous material may be as low as 3.30. The refractive indices for azurite are 1.730 and 1.836, and it is biaxial positive. Faceted azurite is extremely rare; it is generally excessively dark, almost black, even in small gemstones.

Azurite is widely associated with copper ores. Major sources of azurite in the United States are the copper-mining districts at Bisbee and Morenci, in Arizona; it also occurs at several localities in Nevada, New Mexico, Utah, and California. Other notable deposits include Tsumeb, Namibia; Chessy, France; and Morocco, China, Mexico, Australia, the Soviet Union, Romania, and Zaire.

Azurite crystallizes in the monoclinic system, and can vary widely in habit and be highly modified. Among the most attractive specimens are the nearly spherical aggregates or rosettes that exhibit numerous deep blue subparallel sharp-edged crystals (figure 1). Azurite is almost invariably found in conjunction with malachite; some of these specimens can be quite exceptional (figure 2). *RK*

Figure 1. This fine azurite cluster (10 × 7.6 cm) is reportedly from one of the world's earliest exploited copper deposits, near Lyon, Chessy, France.

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

Gems & Gemology, *Vol. 26, No. 4, pp. 294–299*

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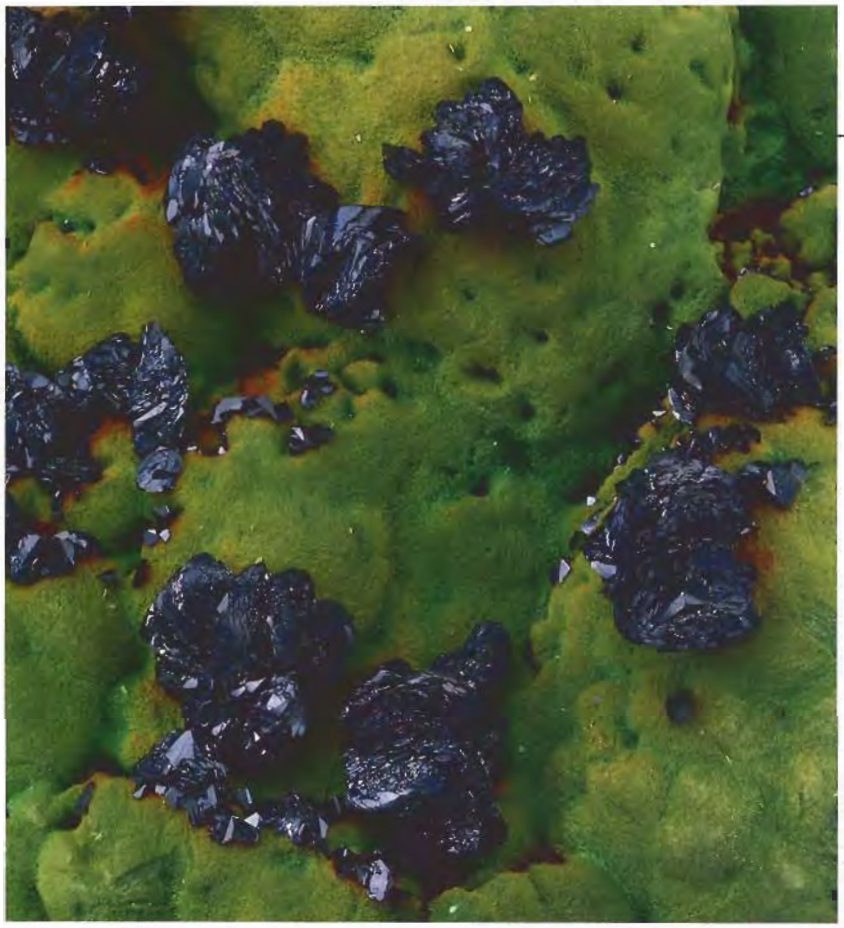

Figure 2. This section of a 22-cm-long azurite specimen reportedly from Bisbee, Arizona, shows the rosettes of deep blue crystals (the largest cluster measures 1.9 cm) that are common from this locality. Here, they emerge from a bed of iron-stained malachite, which often occurs in association with azurite.

CUBIC ZIRCONIA

Simulating a Fancy Yellow Diamond

Yellow cubic zirconia can effectively imitate a fancy yellow diamond. Some years ago, a large yellow cubic zirconia, fashioned to look like a 10-ct cushion octagon modified brilliant, was submitted to the East Coast laboratory (see *Gems & Gemology*, Winter 1985, p. 234). Recently, the East Coast lab was asked to examine the two side stones in a lady's ring; one proved to be a natural-color yellow diamond, but the other was a cubic zirconia.

Spectroscopy is the most useful test for determining the origin of color in a diamond. A Beck hand-held type of spectroscope revealed the Cape series of bands—at 415, 453, 466, and 478 nm—present in the natural-color type Ia yellow diamond. Although cubic zirconia does not contain a 415-nm absorption line, the yellow CZ in this ring did display two prominent absorption bands in the same area as the 453-nm and 478-nm bands. This confirms the need for caution when examining diamond-like materials in this color range.

Other tests helped prove the identity of the imposter. The girdle of the CZ showed the typical attempt to simulate the bruted girdle of a diamond, but it did not approach the frosted appearance of diamond. The orange fluorescence to long-wave U.V. radiation is typical of cubic zirconia, although it has also been seen in some natural-color yellow diamonds. Because the thermal conductivity of CZ is lower than that of diamond, the reaction to the needle on the thermal conductivity tester was minimal. In addition, this stone had a chipped culet with an appearance atypical of diamond. Last, the strong dispersion of CZ (0.60) is noticeably greater than that of diamond (0.44); because the cubic zirconia and diamond were in relatively close proximity in this ring, the difference in dispersion was readily apparent. *DH*

DIAMOND

Fancy Intense Yellow

Ever since the laboratory first encountered a Sumitomo synthetic yellow diamond in the course of routine testing four years ago, we have routinely tested all intense yellow diamonds with both long- and short-wave U.V. radiation. Readers may recall that Sumitomo synthetic yellow diamonds do not fluoresce to long-wave U.V., but do fluoresce a chalky greenish yellow to short-wave U.V. (see Shigley et al., "The Gemological Properties of the Sumitomo Gem-Quality Yellow Synthetic Diamonds," *Gems & Gemology*, Winter 1986, pp. 192–208). In addition, because they are type Ib diamonds, they do not exhibit any absorption lines in the hand-held spectroscope, which are present in many type Ia's.

Thus far, with the exception of the 0.80-ct round-brilliant-cut stone referred to in the above article, all the faceted Sumitomo synthetic diamonds we have seen have been small (less than 0.25–0.30 ct) square step cuts, having been fashioned from the squarish tablets prepared and sold by Sumitomo for use as heat sinks for electronic applications. Although we would be surprised at this time to encounter any other shape, we do test all small intense yellow diamonds, regardless of shape. While writing this note, we learned that Sumitomo has manufactured a few gem-quality synthetic yellow diamond crystals in excess of 9 ct (J. Shigley, pers. comm., 1990). However, the firm still maintains that it has no plans to market crystals to the jewelry industry.

Recently, the East Coast laboratory received for examination a brooch (figure 3) that contained a

Figure 3. Two of the fancy yellow diamonds in this brooch of 0.5–1.0 ct stones fluoresced to short-wave, but not to long-wave, U.V.

Figure 4. The similarity in appearance between a Sumitomo synthetic yellow diamond (here, the 0.19-ct stone in the center) and the natural fancy yellow diamonds in the brooch shown in figure 3 is striking. The stone at the lower left is one of the two that fluoresced to short-wave U.V. radiation.

number of fancy yellow marquise- and pear-shaped brilliants. We were surprised to observe that two of the marquise shapes (each approximately half a carat) did not fluoresce to long-wave, but did fluoresce greenish yellow to short-wave, U.V. radiation. Because of the settings, we could not determine if these stones had the color zoning that is sometimes visible in the Sumitomo synthetic diamonds. However, infrared spectroscopy established that these two stones were not pure type Ib diamonds, as all gem-quality synthetic yellow diamonds encountered to date have been. They were a mixture of types Ib and Ia, a strong indication of natural origin. Figure 4 shows a magnified view of a section of the brooch with a 0.19-ct Sumitomo synthetic diamond placed in the center for comparison. The stone at the lower left is one of the two that fluoresced to short-wave U.V. *RC*

Treated Green

In recent months, the laboratories on both coasts have received increasing numbers of fancy-color diamonds for examination, many over 5 ct. Some of these diamonds had obviously been treated to enhance their color. This was the case with a half-carat dark green round brilliant seen in the West Coast laboratory, which showed a color concentration around the culet with magnification (figure 5). This "umbrella effect" is characteristic of cyclotron bombardment. Usually, this type of treatment does not penetrate very deep into the stone, as evidenced by the restricted color concentration in the area of bombardment. However, this particular treated green diamond differed from others that we had seen before, in that another zone of darker color concentration became visible when oblique lighting was used. This zone, which followed the periphery of the stone (figure 6), actually extended in a definite plane from the crown area into the pavilion, toward the culet.

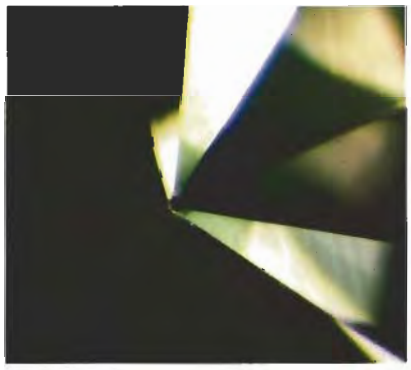

Figure 5. The distinct zone of color around the culet of this green diamond indicates cyclotron treatment. Magnified 15×.

The stone did not fluoresce to either long- or short-wave U.V. radiation. The absorption spectrum, as observed with a GIA GEM hand-held type of spectroscope unit, showed weak Cape lines at room temperature. When the stone was cooled with a refrigerant, an additional faint, but distinct, line at 592 nm became visible. *KH*

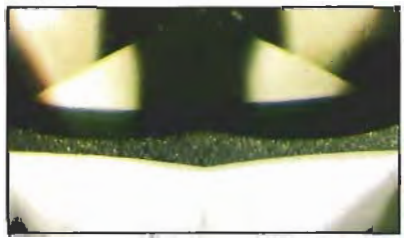

Figure 6. Oblique lighting revealed an additional color zone around the girdle of the stone in figure 5; such a zone had not been observed before in a cylcotron-treated diamond. Magnified 15×.

PEARLS

Dyed Black Cultured, Origin of Color

The GIA Gem Trade Laboratory routinely examines gray to black cultured pearls to establish whether or not their color is natural. Proof of natural color, as in those black cultured pearls grown in the area around Tahiti, lies in the reaction to long-wave U.V. radiation. Like the *Pinctada margaritifera* shell in which they are grown, natural-color Tahitian cultured pearls appear brownish to brownish red when exposed to long-wave U.V. in a dark room. On the other hand, all dyed black cultured pearls seen to date, whether treated with silver nitrate or by another unidentified dye process, either do not fluoresce at all or fluoresce a dull green.

X-radiography may also provide useful information. Typically, the layer of conchiolin in a cultured pearl provides marked contrast between the shell bead center and the overlying nacre in an X-radiograph. In a cultured pearl treated with silver nitrate, however, silver tends to concentrate in the area of the conchiolin; because silver is opaque to X-rays, the X-radiograph of a cultured pearl treated with silver nitrate may show a light ring around the nucleus, or it may show almost no contrast between the nucleus and the nacre.

During the past year, we have encountered a number of gray to black and brown cultured pearls that clients have submitted as "Tahiti" pearls. Figure 7 shows one of three such undrilled 10-mm cultured

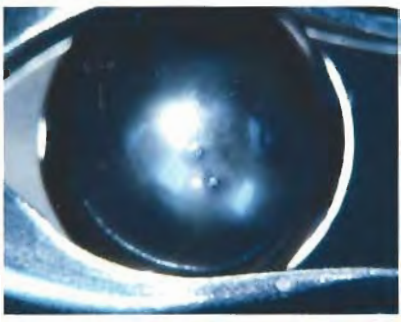

Figure 7. This 10-mm dyed black cultured pearl fluoresced yellow to long wave U.V. radiation.

pearls that were recently seen in the East Coast laboratory. Unlike natural-color Tahitian pearls, these three fluoresced a distinct yellow to long-wave U.V. radiation. The X-radiograph (figure 8) shows that two of these beads have good contrast between the nucleus and the nacre, while the third specimen has a very thin nacre. With magnification, as seen in figure 9, we observed a dark fingerprint pattern on the surfaces of two of the beads that was unlike anything we had seen before. Whatever dyeing method was used does not require that the pearls be drilled, and the color may be confined to a relatively thin surface stain.

Although we were unable to retain these cultured pearls long enough to analyze the coloring agent, similar pearls examined by X-ray fluorescence in the GIA Research Department were found to contain, surprisingly, the metallic element tellurium. *RC*

Uncommon Cultured

The East Coast laboratory was asked to identify the beads in the earrings shown in figure 10. All proved to be cultured pearls. The button cultured pearls are unusual in that they have lentil-shaped nuclei. In addition, the single black cultured pearl showed a reversal pattern (a ring that is opaque, rather than transparent) in the X-radiograph, which is probably due to the use of silver salts.

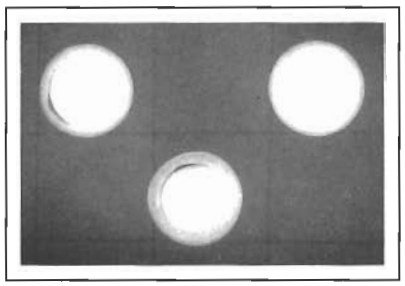

Figure 8. As revealed in this X-radiograph, one of the dyed black cultured pearls has a very thin deposition of nacre, but the other two show strong contrast between the nacre and the nuclei.

Figure 9. A fingerprint pattern (of dye!) was observed on the surface of two of the three dyed black cultured pearls. Magnified 60×.

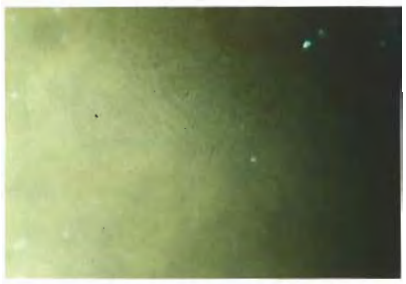

Figure 10. The button-shaped cultured pearls in these earrings contain unusual lentil-shaped nuclei. The single black cultured pearl was found to be dyed.

Lentil-shaped nuclei are uncommon; we have mentioned them only once before in *Gems & Gemology* (Summer 1984, p. 109). At that time, we learned that off-round nuclei are seldom used in the culturing process because they greatly increase the mortality rate of saltwater mollusks. Incidentally, the near-colorless brilliants in these earrings are zircons. *RC*

Unheated RUBY with a Glass Filling

We often associate the presence of glass fillings in rubies with heat treatment, since glass is sometimes used to fill the spall cavities that may occur on the surface of a stone during heating.

Recently, we observed a glass-filled cavity in a 1.12-ct ruby submitted to the East Coast laboratory (figure 11). The presence of numerous crystals and pristine needles, without surrounding stress cracks or other evidence of heating, strongly indicates that the stone had not been

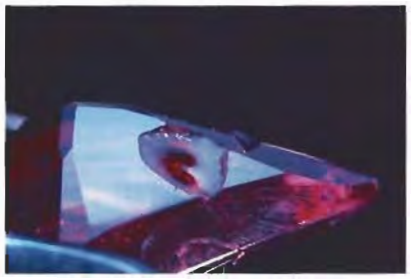

Figure 11. A glass-filled cavity is readily apparent in this 1.12-ct faceted ruby, which showed no other evidence of heat treatment. Magnified 15×.

heat treated to improve color or clarity. However, since some glasses melt at a low temperature, one such glass could have been easily applied to this stone without producing any indications of heat treatment in the stone itself.

The glass filling fluoresced a chalky yellow to long-wave U.V. radiation and contained a large gas bubble. *DH*

SYNTHETIC RUBY, with a Glass Filling

Figure 12 shows what appears to be a modern bar pin, but with an Art Deco design influence, that contains four well-matched red cabochons (each approximately 8.50 × 7.00 × 4.90 mm). When examined with a hand-held type of spectroscope, all four showed the absorption spectrum typical of natural and synthetic ruby. Three of the four contained fine intersecting needles, along with undisturbed subhedral crystals, which proved that these three stones were natural in both origin and color. However, close examination of the fourth cabochon, second from the left in the pin, revealed curved striae and gas bubbles. When we viewed this cabochon through the back, we noted that the bubbles were confined to a shallow cavity that had been filled with a glass-like material (figure 13). The curved striae are typical of a flame-fusion synthetic.

On the basis of our ongoing encounters with filled rubies, we recommend that our readers not only continue to use the techniques outlined in the article "Natural Rubies with Glass Filled Cavities," by Robert E. Kane (*Gems & Gemology*, Winter 1984, p. 187), but that they also be on the lookout for synthetics with this type of treatment.

Tom Moses

Figure 12. The cabochon that is second from the left in this bar pin was found to be synthetic ruby; the other three stones all proved to be natural ruby.

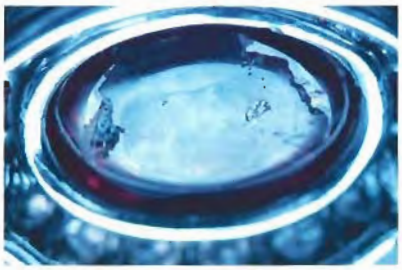

Figure 13. The synthetic ruby in the pin shown in figure 12 has a glass-filled cavity. Magnified 15×.

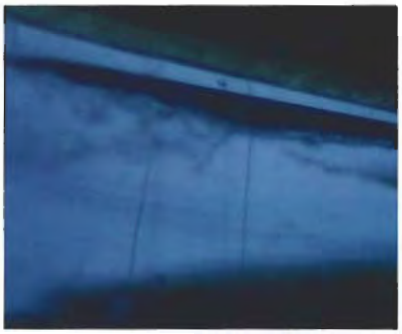

Figure 14. Natural-appearing needle-like inclusions can be seen against a background of curved growth lines in this flame-fusion synthetic sapphire. Magnified 30×.

SYNTHETIC SAPPHIRE

Flame Fusion, with Needle-Like Inclusions

The East Coast laboratory recently had the opportunity to examine a 1.77-ct cushion antique mixed-cut flame-fusion synthetic sapphire that contained some needle-like inclusions. Although these inclusions were very "natural" looking, the presence of curved growth lines, also visible in figure 14, left no doubt that the stone was synthetic. On previous occasions, the lab has observed natural-appearing inclusions in synthetic ruby and synthetic blue sapphire (see *Gems & Gemology*, Spring 1989, p. 38, and Summer 1984, p. 111, respectively).

When the stone was viewed in certain directions, the needle-like inclusions were more prominent than the curved striae and gas bubbles. As seen with higher magnification in figure 15, the needle-like inclusions

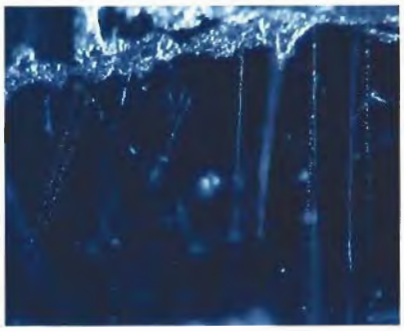

Figure 15. Higher magnification (63×) reveals that the "needles" in figure 14 are actually strings of tiny gas bubbles.

are actually strings of tiny gas bubbles. The inclusions seen in this stone are an uncommon mix for a synthetic sapphire, which is usually an "easy" identification. This should serve as a reminder that no identification should be taken lightly. *Nicholas DelRe*

Orange or Yellow

Historically, the distinction of natural from synthetic orange ("padparadscha") and synthetic yellow sapphire has been the most difficult of the sapphire separations. Some stones contain virtually no identifying inclusions, and curved striae may not be readily visible in synthetic sapphire in this color range (R. T. Liddicoat, Jr., *Handbook of Gem Identification*, 1977). Even today, there are synthetic yellow and synthetic orange sapphires that prove difficult to identify. For these determinations, we are now using a blue filter with the microscope in a technique that was initially reported by B. W. Anderson and was later described by R. Hughes in an ICA Lab Alert and a brief *Journal of Gemmology* article (Vol. 21, No. 1, 1988, pp. 23–25).

This technique involves placing a translucent, medium dark blue plastic filter (just under 3 mm thick) over darkfield or transmitted illumination. The stone is then positioned in a stone holder over the blue-filtered,

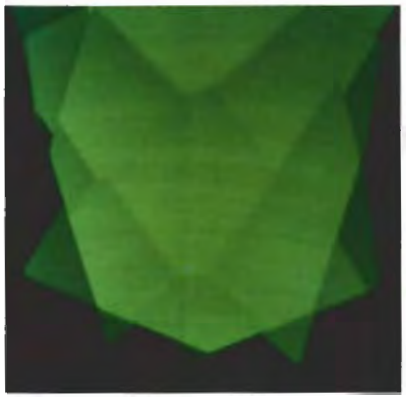

Figure 16. The use of a translucent, medium dark blue plastic filter over transmitted illumination accentuates the curved color banding in this 5.16-ct yellowish orange synthetic sapphire. Magnified 10×.

diffused illumination and is examined in different directions. Curved yellow to orange color banding frequently becomes visible (figure 16) with this combination of color contrast and diffused lighting. Curved color banding is often more apparent in synthetic yellow and synthetic orange sapphires with the blue filter technique than it would be without it. *RK*

Imitation TURQUOISE

The following report was reminiscent of one in the Winter 1965 issue;

Figure 17. Magnification (at 45×) of the scraped surface of the acid-treated chip of imitation turquoise revealed curls of the plastic binder.

it would appear that some things never change. The East Coast laboratory recently received a large piece of light, slightly greenish blue material for identification. Although the color was suggestive of turquoise, the R.I. of 1.56, hardness between 2 and 3, and S.G. of less than 2.57 eliminated natural turquoise as a possibility. The surface of this material was smooth, and magnification revealed a molded appearance on one corner.

With the permission of the client, we broke off several millimeter-size chips for closer examination. The effervescent reaction when one chip was placed in dilute hydrochloric acid indicated that the material was, or at least contained, a carbonate. However, the chip did not completely dissolve. After about 15 minutes the reaction ceased, leaving a rough, whitish surface quite different from the original. The whitish material that remained after the acid bath was easily scraped. These scrapings not only looked like plastic (figure 17), but when touched with a hot point they also gave off an odor characteristic of plastic. The smooth surface below the scraped area reacted again to hydrochloric acid.

The infrared spectrum taken on another chip yielded a curve that was indicative of calcite, thus confirming the carbonate identification. Although I.R. spectroscopy is often useful for identifying plastic treatment, the diagnostic plastic peaks fall at the same energies as broad peaks in the spectrum of calcite. Thus, the calcite spectrum of this piece hid any infrared evidence of plastic treatment. *Ilene Reinitz*

Because of space constraints, we could not publish the Historical Note feature in this issue.

FIGURE CREDITS

Figures 1 and 2 are by Shane F. McClure. Nicholas DelRe supplied figures 3, 4, and 10–15. Figures 5 and 6 are by John I. Koivula. Dave Hargett is responsible for figures 7, 9, and 17. Figure 8 is by Tom Moses. Figure 16 is by Robert E. Kane.