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AMBER Assemblage

The 1993 movie *Jurassic Park* sparked a revival in the popularity of amber. Not surprising is the fact that amber containing insects is often more desirable than plain amber. This spring, the East Coast lab received a transparent, 35.65 ct yellow free-form drilled cabochon containing a large, well-preserved insect that resembled a modern-day housefly (figure 1). The client requested both identification of the material and, if possible, a determination of whether the insect was naturally occurring or artificially introduced into the specimen.

Exposure to long-wave ultraviolet radiation revealed a zoned pattern of fluorescence: strong, chalky yellow

overall, with a distinctly weaker, less chalky reaction in the area containing the insect (figure 2). A thin line surrounding this area did not fluoresce at all. Another patch of weak fluorescence was seen on the reverse side of the specimen. With short-wave UV radiation, the entire specimen showed weaker fluorescence, less chalkiness, and the zoning was not as distinct. This fluorescence zoning suggested that we were examining an assemblage.

We measured the refractive index by the spot method on several parts of the cabochon, taking multiple readings to improve precision. The area that showed stronger, chalkier fluorescence yielded a reading of 1.54, typical

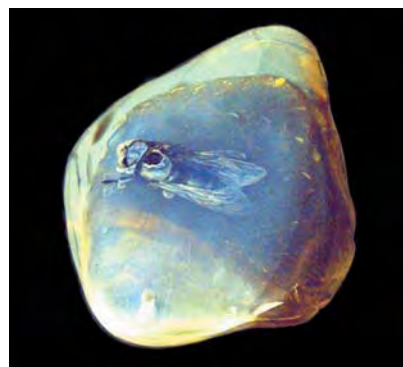


Figure 2. The zoned fluorescence to long-wave UV radiation indicated that the cabochon was an assemblage.

Figure 1. This 35.65 ct cabochon proved to be an assemblage of amber and plastic that contains a “modern” insect.



of amber. Each of the two sections that showed weaker fluorescence yielded a reading of 1.56, which is not uncommon for a plastic imitation of amber, and supported the identification of an assembled piece. Thermal reaction testing (TRT) provided additional evidence: The areas with the 1.54 R.I. had a resinous odor, while the areas with the higher R.I. had an acrid odor. We concluded that this cabochon was an assemblage containing plastic and amber, with the insect encased in one of the plastic sections.

Observation with magnification also indicated an assemblage. The interfaces between the sections had a cracked texture, possibly the result of

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*Gems & Gemology, Vol. 36, No. 2, pp. 155–159
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Figure 3. The dispersion in these Fancy White diamonds resembles a faint play-of-color. From left to right, the diamonds weigh 1.08, 0.62, and 1.02 ct.

the assembly process, which probably involved “fusing” or melting. The section with the insect also had numerous tiny white gas bubbles that decreased its overall transparency. In contrast, the amber section contained a few colorless gas bubbles, as well as a two-phase inclusion in which the gas bubble was quite movable. Although we do not often see this type of assemblage in the laboratory, it is not unique: We have reported on similar combinations of amber and plastic in two previous Lab Notes (Fall 1983, pp. 171–172; Winter 1987, p. 232).

Wendi Mayerson and KH

DIAMOND

Fancy White

Colorless and near-colorless diamonds are sometimes referred to as “white,” in contrast to fancy-color diamonds, but among the fancy colors is a rare appearance described as Fancy White. Such diamonds contain a high concentration of submicroscopic inclusions that scatter light, yielding a translucent “milky” white face-up color. The nature of these inclusions is unknown. These diamonds are sometimes also referred to as “opalescent” because of the flashes of color (caused by dispersion) that are seen in the face-up position. In some instances, the appearance is reminiscent of a white opal with weak play-of-color.

Fancy White diamonds are encountered infrequently in our laboratories, so it was a treat for the East Coast lab to receive three of them this spring for identification (figure 3). The 1.08 ct and 1.02 ct cut-corner rectan-

gular modified brilliants were translucent and showed strong whitish graining. It was particularly unusual to see a matched pair of these stones. The 0.62 ct marquise was translucent, but no distinct inclusions were visible with magnification.

None of the diamonds showed any absorption features with transmitted light through a desk-model spectroscope, although all three exhibited a moderate to strong blue fluorescence to long-wave UV radiation. (Blue fluorescence is typically due to the N3 center, which also gives rise to an absorption line at 415 nm.) The two rectangular modified brilliants showed some yellow fluorescence as well to long-wave UV, in a clover-shaped cloud. The reactions to short-wave UV were similar, but weaker, in each stone. The two larger diamonds showed a weak to medium blue afterglow of more than 10 seconds after the short-wave UV lamp was turned off.

Infrared spectroscopy revealed that these three diamonds were predominantly type IaB, with relatively high concentrations of both nitrogen and hydrogen (as judged by the strength of the absorption peak at 3107 cm^{-1}). Similar white diamonds have been reported in the Gem News column: from Panna, India (Spring 1992, p. 58), and offering an explanation of the opalescent appearance (Spring 1997, p. 60). TM and IR

Blue, Zoned

Recently, the East Coast laboratory had the opportunity to examine a strikingly zoned blue 3.43 ct rough diamond (figure 4) and, later, the 1.33

ct round brilliant that was cut from it (figure 5). Strongly color-zoned faceted blue diamonds have been presented in this column in the past (Summer 1985, pp. 108–109). However, in this case we were able to examine the rough diamond and record infrared spectra of both the blue and near-colorless portions.

Trace amounts of boron are the most common natural cause of blue color in diamond; such boron-bearing diamonds have a strong near-infrared absorption band that extends into the visible range, absorbing red light and imparting a gray-to-blue color. Diamonds that contain boron are described as type IIb, and have a characteristic mid-infrared spectrum with peaks at about 1300 , 2455 , 2800 , and 2930 cm^{-1} . (For further information on diamond types, see Box A in E. Fritsch and K. Scarratt, “Natural-color nonconductive gray-to-blue diamonds,” *Gems & Gemology*, Spring 1992, pp. 35–42.) Diamonds that are depleted in boron (and nitrogen, i.e., type IIa) do not have these same characteristic peaks in the mid-infrared and exhibit no absorption in the near-infrared or visible range. The IR spectrum of the blue portion of the 3.43 ct rough diamond (figure 6A) displays prominent absorption peaks typical of type IIb diamond, while that of the colorless portion (figure 6B) shows very little absorption at these positions. This demonstrates that the uneven distribution of boron

Figure 4. This irregularly shaped 3.43 ct rough diamond shows strong zoning of the blue color.



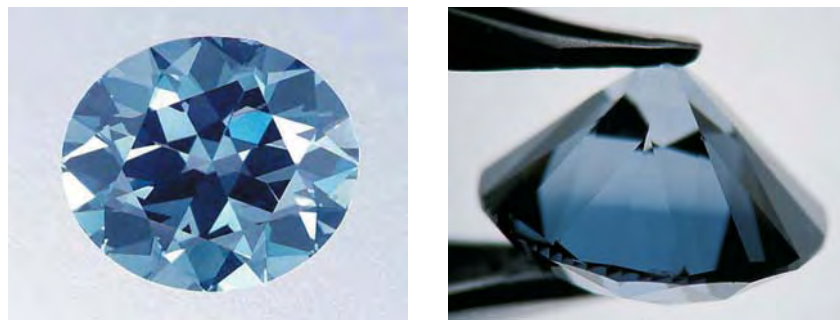


Figure 5. An attractive face-up appearance (left) is shown by the 1.33 ct Fancy Deep Blue round brilliant diamond that was cut from the color-zoned rough shown in figure 4. The view on the right shows how a wedge of the strong blue color was placed at the girdle to take advantage of multiple internal reflections to produce a saturated, well-distributed face-up color.

correlates to the uneven distribution of blue color.

Cutting blue diamonds is often very challenging because of the typically asymmetrical shape of the rough and the irregularity of the color zoning (see also Box B in J. M. King et al., "Characterizing natural-color type IIb blue diamonds," Winter 1998 *Gems & Gemology*, pp. 246–268). The ultimate goal is to achieve a maximum blue saturation with a moderate tone in the face-up position. If the color zone is oriented poorly, low saturation or a dark tone can yield a gray face-up component, which is consid-

ered less desirable than a "pure" blue color. Many of the same issues are encountered when cutting blue sapphires; however, the consequences of a mistake with a blue diamond are much more dramatic in terms of both overall face-up appearance and loss of value. This diamond was fashioned so that the strong wedge of blue color penetrated along the girdle plane (figure 5, right). This position takes advantage of internal reflections to produce an attractive, well-distributed face-up color appearance, and the diamond received a grade of Fancy Deep Blue. *Matt Hall and TM*

Unusual Manufactured GLASS

Glass is the oldest manufactured material used as a gem substitute. Whether single-crystal or multi-component, most gem materials familiar to us have been imitated by glass at one time or another. Even though manufactured glass is quite common and its identification is relatively routine, from time to time some unusual glass items submitted to the Gem Trade Laboratory call for extra testing.

Such was the case with the semi-opaque dark red cabochon pictured in figure 7 and represented as "pupurine." The 43.73 ct cabochon measured 29.28 × 19.76 × 7.77 mm and displayed a spotty or patchwork surface reflectivity in incident light that is somewhat reminiscent of the aventurescence or schiller shown by some feldspars.

Examination with a gemological microscope and fiber-optic illumination showed that the cabochon was primarily composed of interlocked nests of dark red needles that were precisely oriented in a sagenitic (grid-like intersecting needles or plates) boxwork pattern within their respective nests. This caused all of the needles within a nest to reflect incident

Figure 6. The mid-infrared spectrum of the blue portion (A) of the 3.43 ct rough diamond displays characteristic boron peaks at about 1300, 2455, 2800, and 2930 cm^{-1} , while the colorless portion (B) mainly shows absorptions typical of type IIa diamond. Spectrum B has been smoothed to remove noise.

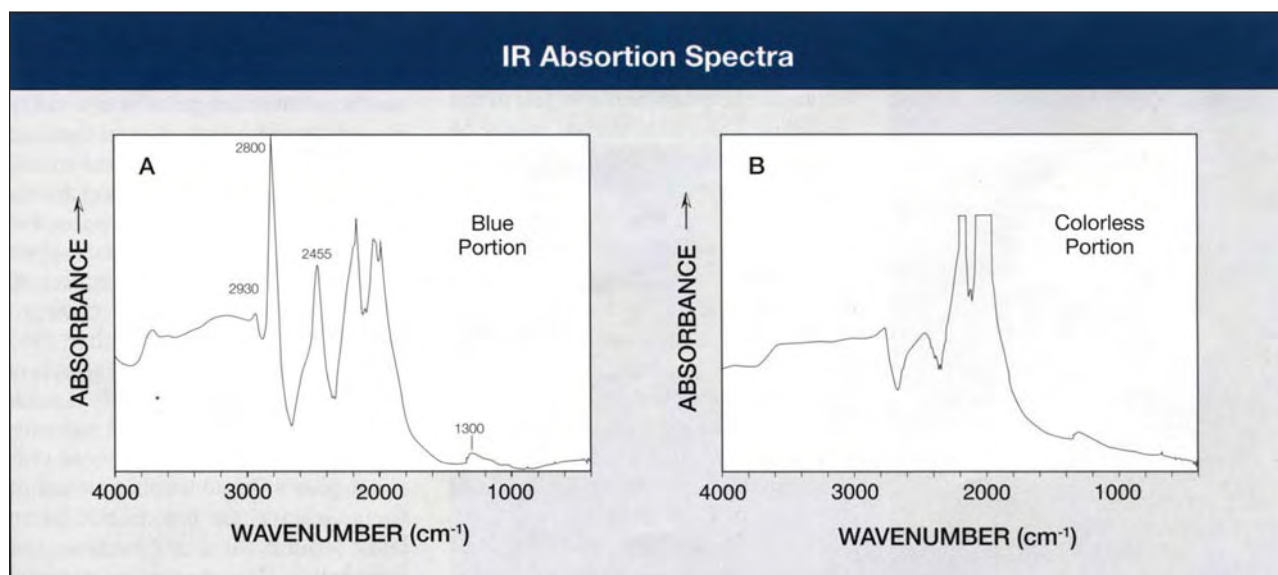
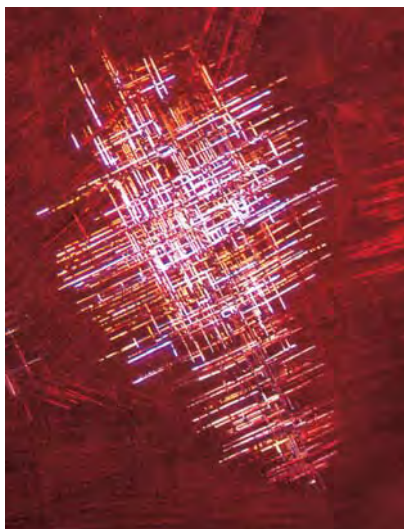




Figure 7. Represented as “pupurine,” this 43.73 ct cabochon was identified as a devitrified manufactured glass.

light simultaneously (figure 8), while surrounding nests remained dark. This directional reflective effect, as well as the general microscopic appearance of the nested sagenitic needles, is somewhat similar to the arborescent patterns observed in some devitrified manufactured glasses produced by Iimori Laboratory Ltd. in Tokyo. In reflected light, it was readily apparent that the luster of the acicular inclusions was much higher than that of the surrounding host. Using an analyzer with reflected light, we did not see any pleochroism, which suggests that the cabochon and its inclusions were singly refractive.

Figure 8. Devitrification resulted in the sagenitic boxwork pattern shown by this nest of synthetic cuprite inclusions in the manufactured glass. Magnified 25 \times .



Examination with a Beck prism spectroscope and surface-reflected light showed a weak absorption band positioned between 495 and 500 nm, another weak band between 585 and 594 nm, a band of moderate strength between 608 and 620 nm, and a sharp, fine line at 632 nm. The specific gravity of the cabochon (determined hydrostatically) was 3.68, and the refractive index obtained by the spot method was approximately 1.62. Our ability to obtain an R.I. reading varied considerably from area to area across the cabochon, which suggests that surface-reaching inclusions might interfere with the reading in some areas.

Since many of the needles were exposed on the surface during polishing, and since their higher surface luster made them easy to target, Raman analysis of both the inclusions and the surrounding “matrix” was easily accomplished. The Raman spectra revealed that the dark red needles were cuprite, a bright red copper oxide, while the pattern shown by the surrounding host material was consistent with a glass. Because these crystals are in a manufactured glass, they are also synthetic.

To complete the description of this material, research associate Sam Muhlmeister performed an EDXRF (bulk area) analysis. EDXRF showed the presence of Si together with Sb, Cu, Fe, and Pb, with Cu being the most prominent metallic element. The abundance of cuprite inclusions explains the prominence of Cu in the analysis. The other metals might be contaminants in the synthetic cuprite or present in the host glass.

Inclusions of synthetic cuprite produced by devitrification in manufactured glass have been observed and identified before. For example, a Fall 1984 Gem News item (pp. 176–177) documented synthetic cuprite inclusions that formed brownish red arborescent dendritic “flowers” against a background of opaque brownish green glass manufactured by Iimori, and marketed as Maple Stone.

In the present case, the matrix of the “pupurine” cabochon appears to

be essentially the same color as the cuprite inclusions. This was apparent when the cabochon was examined around its edges with a pinpoint fiber-optic light source. The synthetic cuprite inclusions also must contribute significantly to the bodycolor of the cabochon, since they are pervasive throughout the glass matrix. We do not know the manufacturer of this attractive cuprite glass.

John I. Koivula

Baroque CULTURED PEARLS

Figure 9 shows a pair of white baroque pearls that were submitted to the West Coast laboratory for an identification report. They had a particularly high luster and were unusually large and well matched in shape. Each measured approximately 32 \times 25 \times 21 mm and had been partially drilled at the apex for setting in jewelry.

We immediately noticed that they felt quite heavy for their size. In addition, peculiar blemishes were present on the surface of each: a small dull-looking oval area on the narrow side of one, and a distinct yellowish brown circular area in a more prominent location on the other (visible in figure 9). At 10 \times magnification with overhead illumination, the dull oval area appeared to be a dense, opaque, white, featureless mass—a nonnacreous material of undetermined identity placed in a natural depression. Magnification showed that the colored area on the companion piece was a circular section of mother-of-pearl that had been carefully attached to the surface.

On the basis of these observations, we suspected that these items had been repaired and/or plugged, so we proceeded with X-radiography to determine the cultured or natural origin of the pearls and whether they had been altered. The X-radiograph of each (see, e.g., figure 10) showed a distinct, partially drilled bead nucleus, which proved that these were cultured pearls. In addition, instead of the characteristic concentric nacre layer around the bead nucleus, the flow pattern of a composite material



Figure 9. These large cultured baroque pearls, each approximately 32 × 25 × 21 mm, showed some unusual blemishes; note the yellowish brown concentration in the center of the pearl on the left.

was clearly visible. It was readily apparent that these cultured pearls had been filled.

Hollow natural pearls sometimes are filled with a foreign material to provide more stability and add weight. In particular, the increased stability reduces the danger of damage when the pearls are drilled prior to setting (see also Fall 1992 Lab Notes, p. 195). This is the first time we have seen cultured pearls of this size with a substantial filling. We concluded that the eye-visible blemishes covered the areas through which the foreign material had been introduced into these cultured pearls. KH

BICOLORED ZOISITE

A Spring 1993 Gem News entry (p. 63) on parti-colored zoisite accurately predicted that additional bicolored zoisites would appear in the trade. Bill Vance recently loaned the West Coast laboratory two fashioned pink-and-yellow bicolored stones (figure 11). He stated that the stones were cut from the same piece of rough zoisite (the largest crystal of a small lot from Tanzania) and that they were not heat treated.

The larger stone, 4.30 ct, showed strong pink color face-up. When viewed through the side, however, it revealed a well-defined color boundary perpendicular to the table; approximately one-third of the stone was purplish pink and the remainder was light yellow. The other stone, 1.62 ct, appeared primarily yellow face up,

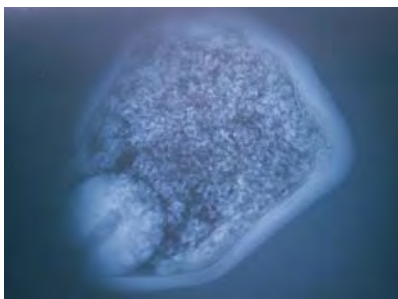


Figure 10. This X-radiograph reveals the filling material around the bead nucleus of one of the baroque cultured pearls shown in figure 9.

with a small pink zone in one corner.

The visible spectrum of the larger stone displayed an absorption band at approximately 455 nm and weak general absorption in the green region. The other stone showed no lines in the hand spectroscope. Both stones were biaxial and yielded refractive indices typical for zoisite: 1.690–1.700. Their specific gravity (determined hydrostatically) was 3.37, and each luminesced very weak yellow to long-wave UV and was inert to short-wave UV. Both displayed distinct purplish pink, yellow, and near-colorless trichroism. These gemological properties, as well as their Raman spectra, confirmed that the material was zoisite.

EDXRF analyses by Sam Muhlemeister on the larger stone's pink and yellow zones revealed that in addition to Al, Si, and Ca, both zones contained traces of Ti, V, Mn, Fe, and Sr. The pink zone showed slightly less Sr and slightly more Mn than the yellow zone. It is unclear whether these small variations were related to the difference in color. However, a notably greater amount of Ti was present in the yellow zone, and one could speculate that the yellow zones might change to blue on heating, as commonly occurs with tanzanite. For a more thorough discussion of these elements and their relationships to the color and pleochroism of zoisite, refer to J. Abrecht's "Pink zoisite from the Aar Massif, Switzerland" (*Mineralogical Magazine*, Vol. 44, No. 333, 1981, pp. 45–49) and G. H. Faye and E. H. Nickel's "On the pleochroism of vanadium-bearing zoisite from Tanzania" (*Canadian Mineralogist*, Vol. 10, No. 5, 1971, pp. 812–821).

CYW

PHOTO CREDITS

Elizabeth Schrader took figures 1ñ3 and 5 (left). Vincent Cracco supplied figures 4 and 5 (right). Maha Tannous took figures 7, 9, and 11. John Koivula provided figure 8.

Figure 11. These bicolored zoisites (1.62 and 4.30 ct) were cut from the same piece of rough. The larger stone appears pink face-up, although well-defined purplish pink and light yellow portions were visible from the side. The smaller stone is mostly yellow with a small pink zone in one corner.

