GEM TRADE LAB NOTES

EDITOR
C.W. Fryer *Gem Trade Laboratory, West Coast*

CONTRIBUTING EDITORS
Gem Trade Laboratory, East Coast
Robert Crowningshield • David Hargett • Thomas Moses

Gem Trade Laboratory, West Coast
Karin Hurwit • Robert E. Kane

CALCAREOUS CONCRETION
From the Bailer Shell?

East and West Coast labs examined yet another unusual nonnacreous calcareous concretion. The opaque light brownish yellow sphere measured approximately 27 mm in diameter and showed a sheen-like effect over its entire surface (figure 1). When the sphere was examined with low-power magnification, the flame-like structure commonly seen in conch or various clam concretions became visible. Because of the much larger size and unusual coloration of this concretion, we reasoned that it must have been produced by a different mollusk. The visual characteristics are similar to those of concretions found in the Bailer shell (*Melo amphora*), which lives in the Indio-Pacific region, as noted in the November 1990 issue of *Australian Gemmologist*. *KH*

Figure 1. This 27-mm-diameter calcareous concretion is similar to those found in the Bailer shell, Melo amphora. *Note the sheen and flame-like structure.*

DIAMOND
With Aggregate Crystallization

A major New York diamond dealer recently found a remarkable aggregate of two gem-quality diamond crystals in his CSO sight. It was examined by GIA Research and both East and West Coast laboratories.

Each of the two diamonds in the aggregate are rounded dodecahedra with etched faces (figure 2). Unlike a twin crystal, they grew together with no particular common crystallographic orientation. The most likely hypothesis is that the two diamonds were very close to each other during growth and ended up growing into each other at random, forming the aggregate.

Although such aggregates are common for fast-growing, industrial-quality diamonds, the probability of this type of aggregate growth occurring in slow-growing, gem-quality diamonds is very low. We at GIA know of only one other such aggregate.

Emmanuel Fritsch

Figure 2. Two gem-quality diamond crystals have grown together to form this unusual aggregate, which weighs 3.34 ct.

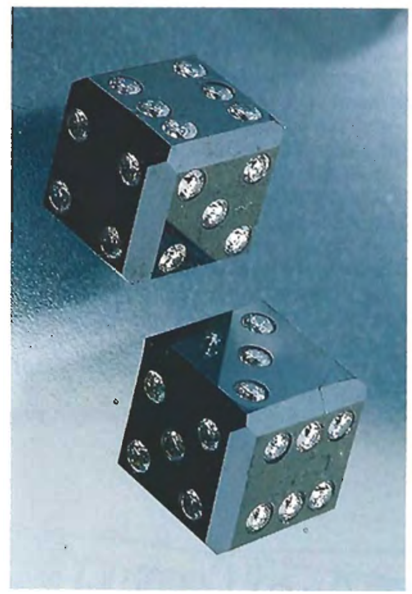

Figure 3. These dice (15.94 and 18.04 ct, respectively) were fashioned from natural-color black diamonds. The smaller measured approximately 10 mm on a side; the larger, approximately 10.5 mm.

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

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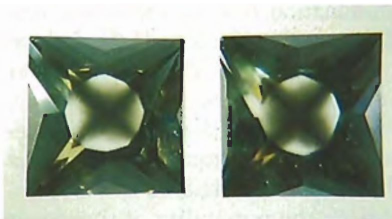


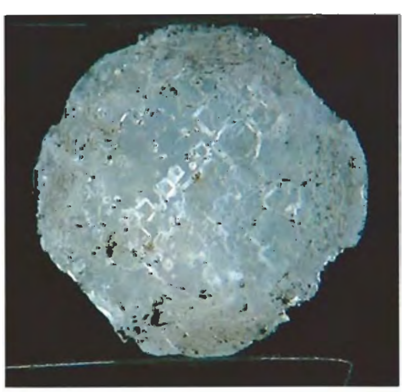
Figure 4. A brown cross-like cloud is a focal point in each of these 1.28- and 1.38-ct natural-color gray diamonds.

Black Dice and Gray with "Crosses"

The handsome pair of faceted black diamond dice shown in figure 3 were recently submitted to the East Coast lab for origin-of-color determination. We do not know the crystal form of the rough from which they were cut. However, we determined them to be natural color. Near-colorless round-brilliant diamonds were used to form the spots on the dice.

We were also asked to determine origin of color for a pair of dark gray square modified brilliants, which weighed 1.28 and 1.38 ct. Each stone contained a brown octahedral cloud that had been cleverly oriented by the cutter to appear as a central cross (figure 4). These stones were also natural color. *GRC*

Figure 5. Prominent etch marks can be seen on the surface of this 1-ct diamond that was damaged in a fire. Magnified 18 ×.



Fire Damaged

Figure 5 shows the remains of an approximately 1.00-ct round-brilliant-cut diamond that was salvaged from the ashes of a home destroyed in last fall's Oakland, California, fire. The damaged stone was shown to East Coast lab staff by a New York client, who was recutting the stone.

To the unaided eye, the fragment had a gray, frosted surface. When the surface was examined with magnification, etch marks could be seen all over it, similar to those seen on rough diamond crystals. For example, the table had prominent square pits—resembling those that sometimes occur on natural cube faces of gem-quality diamonds. Several pavilion facets (which must have approximately paralleled the octahedral faces) had triangular etch pits, like the trigons sometimes seen on the octahedral surfaces of rough diamonds.

It would be interesting to know what conditions produced the etching. Was the diamond in an area of the fire that had an ample air supply or one deprived of air, that is, an oxidizing or reducing atmosphere? Were chemicals involved?

Whatever the conditions, damage was confined to the surface. After recutting, a "new," 0.51-ct stone (figure 6) emerged from the badly damaged original. *GRC*

Figure 6. The fire-damaged stone shown in figure 5 was recut to produce this 0.51-ct diamond.

Green, with Natural Surface Color

In our ongoing study and documentation of green diamonds at both labs, we welcome every opportunity to follow rough diamonds through the manufacturing process (see *Gems & Gemology*, Summer 1991, p. 109). These repeated observations allow the labs to examine how properties—such as U.V. luminescence, U.V.–visible and infrared spectra, and color distribution—may change with cutting. We have noted that some absorption features are altered or created, most likely because of heat generated during cutting and polishing.

The 7.56-ct octahedral crystal shown in figure 7, examined in the East

Figure 7. This 7.56-ct (12.33 × 12.17 × 12.13 mm) octahedral diamond is an example of rough with green surface color.

Coast lab, is a surface-color green diamond. Note the abundant starburst-like green radiation stains (estimated depth of penetration, 0.20 mm), which resulted from exposure to alpha particles emitted by radioactive nuclides. The crystal (reportedly from Brazil) also had a few brown radiation stains in one area (figure 8). Because of their close proximity to a green stain, also seen in figure 8, they could not have resulted from a general heating.

Surface-colored green rough rarely yields a finished stone with any green color. However, this stone was cut care-

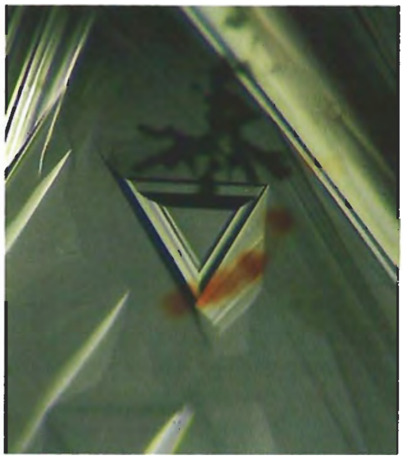


Figure 8. Brown stains were observed next to a green one at a trigon on the rough diamond shown in figure 7. Magnified 126 ×.

fully to enhance the very shallow layer of color through internal reflections. The crystal was sawed off-center, producing a 6.02-ct square modified brilliant (figure 9) and an 0.88-ct cut cornered rectangular mixed cut. The cutter obtained an almost unbelievable weight recovery of over 91%!

No special precautions were taken to cool the stone during manufacture, yet the radiation stains remained green. Total sawing time was approximately 26 hours. The longest continuous sawing time was 12 hours, and the longest continuous cutting or polishing operation took four hours.

As part of his effort to retain some of the shallow green color in the finished stones, the cutter left extremely large naturals on the upper pavilions of both. Naturals comprise about 30% of the surface area of the 6.02-ct stone, including the girdle (figure 10). When we examined the two stones table down, with a view through the polished parts of the pavilion, we determined the body color of both to be a slightly greenish yellow, approximately equal to "M" on the GIA color-grading scale. However, the size, position, and surface color of the naturals allowed both stones to retain enough color to qualify, faceup, as fancy or fancy light grades. The 6.02 was graded Fancy Grayish Yellowish Green and the 0.88, Fancy Light Yellowish Green.

Figure 9. This 6.02-ct stone was cut from the 7.56-ct rough diamond in figure 7, together with a smaller, 0.88-ct, stone.

Both the rough and finished stones fluoresced weak orange to long-wave U.V. radiation, but were inert to short-wave U.V. No graining was visible in the original crystal, but cutting revealed weak planar graining along octahedral planes. There was no detectable transmission luminescence with microscope illumination, or when the stones were illuminated by the lamp in the desktop spectroscope. A Victoreen Geiger counter (see *Gems & Gemology*, Winter 1988, p. 196) registered no radiation above background levels in either the rough or the finished stones, eliminating the possibility of treatment with a radioactive compound such as radium bromide.

Figure 10. To retain as much of the original green as possible, the cutter left large naturals on the pavilion surfaces and girdle of both the 6.02-ct diamond shown in figure 9 and its smaller counterpart. This cutting technique also undoubtedly contributed to the exceptional weight retention. Magnified 15 ×.

The spectral features, as observed with a spectrophotometer, were consistent with those of known natural surface-color rough and polished diamonds. The rough crystal showed a spectrum with strong Cape lines, a 3H center at 504 nm, and a moderate-strength GR1 center from radiation. The zero-phonon line of this center at 741 nm was well defined, but broad—as observed in other natural-color stones with abundant green surface stains. The larger finished stone yielded an identical optical spectrum. The smaller stone showed no 3H absorption and only a very weak GR1, which may have resulted from the passage of a large flux of heat through a small stone during cutting and polishing. It is also possible that the spectral differences reflect an uneven distribution of impurities in this diamond crystal. Most diamond crystals are chemically inhomogeneous, which can lead to both spectral and color differences in stones cut from a single piece of rough.

TM and Ilene Reinitz

EMERALD

Identifying inclusions in an emerald is one of the most important ways of determining synthetic or natural origin. The East Coast lab received two green stones, reportedly emeralds, with very similar-looking inclusions. Microscopic examination of one stone (1.19 ct) revealed spicule-like inclusions (figure 11) that, along with other gemological tests, identified it as a hydrothermally grown synthetic emerald. Spicule-like inclusions in synthetics are two-phase growth features capped by transparent-to-translucent irregularly shaped crystals that, in syn-

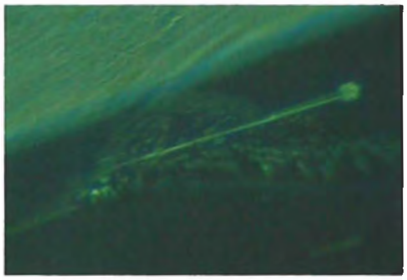
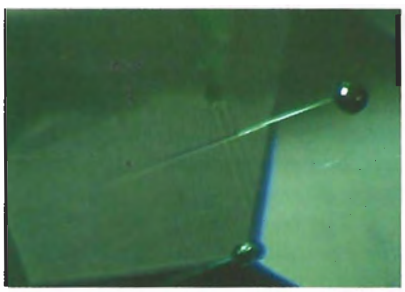


Figure 11. This spicule-like inclusion in a synthetic emerald has a transparent crystal cap typical of hydrothermally grown material. Magnified 126 ×.

Figure 12. This inclusion in a natural emerald appears similar to the spicule shown in figure 11. However, it is probably a tapered growth blockage; note that the crystal cap is opaque and yellow. Magnified 60 ×.



thetic emerald, are usually phenakite.

Initial examination of the other specimen (a 2+-ct stone mounted in a ring) revealed inclusions similar in shape to the ones seen above (figure 12), which might suggest that this stone was also a synthetic. However, the high refractive index, presence of hexagonal crystals (probably calcite), and observation of type 1 and type 2 H_2O bands in the infrared spectrum, in combination with other gemological tests, led us to conclude that it was a natural emerald. Closer inspection with the microscope revealed that the spicule-like inclusions—probably tapered growth blockages—were different from those seen in synthetic stones; in particular, the euhedral crystal caps were opaque and yellow. This is another example of the hazards of making an identification based on only one characteristic or test.

Nicholas DelRe

Imitation LAPIS LAZULI

Figure 13 illustrates one of the most unusual lapis lazuli imitations ever seen in the West Coast laboratory. To the unaided eye, the opaque, slightly violetish blue 4-ct rectangular bar-cut cabochon appeared to be fine lapis lazuli. However, the stone lacked the smooth texture and high polish that contributes to the attractiveness of lapis. With oblique illumination, a distinct granular structure—similar to fine-grained marble—was visible. With magnification, the structural characteristics became more obvious. The material consisted primarily of transparent near-colorless tabular grains, interspersed with irregularly shaped opaque blue areas that produced the prominent blue color (figure 14).

Gemological properties were determined as follows: R.I.—1.55 (spot method), S.G.—2.85 (estimated by heavy liquids). The stone fluoresced a strong chalky greenish yellow to short-wave U.V. radiation, but weak red to long-wave U.V. There was no reaction to the hot needle of the thermal reaction tester and no evidence of dye when a white cotton swab soaked with acetone was gently rubbed over the surface. Chemical analysis by EDXRF showed Si, Al, Mg, K, Ca, and trace amounts of Ti, V, and Fe. X-ray diffraction testing on both near-colorless and colored areas revealed patterns that matched phlogopite mica. These properties indicated that the stone was a manufactured product, possibly a ceramic. The coloring agent has yet to be identified. *KH*

Figure 13. This 4-ct imitation superficially resembles fine-quality lapis lazuli.

Figure 14. At 30 × magnification, transparent, near-colorless granules and areas of blue coloration are readily apparent in the stone shown in figure 13.

OPAL, with Natural Cellular Structure

The West Coast laboratory examined a spectacular natural opal with an unusual mosaic pattern to the play-of-color (figure 15). The extraordinary play-of-color layer comprised about one-quarter of the thickness of the stone, while the remaining three-quarters were primarily natural gray potch, with only some minor play-of-color visible. The vivid geometric play-of-color patches ranged through all the spectral colors when the stone was moved under a stationary light source. The patches were separated from each other by fine serrated seams of black potch.

Several play-of-color patches had a

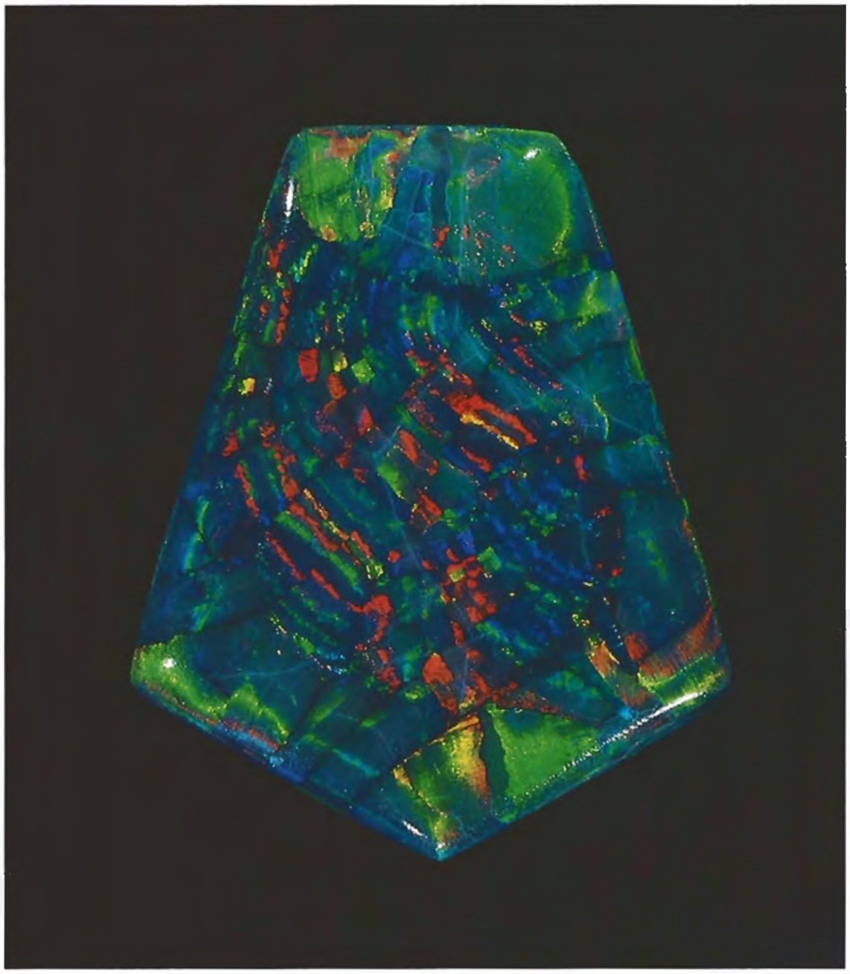
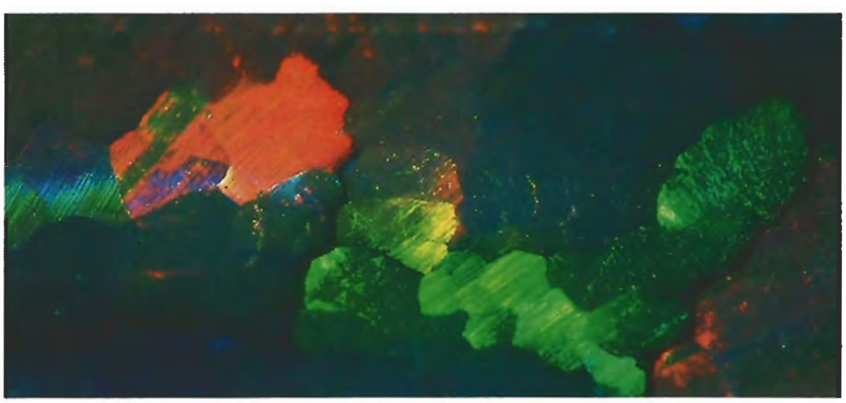


Figure 15. An excellent example of mosaic pattern to the play-of color is seen in this 7.86-ct (20.28 × 16.66 × 4.66 mm) natural opal.

Figure 16. The natural "honeycomb" structure in the opal shown in figure 15 is readily apparent with oblique fiber-optic illumination. Magnified 30 ×.



fine "honeycomb" cellular pattern (figure 16) that, at first glance, closely resembled the snakeskin effect seen in synthetic black opal. In synthetic black opal, however, each individual patch of color can be followed deep into the stone. Natural patches tend to be much shallower and less uniform in their penetration. Also, the natural patches vary more in size and shape.

Gemological properties of this opal are consistent with those of Australian black opal, with a 1.44 spot R.I. reading on the Duplex II refractometer. The stone fluoresced a strong chalky blue to long-wave U.V. radiation, and phosphoresced a moderate greenish white. Gilson and Inamori synthetic opals fluoresce a dull yellowish green with no phosphorescence. The stone showed some crazing, a subtle reminder that such perfection in nature rarely comes without a price.

Patricia Maddison

Unusual POLYNESIAN CULTURED PEARLS

Natural-color black South Seas cultured pearls are usually nucleated with approximately 9-mm-diameter shell beads made from any one of several varieties of American freshwater mussels. As with other bead-nucleated cultured pearls, the shell bead usually comprises most of the weight and volume of the pearl. The South Seas product, however, generally has a thicker nacre deposit.

The East Coast lab recently tested the beautiful natural-color black cultured pearl necklace shown in figure 17. The cultured pearls ranged in size from approximately 12 to 16 mm. When the necklace was X-rayed, we were surprised to see that two of the pearls (marked in figure 17) lacked bead centers. However, the X-radiograph (figure 18) does show some evidence of mantle-tissue nucleation in both.

We hypothesize that these two cultured pearls lost contact with the mantle tissue at an early stage after growth was initiated. Such pearls are usually not very large, but these grew to approximately 14 mm. *DH*

PINITE

From time to time we encounter carved gem materials or beads that are euphemistically called jade, as the green bead shown in figure 19 was represented to our client.

Figure 17. The natural-color black cultured pearls in this necklace range from 12 to 16 mm. The two marked pearls, which we believe are also cultured, did not show bead nuclei in the X-radiograph (figure 18).

However, routine gemological testing by the East Coast lab proved that this material was not jadeite, nephrite, or even serpentine—a common jade substitute. The refractive

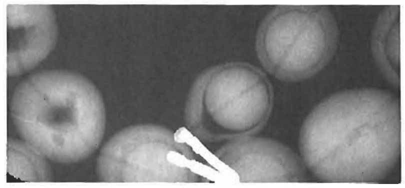


Figure 18. The X-radiograph of the necklace in figure 17 revealed that two pearls do not have bead nuclei.

index was 1.57; the specific gravity (obtained by the hydrostatic method) was approximately 2.80; the hardness test (performed inside the drill hole) was about 3 1/2 on the Mohs scale. There was no reaction to hydrochloric acid or the color filter.

Because of the many massive minerals that could have similar properties, we turned to X-ray diffraction analysis. X-ray diffraction proved this material to be pinite, a form of muscovite mica. A pinite carving that we previously identified is described and illustrated in *Gems & Gemology*, Fall 1983, p. 176.

The bead also showed chromium absorption lines in the hand spectroscope. Care must be taken when evaluating these lines because strong chromium lines may sometimes

Figure 19. This 9.80-mm-diameter pinite bead was sold as jade.

resemble aniline dye bands. X-ray fluorescence analysis confirmed the presence of chromium. DH

PHOTO CREDITS

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