GEM TRADE LAB NOTES

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DIAMOND

Centenary Diamond Graded

In early 1994, a special team of experienced senior staff members from both the East and West Coast labs traveled to London to grade, on-site, the Centenary diamond (figure 1). To ensure a grading environment consistent with that in the GIA Gem Trade Laboratory, specific requirements were forwarded in advance to the CSO Valuations AG, which prepared a room especially for the grading. To further ensure consistency, the grading team brought to the site a Minolta Chromameter, which was used to monitor both the ambient lighting conditions of the room and that of the grading equipment that was brought from New York by the team.

The Centenary was described on the grading report as a modified heart brilliant weighing 273.85 ct. It was graded "D" color, Internally Flawless, with polish and symmetry both graded as excellent, validating previously published information about this diamond. A letter was prepared which accompanied the grading report, stating that the diamond is the largest "D"-color, Flawless or Internally Flawless diamond graded by the GIA Gem Trade Laboratory as of the date of the grading report.

Tom Yonelunas, Ed Schwartz, and John M. King

Color Origin, "Unnamed Brown"

A second purpose of the recent trip to London by GIA Gem Trade Laboratory staff members was to examine and issue an Identification

Figure 1. The 273.85-ct Centenary diamond is the largest "D" color, Flawless or Internally Flawless diamond graded by the GIA Gem Trade Laboratory to date.

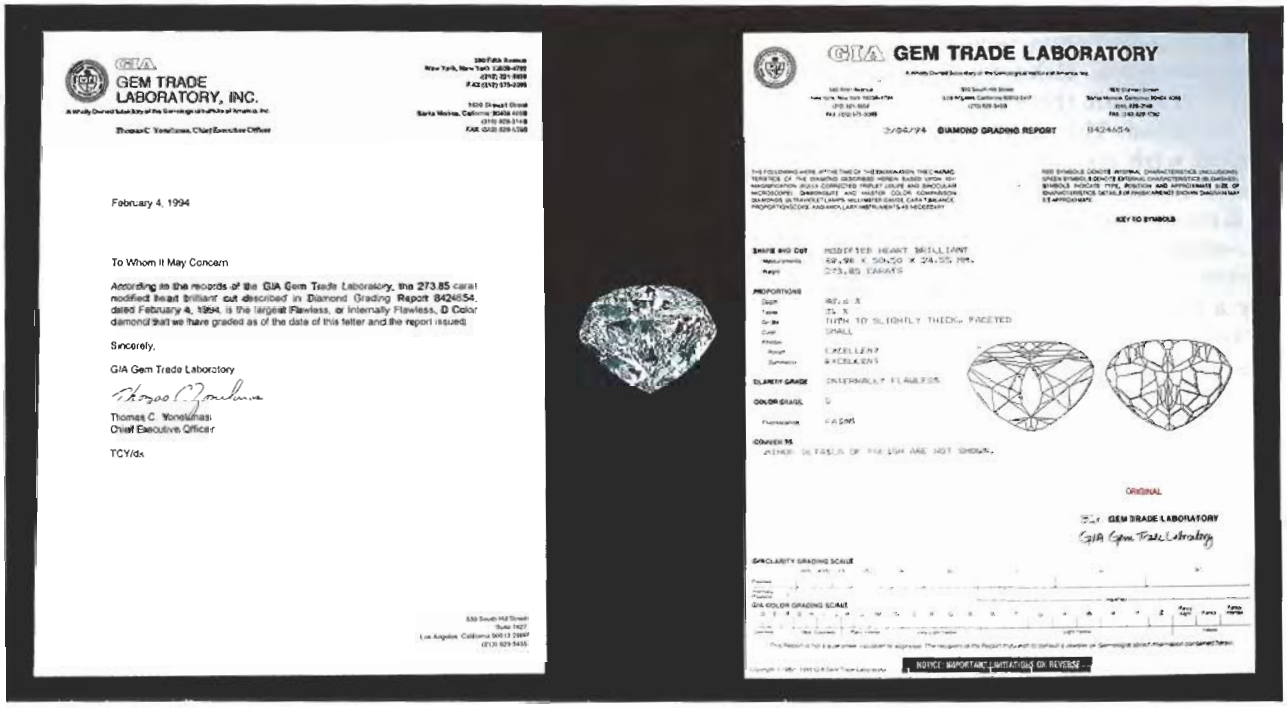


Figure 2. The largest diamond on which the GIA Gem Trade Laboratory has reported to date is the 545.65-ct natural-color, fancy yellow-brown "Unnamed Brown" diamond.

and Origin of Color report on the 545.65-ct diamond known as the "Unnamed Brown" (figure 2). This provided a unique opportunity to document the properties of this important diamond and to authenticate the origin of color.

Examination of the diamond with magnification revealed characteristic brown planar graining alternating with near-colorless zones in some areas. The diamond was inert to both long- and short-wave ultraviolet radiation, although it did weakly transmit the short-wave U.V. radiation. This latter feature, coupled with its ultraviolet and infrared absorption spectra, showed the diamond to be a type IIa. The U.V.–visible spectrum was essentially devoid of sharp features, showing only a gradual rise in absorption toward the shorter wavelengths. These combined properties provided proof of natural color.

The shape of the diamond was described on the report as a modified cushion brilliant, and the color was graded Fancy Yellow-Brown, Natural Color. This report was accompanied by a letter stating that it was the largest diamond on which the GIA Gem Trade Laboratory had issued a report as of the date of testing.

TM and John M. King

Fancy-Colored Rough

In most fancy orange-to-brown diamonds, the color is distributed along graining throughout much—if not all—of the stone. Thus, a New York diamond dealer was surprised—and disappointed—when the cutting of an apparently "fancy" orangy brown piece of rough (as illustrated by the remnant in figure 3—right) produced a near-colorless stone (figure 3—left).

Although this dealer was thoroughly familiar with the green and/or brown irradiation stains seen on the surface of some near-colorless rough, which are usually removed during cutting, he had never observed this kind of color distribution in an orangy brown diamond. Therefore, he brought the cut stone and remnant to the East Coast laboratory for examination, noting that the original rough had been purchased in Bangui, Central African Republic.

When we examined the remnant with a gemological microscope and diffused transmitted light, we noted brown irradiation stains covering the entire surface. Although some darker stains were readily apparent at high magnification, most of the stains were pale brown with poorly defined edges, which contributed to the impression that the skin was evenly brown (figure 4). Almost all of these stains were extremely shallow; even the darkest ones did not appear to penetrate the surface more than 0.05 mm. We

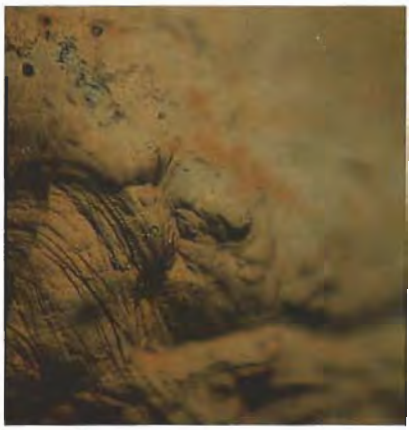
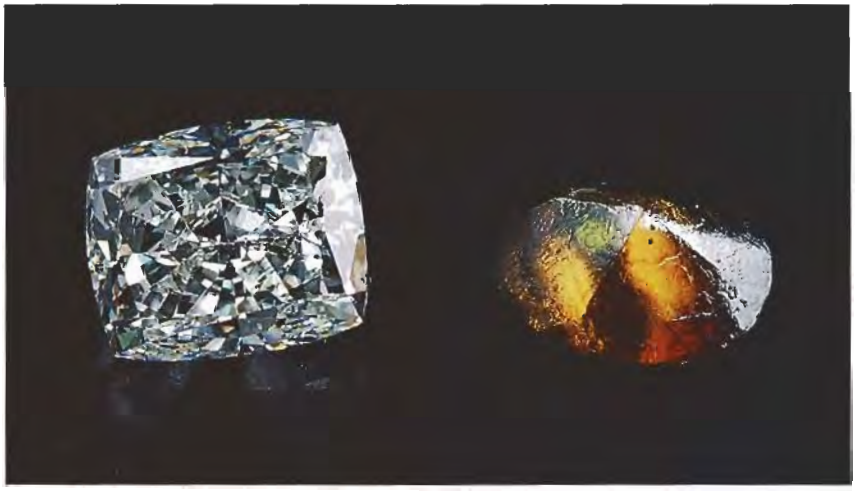


Figure 4. The color of the rough shown in figure 3 was due to the brown natural irradiation stains that cover its entire surface. Note also the green irradiation stain toward the top left of the photo. Magnified 126×.

Figure 3. The dark orangy brown rough diamond on the right is a remnant of the piece from which the 1.18-ct rectangular modified brilliant, of I to J range in color, was cut.



noted one green irradiation stain as well (again, see figure 4).

The visible absorption spectrum of this rough piece, measured at low temperature with a Pye-Unicam SP8-400 spectrophotometer, revealed a weak line (due to irradiation) at 741 nm and a moderate absorption at 595 nm. The latter was strong enough to be clearly visible with a desk-model spectroscope at room temperature. The cut stone, of I to J range in color, also showed an extremely weak 741-nm line in the spectrum, but not the 595-nm absorption line. We detected no residual radioactivity from the shallow surface stains on the rough remnant, one of the properties occasionally encountered in laboratory-treated stones.

It appears that this stone was exposed to both alpha radiation and moderate heating in nature. In 1943, B. W. Anderson noted similar characteristics in brown, surface-colored rough also from the Central African Republic (see, for example, *Gems & Gemology*, Summer 1982, p. 76). Laboratory experiments have shown that heat treating a diamond to 500°–550°C will turn green irradiation stains brown while developing a 595-nm absorption peak. However, some researchers speculate that similar effects may occur in nature at lower temperatures maintained over much longer periods. The green stain on this piece of rough suggests that exposure to radiation continued after heating had stopped.

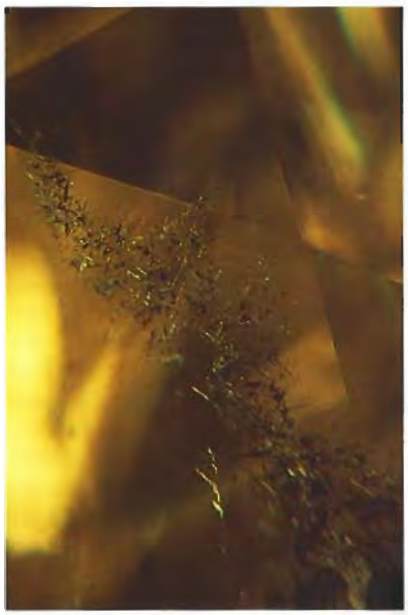
While the GIA Gem Trade Laboratory has seen many rough diamonds with brown and green irradiation stains contributing to the color, this is our first encounter with a stone where the dark brown stains completely disguised the inherent near-colorless body color of the diamond crystal. It also adds to the documentation of rare naturally occurring 595- and 741-nm absorption features; the former was once considered to be evidence of laboratory irradiation and heat treatment in all cases. *Ilene Reinitz and TM*

Characteristic Inclusions in Fancy-Color Diamonds

Gemologists can identify some gemstones with moderate certainty by their characteristic inclusions. For instance, demantoid garnet is well known for its "horsetail" inclusions, and natural spinel for its inclusions of octahedral crystals. The low-relief, rounded crystal inclusions and roiled appearance of hessonite garnet also come to mind, as do emerald's very frequently encountered "three-phase" inclusions.

As we continue our research into the problems of determining the origin of color in colored diamonds, we now routinely establish the diamond type of the stone under examination. This usually requires the use of an infrared spectrometer to study the mid-range infrared spectrum of each stone. (See the article by E. Fritsch and K. Scarratt, in the Spring 1992 *Gems & Gemology*, pp. 38–39, for an excellent discussion of different diamond types.) One type—the rare type-Ib diamond—is noted for producing one of the most commercially desirable fancy colors, called a "true canary" by some in the trade. Here, the nitrogen impurities are dispersed throughout the crystal, replacing some carbon atoms rather than clustering in aggregates. We study such stones in detail when they appear in the lab, because of both their rarity and their intensity of color. Note that type-Ib stones do not show the "Cape" spectrum commonly seen in type-Ia diamonds with a hand spectroscope.

Figure 5. Needle-like inclusions such as these are often found in type-Ib fancy intense yellow diamonds. Magnified 63×.



Over the past few years, as more information has become available on diamond types, researchers and laboratory gemologists have been able to establish correlations between some of the inclusions in a diamond and its type. By extension, these inclusions can be used as indications of the origin of color in fancy-colored diamonds. One feature noted in nearly all predominantly type-Ib diamonds, but not in other types, are clusters of fine dark needles of unknown composition. On the basis of the presence of such clusters (figure 5), we surmised that the 1.01-ct fancy intense yellow diamond in figure 6 was a type Ib. The mid-range infrared spectrum proved that our thoughts were correct.

Some fancy intense yellow diamonds have another distinctive inclusion—oriented platelets—that is even rarer than the dark needles in type-Ib stones. We saw numerous such platelets (figure 7) in another fancy yellow diamond examined in the East Coast lab. These inclusions are reminiscent of those seen in some East African rubies and sapphires. Again, on the basis of the inclusions and the characteristic color, one experienced staff member predicted that the stone would prove to be a type-IaA diamond. The mid-range infrared spectrum showed it to

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

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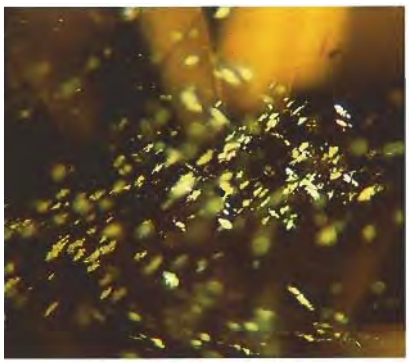
Figure 6. This 1.01-ct fancy intense yellow, pear-shaped brilliant cut—in which the inclusions shown in figure 5 were found—is a type-Ib diamond.

be type IaA>>B, plus minor Ib (to which the intense yellow color is attributed). However, because of the type-Ia component, such a stone may also show a weak 415-nm line of the "Cape series" (as was the case with the sample described above).

Observation of such needles or platelets helps establish that an intense yellow diamond is both natural and naturally colored.

GRC

Figure 7. These oriented platelets appear to be unique to type-IaA fancy yellow diamonds. Magnified 63×.



FELDSPAR and GARNET
Snuff Bottle

Carvings are among the most interesting and challenging items submitted for identification to the GIA Gem Trade Laboratory. Often, their size prevents determination of specific gravity and the typically curved surfaces limit refractometer testing to spot readings (with even less accuracy if the polish is poor). Furthermore, some carved materials consist of more than one distinct mineral, or they represent a mineral that is only rarely seen in carved form. The list of such ornamental materials reported in Lab Notes includes: pinite (Fall 1983, pp. 175–176); a rock consisting of serpentine and other minerals (Winter 1983, pp. 233–234); a rock containing plagioclase feldspar and muscovite mica as major components (Fall 1985; pp. 173–174); clinochlore IIb (Winter 1991, p. 248); massive grossular garnet (Spring 1985, p. 44, and Winter 1991, pp. 248–249); and orthopyroxene (Winter 1993, p. 282).

The latest such novelty to be submitted to the West Coast lab for identification was a snuff bottle, reportedly from China, that was carved from a translucent mottled white-and-green material. It measured approximately 55.0 × 56.1 × 11.6 mm (figure 8). With magnification, we noted that the white areas were similar in appearance to jadeite, and the green component along one side of the bottle consisted of numerous green platelets and mossy-appearing inclusions. Spot refractometer testing of the white area produced a 1.57 value, but the green platelets were too disseminated within the white area to give a separate reading. The specific gravity (determined hydrostatically) was 2.76. The white areas fluoresced a weak, dull gray to long-wave U.V. radiation, but strong red to short-wave U.V. The green areas were inert to both wavelengths.

Figure 8. This 56-mm-high carved bottle is composed primarily of plagioclase feldspar, with garnet of the grossular-andradite-uvarovite series.

On the basis of the gemological properties, we determined that the white component was a plagioclase feldspar. However, X-ray diffraction analysis was needed to identify the green component. Analysis of a minute powder sample from one such area produced a pattern that was very close to our standard reference pattern for uvarovite garnet [$Ca_3Cr_2(SiO_4)_3$]. However, a similar pattern could result from a mixture of grossular [$Ca_3Al_2(SiO_4)_3$] and andradite [$Ca_3Fe_2(SiO_4)_3$], with only a small amount of chromium causing the green color. Therefore, we felt this pattern was insufficient to identify the green component specifically as uvarovite.

Energy dispersive X-ray fluorescence (EDXRF) analysis performed by GIA Research revealed significant aluminum and iron components, in addition to calcium and chromium. This chemistry shows that the mineral in the green areas is actually composed of grossular, andradite, *and* uvarovite, all members of the garnet group. Thus, the snuff bottle was identified as a rock consisting primarily of plagioclase feldspar, plus garnet in the grossular-andradite-uvarovite series, with the possi-

bility of additional minerals. We also noted on the report that petrographic testing (a destructive process) would be necessary to characterize the material fully. *RCK*

Magnetic HERCYNITE, a Warning About Magnetic Cards

Over the past several months, a number of samples of a black spinel-group mineral have come through the West Coast laboratory (see, e.g., Gem News, Fall 1993, pp. 212–213). The spinel group of minerals contains the transparent gem species spinel ($MgAl_2O_4$), as well as the opaque black species hercynite ($FeAl_2O_4$), magnetite (Fe_3O_4), and magnesiochromite ($MgCr_2O_4$), among others. Solid-solution mixtures may occur between two or more members of the spinel mineral group, with the resulting materials exhibiting physical properties—sometimes unexpected—between those of their end-member components.

The East Coast lab received an 8.94-ct black stone for identification. Although the R.I. was over the limits of the standard refractometer (1.80+), the material was similar in appearance to stones from the spinel group that we had tested. The gemological properties and X-ray diffraction results indicated that the stone was an intermediate spinel (about 75% hercynite and 25% spinel). The fact that it was attracted to a pocket magnet suggests that it probably contained some magnetite.

An additional feature of this stone was discovered by accident. After inadvertently placing the stone in contact with a pass card that contained an embedded magnetic strip, we noticed that the key code was no longer valid, rendering the card useless. Although the next two hercynites that we examined were not as magnetic, other magnetic gem materials might also affect magnetic strips on pass cards. Such materials include slag imitations of hematite (used for cameos) and pyrite-rich shale, which has recently been cut for jewelry (G. H. Dick, *American Jewelry Manufacturer*, February 1993, pp. 14–15). Although this is our first experience with a gemstone affecting a magnetic card, it will probably not be the last. Readers are warned to take heed of the potential risks involved in handling such materials. *Mary L. Johnson*

Lavender JADEITE, Impregnated

The article titled "Identification of Bleached and Polymer-Impregnated Jadeite" (E. Fritsch et al., *Gems & Gemology*, Fall 1992, pp. 176–187) focused on predominantly green and white jadeite that has been bleached to remove undesirable brown staining and then is polymer impregnated to improve the stone's transparency and overall appearance. Such treated jadeite, often referred to in the trade as "B jade", has become a major concern to those dealing in jade.

However, polymer impregnation is not limited to green jadeite, as the West Coast lab recently discovered. Standard gemological testing of a 15.86-ct lavender oval cabochon (figure 9) determined that it was jadeite. Examination with magnification provided the first evidence of treatment—small cavities containing a transparent, essentially colorless filling material. Infrared (FTIR) spectroscopy confirmed these initial observations. A strong absorption at about 2900 cm^{-1} confirmed the presence of a synthetic resin similar to that detected in some of the jadeite described in the above-referenced article and in other samples submitted to the East and West Coast labs for identification.

Figure 9. Infrared spectroscopy confirmed that this 15.86-ct lavender jadeite cabochon had been polymer impregnated.

As is done with polymer-impregnated green jadeite, the laboratory report identified this lavender jadeite cabochon as "impregnated jadeite jade." Because we could not definitively determine the origin of the color in this stone (which is typically the case with lavender jadeite), the conclusion also included a note to that effect.

RCK, SFM, and Emmanuel Fritsch

OPAL, Translucent Greenish Blue

Turquoise is probably the best known of the nontransparent greenish blue gemstones. Chalcedony colored by finely disseminated inclusions of the mineral chrysocolla has a color reminiscent of the best turquoise, but typically with a higher degree of diaphaneity. A Mexican locality has produced commercial quantities of this chalcedony, which has been seen in the U.S. market for the past few years (see, e.g., the chalcedony entries in the Spring 1991 Lab Notes, p. 40, and in the Spring 1992 Gem News, pp. 59–60). Occasionally we have seen opal in this color, but that material typically lacked the color saturation that we associate with the finest chrysocolla-colored chalcedony. Such opal is reportedly mined in the Andes Mountains of Peru (see "Fine Greenish Blue Opal," Summer 1991 Gem News, pp. 120–121).

Last fall, the West Coast lab was asked to identify four items—three carved, pierced pendants (see, e.g., figure 10) and one cabochon—that were all translucent and looked very much like the finest Mexican chalcedony. However, gemological testing revealed properties consistent

Figure 10. This 72.69-ct carved opal (approximately 52.65 × 27.65 × 11.53 mm) strongly resembles chrysocolla-colored chalcedony.

with opal, including spot R.I.'s ranging from 1.45 to 1.47 and S.G.'s from 2.15 to 2.17. Magnification revealed a texture that closely resembled that of the Mexican chrysocolla in chalcedony, but was also similar to the structure seen in a reference sample of blue opal from Peru. Because of the unusual appearance of the material, the slightly elevated R.I. (at the high end of values for opal), and the ambiguous structure, we decided to perform X-ray powder diffraction analysis. This produced a very weak cristobalite pattern, which is typical for many opals. The specimens were therefore identified as opal.

RCK

PEARLS
Early Japanese Assembled Cultured Blister Pearls

Only twice in the Lab Notes section's long history have we mentioned so-called "Japanese pearls," the first products of Japan's pearl-culturing efforts. One mention was about a latticework necklace in the Summer 1983 issue (p. 116): A lovely "pearl" appeared at each intersection of the white enameled bars making up the lattice. At that time we had many questions about the formation of these "pearls." The second mention was in Spring 1988 (p. 49), when the lab examined a pair of earrings set with similar "pearls." By then, we had learned enough about these gems to report that they were made before the secret of culturing solid round pearls was discovered.

Within the past few months, the East Coast lab has identified these assembled cultured blister pearls in two pieces of jewelry. Figure 11 shows a necklace clasp with two "Japanese pearls" that were readily identified by the cement plane visible in each. Although not needed for the identification, an X-radiograph (figure 12) was taken to show their typical assemblage: a blister pearl top with a cement backing, sometimes with a shell cube or other insert for support.

The Edwardian ring in figure 13 at first glance appeared to contain colored freshwater pearls, which were popular at the turn of the century. These colors and shapes are typical of American pearls available at that time. Therefore, we were surprised to discover from the X-radiograph (figure 14) that at least the two outer "pearls" were early assembled cultured blisters (i.e., with the rectangular saltwater-shell insert characteristic of this material—again, see the Spring 1988 issue of *Gems & Gemology*, p. 49, for a detailed discussion). Although the center "pearl" showed no evidence on the X-radiograph of the characteristic dark shadow line between the bead implant and the nacreous overgrowth, visual examination from the side showed that it, too, was assembled.

Another surprise was the discovery that all three cultured blister pearls had been dyed, evidently to imitate American freshwater pearls.

Figure 11. Each of these early assembled cultured pearls is about 6.8 mm in diameter. Magnified 10×.

Figure 12. This X-radiograph of the pearls in figure 11 shows rectangular inserts similar to the one illustrated in the Spring 1988 issue of Gems & Gemology.

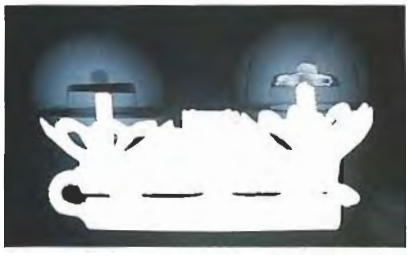


Figure 13. These three assembled cultured blister pearls (6.6–7 mm) have been dyed, perhaps to imitate American freshwater pearls.

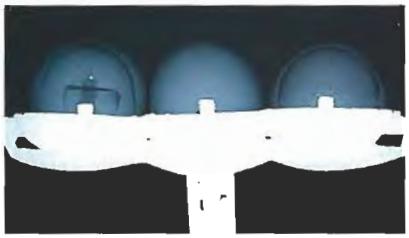


Figure 14. This X-radiograph shows a rectangular insert in one of the assembled cultured pearls illustrated in figure 13.

If, as we surmise, these are "Japanese pearls" and were dyed prior to setting, they would be the oldest dyed cultured pearl product of which we have knowledge. Figure 15 shows the bubble-like separations in the dye layer of the center black "pearl." We had been told that dyed black natural pearls were not routinely produced until the 1920s.

GRC

Experimental Nucleus in a Cultured Pearl

Following work done by Mikimoto in the early 1900s, it was generally agreed that a nucleus of white freshwater mother-of-pearl shell provided the best culturing results. Thus, testing of bead-nucleated ("Akoya") cultured pearls today usually reveals shell nuclei. However, we do rarely encounter whole cultured pearls with other nuclei, including wax (*Gems & Gemology*, Summer 1988, pp. 114–115) and plastic, used as the irritant. When something other than shell is used, the purpose is usually to create a specific effect on the color, as was the case with the green composite nuclei reported in *Gems & Gemology*, Fall 1990, pp. 222–223. Historically, dyed blue shell cores have been used to impart a gray-to-black color to the finished product.

Figure 15. Bubble-like separations can be seen in the dye layer of the gray pearl illustrated in figure 13. Magnified 15×.

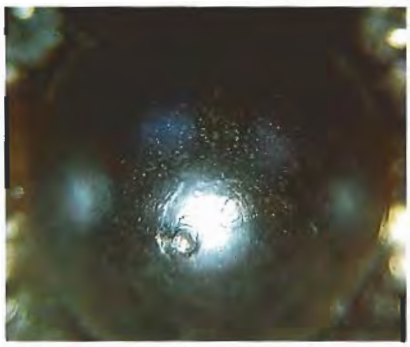


Figure 16. Notice the darker appearance of one of the cultured pearls (approximately 8 mm in diameter) in the center strand.

A necklace recently submitted to the East Coast lab for identification was found to consist of cultured pearls that ranged from 3.75 to 8.50 mm in diameter. One bead had a distinctly different, darker appearance than the rest (figure 16).

An X-radiograph (figure 17) revealed that the nucleus of this cultured pearl was considerably more transparent to X-rays than the typical shell nucleus. Because of this, we took a small scraping from the nucleus and exposed the shavings to a thermal reaction tester. The relative hardness of the material (as determined during the scraping process), and the fact that the shavings did not readily melt, indicate that this was some type of plastic rather than a wax.

On the basis of the unusual nucleus in the one bead, the shape of the cultured pearls, and the thickness of their nacre, we speculate that this necklace was probably produced in the 1920s or '30s, when experimentation with different nuclei was more prevalent. *TM*

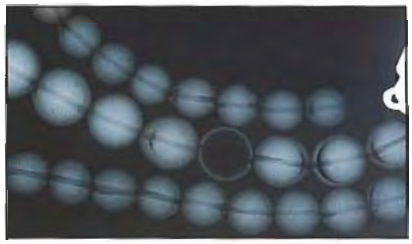


Figure 17. The difference in X-ray transparency of one cultured pearl clearly shows that its nucleus is not the same as that of the other cultured pearls, which appear to have shell-bead nuclei.

Star SAPPHIRE, with a Buff-Top Cut

Generally, most gems fall into one of three broad fashioning categories: faceted, cabochon cut, or engraved. However, there are exceptions, as in the "fantasy cuts" that have received considerable attention over the past several years. Another hybrid style, one that predates fantasy cuts, is known as the buff-top. This features a convex top—like a cabochon—and a faceted pavilion. It is a fashioning style employed most frequently with flame-fusion synthetic corundums and synthetic spinels that are used in class rings and similar types of popular jewelry.

As this cut is most often associated with mass-produced, nonphenomenal synthetic gem materials, it was with interest that the West Coast lab received for identification the stone shown in figure 18. Standard gemological tests proved it to be a natural star sapphire. In addition to exhibiting a star of moderate

Figure 18. Face up, this 11.66-ct blue star sapphire displays asterism, as well as some brilliancy that is not usually seen when a standard cabochon cut is used for such material.

intensity on its domed top surface, this fairly transparent stone also displayed some brilliancy, caused by reflections from its step-cut pavilion facets (figure 19). It is possible that the decision to use this cutting style, which is not common for natural material, was based on the desire to obtain good weight retention from the rough, while at the same time producing an unusual fashioned natural gem. *RCK*

Figure 20. Face up, this 15.80-mm color-change synthetic sapphire appears redder than is typical for this material because of a coating on the pavilion facets.

SYNTHETIC SAPPHIRE, Color-Change with Unusual Backing

The GIA Gem Trade Laboratory periodically receives color-change stones that are subsequently identified as synthetic sapphires. The color change is typically from grayish greenish blue in day or fluorescent lighting to purple-pink under incandescent light.

Figure 19. A side view of the star sapphire shown in figure 18 reveals the cabochon top and faceted pavilion characteristic of the cutting style known as a buff top.

Recently, the West Coast lab received for identification a ring mounted with a reddish purple round brilliant (figure 20). Standard gemological testing revealed properties consistent with those for corundum, and the presence of curved striae proved that it was synthetic. The spectrum was typical of the color-change synthetic sapphires that are colored by vanadium. What was unusual about this specimen was that in both incandescent and fluorescent lighting it had an atypical red component. Although the closed-back nature of the mounting made it impossible to examine the stone from the pavilion, examination with a microscope through the crown revealed that the unusual color was due to the presence of a red foil or paint-like coating on the pavilion facets. We speculated that this backing was applied to add red to the face-up color of the stone in an attempt to approximate more closely the color of alexandrite, rather than the more purple hue of color-change synthetic sapphires, in incandescent light.

We have seen foil-backed synthetic color-change sapphires in the trade (again, often in class rings), but this is the first we recall receiving in the laboratory for identification. Note that usually the backing is not colored and is used to increase apparent brilliance. *RCK*

PHOTO CREDITS

Figures 1 and 2 are courtesy of CSO Valuations AG. Nicholas DelRe took the photos used in figures 3–7, and 11–17. Shane F. McClure provided figures 8–10, and 20. Figures 18 and 19 are by Maha DeMaggio.