Gem Trade LAB NOTES

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ALEXANDRITE, with Unusual Silky Zones

Natural alexandrites frequently exhibit fine silk-like inclusions when a narrow beam of light strikes them. Figure 1 illustrates unusually coarse silk in a 2.10-ct natural alexandrite. Scattered along the silky zones are oval iridescent discs with an appearance unlike any we have ever before encountered. Although most of the alexandrites we have seen show a feeble color change, or only somber colors, this specimen showed a near-textbook change from green to red. *RC*

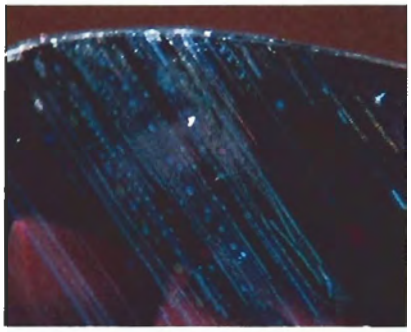


Figure 1. Unusual oval discs along coarse needles in a natural alexandrite. Magnified 30×.

CALCITE Marble Beads

During the past several months, the Los Angeles laboratory has received for identification several strands of round drilled beads that range in color from a yellowish white (figure 2) to a deeper brownish yellow (figure 3). Indistinct refractive indices of 1.48 and 1.66, with the high birefringence that is indicative of a carbonate, were obtained by the spot method. Microscopic examination showed a granular structure. The beads also exhibited a very weak orange fluorescence when exposed to long- and short-wave ultraviolet radiation. The specific gravity was estimated with heavy liquids to be approximately 2.65, which ruled out the possibility of magnesite (3.0–3.1) or even dolomite (2.85), both carbonates that can also occur in massive forms. Therefore, the beads were identified as calcite marble.

During this same period, the laboratory also examined several opaque white beads and cabochons of magnesite that might be confused with calcite marble. Magnesite, however, can be distinguished from calcite on the basis of its higher R.I.

Figure 2. These 9-mm yellowish white beads were determined to be calcite marble.

Figure 3. These 9-mm brownish yellow beads were also identified as calcite marble.

as well as higher specific gravity, and by its inert reaction to a drop of a room-temperature 10% HCl solution (calcite will effervesce). Care must be taken when testing with the HCl solution: Because this is a destructive test, it should only be performed under magnification, with a very small drop of the solution applied to an inconspicuous area of the material, such as in a drill hole. Also, magnesite *will* effervesce if the solution is warm. *RK*

Golden Yellow DANBURITE from Sri Lanka

The Los Angeles laboratory was asked to identify two yellow stones (weighing approximately 11 ct and 4 ct) that appeared to have been cut from the same piece of rough. Both showed the same high luster and golden yellow color, and resembled very fine yellow sapphire (figure 4). Testing, however, proved that the stones were not corundum, but rather were a much rarer gem mineral. The refractive indices were determined on a Duplex II refractometer to be 1.630 and 1.638. Using a glass ball with crossed polaroids in the polariscope, we resolved a biaxial optic figure. The specific gravity was estimated with the use of heavy liquids to be approximately 3.00. There was no reaction to ultraviolet radiation. When examined with a hand spectroscope, both stones showed a very faint, though distinct, absorption line at 585 nm (figure 5), which is probably evidence of a rare-earth absorption spectrum. On the basis of these properties, we identified the stones as danburite, a calcium borosilicate. Our client informed us that both stones had indeed been cut from the same piece of rough, which had been mined in Sri Lanka. We believe that this is the first report of gem-quality danburite from this locality. *KH*

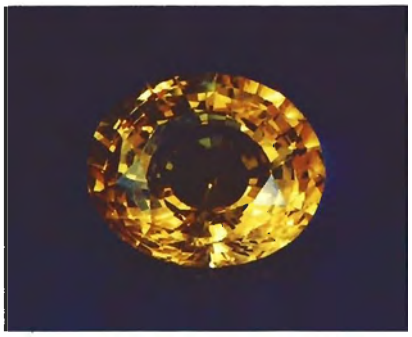


Figure 4. This beautiful yellow danburite (approximately 11 ct) reportedly was mined in Sri Lanka.

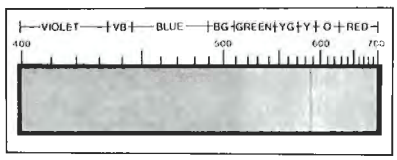


Figure 5. The 585-nm line in this absorption spectrum indicates the rare-earth elements present in yellow danburite.

DIAMOND Alphabet

Since the advent of lasers in diamond cutting, we have seen diamonds cut into shapes that were previously impossible—such as horse heads, four-leaf clovers, Christmas trees, and even a wedding band. Figure 6 shows yet another unusual item: a complete alphabet carved out of diamonds. Each letter is approximately 6.5 × 4.5 × 2.0 mm. *RC*

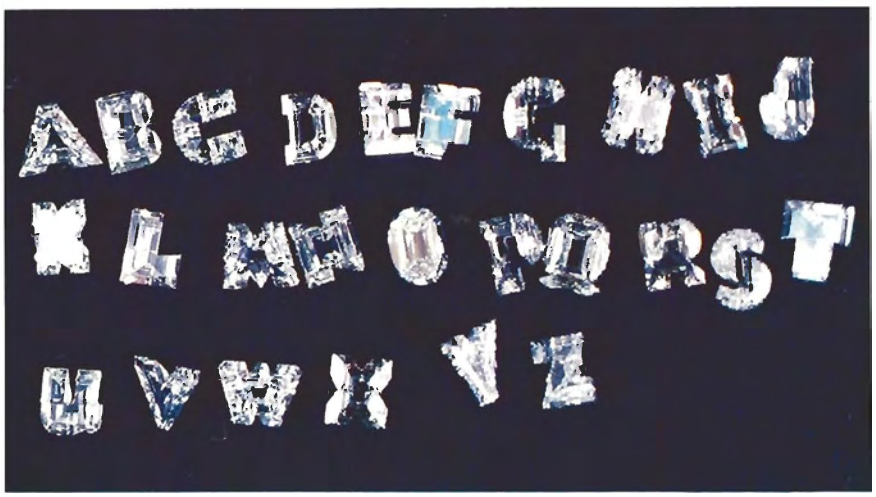


Figure 6. An alphabet cut by laser from diamonds. Each letter measures approximately 6.5 × 4.5 × 2.0 mm.

EKANITE, A Markedly Radioactive Metamict Gemstone

In 1953, a translucent green stone was found in a gem gravel pit in Sri Lanka by F. L. D. Ekanayake. It was subsequently identified as a new mineral, and later given the name ekanite. Since then, we have examined a few of these rare gemstones, the largest of which was a 41.7-ct square emerald cut (see *Gems & Gemology*, Summer 1962, p. 317, and Summer 1977, p. 295). During the past year, the Los Angeles laboratory has had the opportunity to identify three faceted ekanites (figures 7 and 8), each submitted by a different client. These rare gemstones ranged from 0.75 to 3.59 ct. The largest stone (figure 8) in this group was reportedly cut from an 80-ct piece of rough that yielded four

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

Figure 7. These 1.27-ct (left) and 0.75-ct (right) ekanites are reportedly from Sri Lanka. Note the haziness of these metamict gemstones.

Figure 8. This 3.59-ct ekanite, also said to have come from Sri Lanka, is unusually clean.

faceted stones ranging from 3.59 to 18.29 ct.

Ekanite [chemical formula (Th, U)$_2$(Ca, Fe, Pb)$_2$ Si$_8$ O$_{20}$] in a metamict form has only been reported from Sri Lanka. The term *metamict* is used to describe minerals that have become amorphous, or nearly so, as a result of atomic rearrangement (breakdown) caused by radioactive constituents (such as the thorium and uranium in ekanite). Extremely small samples of a yellow crystalline (that is, non-metamict) variety of ekanite have been recovered from a glacial syenitic boulder found in the Tombstone Mountains of the Yukon Territory in Canada.

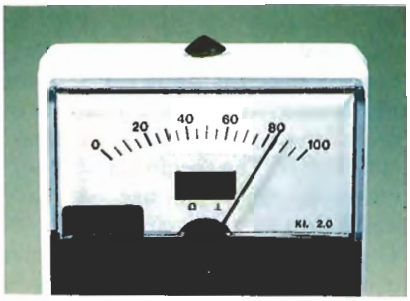


Figure 9. Note the radioactivity of the 3.59-ct ekanite as indicated by a Geiger counter.

The faceted metamict ekanites that we recently examined were light yellowish green, dark yellowish green, and dark greenish, yellowish brown in color. The refractive index was 1.593 for one of the ekanites, and 1.595 for the other two. All three stones were hazy as a result of inclusions and optical irregularities typical of metamict gemstones, such as are often observed in metamict green zircons, although this haziness was much more pronounced in the stones shown in figure 7. Specific-gravity values were estimated with heavy liquids to be approximately 3.30. The stones were inert to short- and long-wave ultraviolet radiation, except for several small orange spots on the large oval stone that were observed when it was exposed to long-wave U.V. With a hand-held spectroscope, a band at approximately 665.1 nm and a weaker one near 637.5 nm were observed in each of the three stones.

The relatively high content of the radioactive element thorium and lesser concentration of uranium causes ekanite to be strongly radioactive, which can be readily detected when the stone is tested with a Geiger counter (figure 9). Dramatic proof of radioactivity was also provided when one of the stones was placed on unexposed X-ray film for two days. The radiation from the stone was so strong that it exposed the film, in the same fashion as most radium-treated green diamonds will do. *RK*

EMERALD, with Iridescent Coating

A ring set with an approximately 2-ct transparent green rectangular step-cut stone, recently examined in the Los Angeles laboratory, revealed numerous inclusions that are typical of emeralds from Zambia. The absorption spectrum observed was also typical of emerald. Interestingly, though, when this stone was tested with a refractometer in conjunction with a monochromatic light source equivalent to sodium vapor, a reading of only 1.48 was obtained. This suggests that the emerald was tarnished, or coated with a substance that was causing the very low refractive index reading. Microscopic examination with reflected light showed an iridescent coating (figure 10) similar in appearance to what we have seen previously on aquamarine, natural emerald, and occasionally on some synthetic emerald (see *Gems & Gemology*, Spring 1984, p. 45).

Using an ordinary ink eraser, we removed a small portion of the coating on one edge of the table (again, see figure 10). We then took another refractive index reading on this area,

Figure 10. A refractive index of 1.48 was obtained on the coated area of this emerald, and indices of 1.579 and 1.588 were found on the cleaned area. Reflected light, magnified 50×.

which revealed indices of 1.579 and 1.588. These values are typical of Zambian emeralds. This is the first time that we have observed that an iridescent coating or "tarnish" on beryl has noticeably affected the refractive index readings. *RK*

GLASS Microbilles from Arizona

An Arizona gemologist found some unusual material while prospecting an alluvial deposit in a canyon near Nogales, Arizona. The material was collected by sweeping dust from the pockets and seams in the bedrock with a small paintbrush onto a plastic card pressed to fit the contour of the rock. A large number of tiny (0.3–0.5 mm) glass-like spheres (figure 11) were separated from the dust under magnification and subsequently sent to the Los Angeles laboratory for identification. Examination with a polarizing microscope revealed them to be strained glass. Most were spherical, although a few were slightly oval. A couple had small protruberances, so that they resembled a dumbbell.

These tiny glass spheres were identified as microbilles. They have also been found in South Africa and Western Australia, as well as in lunar soil samples (*Science News*, February 1, 1986). There are several theories regarding their formation. One states that they were originally formed during volcanic eruption. They are also known to occur in fly ash, a product of combustion. Another theory is that they are debris from meteorite impacts. Although it is not certain how the microbilles from Arizona were formed, it is possible that they may be related to the large meteor crater near Winslow.

John I. Koivula

Figure 11. These microbilles, or glass microspheres, were found in Arizona. Note that some are stained and others occur in color. Magnified 20×.

HORNBLENDE AMPHIBOLE, Magnesian Hastingsite (?)

The translucent variegated green hololith ring illustrated in figure 12 was submitted to the Los Angeles laboratory for identification. When the material was examined with the unaided eye, the very uneven polish and dull waxy luster suggested that it had a very low hardness. Because of the poor polish, no definite refractive index reading could be obtained. The specific gravity was estimated with

Figure 12. This ring is an amphibole, probably magnesian hastingsite in the hornblende series.

heavy liquids to be in the area of 2.90–2.95. Using a hand-held spectroscope, we observed no distinct lines or bands. The ring was inert to both long- and short-wave ultraviolet radiation. Using hardness points on an inconspicuous spot inside the ring, we estimated the hardness to be approximately 3–3½ on the Mohs scale.

Further testing was deemed necessary, so a minute amount of powder was scraped from inside the ring for X-ray diffraction analysis. The results indicated that the material was an amphibole that was neither tremolite nor actinolite; thus, the possibility of nephrite jade was ruled out. The X-ray diffraction pattern came closest to the magnesian hastingsite pattern in the hornblende series. Chemical analysis would be needed for a more precise identification. *RK*

LAPIS LAZULI IMITATION, Dyed Blue Quartzite

A few months ago, the Los Angeles laboratory examined a broken portion of a dyed blue quartzite bead (approximately 8 mm in diameter) that had been represented as lapis lazuli (figure 13). However, as shown in figure 14, the material is actually white with a blue dye penetration of approximately 1.5 mm. The gemological properties of this imitation,

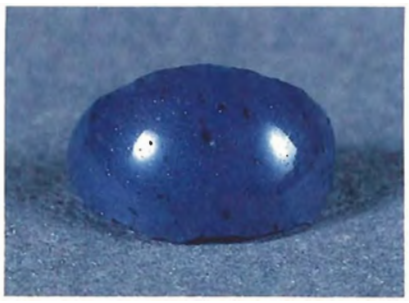


Figure 13. This quartzite bead (which measures approximately 8 mm) was dyed to imitate lapis lazuli.

Figure 14. This broken portion of the imitation lapis lazuli bead in figure 13 shows the dye penetration into the quartzite.

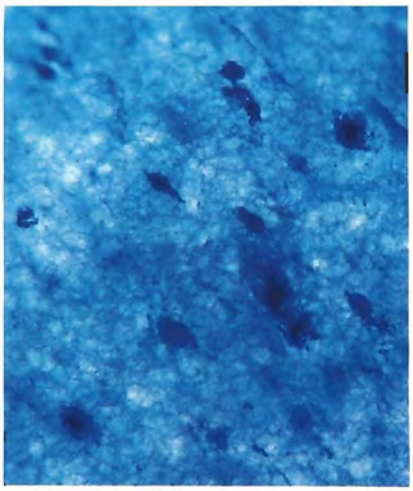


Figure 15. With 25× magnification, dye concentrations can be seen in the pits and fractures of the quartzite imitation of lapis lazuli.

TABLE 1. Gemological properties of dyed blue quartzite and natural-color lapis lazuli.

Property	Dyed blue quartzite[a]	Lapis lazuli
Transparency	Translucent to semi-translucent	Semitranslucent to opaque; shallow transparency (0.5 mm)
Color	Medium blue to violetish blue; coloration often even	Light to dark blue; even coloration to mottled with white calcite and yellow metallic pyrite
Refractive index	1.53 or 1.54[b]	1.50; may show 1.67 R.I. due to calcite or diopside inclusions, or both 1.50 and 1.67, or an R.I. between 1.50 and 1.67
Magnification	Dye concentrations in surface cavities and in fine intertwined network of small thin fractures	Nearly opaque white to transparent colorless calcite and "yellowish" metallic pyrite often present; pyrite has convolution outlines and is usually unevenly distributed; dark blue outline commonly seen around pyrite; may see dye concentrations if the material has been dyed
Fluorescence	Inert to LW and SW	Usually fluoresces moderate to strong chalky yellow, yellowish white to yellowish green (SW); calcite inclusions may fluoresce moderate to strong chalky white or chalky orange (LW)
Fracture	Dull to waxy, conchoidal; may appear granular to uneven under high magnification	Dull, granular to uneven
Acetone	No reaction	No reaction unless dyed
10% HCl acid solution	No reaction	Produces rotten egg odor; if calcite is present, may effervesce

[a]*Results listed are based on one sample.*
[b]*Spot refractive index readings.*

especially the higher refractive index, easily distinguish it from lapis lazuli (see table 1). With magnification, the dye concentrations are visible (figure 15). *RK*

Oolitic OPAL with Chalcedony Matrix

Recently submitted to the Los Angeles laboratory was a 62.56-ct translucent to opaque, variegated white-and-brown free-form polished slab with many areas that displayed a play of color; tiny dark brown circular spots confined to the areas displaying play of color were faintly discernible to the unaided eye (figure 16). In other areas, the variegated white-and-brown material occasionally exhibited a faint, agate-like banding. There was also a cavity lined with small, well-formed colorless quartz crystals. Examination with a microscope and oblique lighting confirmed that the small circular inclusions were the same as those characteristic of oolitic opal.

The variegated white-and-brown areas revealed a refractive index reading of approximately 1.54, which is much too high for opal but does fall within the range for chalcedony. The areas that showed a play of color had a refractive index of 1.45, which is typical of opal. This material was therefore identified as oolitic opal with chalcedony matrix. *RK*

PEARLS, with Unusual Drilling Features

We have on rare occasions identified natural pearls with "Chinese drill-

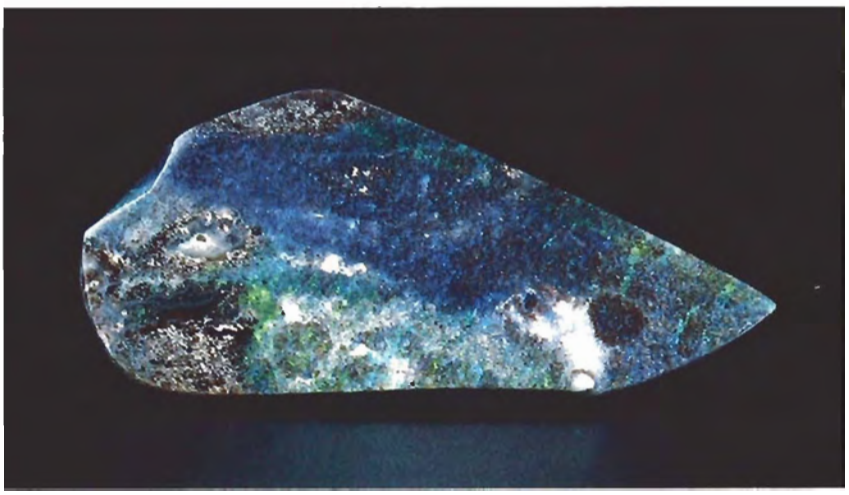


Figure 16. This polished slab was identified as oolitic opal with chalcedony matrix.

ing," a technique whereby two holes are drilled to meet within the pearl so that it can be sewn to a robe. Figure 17, taken in the New York laboratory, is the X-radiograph of a pearl that appeared to be drilled in this manner. Note the two drill holes and what appears to be the "crossover" where they meet. However, thread could not be passed through the holes and the client questioned the notation of "Chinese drilling." A subsequent X-ray (figure 18), taken from a different angle, shows that the two drill holes are actually parallel and that the apparent crossover is merely a dark-appearing center. Experienced pearl dealers we contacted indicated that they had never seen this style of drilling before. One drill hole has always been considered to be sufficient. This approximately 12-mm pearl was unusual for another reason: Although it appeared to be a typical, slightly dull, bone-white freshwater pearl, it did not fluoresce to X-rays as one would expect of a freshwater pearl.

In recent months, the New York laboratory also examined a pair of 20 × 13 mm half-drilled button pearls with suspiciously large drill holes (figure 19). The pearls were determined to be saltwater, mantle tissue–nucleated cultured pearls; however, the X-radiograph revealed that an attempt had been made to drill the bead repeatedly to eliminate evidence of tissue nucleation (figure 20). Although the pearls were of saltwater origin, the laboratory is

Figure 17. This X-radiograph of a 12-mm pearl shows what appear to be two drill holes angled to meet.

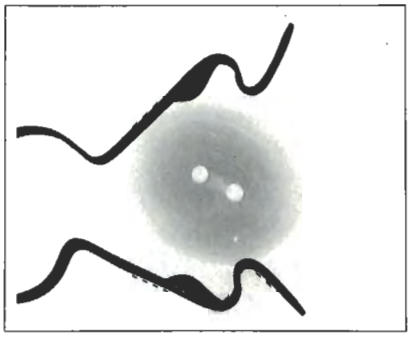


Figure 18. A second X-radiograph of the pearl shown in figure 17, taken from a different angle, shows that the drill holes are actually parallel and do not meet.

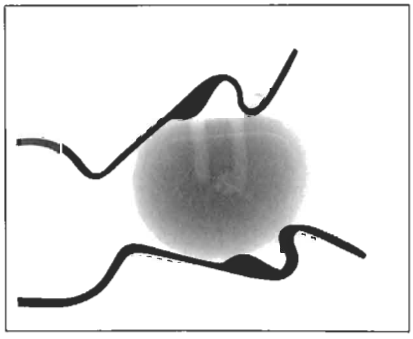


Figure 19. Note the large drill hole in this saltwater mantle tissue–nucleated cultured pearl.

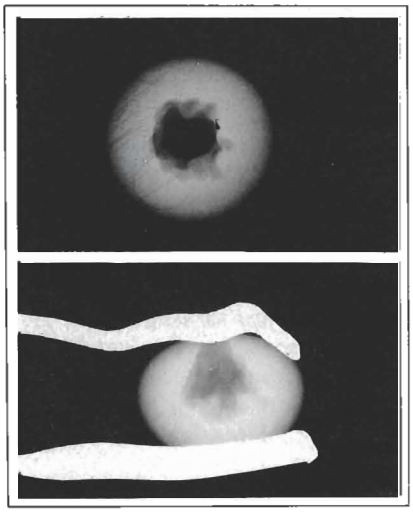


Figure 20. These X-radiographs show efforts to drill out the nuclei of the pearls shown in figure 19.

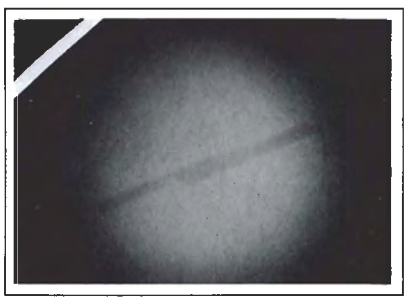
Figure 21. The dyed cultured pearls in this strand have predrilled nuclei.

unaware of any commercial ventures using mantle-tissue nucleation to culture pearls in a saltwater environment.

Not a problem, but of considerable interest to the New York laboratory, was an undrilled light orange pearl that measured over 17 mm in diameter. We were surprised to find that it was a freshwater cultured pearl with a predrilled bead nucleus. Although the use of predrilled nuclei was mentioned in *Gems & Gemology* as long ago as the Spring 1962 issue, the resulting pearls have usually been a disappointment because of color problems. Figure 21 shows a handsome necklace of these pearls which have been dyed a uniform light orangy brown. Sapphire and diamond rondelles separate the pearls in the necklace. Mr. Fred Ward, writing in the August 1985 issue of *National Geographic*, states that one enterprising pearl farmer in Japan is growing both tissue-nucleated and predrilled bead–nucleated pearls, the largest of which to date has been 17 mm. Freshwater mussels cannot be opened for nucleus insertion as wide as the saltwater "akoya" mollusk. To compensate, the nuclei are predrilled (figure 22) so that they can be maneuvered into position with a tool that resembles a toothpick rather than the traditional "spatula."

RC

Figure 22. This X-radiograph shows the predrilled nucleus of one of the pearls in figure 21.



SAPPHIRE, Pinkish Orange ("Padparadscha")

Attracting a great deal of attention during the February 1983 Tucson Gem & Mineral Show was the 1,126-ct pinkish orange sapphire crystal from Sri Lanka shown in figure 23. The firm displaying the crystal expected it to yield a cut stone weighing at least 200 ct. This unusual crystal was illustrated and discussed in the article "Padparadscha: What's in a Name?" by Robert Crowningshield (see *Gems & Gemology*, Spring 1983). Discussed in this article was the term *padparadscha* and the fact that the precise hue represented by this term is often a subject of controversy and discussion. Most of the gem dealers who saw this spectacular crystal agreed that the color was aptly referred to as padparadscha. Because of the subjectivity of the term, however, GIA Gem Trade Laboratory, Inc., does not use it on the GTL identification reports, treating it in the same manner as the trade grades "Burma ruby," "Kashmir sapphire," and "Siberian amethyst." Although this crystal was remarkable and many felt that it should be kept intact as a mineral specimen, everyone was curious as to what color of faceted gems it would yield, since it seemed inevitable that the crystal was going to be cut.

The crystal was indeed subsequently sold and cut. Because much of the crystal proved to be opaque, or too heavily included to facet, only four stones were reportedly fashioned from the 1,126-ct piece of rough. Three of these stones (16.92 ct, 23.55 ct, and 47.00 ct) were recently examined in the Los Angeles laboratory (figure 24). The fourth stone, which weighed just over 4 ct, was recently shown to the writer by Dr. E. Gübelin; it was similar in color to the 47.00-ct stone pictured here.

The 16.92-ct stone had been heat treated in an attempt to improve the appearance by reducing the dense concentration of intersecting stringers of minute particles (presumably rutile) that were oriented in planes throughout all three stones. This stone was reportedly treated in Sri Lanka using four blow pipes, in contrast to the furnaces that are usually used to heat treat sapphire. Although the treatment did improve the transparency of the stone, it also produced an unnatural-appearing intense orange color. However, the flu-

Figure 23. A 1,126-ct pinkish orange sapphire crystal from Sri Lanka.

Figure 24. The crystal shown in figure 23 yielded these 23.55-ct, 47.00-ct, and 16.92-ct cut stones. The stone on the far right has been heat treated.

orescence and absorption spectrum of this stone were quite different from those typically observed in heat-treated sapphires of this color. This stone showed a strong slightly reddish orange (tangerine color) when exposed to long-wave ultraviolet radiation and the same color, but weaker, with short-wave ultraviolet radiation. Most heat-treated yellow-to-orange sapphires show either a weak reaction or are inert. Interestingly, the other two untreated stones exhibited the same general color of fluorescence of a slightly greater intensity. The difference in fluorescence between this heat-treated sapphire and most others of this color may be because the original material is usually very light yellow to "milky white" and lacks the amount of chromium that causes the fluorescence in naturally colored yellow to orange sapphires. All three stones faceted from the pinkish orange crystal also exhibited absorption lines in the red portion of the visible spectrum, which are attributed to chromium. Again, yellow-to-orange heat-treated sapphires generally do not show chromium absorption due to the nature of the starting material. *RK*

YTTRIUM ALUMINUM GALLIUM GARNET

Several years ago, a new man-made product appeared that has occasionally been referred to as "synthetic tsavorite." Recently, the Los Angeles laboratory had the opportunity to examine a few samples of this material. At first glance, the round-brilliant-cut stones, each weighing approximately 1 ct, resembled in color and luster deep green vanadium grossularite, which is known in the trade as tsavorite. However, examination with the microscope revealed prominent reddish brown flux-melt inclusions and fine unmelted flux in wispy veils, which proved that the stones were of synthetic origin. The refractive index was determined to be 1.885, singly refractive, on a cubic zirconia refractometer. This figure is considerably higher than the range for tsavorite. The absorption spectrum showed a broad band at 570–620 nm and also distinct lines at 660, 670, and 690 nm, an absorption pattern that is similar to green "YAG." All sample stones transmitted red and showed red fluorescence, which was stronger to long-wave than to short-wave radiation. Using the hydrostatic method, we determined the specific gravity to be 5.05. On the basis of these properties, we concluded that the stones were another man-made product with a garnet structure, grown by a flux-melt method. A nonquantitative X-ray fluorescence analysis showed the major constituents to be yttrium, gallium, and lesser amounts of aluminum, chromium, and nickel, thus identifying the product as "yttrium aluminum gallium garnet." This type of synthetic is also grown by the Czochralski pulling technique. *KH*

FIGURE CREDITS

Dave Hargett supplied the photos used in figures 1, 6, and 19. Shane McClure furnished figures 2–4, 7–9, 12–14, 16, and 24. Karin Hurwit prepared figure 5. Bob Kane produced figures 10 and 15. John Koivula took figure 11. Robert Crowningshield did the X-radiographs for figures 17, 18, 20, and 22, and Richard Cardenas took figure 21. Figure 23 is © Tino Hammid.