# Gem Trade LAB NOTES

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## DIAMOND

### "Chameleon" Diamond

Perhaps the most striking color change of a diamond is in the so-called chameleon. These diamonds were discussed, but not illustrated, in the Winter 1981 issue of *Gems & Gemology.* It was noted at that time that these stones glow red while hot from being on the wheel, then on cooling appear to be fancy yellow before changing on exposure to light to the dull yellow or gray-green usually associated with chameleon diamonds.

Figure 1 shows a particularly attractive dark yellow-green emerald-cut diamond seen recently in the New York lab. The stone displayed strong yellow fluorescence and phosphorescence. Also observed were a weak pair of absorption lines at approximately 4155 Å and 4190 Å in the spectroscope. Figure 2 shows the same stone while it is still warm from an alcohol flame. In this phase, it would be considered a fancy, intense orange-yellow. Unfortunately, few future owners will ever see this color, as the diamond returned in seconds to its "normal" green as soon as it was exposed to light.

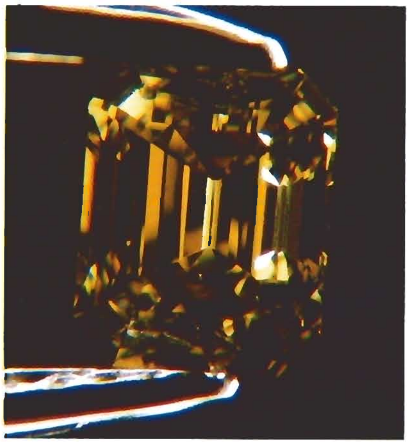

*Figure 1. Normal color of this 2.5-ct "chameleon" diamond.*

*Figure 2. The stone shown in figure 1 after heating and before exposure to light.*

### Crusader Diamond

What's new in diamond cutting? In New York, we had the opportunity to examine a seven-sided modified brilliant resembling a crusader's shield, complete with a white cross engraved on the table (figure 3). It appeared at first that the table was originally mechanically "frosted," then repolished with four shallow facets designed to leave the cross as shown. However, the mechanical etch marks are at right angles to the two cross members, which suggests that the "frosting" may have been done later.

*Figure 3. Shield-shaped diamond with cross on the table. Magnified 10×.*

### Diamond Oddities

Only rarely have we seen needle-like inclusions in diamonds, and even more rarely have we seen them in patches resembling those found in natural corundum. Figure 4 shows two long rows of needles as viewed through the crown of a round brilliant that came into the New York lab. When viewed from the pavilion, the needles take on a more scattered appearance, with brilliantly reflected spots along some of them.

A naturally yellow fancy diamond that also came into the New York laboratory for a complete quality analysis was puzzling to the graders because of what appeared to be the blackish outlines of all the

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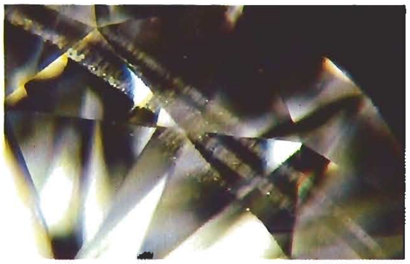


Figure 4. Needle-like inclusions in diamond. Magnified 30×.

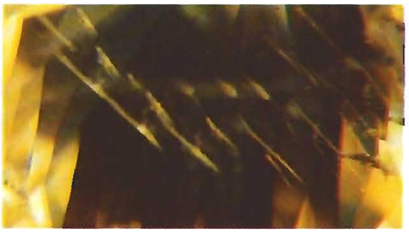


Figure 5. Unusual facet-edge appearance in yellow diamond. Magnified 20×.

Figure 7. Natural 6-ct emerald from Zambia.

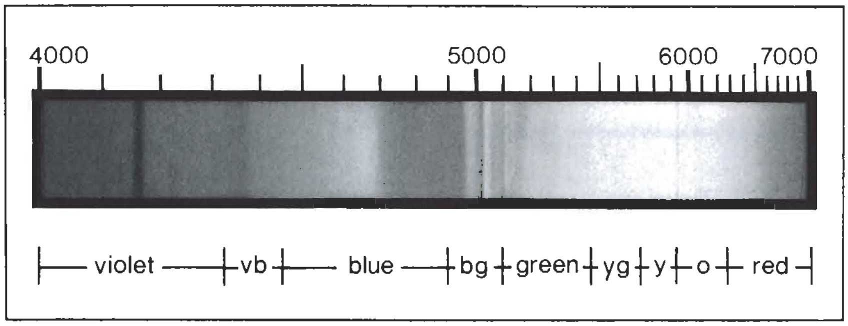
pavilion facets (figure 5). The best explanation we had for the appearance was that the pavilion had been lightly burned. With the dark yellow as contrast, the nonburned areas appeared blackish. It was odd that the effect was confined to the pavilion; one possible explanation is that the stone had been lightly burned all over and repolished only on the crown.

### Unusual Absorption Spectrum

The spectroscope is invaluable in determining the origin of color in most colored diamonds. This determination is usually routine, and we see new or unexpected absorption spectra only infrequently. Recently, however, a bright yellow marquise-shaped diamond weighing approximately 1.38 ct was sent to the Los Angeles laboratory. This stone exhibited an absorption spectrum almost identical to that described for bright yellow diamonds of natural color on page 210 of the 11th edition of the *Handbook of Gem Identification,* by Richard T. Liddicoat, Jr. Upon careful examination of the spectrum, however, a very faint line was noted at 5920 Å, which proved that the stone had been treated (see figure 6). Even when the diamond was cooled with an aerosol refrigerant gas, which often aids greatly in observing absorption spectra, the 5920 Å line was difficult to see.

This stone exemplifies the fact that care must be taken when examining the absorption spectra of diamonds. If a stone like this one were hastily examined, a gemologist might miss the very faint 5920 Å line and therefore misinterpret the spectrum as being that of a natural yellow diamond. Note also that the long-wave ultraviolet fluorescence was a strong yellow, rather than the expected yellow-green.

Figure 6. Absorption spectrum of treated bright yellow diamond.



## EMERALD

Figure 7 illustrates a nearly flawless 6-ct Zambian emerald that recently came into the New York lab. When examined with a hand spectroscope, the stone showed a distinct line at 4270 Å. This absorption line has heretofore been reported as being present in some natural emeralds of unknown origin (Kane, *Gems & Gemology,* Winter 1980–81) and in some Pakistan stones (Gübelin, *Gems & Gemology,* Fall 1982), as well as in iron-rich Gilson synthetic emeralds. The identifying features of this Zambian stone are its nearly inert reaction to ultraviolet radiation and its high refractive indices (1.585–1.592). Other stones from the same lot, but with inclusions, had similar properties.

### PARISITE

A client submitted two earthy-looking hexagonal crystal fragments to the New York laboratory with the comment that they were very rare gems. The crystals resembled brown corundum with a highly developed basal parting, or cleavage. We accepted them for identification only after determining that one had a natural face that appeared to be smooth and lustrous enough to allow a refractive index reading.

The test for refractive index was inconclusive, though the stone appeared to be strongly birefringent, with readings of approximately 1.67–1.77. This suggested the possibility that the material might be a carbonate. The hardness was approximately 4½ on the Mohs scale. Specific gravity was 4.18. When we observed the crystals with a hand spectroscope, we were amazed to see many bands of the spectrum that would be associated with a rare-earth element.

One of the many possibilities we considered on the basis of these properties was siderite, an iron carbonate, but our samples of siderite are semitransparent, greenish yellow-brown cleavages, with a different absorption spectrum (figure 8) and refractive indices of approximately 1.63 to above the scale (actually, 1.873).

Before we were able to complete our tests, however, our client returned for her stones and told us they were parisite crystals that she had collected herself at the Muzo mine in Colombia. She said she just wanted to know if we could recognize a "gem" when we see one. With a hardness of only 4½, basal cleavage, and a nondescript color and appearance, parisite seems a poor candidate for adding to the list of gemstones, though her crystals (one weighed in excess of 5 ct) are indeed rare.

Gemologists are acquainted with parisite (named for J. I. Paris, first lessee of the Muzo mine after Colombia gained its independence in 1819) as a yellowish, blade-like inclusion in Muzo emeralds. In fact, their presence in an emerald is considered proof that the stone came from the Muzo mine. Parisite is a fluocarbonate of the cerium metals (cerium, lanthanum, and the pair praseodymium and neodymium [usually called didymium]) that are collectively known as rare-earth elements. It is, therefore, not surprising to see that parisite has a rare-earth spectrum. Robert Webster mentions seeing an emerald with a rare-earth spectrum that was later found to be due to the numerous parisite inclusions in the stone. Note, however, that the spectrum shown here in figure 9 is somewhat different from the one shown in the Spring 1973 issue of *Gems & Gemology,* which was of a lighter-colored parisite inclusion in emerald.

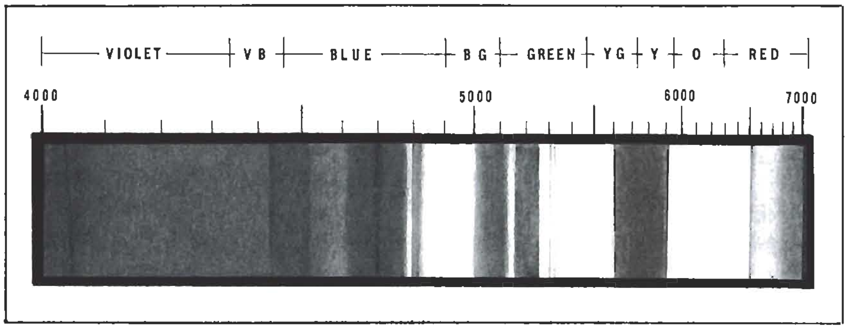
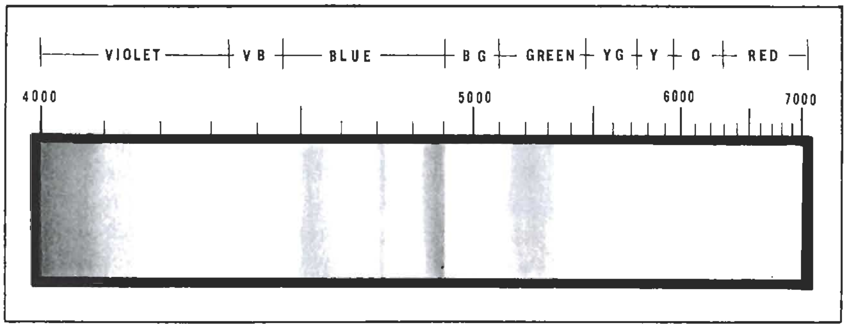


*Figure 8. Absorption spectrum for siderite.*

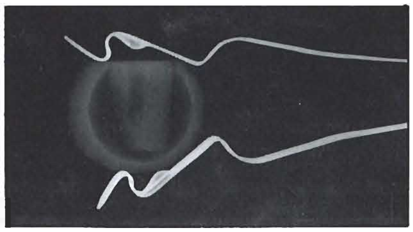
*Figure 9. Absorption spectrum for parisite.*



### PEARLS, Plugged Natural Blister

Since preparing the entry on cultured ¾ blister pearls for the Spring 1982 issue of *Gems & Gemology,*

*Figure 10. X-ray showing plug in a blister pearl. Actual size.*



we at the New York lab have been more conscious of blister pearls than before. The X-radiograph of a large "pearl" in figure 10 shows that it is actually a natural blister pearl that has been plugged. The plug provides the material for the drill hole and the peg used to secure the pearl to its mounting.

### Star QUARTZ

The 11.77-ct translucent, white, asteriated, oval double cabochon shown in figure 11 was recently brought to the Los Angeles laboratory for identification. When the stone was examined in a polariscope, a "bulls-eye" uniaxial interference figure was obtained, thus proving it to be quartz.

The phenomenon of asterism in quartz was discussed in some detail in the Winter 1981 issue of *Gems & Gemology,* on page 230. The unusual feature about this stone, reportedly from Sri Lanka, was the fact that the rutile needles that evoked the asterism were relatively large, and were even visible to the unaided eye. When examined with the microscope, the rutile needles were strikingly enhanced by interference colors that changed as the stone was moved (see figure 12). The iridescence produced by the interference of light with the rutile needles was easily visible to the unaided eye as the stone was rotated under a single light source.

### SAPPHIRE, Heat Treated

A natural sapphire of unusual color came into the New York lab for identification. The brilliant orange-yellow seemed unnatural, and the lack of fluorescence and absence of an iron line in the absorption spectrum strongly suggested a heat-treated stone. The clincher, however, was an unpolished burned area near the multiplane girdle (figure 13).

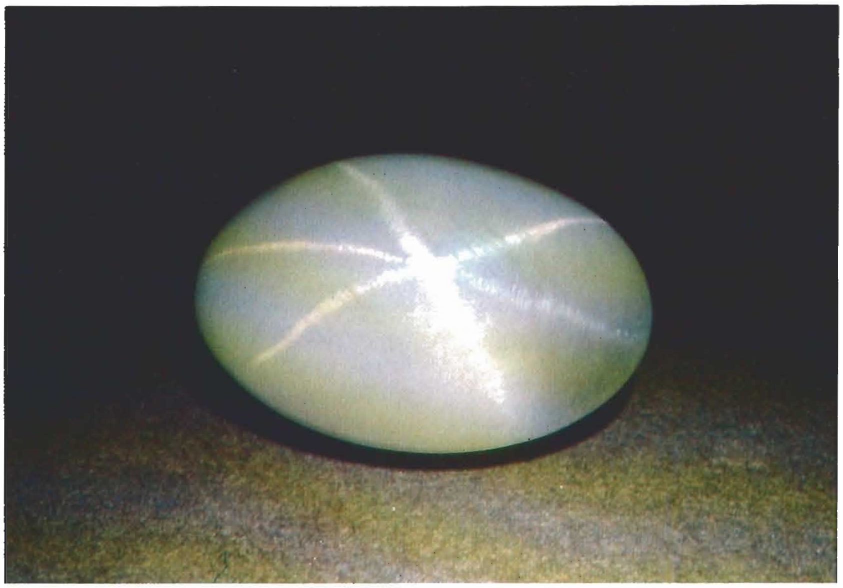


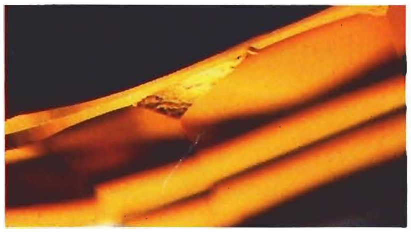
*Figure 11. Star quartz, 11.77 ct.*

*Figure 12. Rutile needles in the star quartz cabochon shown in figure 12. Magnified 30×.*

Figure 14 shows yet another example of incomplete repolishing of a heat-treated orangy yellow natural sapphire. It came from a lot of six stones, all of which clearly owed their color to heat treatment.

One yellow sapphire from another lot of four stones recently seen in New York faded appreciably after exposure to south daylight for a day or so. Normally, we would assume that the color was due to irradiation and not to heat, but we recently heard that certain heat-treated yellow natural sapphires may fade (*Gems & Gemology,* Spring 1982, pp. 47 and 48). This has not yet been confirmed.

*Figure 13. The unpolished burn area near the girdle of this yellow sapphire reveals heat treatment.*



### SPINEL AND SAPPHIRE, Colored by Cobalt (?)

One of the most unusual coincidences to occur in the New York

*Figure 14. Partly polished facet of a yellow heat-treated sapphire. Magnified 10×.*

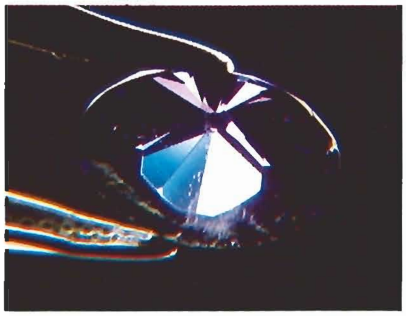


*Figure 15. Red flashes in a dark blue spinel, 2.56 ct. Magnified 10×.*

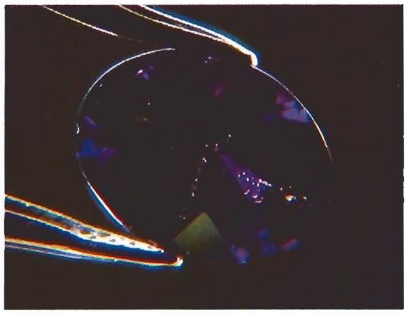


*Figure 16. Rain-like inclusion in the spinel shown in figure 15. Magnified 10×.*

laboratory in recent years was the receipt in one week of identification requests for two natural-appearing blue gemstones that seemed to be colored by cobalt. All gemologists have been taught that cobalt-colored blue stones do not occur in nature. It was therefore a distinct surprise to test a dark blue oval stone that exhibited red flashes (figure 15) similar to those seen in synthetic blue spinel. The presence of included crystals and fingerprint inclusions suggested natural origin. However, the unnatural-appearing "rain" inclusions (figure 16), normally associated with flux-grown materials, puzzled us. The refractive index of 1.715 was normal for natural spinel. The stone appeared red under the color filter. In addition to the cobalt spectrum associated with synthetic spinel, the absorption spectrum showed a weak iron line at approximately 4500 Å (figure 17).

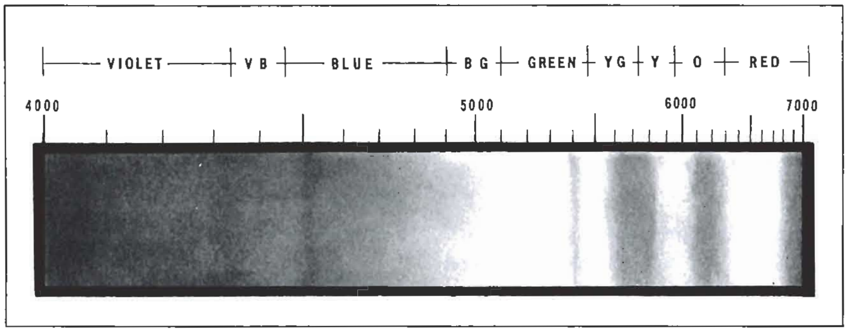
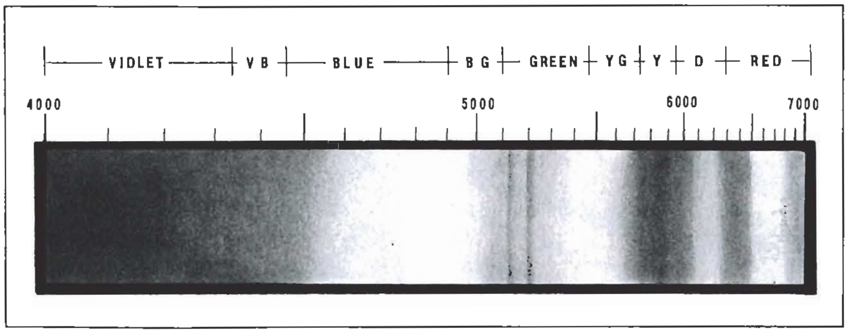


*Figure 17. Cobalt-like absorption spectrum in spinel.*

*Figure 18. Unusual spectrum observed in a sapphire.*



A search of the literature turned up only one report of stones that fit this description. In an article in the July 1977 issue of the *Journal of Gemmology*, R. Keith Mitchell describes three such spinels with these characteristics. In view of advances in the flux growth of synthetic crystals and in the heat diffusion of surface color in corundum, it would be hasty to conclude that these "new" blue spinels are in truth natural. The stone we had in the laboratory, with both crystals and "rain-like" (flux?) inclusions, is suspicious. However, the only flux-grown cobalt-colored blue synthetic spinels we have seen, which were kindly furnished by Dr. Kurt Nassau, had no inclusions and the surfaces of the octahedra were crazed, which suggests difficulty in manufacturing. There was really no comparison to be made other than color, red flashes, refractive index, and color filter reaction. We did not detect iron in the absorption spectrum of the flux-grown synthetic spinels provided by Dr. Nassau.

Later that same week another client asked if we could identify a purple-blue stone in an Edwardian ring while his customer waited. This stone was clearly an unusual, but natural, purple-blue sapphire. The stone appeared red under the color filter and showed red flashes under a direct incandescent light. The absorption spectrum (figure 18) was unlike any we had seen before in natural sapphire. It resembles the absorption spectrum of cobalt-colored synthetic blue spinel; the only differences are that the two long-wave bands toward the red end are approximately 200 Å higher in the spectrum of this sapphire, and the shorter wave-length band toward the blue end becomes two bands offset 200 Å toward the shorter wave-length end of the spectrum.

The fact that surface diffusion of titanium and iron as well as chromium has been successfully used to impart a "synthetic" color to natural corundum makes it a matter of conjecture as to the possibility that cobalt could be used for the same purpose. Possibly, cobalt may diffuse much more readily than the other elements so that more than just surface coloration would be the result. We must emphasize, however, that we have not encountered any report of such cobalt diffusion, so this is merely conjecture at this time.

## Star SPINEL

The New York lab also received for identification a very "clean" gray-purple six-ray star spinel (figure 19). The asterism was exceptionally sharp but showed the alternating six- and four-ray stars expected of asteriated spinel in different orientations (figure 20).

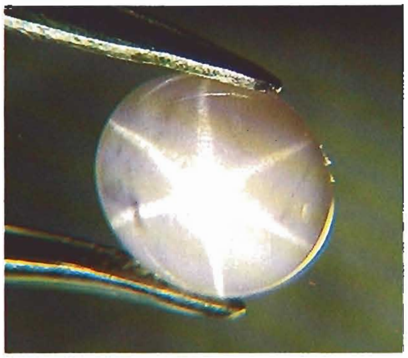


*Figure 19. A 1.83-ct star spinel showing six rays.*

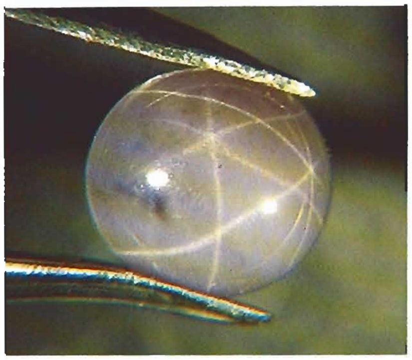


*Figure 20. Four- and six-ray stars visible in the star spinel shown in figure 19.*

## UNCLASSIFIED ODDITIES

The Gem Trade Laboratory in Santa Monica was recently asked to issue identification reports on two rather interesting man-made items. The first was a singly refractive, transparent, green, rectangular piece of rough material that had one of the most intricate internal patterns we have yet encountered. The pattern, as can be seen in figure 21, showed the isometric nature of the host. The refractive index was 1.39, and the specific gravity was approximately 2.64. The material, which showed perfect cleavage in two directions, fluoresced a very strong yellow to long-wave ultraviolet radiation and a strong greenish yellow to short-wave ultraviolet radiation. X-ray diffraction proved the material to be lithium fluoride, a slightly water-soluble chemical compound. There is no known natural counterpart.

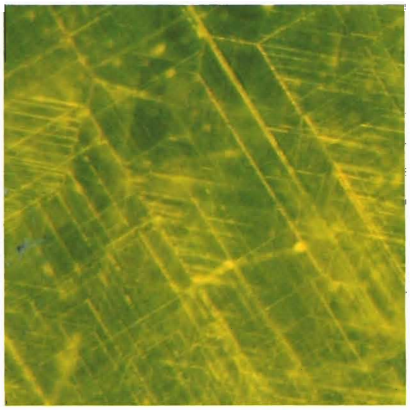


*Figure 21. Isometric inclusion pattern seen in lithium fluoride. Magnified 25×.*

The second item was a singly refractive, transparent, purplish blue, triangular piece of rough material that had no distinctive internal patterning. X-ray diffraction and chemical analysis by the electron microprobe proved the material to be potassium chloride, a highly water-soluble substance. Because of the poor surface on the material, only a hazy refractive index was seen at approximately 1.49. There was no reaction to ultraviolet radiation. Potassium chloride does occur in nature as the mineral sylvite.

*ACKNOWLEDGMENTS*

*Andrew Quinlan from New York supplied figures 1, 2, 3, 4, 5, 13, 14, 15, 16, 19, and 20. Peter Johnston drew the absorption spectrum in figure 6. Shane McClure provided figure 11. Figure 7 was supplied by Tino Hammid. John Koivula is responsible for figure 21. Bob Crowningshield prepared figures 8, 9, 10, 17, and 18. Bob Kane took the photo in figure 12.*