
GEMOLOGICAL ABSTRACTS

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COLORED STONES AND ORGANIC MATERIALS

Bowesite—a new lapidary material from Australia.
S. M. B. Kelly, *Australian Gemmologist*, Vol. 16, No. 1, 1986, pp. 5–8.

The author reports on a new ornamental gemstone found near the town of Cracow in Queensland, Australia. Dubbed "bowesite," the material contains widely varying amounts of diopside, epidote, grossularite garnet, actinolite, andesine feldspar, quartz, sphene, calcite, and an iron oxide (probably magnetite).

The gemological properties of "bowesite" are as follows: color = green, from light to very dark (almost

black), occasionally streaked or mottled with green and white; luster = vitreous on polished surfaces, dull to subvitreous on rough surfaces; diaphaneity = opaque; fracture = uneven to hackly; cleavage = none; refractive index = 1.57; specific gravity = 2.78–3.10, the higher values for darker-colored material; spectra, pleochroism, and fluorescence to ultraviolet radiation = none.

This material is currently being used for carving.
RCK

Emeralds. H. de Santana, *City & Country Home*, Vol. 5, No. 3, 1985 pp. 112–122.

Aimed primarily at more knowledgeable consumers, this article is meant to be a "primer" on emeralds. It flows through emerald folklore, history, and gemology, and concludes with a few cautionary tips on how and where to buy emeralds and what to look out for in emerald fakes, treatments, and synthetics.

Although most of the information should be familiar to the jeweler/gemologist, de Santana does present several interesting nuggets. For example, he reveals how the Spanish traded their glut of newly discovered Colombian emeralds to the Moghul princes of India, who were eventually robbed of their treasures by the Persians. In this way, many spectacular Colombian emeralds were incorporated into the crown jewels of Iran and the coffers of other Middle Eastern countries.

This section is designed to provide as complete a record as practical of the recent literature on gems and gemology. Articles are selected for abstracting solely at the discretion of the section editor and her reviewers, and space limitations may require that we include only those articles that will be of greatest interest to our readership.

Inquiries for reprints of articles abstracted must be addressed to the author or publisher of the original material.

The reviewer of each article is identified by his or her initials at the end of each abstract. Guest reviewers are identified by their full names.

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Color photos of magnificent emerald crystals and jewelry accompany the text. SAT

Les gemmes en lumière (Gems in light). C. da Cunha and A. da Cunha, *Monde et Minéraux*, No. 73, 1986, pp. 27–29.

In this second in a series of articles that uses diverse specific examples to educate about gemology, the authors discuss three stones: a color-change sapphire, a sinhalite mistaken for a zircon, and, most interestingly, a blue sapphire from Ceylon that contains a new type of inclusion. When viewed with $40\times$ magnification, the inclusion resembles the pattern seen in nylon hosiery (with one run!). This striking new feature is illustrated by a color photograph. Although this is the only stone in which the authors have seen such a pattern, they speculate that this may be a characteristic inclusion of a natural stone. EF

Irradiated gems: why the color comes and goes. K. Nassau, *Jewelers' Circular-Keystone*, Vol. 157, No. 7, 1986, pp. 294–299.

In this article, Dr. Nassau clarifies how the irradiation process relates to color changes in certain gemstones. The reason behind these color changes is color centers, a concept that Dr. Nassau simplifies well for the reader. Because color centers vary in strength from one material to another, irradiation-produced color is stable in some gemstones and not stable in others. The author then explains how different types of irradiation produce different results. The two major irradiation processes are discussed, with disadvantages and advantages of each process.

The first process uses either X-rays or gamma rays. Gamma-ray facilities produce uniform coloration without generating any significant heat or other hazard, such as radioactivity. X-rays behave much like gamma rays, but they produce color less uniformly and more slowly. The second major process involves high-energy electrons or neutrons. High-energy electrons are produced in linear accelerators by means of a process that consumes considerable electricity and can produce intense localized heating. Flowing cold water is needed to keep the gemstones from melting. Neutrons in a nuclear reactor produce uniform color without localized heating. Both electrons and neutrons can induce radioactivity, so gemstones may need to "cool off."

The author also explains how to tell whether a color produced by irradiation is stable or will fade. A section on the materials that are commonly irradiated is included, along with a convenient table summarizing the treatments and their stability. The article is well written and easy to understand. David C. LeRose

Isomorpher Einbau von Eisen und Titan zur Erklärung der blauen Farbe von Rutil- und Spinell-haltigen seidig weissen Korunden nach einer Wärm-

ebehandlung (Solid solution of iron and titanium for explaining the blue colour of rutile- and spinel-containing silky-milky corundum after heat treatment.) H. Harder and A. Schneider, *Neues Jahrbuch für Mineralogie Monatshefte*, No. 5, 1986, pp. 209–218.

The treatment of gemstones, especially corundum, has become a growing concern to the trade in recent years. The authors report that heat treatment to produce blue sapphires is usually undertaken on nontransparent, heavily included grayish corundum from Sri Lanka. The blue color appears during heating, along with a striking improvement in transparency. However, clear sapphires seem to lose their color by the same process. This is related to dissolution of rutile needles in the corundum matrix at temperatures above 1550°C .

The origin of the blue color in natural sapphires has previously been attributed primarily to intervalence charge transfer between Fe^{2+} and Fe^{3+} , although we know that the blue in synthetic sapphires is due mainly to $\text{Fe}^{3+}-\text{Ti}^{4+}$ charge transfer. To understand the origin of the heat-induced color, the authors investigated iron-bearing inclusions in a sapphire from Sri Lanka with an electron microprobe. Rutile needles were observed which were found to contain up to 30% iron in both valence states. An Fe- and Mn-rich phase, probably spinel, was also found. The corundum contains 0.1% FeO and 0.005% TiO_2 .

After a 30-minute treatment at 1600°C , the corundum was found to contain about the same percentage of iron oxide but 0.17% TiO_2 , a 30-fold increase. Titanium in lower concentrations was found in the vicinity of former rutile inclusions. This clearly demonstrates that rutile inclusions are dissolved and titanium diffused away during the heating process. Iron appears to be mobile as well, but it reappears in the form of other types of inclusions (such as magnetite) on cooling, and does not remain diluted in the corundum host. The magnesium is not mobile.

Unfortunately, an optical absorption spectrum is not available. However, it is hypothesized that the increase in available diluted titanium after heat treatment is responsible for the blue coloration. Therefore, this is an example of a $\text{Fe}^{2+}-\text{Ti}^{4+}$ charge transfer. EF

On the origin of blue sapphire from Elahera, Sri Lanka.

G. Heilmann and U. Henn, *Australian Gemmologist*, Vol. 16, No. 1, 1986, pp. 2–4.

In this report on light blue sapphire found near Elahera in the Central Province of Sri Lanka, the authors describe the geology of Sri Lanka and the Elahera area specifically, and then present chemical data from electron microprobe analyses of the samples studied. These data show color-causing iron and titanium contents comparable to those of sapphires from other Sri Lankan sources.

Examination of the sapphires with a microscope

revealed the following: feathers consisting of elongated liquid-filled and two-phase inclusions, oriented rutile needles, rounded zircon crystals with pleochroic halos, prismatic apatite crystals, and platelets of biotite mica that show areas of severe corrosion. Based on the nature of the mica inclusions, the authors conclude that the sapphires originated from garnet-bearing gneisses that form the ridges bordering the gem pits. *RCK*

Possibilities and limitations in radiographic determination of pearls. I. Lorenz and K. Schmetzer, *Journal of Gemmology*, Vol. 20, No. 2, 1986, pp. 114–123.

In the introduction, the authors briefly cover the investigations of other authors who have previously worked on the different methods of identification of pearls, fresh- or saltwater, natural or cultured. An outline of the experimental details used in this project is then given, including a list of the number of necklaces or individual pearls the authors tested and the testing parameters for each different method.

Results of the X-radiographs, X-ray diffraction (Laué) patterns, and X-ray luminescence are discussed and combined in capsule form in a table. However, there appears to be an error in the table, where the authors state that there is a radio-opaque bead in the center of bead-nucleated cultured pearls. Beads used for nuclei are usually made out of freshwater shell, which is translucent to X-rays, not opaque. While the beads are not as transparent to X-rays as conchiolin is, they are far from opaque, and are actually very slightly less transparent to X-rays than is saltwater nacre.

In their discussion of the various X-ray testing methods, the authors point out what they feel are the advantages and disadvantages of each test. They conclude by giving a schematic diagram which proposes a plan to determine the identity of a pearl of unknown origin. *C. W. Fryer*

Rare among rare. J. C. Zeitner, *Lapidary Journal*, Vol. 39, No. 12, 1986, pp. 26–34.

This article capsulizes the properties, history, and some interesting facts about the more unusual gems of Asia. The author has classified these gems as rare using as her criterion the fact that only a few specimens are known (such as painite), or that the material is a rare variety of a more common species (such as imperial jadeite). Not only does the author discuss gems that have been used for centuries (despite their rarity), such as cat's-eye chrysoberyl and "padparadscha" sapphire, but she also describes the more recent discoveries of painite and taaffeite. Included in the article is a spectacular multi-star variety of quartz found in Sri Lanka—as many as 16 stars have been observed on one gem. Another stone discovered in Sri Lanka, cat's-eye zircon, has an unusual chatoyant eye caused not by rutile but by tightly packed bands of mineral flakes, which are visible under magnifi-

cation. Other gems mentioned in this article include kornepurine, sinhalite, manganotantalite, alexandrite, sapphirine, demantoid, cassiterite, iolite, and triphane spodumene. *David C. LeRose*

DIAMONDS

Famous diamonds of the world (XXIV): the "Nassak" diamond. I. Balfour, *Indiaqua*, Vol. 42, No. 3, 1985, pp. 133–135.

According to Balfour, a 90-ct stone known as the Nassak originally graced a statue of the god Shiva that stood in a Hindu temple in the town of Nasik, India. When the British defeated the last Indian Peshwa in 1818, the stone came into the possession of the Marquess of Hastings, who in turn presented it to the East India Company. They handed the precious stone over to the firm of Rundell and Bridge, who had the awkwardly cut stone recut for greater brilliance with only a 10% weight loss.

In 1831, Emanuel Brothers bought the Nassak for only £7,200 (the low figure has been attributed to the depressed financial conditions during that period). In 1837, the Nassak was sold at auction (along with the Arcot and King George diamonds) to the first Marquess of Westminster, and it remained in the family until 1926 when it was sold to Georges Mauboussin, a Paris jeweler. Subsequently, the Nassak was purchased by Harry Winston, Inc., of New York, who had it recut to its present 43.38 ct. The stone went through the hands of three more owners until 1977, when it was sold to the King of Saudi Arabia. *SAT*

Latter-day origin of diamonds of eclogitic paragenesis.

S. H. Richardson, *Nature*, Vol. 322, No. 6080, 1986, pp. 623–626.

Mineral inclusions of syngenetic origin in diamonds (inclusions that formed contemporaneously with the diamond) provide a means of determining the conditions of diamond formation. The mineral inclusions in diamond fall into two groups: (1) a group consisting of olivine, orthopyroxene, and chrome pyrope, referred to as the "peridotitic" paragenesis; and (2) a group containing pyrope-almandine and omphacitic clinopyroxene, known as the "eclogitic" paragenesis. Inclusions of both groups can be age dated by any of several isotope dating methods. Using samarium-neodymium isotope ratios, diamonds of the peridotitic paragenesis from the Kimberley and Finsch kimberlites in southern Africa were dated at approximately 3.3 billion years. In contrast, diamonds of the eclogitic paragenesis, which predominate at the Premier kimberlite in southern Africa and the Argyle lamproite in northwestern Australia, have much younger ages of 1.1–1.2 billion years. Thus, the diamonds in the latter group represent a second, genetically distinct origin as compared to the much more ancient group of diamonds with "peridotitic" inclusions. The origin of diamonds in the second group is related in

time and space to periods of kimberlite or lamproite magmatism. JES

The rarest gem. D. Kaye, *Town & Country*, Vol. 140, No. 5073, 1986, pp. 134–139, and 177.

Fancy colored diamonds, which are among the rarest of all gemstones, have never before enjoyed such popularity and awareness as they do today. In the case of natural-color diamonds, the increased awareness of their breathtaking beauty and rarity has created unprecedented demand and unparalleled prices.

The author presents a lively story of today's colored diamond market, reflecting on the experiences and personal opinions of several dealers and collectors who specialize in these spectacular gems.

A brief explanation of the chemical make-up of diamonds acquaints the reader with the cause of color in these stones. The artificial coloring of diamonds by atomic bombardment is also mentioned. A brief account of yellow, pink, blue, and brown diamonds familiarizes the reader with historical notes, mining locations, and descriptive terms associated with these color varieties.

A discussion based on several interviews with dealers and gemologists regarding the judgment of color in these gems concludes that color discrimination is a difficult process that requires years of experience to develop. Current grading practices are also discussed, and their strengths and weaknesses identified.

Despite a few minor errors and omissions, the article is very interesting reading. It is well illustrated with 20 color photographs of colored diamonds set in a spectacular array of jewelry pieces. SCH

Rise in output: mining the same but officially reporting more. J. Roux, *Jewellery News Asia*, No. 19, 1986, pp. 39–47.

It is difficult at best to compile figures for world production of diamond rough. In some countries these statistics are unobtainable, and in others the activities of illicit miners and smugglers make accuracy impossible. Nevertheless, using statistics from the United States Bureau of Mines and the *Mining Annual Review*, Mr. Roux presents as detailed an analysis of the current diamond production as possible.

The report, broken down by continent, country, and, where applicable, individual mines, lists the output of diamond rough for 1983 and 1984, and the reasons for increases or decreases in each case. For example, in Botswana, a better grade of ore (where grade equals the number of carats obtained from 100 tons of ore) is responsible for the increase in production from the Jwaneng mine. In Angola, the war between the UNITA rebels and the existing Angolan government plus the high incidence of diamond smuggling are responsible for the drop in production.

Essentially, production increased in Botswana, the Central African Republic, Guinea, and Zaire; it de-

creased in Australia, Angola, South Africa, Liberia, and Namibia. Production figures for South America, the People's Republic of China, the USSR, and a few other countries are only estimates due to the difficulties in obtaining reliable information.

The author's comprehensive style, augmented by graphs, makes this a fine overview of an important subject. EBM

GEM LOCALITIES

A bibliography of general mineral locality publications for the United States and Canada. R. D. Titamgim, *Rocks & Minerals*, Vol. 61, No. 4, 1986, pp. 203–209.

The gem and mineral collector can make his field trips much more rewarding by finding reference to locations that have already produced the minerals that interest him. Here Titamgim discusses how to research localities through the literature. An annotated bibliography of publications that describe gem and mineral localities in the United States and Canada (listed by state or province in addition to general references) is the focal point of the article. Many of these publications in turn include bibliographies that will provide additional sources of information. Barton C. Curren

Locating gem deposits by computer. M. O'Donoghue, *Journal of Gemmology*, Vol. 20, No. 2, 1986, pp. 87–90.

O'Donoghue presents an excellent introduction on how computer-searchable databases can aid the gemologist in locating gem-locality information. He begins with a review of the printed sources of information on gem deposits, commenting briefly on geologic maps. Then he turns his attention to strategies for computer searches in two earth science bibliographic databases: *GEOREF* and *GEOARCHIVE*.

Performing computer searches is like mastering a new language, with a new vocabulary to learn and new rules to follow. O'Donoghue points out some of the most essential of these rules, including spelling, truncation, and Boolean logic, as he discusses specific gem localities such as the ruby mines in Mogok, Burma. By carefully studying this article, the reader can learn some of the difficulties encountered in doing computer searches.

O'Donoghue concludes his article with two of the most challenging variables, geographical coordinates and chemical data. It is important to emphasize a caution the author touches on early in the article: Databases can be expensive to use. To avoid unnecessary costs, one must be well prepared before beginning a computer search. A good way to begin is to ask a librarian trained in database searching for assistance. DMD

Peridotites from the Island of Zabargad (St. John), Red Sea: petrology and geochemistry. E. Bonatti, G. Ottonello, P. R. Hamlyn, *Journal of Geophysical Research*, Vol. 91, No. B1, 1986, pp. 559–631.

The small island of Zabargad, in the Red Sea, has long been known as a source of gem-quality olivine, or peridot, which occurs in mantle-derived rock known as peridotite. Despite the historic notoriety of this island, there have been few detailed studies of its geology. This article presents results of a recent detailed study of the Zabargad peridotites that was undertaken to document their geologic features and establish their origin.

Bodies of peridotites crop out at several locations on the island. The peridotites can be divided into three groups: (1) a spinel lherzolite containing olivine, orthopyroxene, clinopyroxene, and spinel; (2) amphibole peridotites, with some magnesiohornblende in addition to the group of minerals mentioned above; and (3) plagioclase peridotites that contain plagioclase along with the other four minerals. Detailed mineralogic and geochemical data are presented for each rock type. All three rock types were derived from peridotitic melts that originated in the upper mantle at depths of approximately 30 km. The melts were probably emplaced from the upper mantle into the crust during the development of the Red Sea rift zone, in post-Mesozoic time.

Gem-quality olivine crystals are usually found in sizes up to 1 cm, although larger pieces have been mined. They are principally found in one area on the south side of the island, near a major fault along which a zone of alteration of the peridotite has developed. These gemmy crystals appear not to have been formed by the same process of melt crystallization that resulted in the formation of olivine and other minerals of the peridotite. Rather, the gem olivines probably crystallized as a result of the reaction of a volatile-rich hydrothermal fluid and the already crystallized peridotite. These reactions are thought to have taken place at temperatures in excess of 500°C but at relatively low pressure. JES

INSTRUMENTS AND TECHNIQUES

New developments in spectroscopic methods for detecting artificially coloured diamonds. G. S. Woods and A. T. Collins, *Journal of Gemmology*, Vol. 20, No. 2, 1986, pp. 75–82.

In this article on the separation of natural from treated (i.e., irradiated and heated) yellow diamonds, the authors describe the importance of sophisticated equipment. They focus on the UV-spectrophotometer (which provides a graph of the spectra), coupled with a cryogenic unit to cool the diamond and sharpen absorption bands, as well as an infrared spectrometer. We now know that the 595-nm absorption line ("5920"), once thought to be characteristic of treated stones, is destroyed when the diamond is heated at about 1000°C; as a consequence, some treated yellow stones do not show this band.

Woods and Collins present the various causes of the yellow color in diamonds, as they describe the effect of radiation damage and annealing. New criteria for the identification of treated yellow diamonds are proposed on the basis of sharp infrared absorption bands that appear after a diamond has been both irradiated and annealed: the H_{1b} and H_{1c} lines (at 2024 and 1935 nm, respectively). These lines may be eliminated by heating the stone to 1400°C, but the result is a very unattractive green color and graphitization of the inclusions.

In general, a treated stone should exhibit either the 595-nm line or the H_{1b} and H_{1c} lines. The presence and intensity of other bands (H_3 , H_4 , 1450 cm^{-1}) may help confirm the diagnosis. With such criteria, no treated yellow diamond should be mistaken as naturally colored. However, a yellow diamond that the late Basil Anderson had purchased before 1950, and which he was certain was natural, exhibits the features of an irradiated and annealed stone. Consequently, the authors conclude that a natural color yellow diamond could very rarely be classified as treated. EF

JEWELRY ARTS

Goldsmithing for profit. A. Revere, *Jewelers' Circular-Keystone*, Vol. 156, No. 13, 1985, pp. 120–124.

The title of this article is somewhat misleading, since it does not reveal money-making techniques for established goldsmiths. It does, however, contain step-by-step instructions for making two pieces of jewelry as outlined by Alan Revere, instructor at the Revere Academy of Jewelry Arts in San Francisco, California.

The first project instructs beginning goldsmiths on how to make a pearl ring, covering the basics of sawing and filing, as well as measuring, soldering, and finishing. The second project, a cylinder box clasp, requires a more advanced expertise in these techniques. Both projects are accompanied by helpful photos and notes. SAT

Indian antiquity. P. Francis, Jr., *Lapidary Journal*, Vol. 39, No. 12, 1986, pp. 45–55.

Although this article contains a plethora of information about Indian amethyst and citrine (including folklore, geology, trade between India and Rome, and heat treatment), it is primarily focused on the ancient lapidary centers of Kotalingala and Arikamedu. Much of the information is based on recent archaeological excavations of the sites.

Kotalingala, located on the Godavari River in central India, thrived from the fifth to the first century B.C. Although Kotalingala was a major regional trade city and was known for its amethyst and agate beads, it does not appear that the beads produced there were traded out of the country. The lapidaries in this city made only relatively simple round, cylindrical, or barrel-shaped beads. Careful excavation of a Kotalingala lapidary shop revealed that it was a small operation that required only

four basic tools, and probably employed only one or two workers. Since very little citrine has been recovered from this site, experts believe that Kotalingala lapidaries did not know how to heat treat amethyst to create citrine.

In contrast, the slightly more recent city of Arikamedu, located on India's southeast coast, was much more involved in foreign trade, especially with the Romans. This city boasted several different lapidary shops, which produced a dazzling array of both glass and stone beads. The Arikamedu lapidaries were far more advanced technologically than those of Kotalingala, as revealed by their extremely fine, uniformly shaped beads, pierced with diamond-tipped drills. The great number of citrine fragments recovered from the Arikamedu lapidary shops indicates that these lapidaries may have been skilled at creating citrine from amethyst.

SAT

JEWELRY RETAILING

The refashioning of Zale. S. Jensen, D. Federman, and J. Thompson, *Modern Jeweler*, Vol. 85, No. 7, 1986, pp. 100–123.

Zale Corporation has undergone enormous changes during the past two years, and three *Modern Jeweler* editors spent a week interviewing company officials and former employees to find out why. This special report delves into Zale's new corporate strategy, their new breed of executives, and the upscale Bailey Banks & Biddle division. Also included are interviews with Zale Chairman Donald Zale and President Bruce Lipshy, and a synopsis of Peoples Jewelers' attempt to overthrow the megaretailer. Although much of it is repetitious, this 23-page article does reveal the relentless, unified force behind "the golden arches of the jewelry industry."

In 1984, Zale's merchandising changed from bridal diamonds to a wider fashion image that includes gold, pearls, and colored stone jewelry. On the basis of what Zale claims to be voluminous market research, the company is now driven by marketing rather than manufacturing considerations. To a man (there appear to be no female top executives), the new generation at Zale's believes that today's target consumer is the fashion-conscious American working woman who now has the financial and emotional power to deck herself out. According to Zale's stats, these "jewelry junkies" are primarily interested in style, beauty, and price rather than consumer knowledge, and have little loyalty to any particular jewelry store. Interestingly, this philosophy conflicts with that voiced by seven women interviewed by S. Jensen in the May 1986 issue of *Modern Jeweler*, all of whom were unanimous in their quest for product knowledge and in their loyalty to a trusted, proven jeweler.

Ultimately, only time—and profits—will tell if Zale's "ready-aim-fire" mentality is really on target. SAT

Sophisticated ladies—what seven smart jewelry shoppers really think about you. S. Jensen, *Modern Jeweler*, Vol. 85, No. 5, 1986, pp. 37–43.

This article is an interview with a panel of seven women who frequently purchase fine jewelry from retail outlets. They express their likes, dislikes, and what, if possible, they would change in retail operations.

These women have a strong desire to be educated by their jeweler about the jewelry and gemstones they purchase. They are discouraged by quiet showrooms with high-pressure sales personnel, preferring to be greeted and left to browse and ask questions at their leisure. The panel expects certain services from their jeweler such as the cleaning and inspection of their jewelry. They expect problems to be brought to their attention before they turn their jewelry in for repair or cleaning. A store that employs an imaginative designer who can accurately sketch and describe the finished piece of jewelry is also important. They are not opposed to purchasing gold and silver from discount stores, but they prefer to purchase gemstones from their established jewelers. All are put off by advertising that insults their intelligence.

This article presents excellent insights into the desires and expectations of some important customers. Catering to the needs of these customers will lead to increased popularity and, more importantly, increased sales.

Barton C. Curen

SYNTHETICS AND SIMULANTS

Natürliche kobaltblau Spinelle von Ratnapura, Sri Lanka (Natural cobalt blue spinel from Ratnapura, Sri Lanka). H. Harder, *Neues Jahrbuch für Mineralogie Monatshefte*, No. 3, 1986, pp. 97–100.

This article compares the chemical and gemological properties of a set of Verneuil synthetic cobalt-colored blue spinels with one natural cobalt-colored blue spinel. The color in the synthetic stones is caused by cobalt (up to 0.02%) or by a mixture of cobalt with chromium (0.003%), vanadium (0.001%), and titanium (0.013%). Verneuil synthetics almost always contain more aluminum than natural stones contain, and show no detectable gallium. Their refractive index range is higher (1.719–1.730) than that of natural spinel (1.715–1.720), as is the specific gravity (3.63–3.64 vs. 3.58–3.61). Irregular color zoning and strong ultraviolet fluorescence in the synthetic stones can be considered as complementary identification criteria.

Natural cobalt-colored blue spinel has been found in the Paradise mining area of Sabaragamuwa Province, in the Ratnapura District, Sri Lanka. The author examined a 1.22-ct rough crystal. It showed an absorption between 535 and 600 nm—like the Verneuil synthetics but weaker—and a strong red fluorescence near 720 nm; so, those optical criteria could not be used for identification. But some unspecified inclusions in a cleavage leave

no doubt about the natural origin of the stone. X-ray fluorescence revealed an extremely high cobalt concentration (0.09%) as well as 0.29% iron, and 0.01% gallium (which are almost always under the detection limits in synthetics) together with 0.025% chromium and 0.035% vanadium.

As a conclusion, the author recommends the use of refractive index and inclusions to distinguish between natural and synthetic spinels. Surprisingly, this study does not refer to any literature, even to the well-documented paper by J. E. Shigley and C. M. Stockton (*Gems & Gemology*, Spring 1984, pp. 34–41), which focused on the same subject. EF

On the problems of using the gallium content as a means of distinction between natural and synthetic gemstones. H. Schrader and U. Henn, *Journal of Gemmology*, Vol. 20, No. 2, 1986, pp. 108–113.

Recent investigations of trace elements in gemstones have led to claims that gallium content can be used as a means to distinguish natural from synthetic gemstones. The results obtained by the authors of this article through neutron activation analysis of natural and synthetic emeralds, corundums, and chrysoberyls reveal that the guidelines set by previous researchers are inadequate. The ranges of gallium content for natural and synthetic emeralds and corundums overlap considerably, while those of chrysoberyls are close enough to overlapping that they warrant extreme caution.

The authors also review the nondestructive techniques available for trace element determination as well as the advantages and drawbacks of each. It becomes readily apparent that such methods are far from becoming standard gemological techniques. The article concludes with a warning against reliance on gallium content for determination of origin and a proposal for further research in this area. CMS

Opticon! O, Opticon! B. Jones, *Rock and Gem*, Vol. 16, No. 7, 1986, pp. 60–61.

Opticon is the registered trademark for a prepolymer plastic resin produced by Hughes Associates of Excelsior, Minnesota. This resin is being promoted as filler for mineral specimens and gemstones that have cracks or cavities which extend to their surfaces. Opticon has a refractive index of 1.545, which is very close to that of quartz (1.544–1.553). Cracks or cavities within stones of a similar R. I. will virtually disappear when penetrated by this resin. Quartz gems, such as amethyst and citrine, members of the beryl group, such as aquamarine and emerald, as well as iolite and the feldspar group lend themselves very well to this treatment.

If a gem is suspected of being treated with Opticon, it can be tested with a hot point, which will melt the resin filler and have no effect on the gemstone itself.

Barton C. Curren

Synthesis and characterization of tourmaline in the system $\text{Na}_2\text{O}-\text{Al}_2\text{O}_3-\text{SiO}_2-\text{B}_2\text{O}_3-\text{H}_2\text{O}$. P. E. Rosenberg, F. F. Foit, Jr., and V. Ekambaram, *American Mineralogist*, Vol. 71, No. 7/8, 1986, pp. 971–976.

A generalized ideal chemical formula for the tourmaline mineral group can be written $\text{XY}_3\text{Z}_6\text{B}_3\text{Si}_6(\text{O}, \text{OH})_{30}(\text{OH}, \text{F})$. In this formula, 'X', 'Y', and 'Z' represent sites of different size and geometry in the tourmaline crystal structure where various cations are located. In the case where $\text{X}=\text{Na}^+$ and $\text{Z}=\text{Al}^{3+}$, there are the four tourmalines: elbaite ($\text{Y}=\text{Al}^{3+} + \text{Li}^+$), schorl ($\text{Y}=\text{Fe}^{2+}$), dravite ($\text{Y}=\text{Mg}^{2+}$), and buergerite ($\text{Y}=\text{Fe}^{3+}$). The authors of this article describe the laboratory synthesis of a similar Na-Al tourmaline whose composition approaches that of ($\text{Y}=\text{Al}^{3+}$). The tourmaline formed by melt crystallization in tiny, acicular crystals up to 200 micrometers in length. Refractive indices are epsilon = 1.639 and omega = 1.642. The chemical and physical properties of these crystals are similar to those of elbaite and dravite. The results reported in this article demonstrate the progress that has been made in the laboratory toward synthesizing minerals with complex chemistry. JES

Synthetic diamond as a pressure generator. A. Onodera, K. Furuno, and S. Yazu, *Science*, Vol. 232, No. 4756, 1986, pp. 1419–1420.

Synthetic diamonds have recently become available in suitable size (approximately 1 ct) and quality for use as opposed anvils to generate high static pressure (up to 680 kilobars). These stones have been grown by Sumitomo Electric Industries in Japan. They are type Ib diamonds, containing singly substituting nitrogen, and therefore have a deep yellow color. The nitrogen concentration ranges from 30 to 60 ppm, as determined with the IR absorption at 1130 cm^{-1} . An X-ray topography study suggests that they have very few extended defects. The authors claim the following advantages for the use of synthetic diamonds in high-pressure experiments: (1) extended defects are fewer and can be controlled, (2) the concentration of nitrogen can be monitored to improve the strength, (3) the pressure-temperature conditions for preparing diamond crystals can be determined, and (4) suitable crystals can be obtained repeatedly. (However, the authors do not say that the growth experiment is reproducible).

Interestingly, the fracture mode of these synthetic diamonds is very different from that of natural diamonds. The cracks remain very shallow instead of leading to spalling or vertical fractures. The hardness, determined by indentation ("deformation" hardness), depends very little on the orientation, in contrast to natural diamond, which is anisotropic.

Although this article does not provide information on current production and price, it does give very interesting technical insights on the quality of Japanese synthetic diamonds. EF