GEMOLOGICAL ABSTRACTS

C. W. FRYER, EDITOR

COLORED STONES AND ORGANIC MATERIALS

Captured in amber. D. A. Grimaldi, *Scientific American*, Vol. 274, No. 4, April 1996, pp. 70–77.

This short article about Dominican and New Jersey amber does not really furnish much essential news for gemologists, but it is impressive because of its many fascinating color photos of different insects in amber frozen forever in different acts (even sex). Also pictured are a gecko, frogs, and a feather (the latter the oldest terrestrial record of a bird in North America). David Grimaldi (amber expert and professor of entomology at the American Museum of Natural History in New York) describes how the excellent preservation of plant and animal tissues in amber allows examination of minute details by electron microscopy (illustrated here by a series of photomicrographs). Creating dinosaurs from DNA preserved in amber, as was done in the novel/movie *Jurassic Park*, may still be the stuff of fiction. However, it has been possible to analyze the DNA preserved in some cells and thus establish the evolutionary relationship between termites, cockroaches, and praying mantises. *RT*

Corundum from basaltic terrains: A mineral inclusion approach to the enigma. J. Guo, S. Y. O'Reilly, and W. L. Griffin, *Contributions to Mineralogy and Petrology*, Vol. 122, No. 4, 1996, pp. 368–386.

From over 1,000 corundum (predominantly sapphire) crystals and fragments associated with basaltic rocks, mostly from eastern Australia and China, 82 primary mineral inclusions were identified. Most abundant (65% of the total) were niobium (Nb) and tantalum (Ta) oxide minerals, of which columbite, ilmenorutile, and pyrochlore are the most important. Silicates (30%) were predominantly zircon and feldspar, and rare sulfide (pyrrhotite) and phosphate (brockite) minerals made up most of the remainder.

On the basis of known geochemical characteristics and geologic associations of these mineral inclusions, the authors postulate that at least two magmas are involved in the formation of the corundum crystals. For example, feldspar, zircon, and ilmenorutile are associated with alkaline felsic rocks, whereas the types of columbite and pyrochlore that occur as inclusions in the corundums are associated with carbonatitic rocks. From this they devel-

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op a "mixing-hybridisation" process to explain the origin of corundum at these localities.

The proposed process involves the interaction between a high-silica magma and a carbonatitic (or some other silica-poor) magma. From the resulting hybrid magma, corundum precipitates and gives rise to locally distributed lenses of corundum-bearing rock. Subsequent volcanic eruptions of basaltic magma, from mid-crustal levels within the Earth, bring the corundum as xenocrysts to the Earth's surface (the corundum-bearing rocks having been disintegrated by the basaltic magma and the sapphires released). Regrettably, the authors have not considered other recently proposed mechanisms for the origin of corundums from the same localities. *AAL*

Notes from the Gem and Pearl Testing Laboratory, Bahrain—5. A. Bubshait and N. Sturman, *Journal of Gemmology*, Vol. 25, No. 1, 1996, pp. 20–23.

This issue's Notes section focuses on amber and emeralds. An amber box, reportedly of Russian origin, was constructed primarily of natural amber, but darker-colored inlays in the lid proved to be pressed amber. The latter was identified on the basis of interference colors and typical inclusions—that is, minute brown to black impurities forming swirled, smoke-like patterns. The identification was made more challenging by the presence of a reddish brown dye in the adhesive. A string of prayer beads that were represented as amber proved to consist of amber particles embedded in molded plastic. The nature of the beads became evident with magnification, which revealed typical seam lines running around the midsection of each bead.

Recently, the lab has encountered a number of resin-filled emeralds, primarily of Colombian origin. One notable example exhibited a pronounced flash effect from numerous filled fractures, as well as moderate reactions to both long-wave and short-wave UV radiation—both fluorescence and (to short-wave) phosphorescence. Staff members at the Bahrain lab had previously not seen such luminescence in resin-filled emeralds. This entry also addresses the ongoing debate on disclosure, and closes by stating the lab's policy on such identifications: The report simply states that a filler is present (because of the difficulties in determining the exact identity of these fillers). When lab staff agree on a more exact identification for a filler, they report it verbally to their clients. *CMS*

DIAMONDS

1995 a record year for diamond imports, exports. M. K. Golay, *National Jeweler*, April 1, 1996, p. 76.

In 1995, American merchants imported 11.9 million carats of cut, unset diamonds valued at more than $5.3 billion, compared to 10.6 million carats valued at more than $4.9 billion in 1994, according to U.S. government information interpreted by the American Diamond Industry Association, New York. Both figures established year-to-year records—an 11.7% increase in carats and 7.6% in value. More than 39% of the diamonds by value ($2.1 billion) came from Israel. India ($1.4 billion) and Belgium ($1.3 billion) followed. Together, the three countries supplied more than 95% of the total weight in diamonds imported into the U.S. The average price of imported loose, polished diamonds dropped 3.7% in 1995, from $463 to $446 per carat. Of the top eight sources by value, the average price of diamonds imported from Switzerland was highest, at $6,978 per carat, whereas stones from India averaged $183 per carat.

Exports of cut, unset diamonds from the United States in 1995 set a record. Total shipments of 2.1 million carats ($2 billion) were all-time highs for both weight and value. Exports were up 62.2% by weight and 15.6% by value over 1994. Israel, Belgium, and Hong Kong were the United States' top export trading partners by value, at $478 million, $463 million, and $433 million, respectively. Shipments increased in value to each of these countries over 1994 by 22.9%, 15%, and 8.5%, respectively. Percentage increases were also seen in the value of diamonds exported to Singapore (58.4%), Japan (18.2%), and Canada (12.6%). U.S. diamond exports averaged $932 per carat in 1995, compared to $1,317 per carat in 1994. This 29% drop is a reflection of larger shipments of lower-priced goods to each of the top eight trading partners, except the United Kingdom and Canada. *MD*

Canadian diamond boom. S. Voynick, *Rock & Gem*, Vol. 26, No. 6, June 1996, pp. 21, 22, 24, 26, 68.

It is now about six years since the Lac de Gras kimberlite field in the Northwest Territories of Canada was discovered. It is anticipated that, in a few years, this locality will be producing about 3,000,000 carats of diamonds annually. This timely, well-written article repeats the saga of how Charles Fipke followed the trail of diamond-indicator minerals (pyrope garnet, ilmenite, chrome diopside) dispersed from kimberlites by glaciers, persevering over great adversities until he found the first of the many pipes in this inhospitable region. Mr. Fipke is now estimated to have a personal wealth of more than $300 million.

This article, however, differs significantly from most others written on this topic in that it begins with a summary of the basic facts of diamond formation and occurrence that were undoubtedly used by Mr. Fipke in his exploration concepts and decisions. These include the depth (at least 120 km) within the Earth at which diamonds form (diamond stability zones); the rapid rate at which diamonds must be carried to the surface by kimberlite magma (or else they will not survive the trip, because they will dissolve in the kimberlite); and the critical recognition that kimberlite is emplaced in specific geologic regions (archons).

The article also discusses the importance of geophysics (e.g, airborne magnetics) in exploration, how diamonds are recovered from kimberlite rock (e.g., dense-medium separation, X-ray sorters), and other topics of a general nature. *AAL*

Discard small diamonds—they're not worth the effort. *Diamond Industry Week*, Vol. 2, No. 39, October 9, 1995, p. 4.

The per-carat value of large diamonds compared to small diamonds is much greater than can be accounted for by the difference in carat weight alone. In recognition of this fact, Western Australia's Argyle diamond mine will no longer process ore to extract diamonds smaller than 1.5 mm. Although revenue is expected to increase as much as 10% because of this decision, the projected open-pit life of the Argyle mine will decrease by 10 months (ending in 2004).

Argyle's decision is likely to result in a slight increase in the price of small diamonds, which may hurt the diamond industry in India, where many such stones are cut. However, ignoring smaller diamonds is an action consistent with a "true market economy for diamonds." *MLJ*

Inclusions in precious stones. I. Solid inclusions in diamonds (Polish with English abstract). M. Plaszynska, *Mineralogia Polonica*, Vol. 26, No. 1, 1995, pp. 79–86.

Mineral inclusions identified in diamonds are listed and linked to their probable paragenesis. The author concludes (1) that the chemical nature of most of these inclusions does not depend on the mode of occurrence of the diamonds, and (2) that two distinct suites of primary inclusions in diamonds can be distinguished (on the basis of X-ray and microprobe analyses). *RAH*

New places to look for diamonds. B. Cordua, *Rocks Digest*, Vol. 8, No. 1, 1995, pp. 5, 8.

Very small diamonds (about 0.01 mm) have been found as perfect cubes and octahedra in garnet and zircon crystals recovered from metamorphic gneisses in the Kukchetin (or Kokchetev) block in Kazakhstan, about 800 km west of Novosibirsk. These rocks were first laid down as sediments about 2 billion years ago, and they were metamorphosed about 530 million years ago. In 1990, Sobolev and Shatsky concluded that the diamonds grew during the metamorphism of the rock, which occurred at temperatures about 900°–1000°C and pressures above 40 kbars (depths greater than 100 km). The diamonds survived the uplift interval, which should have converted them to graphite, because they were encased in the garnet and zircon; a short time-scale for uplift is also implied. *MLJ*

South Africa diamond plant success. *Mining Journal, London*, September 22, 1995, p. 216.

Dowding Reynard and Associates, in Johannesburg, South Africa, design mineral processing plants. In 1995, they reported sharply increased interest in modular diamond-recovery plants for delivery to Africa and elsewhere. A new product is a full-scale dense media separation plant that is exported in modular form. Traditional modular diamond plants can process up to 25 tons per hour of diamondiferous material; however, a 150-ton-per-hour plant has been ordered for De Beers in Namibia (Namdeb), a 120-ton-per-hour plant for De Beers in Tanzania, and two 100-ton-per-hour plants for Auridiam's River Ranch project in Zimbabwe.

Smaller plants require fewer resources. A jig plant for exploration in Mozambique, which processes 8 tons per hour, has an onboard diesel generator for stand-alone use; and a miniature DMS plant has been designed for field sampling and on-the-spot appraisal of resources in northern Canada. *MLJ*

Southern Era reports significant values at SUF-1. *Diamond Industry Week*, Vol. 2, No. 40, October 16, 1995, p. 3.

Southern Era Resources announced the most recent valuations of diamonds recovered from its kimberlite dike project in South Africa: The two lowest averaged US$85.29 per carat. As of mid-October 1995, 263.39 carats had been recovered from the main pit (average grade was 5.49 carats per metric ton); an additional 22.05 carats were recovered from 17.66 metric tons of fault breccia. The largest diamond weighed 10.51 carats, and about 94% of the diamonds were "cuttable gems."

Reconnaissance sampling indicates that the main fissure zone contains kimberlite and/or diamonds along its length for at least 30 km. Diamonds have also been recovered as far as 1150 m from the main fissure *MLJ*

Thinking the unthinkable: Argyle ponders a break from De Beers. R. Shor, *Jewelers' Circular Keystone*, Vol. 167, No. 5, May 1996, pp. 98–105.

Australia's Argyle diamond mine is weighing the pros and cons of going independent, as De Beers's Central Selling Organisation successfully concludes negotiations to continue distributing and marketing Russia's diamond production. An independent Argyle could fundamentally change the way rough diamonds are sold in the international marketplace. Foremost, De Beers's price-control policies would face the reality of actual supply and demand. An independent Argyle could help restructure control of the diamond trade, in essence allowing several large corporate mining companies to control the core trade in the future. Possible future "diamond czars" (along with De Beers) include RTZ-CRA, a British conglomerate and now the world's largest mining company; BHP, a large Australian mining group that controls the major Canadian diamond discoveries; and Ashton, a smaller Australian mining company with a 40% share of the Argyle Mine.

Argyle executives realize the importance of their decision and have been planning a possible break with De Beers for a long time. To this end, they have worked (successfully) to enlarge their customer base and improve the efficiency of their current mining operations. Even with a recent revamping of surface mining at Argyle, however, the future economic success of the mine will depend on whether the company can afford to develop an underground shaft, a decision that may have to be made as soon as next year. *JEC*

A year of overfeed. L. Rombouts, *Diamond International*, No. 39, January-February 1996, pp. 61, 62, 64–66, 68.

In 1995, more rough diamonds—130 million carats—entered the market than in any other year in history (108 million carats in 1994). Production statistics for 1995 are presented for 21 countries (which accounted for 111.5 million carats). The remaining 18.5 million carats are believed to have originated from Russia (as diamonds brought to the market via non-CSO channels, either from Russia's stockpile or through polishing joint ventures) and from artisanal mining in Africa and South America. Notwithstanding the large increase in "outside" rough, the diamond market absorbed the "overfeed" without serious problems. Statistics are also presented for the average value (US$ per carat) of each country's production and for production from the world's 18 major mines (mostly pipes, but also some secondary deposits, such as in Namibia). In 1995, CSO sales amounted to 63% of the world's total rough diamond supply.

The status of diamond exploration in numerous countries is reviewed with the purpose of predicting future diamond reserves. For the next 20 years, according to Dr. Rombouts, 98% of the world's diamond reserves by weight will be found in eight countries: Botswana (32%), Russia (21%), Australia (11%), Angola (10%), South Africa (9%), Zaire (8%), Canada (5%), and Namibia (2%). However, by value, the sequence is (for 97% of the total): Botswana (33%), Russia (26%), Angola (11%), South Africa (10%), Namibia (7%), Canada (5%), Zaire (3%), and Australia (2%). Relative to 1995 production statistics, the above 20-year reserve and value estimates show major reductions in the role of Australia and Zaire and, for the first time, a significant role for Canada (where production is expected to start in 1998). *AAL*

GEM LOCALITIES

Atop the Andes—mining Chile's mountain-high lapis. F. Ward, *Lapidary Journal*, Vol. 50, No. 3, June 1996, pp. 36–40.

I had always considered Chilean lapis lazuli to be somewhat "second-rate" until I read this enlightening article by a popular and well-known gemological author. Eight beautiful color photos illustrate quality lapis from this locality, now available in sculpture, accent tile, and a variety of other decorative objects. Covered are the geologic forces that form the lapis, the history of the Las Flores de los Andes lapis mine and methods of mining there, nomenclature, and differences between the classic Afghanistan deposit and its Chilean counterpart. *JEC*

Chad: Discovering new mineral wealth *Mining Journal, London* [advertisement supplement], September 22, 1995, 12 pp.

The geology and mineral potential of this land-locked African nation have not been investigated to any great extent; however, alluvial diamonds have been found in many regions. The main areas of alluvial diamond production are Abeche, Biltine, Am Zoer, and Adre in Ouadday, and Melfi-Bitkine in Guera. Some alluvial stones also have been found along the Lim River in Baibokoum (on the Central African border), but the lack of diamond-indicator minerals implies that these diamonds may have come from sources in neighboring countries. The Oadday and Guera stones are far from other drainages, however, and the primary sources, although not yet found, are believed to be in Chad. *MLJ*

The gems of Mont Saint-Hilaire, Quebec, Canada. W. Wight, *Journal of Gemmology*, Vol. 25, No. 1, 1996, pp. 24–44.

The common gravel quarry at Mont Saint-Hilaire is one of the world's richest sources for rare minerals, many of which have been faceted or polished as collectors' gems. Within this small (about 0.5 km^2) area, more than 300 species of minerals have been found, many for the first time and others in colors or qualities found nowhere else. Remarkably, this rich source has attracted the attention of mineral collectors only since the 1960s and lapidaries only since the 1970s. Among the notable (and facetable) minerals found at Mont Saint-Hilaire are serandite, willemite, siderite, rhodochrosite, carletonite, hackmanite, and shortite. These and others are illustrated. In addition, two tables list notable minerals recovered from this deposit, as well as identification properties for a considerable number of them. The author cautions that many of these minerals and gems can be very difficult to identify. *CMS*

A guide to new fossicking legislation. B. Neville, *Queensland Government Mining Journal*, Vol. 96, No. 1123, June 1995, pp. 5–9

"Rockhounding" in the United States is called "fossicking" in Australia. Many Australian states have laws to regulate this activity. In 1994, Queensland revised its fossicking law. Although fossicking is defined as purely an amateur activity, a renewable license is now required. Certain public lands are designated as Fossicking Lands and Fossicking Areas, collecting is permitted on private lands (with the owner's permission), and some areas—including national parks and lands under native title—are closed to collecting. There are limitations on the types of tools allowed, and fossickers must pay royalties to Queensland for quantities removed above exempted amounts. Among the places set aside especially for fossickers are some sapphire and opal fields. Vertebrate fossils and meteorite-related materials are not covered by fossicking regulations; however, this article does not say whether such materials may be collected legally. *MLJ*

India: A rich mining heritage. *Mining Journal, London* [advertisement supplement], September 15, 1995, 12 pp.

This review article contains some information (from India's Ministry of Mines via *Mining Journal* resource services) about diamonds and other gem materials found in

India. Primary diamond deposits (kimberlites and/or lamproites) are found in the states of Madhya Pradesh (the Panna district) and Andhra Pradesh (the Anantpur, Krishna, and Karnool districts); reserves are estimated at one million carats. One mine—the Majhgawan operation in Madhya Pradesh—produces 19,000 carats annually. Diamonds are also found in the "extensive" conglomerates in the Kurnool and Vindhyan basins, and in gravels along the Krishna and Mahanadi Rivers. India has the "world's largest diamond cutting and polishing industry," employing 600,000 people and producing 70% of the world's finished diamonds. Colored stones (such as emeralds, rubies, garnets, and cat's-eye stones) are mined in the Kalahandi and Bolangir districts of Orissa. *MLJ*

River pearls from Bavaria and Bohemia. H. Hahn, *Journal of Gemmology*, Vol. 25, No. 1, 1996, pp. 45–50.

The freshwater mussel *Margaritifera margaritifera* has long lived in the streams and rivers of northern Europe. During the Middle Ages, these mussels were exploited heavily for their pearls, and exquisite examples of their use—in both religious and secular pieces—can be seen in the museums of Germany and Austria in particular. Bohemia developed both a thriving pearl trade and an extensive jewelry manufacturing center in Prague. By the 19th century, *M. margaritifera* had become virtually extinct, largely as a result of industrial pollution of the rivers. In fact, recent interest in propagating *M. margaritifera* is due primarily to the fact that these mussels are so sensitive to water pollution that they are one of the best indicators available to ecologists concerned with river and stream conditions. Various government and educational groups throughout northern Europe are cooperating to expand the distribution of *M. margaritifera*.

The author also provides some fascinating information on these mussels, including their dependence on a particular species of trout for propagation. As this once nearly extinct animal again begins to thrive in European waters, gemologists can look forward to the bonus of seeing more of their exceptional by-product—pearls. *CMS*

The role of fluorine in the formation of colour zoning in rubies from Mong Hsu, Myanmar (Burma). A. Peretti, J. Mullis, and F. Mouawad, *Journal of Gemmology*, Vol. 25, No. 1, 1996, pp. 3–19.

The growth patterns and color zoning typical of Mong Hsu rubies suggest a complex growth history with compositional fluctuations in the formation environment. When both Ti and Cr are abundant, violet-to-black sapphire forms; when Cr is moderate to high and Ti virtually absent, ruby forms; and when Cr is moderate and Ti low, pink-to-violet sapphire forms. The great number of mineral inclusions found in these rubies confirm the complexity of their growth environment and provide information about that environment. Specifically, the presence of fluorite inclusions is evidence that fluorine (F) was an element of the growth solution. Likewise, fluid inclusions indicate the presence of water. On the basis of a preliminary model, the authors conclude that F concentrations played a major role in the development of the color zoning in Mong Hsu rubies. *CMS*

Shenzi: The politics of mining tanzanite. E. Blauer, *Lapidary Journal*, Vol. 50, No. 3, June 1996, pp. 42–45.

This beautifully illustrated, concise article chronicles the fascinating history of tanzanite mining in the country after which this distinctive blue gem was named. According to the author, *shenzi* is a Swahili word that translates roughly to "sleazy." After reading this article, it is not difficult to see why the word might apply to the subject at hand.

Discovered in 1967, tanzanite (a gem variety of the mineral zoisite) has suffered through periods of erratic supply because of government intervention. Since 1971, the Tanzanian government has tried to control and profit from mining and sales of tanzanite. The net result of these efforts has been rampant illegal mining and smuggling that, at times, only served to drive prices down, as large quantities of the gem entered the market with no regard to the sizes and qualities that were really needed.

Although goods are still plentiful, especially the big stones that have made tanzanite so popular with designers, there is concern that some areas at the Merelani mining district are worked out. Smaller stones appear to be in short supply, especially in light of the demand created by the home shopping networks. Reported new discoveries in Kenya and elsewhere in Tanzania, however, may help to keep the supply steady for now.

The final page of the article describes how Narottam Pattni discovered how to heat treat tanzanite, turning a near-worthless off-color crystal into the sought-after deep-blue treasure that it is today. *JM*

Treasures of Glen Innes. M. Kelly, *Australian Gold Gem & Treasure*, Vol. 11, No. 2, February 1996, pp. 32–37.

The New England region of New South Wales, Australia, has many different gem materials for the amateur collector. Buried alluvial beds at Wellingrove contain sapphire, topaz, and zircon; beryl is found in Torrington, and nearly all the streams in the Glen Innes area contain sapphires. Persistent searchers continue to turn up stones missed by commercial miners. Unlike Queensland, however, there are no large zones of free access for gem mining, so collectors must ask local landowners for permission to dig.

Although "cornflower blue" sapphires are easily recognized in washed gravels, other colors (and shades of blue) can be overlooked. One technique to spot these sapphires is the "old mirror trick": Take a large spoonful of gravel concentrate—washed "as clean as the water available to you will allow"—and spread it across the surface of a mirror in the sunlight. The sapphires become translucent from the light reflecting back through them.

The town of Glen Innes boasts "the best country museum in Australia," the Land of the Beardies Museum.

It contains displays of minerals, gems, and old mining equipment. *MLJ*

An unusual ruby-sapphire-sapphirine-spinel assemblage from the Tertiary Barrington volcanic province, New South Wales, Australia. F. L. Sutherland and R. R. Coenraads, *Mineralogical Magazine,* Vol. 60, No. 4, 1996, pp. 623–638.

Small, corroded, crystalline aggregates of ruby-sapphire-sapphirine-spinel occur in corundum-bearing alluvial deposits derived from the Barrington shield volcano. The sapphirine has a near 7:9:3 ($MgO:Al_2O_3:SiO_2$) composition and, together with the corundum, shows reaction rims of pleonaste. Spinel in these aggregates has a composition of $Sp_{68\text{-}73}Hc_{27\text{-}29}Cm_{0\text{-}3}$. Potential origins for these aggregates include metamorphic recrystallization of aluminous material (<1460°C) or high-temperature, high-pressure crystallization reactions related to lamprophyric or basaltic magmas (≤1300°C and 20 kbar). Sapphirine-spinel thermometry suggests final crystallization for the aggregates at ~ 780°–940°C and reaction with the host magmas at >1000°C. The Barrington gemfield includes two distinct corundum sites. One, typical in eastern Australia, is dominated by blue-green, well-crystallized, growth-zoned sapphire, commonly containing rutile silk and Fe-rich spinel inclusions. The other, an unusual site, is dominated by ruby and pastel-colored sapphires; these have little crystal shape or growth zonation, and they have limited mineral inclusions of chromian pleonaste and pleonaste. Chemical analyses are given for sapphirine and a range of spinels. It is tentatively suggested that sapphirine may be of use as an alluvial indicator mineral for ruby. *RAH*

INSTRUMENTS AND TECHNIQUES

Hanneman-Hodgkinson synthetic emerald filter. T. Linton and A. Shields, *Australian Gemmologist,* Vol. 19, No. 2, 1995, pp. 65–68.

The authors tested the Hanneman-Hodgkinson Synthetic Emerald Filter and found that it performed as stated in the instruction booklet. This new emerald filter is designed to be used with the well-established Chelsea filter, not as a substitute for it. While jewelers are always hoping for the so-called black box that will easily separate natural from synthetic emeralds, the Hanneman-Hodgkinson Synthetic Emerald Filter is not the all-inclusive answer. It is a gemological tool that works when used as specified. However, it does have certain limitations.

For instance, table 1 shows that six observers differed about what color they saw when examining the same test stone(s). They variously described the filter reaction for an emerald from Colombia as colorless, green, blue, and pink. The filter colors reported for some of the synthetic emeralds tested also varied somewhat. While all observers agreed that the Regency hydrothermal synthetic emerald appeared red through the filter, the visual color opinions on the Chatham and Inamori stones were far less consistent.

Another limitation, as stated by the filter's inventors, is that it does not work on Biron or Russian hydrothermal synthetic emeralds. These appear to have the same color through the filter (green) that most natural emeralds have.

With the Hanneman-Hodgkinson Synthetic Emerald Filter, if one observes a red color, then the stone is not a natural emerald. If a pink color is noted, then the stone is probably synthetic, but caution is in order. If the stone appears green, then other avenues of gemological testing are needed.

As with all gemological testing techniques that appear outwardly simple, the Hanneman-Hodgkinson filter actually requires a great degree of interpretive expertise and experience. The usefulness of this filter would be greatly enhanced if a set of reference emeralds of known natural and synthetic origin were available for direct comparison. *John I. Koivula*

New methods of photography through the microscope: Application to gem materials. K. A. Kinnunen, *Geological Survey of Finland, Special Paper 20* (Current Research 1993–1994), 1995, pp. 185–187.

New techniques are described for the photomicrography of macroscopic specimens, including crystal faces and gold nuggets, in their natural state. An acetate peel is obtained from the cleaned surface of the specimen, and the peel is mounted and studied in transmitted light and photographed. Color-filter shadowing is used to enhance the specimen's three-dimensional aspects. Examples given include photographing the rhombohedral faces of amethyst crystals. The method has been used to identify faked specimens and in criminological studies. *RAH*

PRECIOUS METALS

U.S. mines more gold. M. K. Golay, *National Jeweler,* April 1, 1996, p. 24.

The United States could top South Africa as the world's largest gold producer by the year 2000, if the current trend continues, according to the Gold Institute. It is projected that by 1998, U.S. gold production will supply 16% of the world's demand, as compared to 2% for 1979. However, South Africa's contribution has dropped from 53% to 21%. Royal Oak Mines, Kirkland, Washington, expects its 1996 gold production to reach approximately 425,000 ounces, about 15% more than its 1995 production of 371,151 ounces. Australia's gold production is also rising, from 1% of the world total in 1979 to an estimated 13% in 1998. Canadian output remained roughly the same, up just slightly from 4% to 6%. *MD*

World silver use. M. K. Golay, *National Jeweler,* April 1, 1996, p. 24.

Jewelry and giftware manufacturers in the United States used approximately 10.8% more silver in 1995 (a total of 4.1 million ounces) than in 1994, according to the *Silver Survey 1996,* by CPM Group, a precious metals research firm. The increase was due to greater consumer interest in silver jewelry, reports CPM. Worldwide silver use in jewelry and decorative objects was relatively stable last year, rising only 0.4% from 222 million ounces in 1994 to 222.9 million ounces in 1995. The major reason for the sluggish market was a 15% decline in silver use in India because of severe supply constraints there. U.K. jewelers and silversmiths continued to expand, consuming 3 million ounces of silver in 1995, an 11% increase. Italian jewelers increased their silver use by an estimated 14.5% to 46.6 million ounces last year, CPM said. Silver prices year-to-year ended up fairly even; 1995 was the sixth straight year in which silver fabrication demands exceeded total new silver supplies. *MD*

SYNTHETICS AND SIMULANTS

[New type of] synthetic alexandrite we encounter in gem ID lab lately (in Japanese). National Gemmological Association Technical Laboratory, *Gemmology*, Vol. 26, No. 308, May 1995, pp. 4–5.

This article describes a new type of synthetic alexandrite, which contains needle-like inclusions that are very similar to those seen in natural alexandrite. This material first caught the authors' attention in November 1994. Since then, they have tested several mixed-cut loose synthetic alexandrites, from 1 to 3 carats. All of the samples examined were of high clarity and showed a strong change-of-color from bluish green to purplish red, similar to that seen in natural alexandrite from Brazil.

Their refractive index was 1.738–1.746 ± 0.001, which were low values for their color (birefringence, 0.008). All of the samples fluoresced strong red to long-wave ultraviolet radiation; some showed strong red, and others showed moderately strong chalky yellow, to short-wave UV. With magnification, the authors observed randomly placed, needle-like metallic inclusions that were sometimes accompanied by gas bubbles. Immersed in methylene iodide, the stones showed curved color bands. The spectroscope revealed absorption at 680, 665, 655, 645, and 465 mm, but it did not reveal the 365 and 375 mm features almost always shown by natural alexandrites. In addition, the absorption cut-off in the violet was shifted toward the lower wavelenghts. From these testing results, the authors concluded that the samples were manufactured by the (Czochralski) pulled method. *HN*

TREATMENTS

Heat treating sapphires from the Anakie District, Australia. T. Themelis, *Australian Gemmologist*, Vol. 19, No. 2, 1995, pp. 55–60.

This article vaguely discusses the colors that resulted when 20,000 carats of rough sapphires were heat treated at various temperatures and atmospheres. The article looks very scientific and informative at first glance, but few practical details are given. For example, the author says that "careful controlled rates of heating and cooling" were used, but he does not say what the rates were. Nor does he elaborate on the "gas mixtures used [that] were poisonous." However, I did glean a few facts: A 20°C-per-minute rate of heating and cooling prevented recrystallization of rutile; strong reducing atmospheres during heating produced muddy green or black colors; blue-to-green sapphires turned a better color than green-to-yellow ones; and final color was established one to two days after treatment. *CEA*

MISCELLANEOUS

1995: The geosciences in review. [Various Authors], *Geotimes*, Vol. 41, No. 2, February 1996, pp. 17–54.

This compendium reviews trends and new discoveries in the geologic sciences during 1995; some of these insights may be relevant for gemologists. Perhaps the most significant change in recent years has been the drastic decrease in government funding for the geologic sciences, as evidenced by the recent closure of the U.S. Bureau of Mines Also included in the many topics covered:

- Information-science trends (reviewed by B. E. Haner) reflect the increasing importance of communication through computer networks, especially—but not limited to—the rising prominence of the World Wide Web. The invaluable *GeoRef* CD-ROMs (which this abstracter consults frequently) continue to be updated, and high-resolution scanning is being developed, leading to the preservation as digitized information of large-format illustrations, such as fragile geologic maps.
- Although planetary geology (reviewed by J. R. Zimbelman) leans toward the esoteric, one result this last year is that there are a calculated 72,000 tons of (admittedly tiny) 0.2 mm diamonds in the suevite rocks within the Ries impact crater, Germany. Similarly, meteoritics (reviewed by H. Y. McSween Jr.) reveals still smaller diamond, silicon carbide, and corundum grains (older than our solar system) found in chondritic meteorites.
- An exciting trend in exploration geophysics (reviewed by W. H. Dragoset) is the development of real-time, three-dimensional seismic characterization of subsurface rocks in the field.
- Exploration geochemistry (reviewed by J. E. Gray) continues to be invaluable in the search for diamonds in Australia, Brazil, China, Guyana, India, Indonesia, Namibia, South Africa, Tanzania, Venezuela, Zimbabwe, and several provinces of Canada.
- Satellite remote sensing data (reviewed by E. D. Paylor II and M. Baltuck) have been used for observation of paleodrainages (former river channels) along the Nile River.
- In the field of mineral chemistry (reviewed by C. Shearer), a research effort approaching fruition is the understanding of the rules governing trace-element distributions in minerals, especially for the rock-forming clinopyroxenes (such as diopside and jadeite).
- The growing development of microbeam analytical techniques (such as ion microprobes and laser ablation/mass spectrometry) has enabled the study of light

elements (H, Li, Be, B) in tourmaline, vesuvianite, and other minerals. The ion microprobe is also being applied to the study of changes in rocks and minerals induced by metamorphism (reviewed by G. E. Bebout). Computed X-ray tomography, another new technique, is currently being used to study the porosity of carbonate rocks (reviewed by C. Kerans, R. K. Goldhammer, and J. L. Banner).

• In clastic sedimentology (reviewed by M. H. Gardner), fluid dynamics models are being applied to stream flow, in the hopes of determining original depositional environments (e.g., valleys versus channel-fill deposits). *MLJ*

GPS: Useful, with care. L. R. Ream, *Mineral News*, Vol. 11, No. 4, April 1995, p. 10.

Global Positioning Satellite (GPS) receivers, which can pinpoint a position on the basis of data received from several orbiting satellites, are a wonderful way to find out where you are on the Earth's surface. Now they are commercially available at modest ($300) to immodest ($15,000) prices. However, some factors limit their usefulness. These include interference from dense foliage, narrow views of the sky, and signals bounced off mountainsides and canyon walls (not to mention the fact that the U.S. Department of Defense purposely degrades the accuracy of publicly accessible satellite signals). The more expensive units are generally more accurate.

The author recounts several anecdotes regarding false GPS readings. He notes that a GPS unit is generally more accurate than precise (i.e., although the readings may not be the same each time, they will be "in the vicinity" of correct) and is subject to long-term drift in its information. He suggests that, if you buy one of the lower-end GPS units, you first take several readings and average them, to learn the limitations of the device and how to work with them. *MLJ*

Minerals in rock mass hold clues to 400-kilometer ascent. R. A. Kerr, *Science*, Vol. 271, March 1996, p. 1811.

Mineralogists are agog over the discovery of a large chunk of garnet peridotite in the mountains of southern Switzerland, 400 km above the strata in the Earth's mantle where all mineralogical knowledge says it should be.

The Alpe Arami massif, which measures 800 × 500 m, has traveled to the surface from the mantle transition zone, 400 to 670 km down. Researchers determined its original depth of formation from the presence of ilmenite inclusions in olivine—some rod-shaped and some of a structure previously unknown—all indicating formation below 300 km.

Researchers can only tentatively explain this phenomenon as "deep subduction"; that is, the peridot massif was surrounded by much lighter sedimentary crustal rock and buoyed to the surface. To the question of why this lightweight sedimentary rock from the Earth's crust was in the deep mantle zone in the first place, some mineralogists have proposed "the Ivory soap principle." According to this theory, light crustal rock was driven downward by the collision of continents, then warmed up and bobbed back to the surface (like Ivory soap), carrying chunks of heavier mantle with it.

Diamonds, which occur in the only other rocks known to have pulled off the trick, arrived by a different mechanism (having been blasted up from more than 100 km depth through narrow volcanic conduits, or pipes). There are, however, similarities between the odd mixture of minerals in these rocks and that in the one from the Alpe Arami massif. Although "the Ivory soap principle" to explain the massif rock is controversial, the discovery has major implications for scientists' understanding of the subduction process, and of the mineralogy and chemistry of the Earth's mantle. *AC*

Twisted and contorted plants. E. B. Heylmun, *International California Mining Journal*, Vol. 65, No. 1, September 1995, pp. 30–31.

This short summary of the 1983 textbook *Biological Methods of Prospecting for Minerals*, by R. R. Brooks, describes plants that are found preferentially in regions where the soil contains economically valuable elements. California poppies indicate copper, alyssum indicates silver-lead-zinc or nickel (and nickel is often associated with platinum), pennycress can indicate silver-lead-zinc, wild buckwheat is associated with silver, and wild rye grass occurs with sulfur. Equisetum (horsetails), wild onions, and "miner's moss" are claimed by some to be associated with gold. In general, any poisonous, hallucinogenic, or foul-smelling plant (except poison ivy and poison oak) may indicate that the soil is rich in unusual elements.

Another indicator of mineralization is unusually "stressed" plants—especially composites (daisies)—showing features such as stunted growth, twisted or contorted growth, yellow foliage, or unusually colored flowers; or plants that are unusually early or late blooming. Boron, radioactivity, and bitumenous hydrocarbons may cause gigantism in plants. *MLJ*