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REGULAR FEATURES

ABOUT THE COVER: Inspired by Wagner's opera "Tristan and Isolde," this pendant is an excellent example of a gothic theme as interpreted in the Art Nouveau style by Spanish jeweler Luis Masriera. The materials—gold, plique à jour enamel, ivory, a baroque pearl drop, and diamond and sapphire accents—are typical of those used in this short-lived but pervasive style. In this issue, authors Elise B. Misiorowski and Dona M. Dirlam present a fascinating article on the jewels and jewelers of the Art Nouveau movement. The piece, 6.2 × 5.5 cm, was manufactured c. 1900–1905. From a private collection. Photo © 1986 Harold & Erica Van Pelt—Photographers, Los Angeles, CA.

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THE ULTIMATE SYNTHETIC: A JEWELRY-QUALITY DIAMOND

Ever since the early 1970s, when General Electric Company elected to discontinue their fascinating project to produce synthetic diamonds in cuttable sizes and qualities, I've been convinced that there was only the remotest possibility that anyone would produce economic quantities of cuttable synthetic diamonds in the near future. When one examines the phase-rule diagram for carbon, it is readily apparent that extended periods at extremely high temperature and pressure are necessary to grow diamonds. At General Electric, production of a single crystal required a week or more under such conditions, at a cost of about $20,000. Obviously, the quarters or thirds that could be cut from the one-plus carat crystal would not be competitive with natural diamonds at least for generations to come. General Electric apparently reached the same conclusion regarding the bottom-line prospects for these synthetic diamonds, and they abandoned the research.

Since that time, both Russian and Japanese groups have been working on diamond synthesis. Russian scientists have had considerable success in the deposition of thin layers of synthetic diamond on other materials. And in 1985, Sumitomo Electric Industries in Japan succeeded in the practical application of the G.E. technology: the commercial production of cuttable synthetic diamonds. We are now looking at the very real prospect of readily available cuttable *synthetic* diamonds (man-made stones that *duplicate* the properties of natural diamonds, not simulants like cubic zirconia) in sizes up to at least one-half carat.

The researchers at Sumitomo have made great strides since the G.E. developments. Although they use the same principles, they have enlarged the size of the temperature-pressure chamber in which synthesis takes place from a capacity of one relatively small crystal to that of many crystals as large as 2 ct all growing at the same time. Whereas the growth of a single crystal over the relatively long period required had no hope of being economically viable, the production of many crystals during the same growth cycle makes possible a competitive picture.

The meaning of all this to the jewelry industry at the moment is not clear. Synthetic rubies and sapphires appeared before the turn of the century, and many other synthetics have followed, but the ultimate goal of cuttable synthetic diamonds at a potentially competitive price has not occurred until now. Even now, no one knows what price range would make detectable synthetic diamonds fully marketable. If the manufactured product can be detected very easily, as is the case with the yellow synthetic diamonds that Sumitomo has produced and sold to date, the impact on the industry will be just to give an added dimension to product availability. If in the future a product is released that our gemological community is unable to distinguish, a quite different scenario would seem likely.

Regardless, members of the jewelry trade must make themselves aware of the existence of these synthetic diamonds and of the fact that, although they are currently being sold in "canary" yellow only and only for use as heat sinks in industry, it is very likely that they will appear in the gem market in the not-too-distant future. What is perhaps the last great barrier of gemology has been breached; never has the role of the gemologist been more important.

Richard T. Liddicoat, Jr.
Editor-in-Chief

THE GEMOLOGICAL PROPERTIES OF THE SUMITOMO GEM-QUALITY SYNTHETIC YELLOW DIAMONDS

By James E. Shigley, Emmanuel Fritsch, Carol M. Stockton, John I. Koivula, Charles W. Fryer, and Robert E. Kane

The distinctive gemological properties of the gem-quality synthetic yellow diamonds grown by Sumitomo Electric Industries are described. These synthetic diamonds, produced on a commercial basis, are grown as deep yellow single crystals in sizes up to 2 ct. The material is currently marketed for industrial applications only, in pieces up to about 0.40 ct. The synthetic diamonds can be distinguished by their ultraviolet fluorescence (inert to long-wave; greenish yellow or yellow to short-wave); their unusual graining, veining, and color zonation under magnification; and the absence of distinct absorption bands in their spectra.

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Dr. Shigley is director of research at the Gemological Institute of America. Dr. Fritsch is research scientist, Ms. Stockton is senior research gemologist, and Mr. Koivula is senior gemologist in the GIA Research Department, while Mr. Fryer is director of gem identification and Mr. Kane is research and gem identification supervisor of the GIA Gem Trade Laboratory.

Acknowledgments: The authors thank Dr. A. Hara, Dr. S. Yazu, and R. Ladd of Sumitomo Electric Industries for their cooperation in supplying information for this study, and Dr. S. Rand for first bringing this material to our attention. The following individuals assisted in faceting the synthetic diamonds: G. Kaplan (L. Kaplan Int'l., Inc.), R. Bogel and H. Lieberman (W. Goldberg Diamond Group), and U. Uralevich (Diamond Manufacturers). The article benefited from suggestions from R. T. Liddicoat, B. Krashes, R. Crowningshield, Dr. G. Rossman, Dr. K. Nassau, J. Lucey, and R. Page. Ruth Patchick typed the original manuscript.

The first synthetic diamond crystals of a quality and size suitable for gem use were produced by the General Electric Company in 1970. These crystals were reported to range up to slightly more than 1 ct and to be colorless, yellow, or blue. Although the crystals were of very good gem quality, technical difficulties and high costs prevented the production of these synthetic diamonds from proceeding beyond an experimental stage. It has been widely believed in the jewelry trade since then that such problems would render the commercial production of gem-quality synthetic diamonds economically impractical for some time. Even so, the success of the G.E. scientists in growing gem diamonds in the laboratory prompted some initial concerns within the jewelry industry.

The situation has now changed. In April 1985, Sumitomo Electric Industries of Itami, Japan, announced that they had accomplished the large-scale production of synthetic diamond in the form of gem-quality single crystals (figures 1 and 2). In that report, the synthetic diamonds are described as yellow crystals in sizes up to 1.2 ct (about 6 mm in maximum dimension). More recent information supplied by Sumitomo representatives indicates that they are now producing crystals up to 2 ct (about 8 mm in maximum dimension). Technical product information published by Sumitomo characterizes these synthetic diamonds as being particularly well suited for industrial uses because of their high thermal conductivity, high fracture strength, and relative absence of inclusions. The principal market for these synthetic crystals is for use in precision cutting tools and for heat sinks in electronic equipment. The reported commercial production of synthetic diamonds by Sumitomo indicates that they are able to grow the crystals at a rate sufficient to sustain the needs of an industrial market. This means that we are no longer dealing with an experimental laboratory product but rather with a gem-quality synthetic diamond that is being manufactured on a large-scale and routine basis. Thus, the

Figure 1. Three synthetic yellow diamond crystals manufactured by Sumitomo Electric Industries along with four of the synthetic yellow diamonds that we had faceted. The crystals (left to right) weigh 1.05, 0.63, and 1.07 ct, and measure 5.5, 4.7, and 5.3 mm in maximum dimension. The crystals can be described as distorted octahedral shapes that are modified by large cube crystal faces on the top and bottom and by smaller dodecahedral crystal faces around the edges. The four faceted stones were cut from the rectangular pieces of synthetic diamond (the form in which it is currently sold for use as heat sinks) in such a fashion as to retain maximum weight. The faceted stones weigh between 0.16 and 0.24 ct, and measure between 3.48 to 3.84 mm in maximum dimension. Photo © Tino Hammid.

time is at hand when we may see synthetic gem diamonds coming to light in the jewelry trade.

Representatives of Sumitomo state that their company has no current interest in expanding the sale of gem-quality synthetic diamonds for use in jewelry. At present their entire production of single-crystal synthetic diamonds can be absorbed by their industrial market. However, because of the future implications of this new diamond synthesis technology, and because of the possible directions that developments in this area may take in the next few years, the GIA Research Department has carried out a careful examination of this material to document its gemological properties and means of identification. This article reports the results of our testing by both standard gemological methods and more sophisticated laboratory techniques. As part of the study, we arranged with diamond cutters in New York and Los Angeles to have several pieces of the Sumitomo synthetic diamond faceted. Some general information is presented on the cutting and polishing behavior of the material. The results of our study indicate that the Sumitomo synthetic diamonds exhibit some distinctive features that easily enable them to be separated from natural diamonds by conventional gemological techniques.

BACKGROUND

Some three decades have gone by since the successful synthesis of diamonds was first publicized. The recognized creation of diamonds in the laboratory was achieved in 1955 by scientists at the General Electric Company (Bundy et al., 1955). Since then the synthesis of industrial diamonds has been carried out on a very large scale using several

Figure 2. This close-up view of a Sumitomo synthetic diamond crystal illustrates the appearance of the crystal, the arrangement of the crystal faces, and the nature of the outer surface of the crystal. The crystal weighs 1.07 ct. Photo by John Koivula.

different crystal growth techniques. Synthetic industrial diamonds are currently produced in a number of countries, including South Africa, the Soviet Union, and Ireland, for a wide range of applications. Nassau (1980) and Davies (1984) both review the history of diamond synthesis.

As mentioned above, synthetic diamonds in cuttable-size, gem-quality crystals were first produced by G.E. in small numbers in the early 1970s. The gemological properties of these synthetic gem diamonds have been documented by Crowningshield (1971) and by Koivula and Fryer (1984). The unusual magnetic properties of G.E. synthetic diamonds, first noted by B. W. Anderson (Webster, 1970) and later discussed by Koivula and Fryer, were further investigated by Rossman and Kirschvink (1984). On the basis of the work of these various researchers, the G.E. synthetic diamonds were found to exhibit distinctive gemological properties such as fluorescence, phosphorescence, lack of strain and graining, and the presence of metallic inclusions that would allow them to be recognized using conventional gemological testing methods. The very limited experimental production of these gem-quality diamonds by G.E., however, meant that there was little if any chance that one of these synthetic diamonds would appear in the jewelry market.

SYNTHETIC DIAMOND PRODUCTION BY SUMITOMO

With the recent announcement by Sumitomo, the possibility that gem-quality synthetic diamonds will be seen in the jewelry trade now takes on new importance. According to the information provided by Sumitomo representatives, they have succeeded in mass producing single-crystal synthetic diamonds of consistently high quality for various industrial applications. The crystals are grown at high temperatures and pressures by a flux method using a metal alloy solvent. Small diamond seed crystals are used to start the growth process. The synthetic diamond crystals are transparent, largely free of inclusions and defects, and range up to 2 ct. These synthetic diamonds not only compare very favorably in mechanical properties (such as fracture strength) and thermal conductivity with the best grade of natural industrial diamonds, but they also have the additional important characteristic of possessing very consistent physical properties from one crystal to the next. This is particularly significant for industrial uses. Such uniformity is rarely found in any given selection of natural diamonds. The synthetic diamonds produced thus far contain a controlled amount of nitrogen (reported to be 30 to 60 parts per million), and are thus yellow in color. Although the company representatives state that they are able to vary the color in the crystals from near-colorless to deep yellow, the only material currently being sold is deep yellow. A brief description of the Sumitomo synthetic diamonds and one use of them to develop high pressures is reported by Onodera et al. (1986).

Representatives of Sumitomo state that they are marketing the product for industrial applications in the form of sawn, laser-cut, partly polished, rectangular pieces in various sizes from 0.10 to 0.40 ct (approximately 3 × 1.5 × 1.5 mm to 4 × 4 × 2 mm). This size range is dictated by the industrial application, the production costs, and the yield obtainable from cutting one of the single crystals. It is in this rectangular form that the synthetic diamonds are sold for electrical heat sinks (their primary market) and for industrial and surgical cutting tools. The current price range is $60 to $145 per rectangular piece for sizes from 0.10 to 0.40 ct. Sumitomo does not sell, and does not at present have plans to sell, the uncut synthetic diamond crystals to anyone. Sumitomo representatives have also stated that the company is currently experimenting with the production of synthetic blue diamonds for use as semiconductors as well as synthetic colorless diamonds for industrial applications. Both the blue and the colorless synthetic diamonds have already been grown in the laboratory as single crystals, but they are not yet being produced on a commercial scale.

DESCRIPTION OF THE SUMITOMO SYNTHETIC YELLOW DIAMOND

To document the gemological properties of this new kind of synthetic diamond, we examined 20 of the rectangular pieces of the material as currently marketed by the Sumitomo company. The 20 pieces were produced from at least five different batches (as determined from batch numbers supplied with the pieces) grown over an unknown period of time, with 10 of the pieces coming from a single batch. Each piece has two large, polished, parallel surfaces with various smaller crystal faces around the edges (figure 3). The pieces range in size from 0.11 ct (approximately 3.0 × 1.6 × 1.4 mm) to 0.37 ct (3.7 × 3.6 × 1.7 mm), with the majority representing the larger sizes. All are of similar appearance and of high quality—transparent, free of any cleavages or other prominent inclusions—and an attractive deep yellow color. Even when taken from different growth batches, the synthetic diamonds as a group exhibit a virtually identical appearance and very uniform physical properties. Such consistency illustrates the degree of control of the diamond growth process that has been attained by Sumitomo.

In conjunction with the preparation of this article, the authors met with several Sumitomo representatives. They showed us various examples of their synthetic diamond production, including a very deep yellow round brilliant identified as weighing approximately 0.8 ct. They reported that this well-cut round brilliant was fashioned from a 1.7-ct rough crystal. A brief examination of the cut stone with the microscope revealed a cloud under the table, a step-like fracture under the girdle, and a rod-shaped grayish metallic piece of flux material near the culet. This cut stone is presently on exhibit at the Sumitomo company headquarters.

By special arrangement, we were also able to examine in greater detail three of the uncut single crystals of synthetic diamond. Sumitomo representatives state that the morphology of their synthetic diamond crystals can be varied to yield from cube to octahedral crystal shapes. A typical crystal is a distorted octahedron modified by cube and dodecahedral faces. Crystals with perfect octahedral shapes are reported to be difficult to grow.

Figure 3. This is one of the larger pieces of Sumitomo synthetic diamond that is currently marketed for industrial applications. The piece has been cut from a single crystal such as the ones shown in figure 1. It weighs 0.37 ct and measures 3.7 × 3.6 × 1.7 mm. The large front and back surfaces have been sawn and polished. Various cube, octahedral, dodecahedral, or crystal faces that are modifications thereof, occur along the edge. Magnified 12×; photomicrograph by John Koivula.

The crystals we examined are roughly equidimensional and are more regular in shape than most natural diamond crystals. They are covered by various cube, dodecahedral, and octahedral crystal faces (again, see figures 1 and 2). The dominant development of the cube faces relative to the other faces results in the equidimensional shape of these crystals, which apparently represents Sumitomo's standard product. On each crystal, the upper cube face is smooth, but the lower cube face is quite rough and bears the imprint of the small seed crystal. Depending on the type of industrial application, the rectangular pieces of synthetic diamond are cut from the crystals parallel to either the cube or dodecahedral directions.

Figures 2, 3, and 4 illustrate the appearance of the crystal faces on a crystal and on pieces of the Sumitomo synthetic diamond. Some pieces ex-

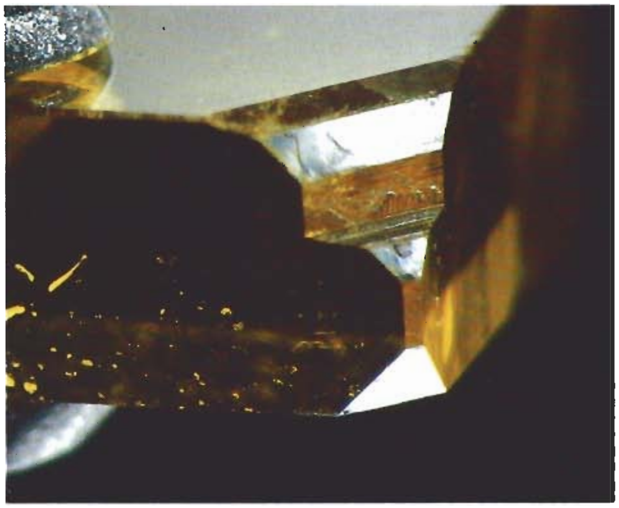


Figure 4. This edge of a piece of Sumitomo synthetic diamond shows the step-like appearance and arrangement of crystal faces. Magnified 25×; photomicrograph by John Koivula.

hibit only a few faces, whereas others show groupings of faces that are more complex. The uneven development of the crystal faces results in variations in their relative surface areas. The faces themselves are flat with no indication of curvature. The smoothness of the faces also varies greatly, from a polished appearance in some instances to very rough and irregular in others. Occasionally the pattern on a crystal face takes on a dendritic appearance, as in figure 5. Sumitomo reports that their synthetic crystals often have surfaces with dendritic growth patterns. However, some of the more irregular crystal surfaces have almost a frosted, melted, or coated look.

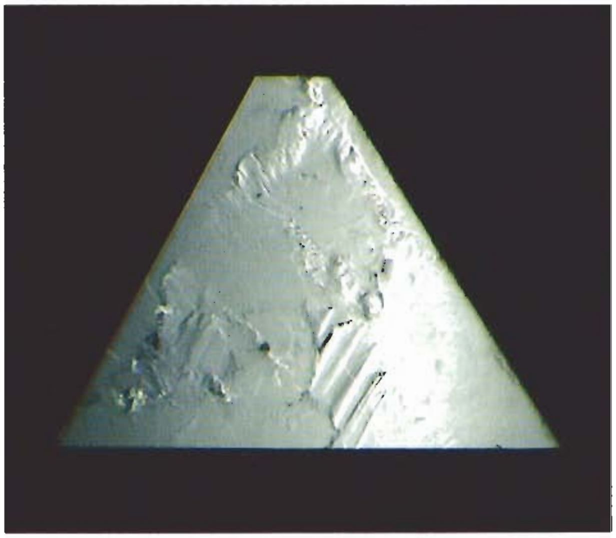
Figure 5. This close-up view of a crystal face on a Sumitomo synthetic diamond displays an irregular surface in the form of a dendritic pattern. The edge of this face has an unusual smooth border. Magnified 40×; photomicrograph by John Koivula.

We carefully examined all 20 pieces of synthetic diamond for the trigons or other growth features that are commonly observed on natural diamond crystals. Each of the synthetic diamonds exhibits various growth features, but in general these differ in appearance from the features on natural crystals. Figure 6 shows the unusual growth-related features that appear on an octahedral face of a Sumitomo synthetic diamond. Between adjacent crystal faces the edges are rather sharp, with no indication of the rounding that is often seen on natural diamond crystals. These differences in the shape and appearance of the synthetic diamond crystals as compared to natural crystals reflect differences in the conditions of growth rate, temperature, time, pressure, and chemical environment, and in depositional history.

DIAMOND TYPES

The discussion of the gemological properties of the Sumitomo synthetic diamond that follows requires a brief summary of what is known about the different types of diamond. It was recognized at an

Figure 6. An octahedral face of a Sumitomo synthetic diamond, seen here in reflected light, shows the unusual growth features on the diamond's surface. No trigons or other growth features seen on natural diamonds are present. Magnified 40×; photomicrograph by John Koivula.



early stage in diamond research that differences in the absorption of light and in other physical properties could be used to classify diamonds into general categories. The classification scheme proposed by Robertson et al. (1934), and since elaborated on by other workers, is generally accepted and is helpful in understanding the gemological properties of diamond. Although the system was initially founded on measurable physical properties, it became clear as research proceeded that the presence of small amounts of nitrogen and boron in diamonds were the major causes of the differences in properties. The classification scheme is based on the concentration levels of nitrogen and boron as well as on the state of aggregation of the nitrogen in a diamond. According to this scheme, all diamonds can be described as containing one or more of the following categories or types:

Type Ia: About 98% of natural gem diamonds are of this type, which is characterized by the presence of nitrogen in fairly substantial amounts (up to about 3000 parts per million, or 0.3%). The nitrogen is distributed in aggregates of a small number of atoms substituting for neighboring carbon atoms. Several kinds of nitrogen aggregates are recognized, leading to the designation of IaA and IaB subcategories. Diamonds in this category usually range from near-colorless to yellow, but they may also be brownish or grayish.

Type Ib: Diamonds of this type are very rare in nature (less than 1%), but all yellow synthetic diamonds are type Ib. They contain lower amounts of nitrogen (up to about 1000 parts per million). The nitrogen is dispersed through the crystal structure in the form of singly substituting atoms. Diamonds in this group are intrinsically yellow and usually have a deep color.

Type IIa: These diamonds are very rare in nature. They are believed to contain nitrogen but at concentration levels below that which can easily be detected with standard infrared techniques. These diamonds are usually near-colorless.

Type IIb: Diamonds in this category are extremely rare in nature, and are believed to contain greater amounts of boron than nitrogen. They exhibit electrical conductivity and are usually blue or gray in color, although on occasion they can be near-colorless.

Excellent reviews of diamond types and the related optical and physical properties can be found in Clark et al. (1979), Walker (1979), Field (1979), and Collins (1982).

Diamond types can be identified by infrared spectroscopy, even if two different types are present in the same stone (as is the case with most natural diamonds). As shown in figure 7, the various diamond types have different and distin-

Figure 7. These infrared spectra were recorded with GIA's NICOLET 60SX FTIR spectrometer for three diamonds: type IaA—a 0.36-ct light gray stone with parallel polished flat surfaces; type IaB—a 1.13-ct milky round brilliant faceted stone; type Ib—one of the rectangular pieces (0.37 ct) of Sumitomo synthetic diamond. As is evident from these spectra, the differing patterns of infrared absorption bands provide a way to distinguish diamond types.

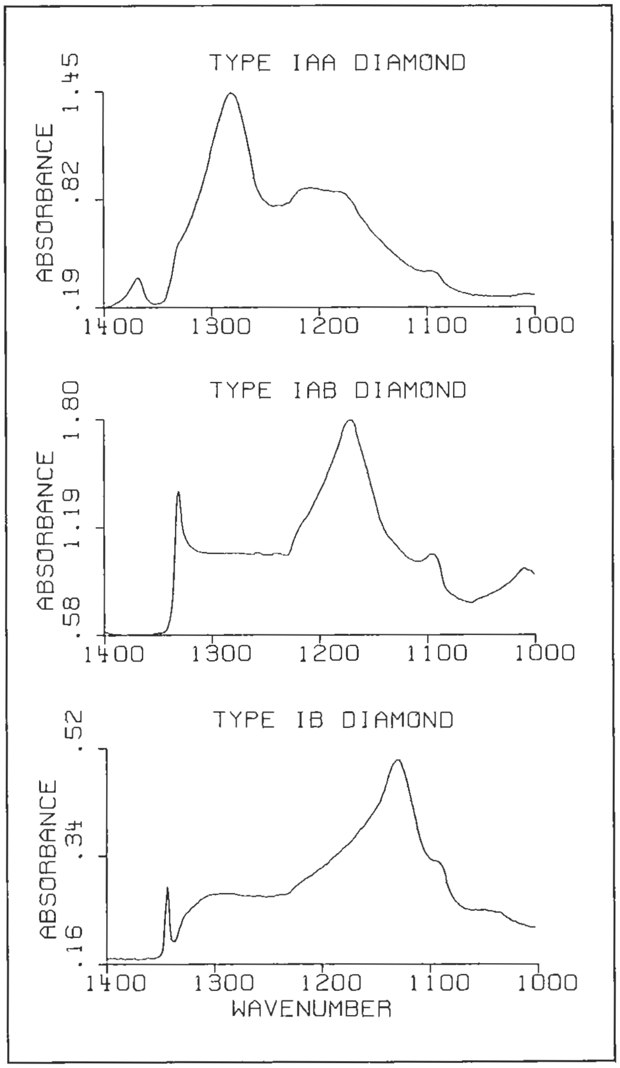


TABLE 1. Comparison of intense yellow natural and synthetic diamonds.

Properties	Natural		General Electric synthetic	Sumitomo synthetic
Type	Ia	Ib	Ib	Ib
Form of nitrogen and concentration level	Aggregated; usually 2000–3000 ppm	Dispersed; usually 100–1000 ppm	Dispersed; usually less than 100 ppm	Dispersed; usually less than 100 ppm
Abundance	Common—about 98% of all gem diamonds	Rare—about 1% of all gem diamonds	All yellow G.E. synthetic diamonds	All yellow Sumitomo synthetic diamonds
Size range of rough	Crystals up to several hundred carats known	Uncertain; crystals up to about 40 ct known	Crystals slightly more than 1 ct or smaller	Crystals about 2 ct or less
Key Identifying Features				
Ultraviolet fluorescence				
Long wave	None to intense; blue, green, yellow, or orange	Usually none, but occasionally orange	None	None
Short wave	Same colors as LWUV fluorescence but variable intensity	Same colors as LWUV fluorescence but variable intensity	None	Moderate to intense; yellow or greenish yellow
Phosphorescence to ultraviolet radiation	None to persistent; various colors	None to persistent; various colors	None	None
Fluorescence to X-rays	None to intense; various colors	None to intense; various colors	None	Weak to moderate intensity; bluish white
Optical absorption spectrum (hand spectroscope)	Usually one or more sharp absorption bands; variable intensity	No sharp bands	No sharp bands	No sharp bands
Additional Characteristics				
Color distribution	Uniform or zoned	Uniform or zoned	Obvious color zoning	Obvious color zoning in rough
Strain (with magnification)	None to obvious; various patterns	None to obvious; various patterns	None to weak strain around inclusions of flux	Cross-shaped pattern in rough
Graining (with magnification)	None to obvious; various types; sometimes colored	None to obvious; various types; sometimes colored	None	Cross-shaped or phantom patterns in rough; hourglass pattern in faceted stones
Inclusions	Crystals, mineral grains, cleavages, knots	Crystals, mineral grains, cleavages, knots	Flux, pinpoints, broom-like features	Vein-like colorless areas, black flux, white pinpoints in rough
Surface appearance of rough	Trigons and other surface growth markings	Trigons and other surface growth markings	Dendritic patterns sometimes present	Irregular or dendritic patterns
Reaction to magnet	No reaction	No reaction	Some attraction due to metallic flux inclusions	Some attraction due to metallic flux inclusions

guishable infrared spectra in the range between 1000 and 1400 wavenumbers (cm^{-1}). The lowermost spectrum in this figure is for one of the Sumitomo synthetic diamonds, which on the basis of its spectrum was determined to be a very pure type Ib. This is important because most natural type Ib diamonds are not a pure type Ib, but also have a small percentage of type Ia character that is easily recognizable in their infrared spectra.

On the basis of our examination using infrared spectroscopy, we can quickly substantiate the pure type Ib character of all the yellow Sumitomo synthetic diamonds. Therefore, the first thing to realize when considering the features that will help to identify these synthetic diamonds is that they represent a type of diamond that is extremely rare in nature. The Sumitomo synthetic diamonds do not correspond with the vast majority of yellow natural diamonds of similar color that are type Ia. The gemological properties discussed in the next section provide a means of identifying diamond types in general and the ways to recognize a Sumitomo synthetic diamond in particular.

RESULTS OF TESTING

During our study we examined three single crystals and 20 rectangular pieces of the Sumitomo synthetic yellow diamond. After examination, we had nine of the rectangular pieces faceted so that we could document the behavior of the material during cutting. In general, all samples of the Sumitomo synthetic diamond exhibit similar, if not identical, gemological properties. The properties discussed below apply to the crystals, the rectangular pieces, and also the faceted synthetic diamonds unless otherwise indicated. Table 1 compares key features of type Ia natural, type Ib natural, the G.E. type Ib synthetic, and the Sumitomo type Ib synthetic yellow diamonds as an aid in the following discussion.

Color. While we are aware that Sumitomo synthetic diamonds can be grown in various shades from near-colorless to deep yellow, all of the stones we examined are deep yellow, and this color is virtually identical from one sample to the next. As expected, the color of the stones became slightly more saturated in appearance after faceting. When compared to the fancy intense yellow master diamond at the Los Angeles Gem Trade Laboratory, the color of the synthetic diamond was much more saturated. When color graded, the faceted synthetic diamonds ranged from yellow to brownish yellow or orangy yellow. The color of some of these Sumitomo synthetic diamonds corresponds to that of the best natural-color yellow diamonds, which the trade frequently refers to as "canary."

Upon further examination, we found that the color of the synthetic diamonds is not distributed evenly within the material. All the pieces of partly polished rough synthetic diamond exhibit a deep yellow inner zone and a narrow near-colorless outer zone, as shown in figure 8. In addition, within the area of deep yellow color there sometimes is a more subtle variation in color intensity. This color zoning was observed to be much less obvious (and sometimes totally absent) in the Sumitomo synthetic diamonds that we had faceted.

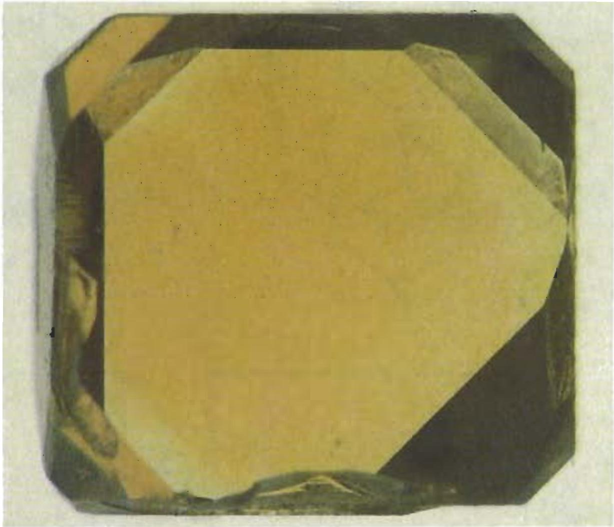


Figure 8. Color in a rectangular piece of the Sumitomo synthetic diamond is distributed such that the deep yellow central portion is rimmed by a narrow (1 mm wide) zone that is either colorless or very pale yellow. The straight line separating these two color zones is sharp and follows the outer shape of the crystal. The colorless zone appears to extend around the entire outer portion of the crystal. This color zoning may be less obvious in a faceted Sumitomo synthetic diamond. Magnified 18×; photomicrograph by John Koivula.

Spectroscopy. Because the Sumitomo synthetic diamonds are type Ib (as are the yellow G.E. synthetic diamonds), their spectra as seen with a hand spectroscope are very different from those seen in most type Ia natural yellow diamonds. The yellow coloration of diamond is due to the concentration of nitrogen and its presence in either a dispersed (type Ib) or an aggregated (type Ia) form. During the growth of most diamonds in the earth, which requires extended periods of time under high temperatures and pressures, some of the nitrogen atoms are able to migrate into clusters within the diamond crystal structure. This leads to the formation of a triangular arrangement of nitrogen atoms that is responsible for the N2, N3, and N4 groups of absorption bands. The N2 and part of the N3 groups are referred to as the "Cape lines" often observed in the ultraviolet and visible spectrum. Because synthetic diamonds are grown in a laboratory over a relatively short time and do not remain at high temperatures and pressures for long periods, there appears to be no opportunity for nitrogen atoms to migrate into groups. The nitrogen atoms thus remain dispersed, and the synthetic diamonds fall within the type Ib category.

Figure 9 illustrates the differences in nitrogen configuration and visible-range absorption spectra for yellow diamonds. The singly substituting nitrogen in a type Ib diamond (like the Sumitomo synthetics) produces a gradually increasing absorption of light toward the violet end of the spectrum. Using a Beck hand spectroscope at both room and cooled temperatures, we observed no sharp absorption bands in the Sumitomo synthetic diamonds, but only a gradual darkening of the

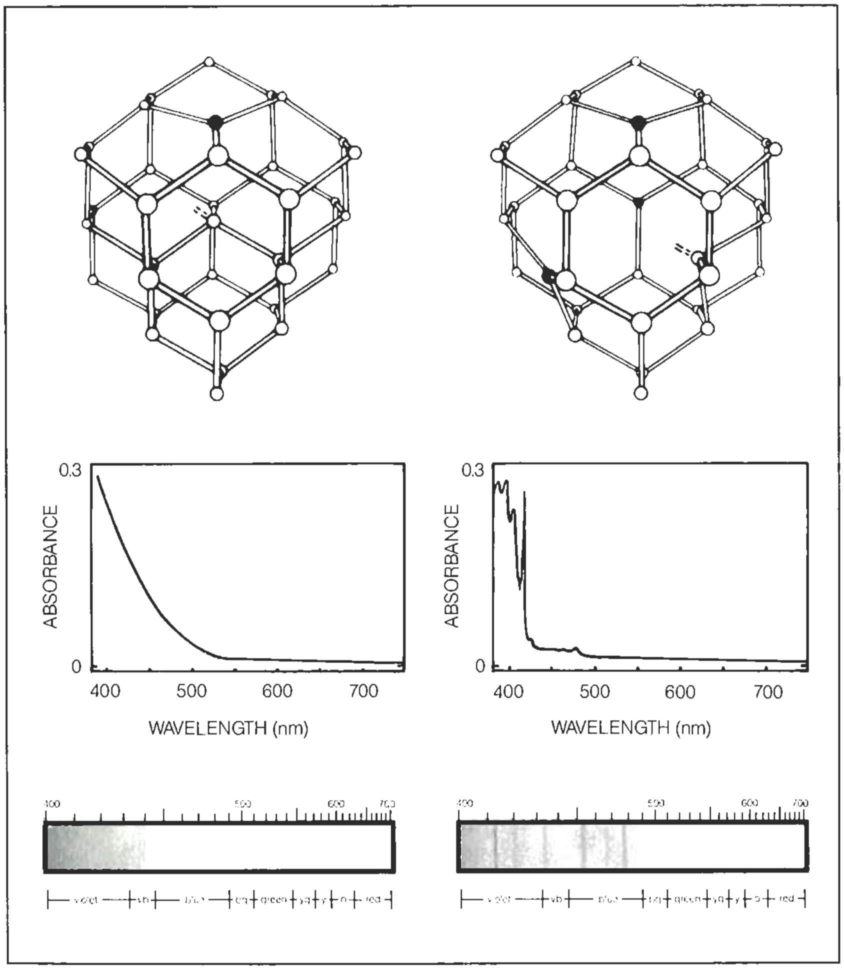


Figure 9. Comparison of yellow type Ib (left) and type Ia (right) diamonds. At top is a drawing of the diamond crystal structure (adapted from Bursill and Glaisher, 1985). Carbon atoms are depicted as open circles, while nitrogen atoms are shown as black circles. In a type Ib diamond, nitrogen substitutes for carbon in the form of single, dispersed atoms. In contrast, in a type Ia diamond, there are clusters of nitrogen atoms like the N3 center, shown at the upper right. In the middle section are absorption 'spectra for these two diamond types as obtained with an ultraviolet-visible spectrophotometer. Absorption of violet and blue light results in a yellow color. A type Ib diamond (e.g., a Sumitomo synthetic diamond) has an absorption curve that increases smoothly toward the violet end of the spectrum. In contrast, in a type Ia diamond there often are sharp absorption peaks, such as the "Cape" series, that can be seen with the hand spectroscope.

spectrum toward the violet end. These results were confirmed by spectra recorded at 60°Kelvin (−213°C) with a Pye-Unicam dual-beam ultraviolet-visible spectrophotometer. In contrast, in a type Ia diamond, the clusters of nitrogen atoms lead not only to an increasing absorption toward the violet end but also to the presence of superimposed sharp absorption bands. With a hand spectroscope, many near-colorless to yellow type Ia diamonds (the vast majority of natural diamonds) exhibit all or some portion of a series of absorption bands of varying intensity at 415, 423, 435, 452, 465, and 478 nm, which is known as the "Cape" series. Most other diamonds in this same color range exhibit other absorption bands (e.g., 503 nm). Thus, at present the observation of any one or more sharp absorption bands in the spectrum of a yellow diamond would immediately identify it as natural (although not necessarily naturally colored). However, the absence of absorption bands does not prove synthetic origin.

Ultraviolet Fluorescence. When exposed to ultraviolet radiation, natural yellow diamonds can either be inert or they can fluoresce in a range of colors. If they do fluoresce, natural yellow diamonds can appear blue, green, orange, yellow, or (rarely) red, when exposed to ultraviolet radiation, and the intensity of fluorescence is typically greater under a long-wave as opposed to a short-wave lamp. After such exposure, many natural yellow diamonds will also continue to glow or phosphoresce when the lamp is turned off.

The synthetic diamonds we examined respond quite differently when tested for ultraviolet fluorescence. When exposed to long-wave ultraviolet radiation (366.0 nm), the Sumitomo synthetic diamonds are inert; but when exposed to short-wave ultraviolet radiation (253.7 nm), they display a zoned moderate to strong yellow and green fluorescence (figure 10). The core of the crystal has a distinct green fluorescence. The fluorescence emission spectrum corresponding to the green

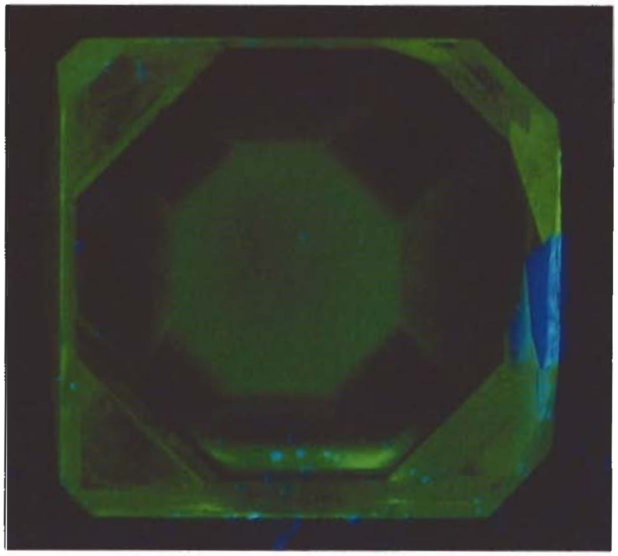


Figure 10. A Sumitomo synthetic diamond fluoresces yellowish green to yellow to short-wave ultraviolet radiation. The greenish fluorescence is often especially pronounced within the central portion of the diamond in the form of a phantom cloud. Four-hour exposure, 160 ASA film, magnified 20×; photomicrograph by John Koivula.

fluorescence seen with short-wave ultraviolet radiation is illustrated in figure 11. The same zoning of luminescence colors can be observed using cathodoluminescence. This kind of fluorescence response, whereby the stone is inert to long-wave ultraviolet radiation but fluoresces greenish yellow to short-wave ultraviolet radiation, has not been reported for natural yellow diamonds and provides an easy way to recognize the Sumitomo material. The small number of natural type Ib diamonds we have observed fluoresce orange to short-wave ultraviolet radiation. Interestingly, some other colors of the G.E. synthetic diamonds examined by Crowningshield (1971) showed a similar fluorescence behavior, but the yellow G.E. synthetic diamond he examined was inert to both long-wave and short-wave ultraviolet radiation. The Sumitomo synthetic diamonds were found to display no phosphorescence.

Fluorescence to X-rays. Many natural diamonds show a bluish white glow when exposed to X-rays. The Sumitomo synthetic diamonds were found to react in the same way when exposed to an X-ray fluorescence unit operating at 66 kV and 35 mA. Under these conditions, the synthetic diamonds all show a bluish white glow of variable intensity but no phosphorescence.

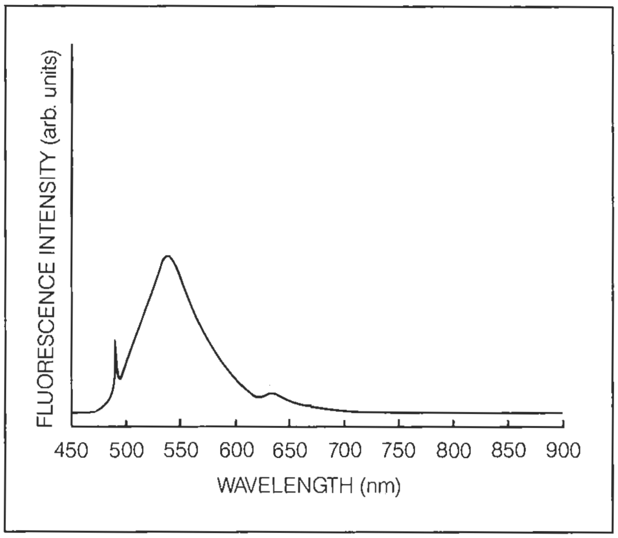


Figure 11. A Sumitomo yellow synthetic diamond produces this fluorescence emission spectrum when excited by a tunable laser. The broad emission peak centered at 540 nm is the green fluorescence of the core of the stone when exposed to short-wave ultraviolet radiation. This broad band and the sharp emission band at 496 nm are thought to be caused by the H4 center. Since the H4 center is related to nitrogen aggregation in the diamond crystal structure, the fluorescence spectrum shown here reveals some unexpected nitrogen aggregation in very minor amounts in the synthetic diamond, at levels apparently not detectable by infrared spectroscopy. Spectrum recorded by Dr. Stephen Rand at Hughes Research Laboratories, Malibu.

Electrical Conductivity. Each of the Sumitomo synthetic diamonds was tested for electrical conductivity with a standard conductometer; as expected, none showed conductive behavior.

Thermal Conductivity. As mentioned above, the Sumitomo synthetic diamonds are reported to have a high thermal conductivity. Using a standard GEM Duotester, which is designed to differentiate a diamond from a diamond simulant on the basis of thermal conductivity, we found that the Sumitomo synthetic diamond responds the same as does a natural diamond. Testing with this type of meter will not indicate that a diamond is synthetic.

Specific Gravity. The specific gravity of the Sumitomo synthetic diamonds was tested using the same heavy-liquid procedure devised by Koivula and Fryer (1984) when they examined the G.E. synthetic diamonds. A large, 16-ct, gemmy octahedral natural diamond, with a specific gravity of 3.51 calculated by careful hydrostatic measurements, was suspended in a specially prepared liquid of Clerici's solution mixed with distilled water. The synthetic diamonds were placed in this liquid one at a time, and each was observed to rise very slowly. The specific gravity of the Sumitomo synthetic diamonds was thus estimated to be 3.505 (±0.005) as compared to about 3.52 for many natural diamonds. The difference is not sufficient to enable one to distinguish a synthetic from a natural diamond based on this property.

Examination with the Microscope. All of the synthetic diamonds were carefully examined to document the nature of any inclusions and other microscopic features. With the microscope, two kinds of solid inclusions were observed in the rectangular pieces of synthetic diamond. Almost all of the synthetic diamonds contain the first kind—whitish, pinpoint-size or smaller inclusions randomly distributed within the material. The other, more prominent type of inclusion consists of opaque, black, metallic pieces of varying size of the metal alloy flux material used to grow the synthetic diamond crystals (figure 12). These flux inclusions, which do not look like any inclusions in natural diamonds, occur most commonly near the outer edges of the rectangular pieces of synthetic diamond. After faceting, neither of these two types of inclusions could be observed in the cut stones. In addition to the inclusions, some of the pieces of synthetic diamond contain small cleavages or fractures near their edges, but these are not common.

A less common but diagnostic inclusion observed with magnification in most of the synthetic diamond pieces consists of unusual, vein-like colorless areas (figure 13). The cause of this feature is not known, but the areas extend from the outer edge of the synthetic diamond inward for a distance of several tenths of a millimeter. Because of this location, however, these colorless veins were not present in the faceted synthetic diamonds. The vein-like areas appear to be randomly distributed among the crystal pieces, but usually only one or two occur in any one piece. When present, the colorless veins are parallel to the dodecahedral crystal faces. Features such as this have not been observed in natural diamonds.

Figure 12. A large, opaque, black inclusion of flux material can be seen near the edge of this piece of Sumitomo synthetic diamond. Magnified 50×; photomicrograph by John Koivula.

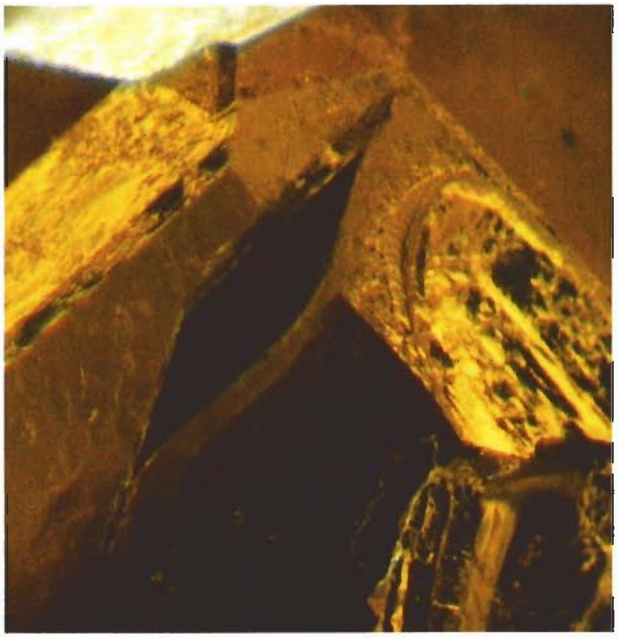
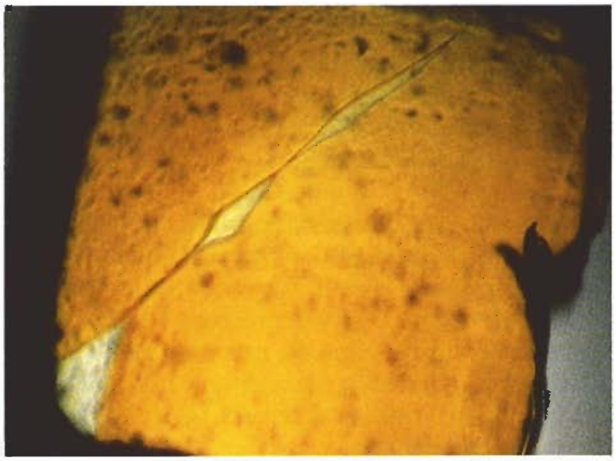


Figure 13. This vein-like colorless zone is a diagnostic feature in the Sumitomo synthetic diamonds we examined. Such a zone is associated with a prominent strain pattern observable in polarized light. Since these vein-like colorless zones are usually near the outer edge of a synthetic diamond crystal, they may be removed during cutting, and thus may not be seen in a faceted Sumitomo synthetic diamond. Magnified 50×; photomicrograph by John Koivula.



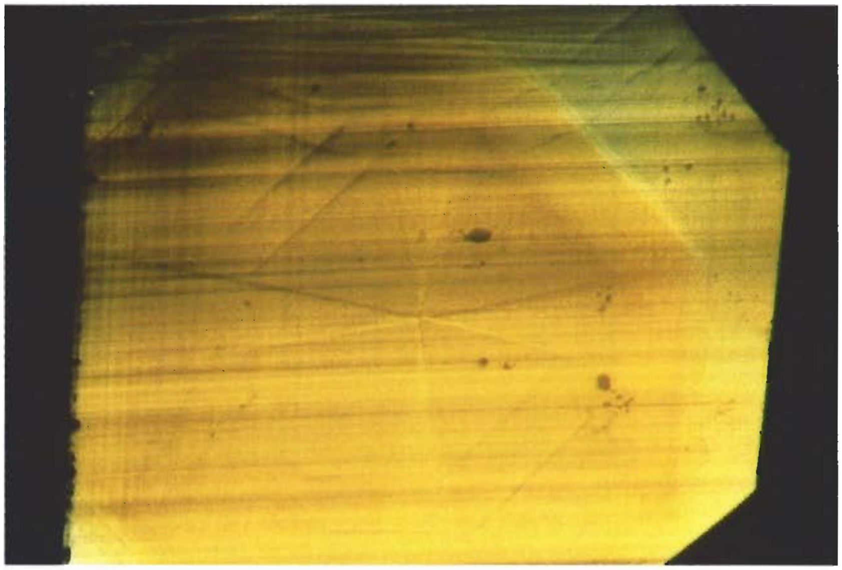


Figure 14. This view of a Sumitomo synthetic diamond illustrates the two prominent types of internal graining seen in this material as well as the distinct color zoning. Comprising one type are the sets of grain lines that parallel the outer shape of the crystal. Comprising the other type are the sets of grain lines that radiate outward from the center to form four wedge-shaped areas. These two types of internal graining were not seen in any of the faceted Sumitomo synthetic diamonds. Magnified 35×; photomicrograph by John Koivula.

In contrast to the scarcity of prominent inclusions, graining is especially evident in the Sumitomo synthetic diamonds. It was observed both internally (figure 14) and even on the surface (figure 15) on almost all pieces of the material. As evident in figure 14, two types of graining are present. The first type occurs as sets of lines seen internally and externally that appear to be parallel to the outer shape of the original diamond crystal. These grain lines provide a phantom "record" of the external shape during crystal growth of the diamond. The second type, seen only internally, occurs as sets of straight lines that radiate outward from the center of the crystal, forming four wedge- or V-shaped areas in the shape of an "iron cross."

Because graining was so prominent in the pieces of Sumitomo synthetic diamond, we were especially interested to see how it would appear in the stones we had faceted. Neither the grain lines that parallel the shape of the crystal nor those that form the wedge-shaped areas could be seen in the faceted stones. Rather, a different pattern of graining, in the form of an "hourglass" shape, was observed through the pavilion of all the faceted stones (figure 16). In addition, as seen in figure 17, some faint phantom grain lines were observed on the surfaces of all the faceted stones, similar in appearance to those seen externally on the pieces of synthetic diamond (figure 15).

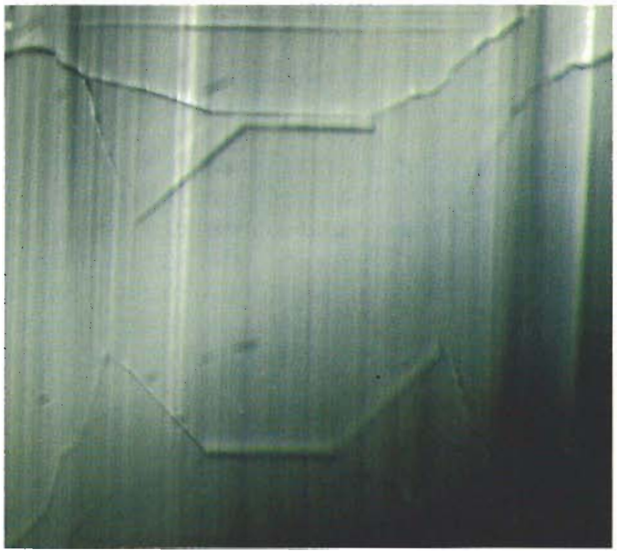


Figure 15. When the synthetic diamond shown in figure 14 is viewed using lighting by surface reflection, graining is evident on its exterior. This graining often persists after cutting on a polished outer surface. Magnified 35×; photomicrograph by John Koivula.

Reaction to Polarized Light. When examined with either a standard polariscope or a microscope equipped with polarizing filters, the Sumitomo synthetic diamonds exhibit a distinctive cross-shaped interference pattern (figure 18). This pattern varies slightly in appearance from one stone to the next, and is most evident when the rectangular pieces of synthetic diamond are viewed along a direction perpendicular to the two parallel polished sides. When the diamond is rotated to a direction perpendicular to the edge of a rectangular piece, the interference pattern cannot usually be seen. The four arms of the cross-shaped pattern either coincide with or are at a 45° angle to the directions of the radiating internal grain lines

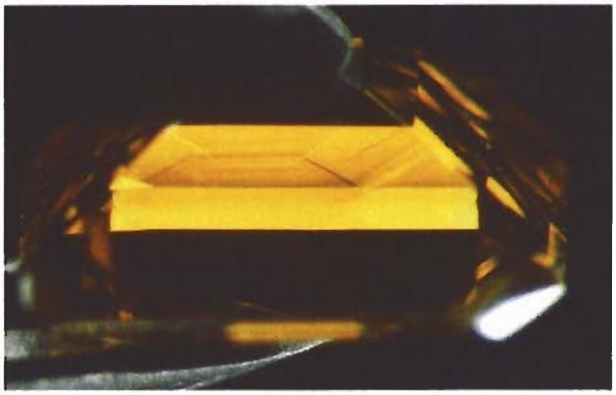


Figure 16. This type of hourglass-shaped internal graining pattern was visible in all eight of the emerald-cut synthetic Sumitomo diamonds. It was always observed in shadowed darkfield through the pavilion. No similar pattern was observed in any of the rough crystal sections. Magnified 35×; photomicrograph by John Koivula.

described earlier. This cross-shaped pattern could not be observed in the faceted synthetic diamonds.

Magnetism. Because, as reported by B. W. Anderson (Webster, 1970) and more recently by Koivula and Fryer (1984), some of the G.E. synthetic diamonds react to a magnet, the Sumitomo synthetic diamonds were tested in a similar manner. Each was attached to a string and then a magnet was positioned nearby. Only one of the Sumitomo synthetic diamonds was attracted to the magnet. An additional test was devised in which the synthetic diamonds were again suspended in the same mixture of water and Clerici's solution used for specific-gravity testing. When a magnet was brought close to the glass container holding this liquid and the suspended diamonds, two of the eight diamonds tested were observed to move through the liquid in the direction of the magnet. We suspect that this magnetic behavior is related to the occasional presence of metallic flux inclusions in the synthetic diamonds. Since the number of flux inclusions varies greatly from one diamond to the next, this could explain the observed difference in magnetic attraction.

Figure 18. Before faceting, the Sumitomo synthetic diamonds typically exhibit a cross-shaped interference pattern when examined with a polariscope or a polarizing microscope. Magnified 18×; photomicrograph by John Koivula.

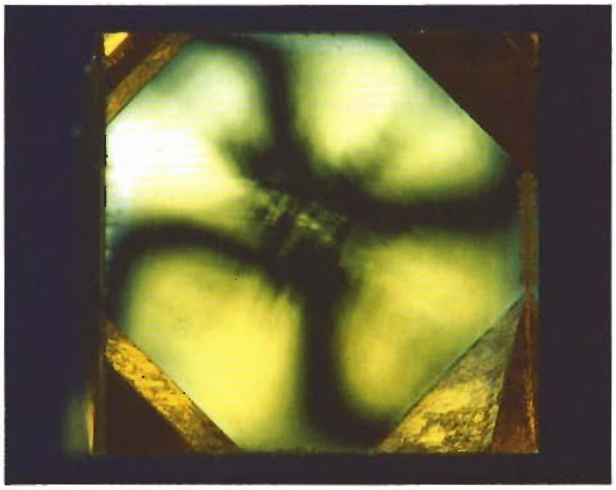


Figure 17. The surface grain lines shown here on one of the faceted stones reflect the external shape of the original Sumitomo synthetic diamond crystal. All of the faceted Sumitomo diamonds showed similar patterns on their tables. Oblique shadowed illumination, magnified 25×; photomicrograph by John Koivula.

FACETING BEHAVIOR

Because the Sumitomo synthetic diamonds are now available on a commercial basis, we were interested in documenting some aspects of how the material might behave during faceting. In particular, we wanted to learn how easily these synthetic diamonds could be polished and what their weight retention from the rough might be. We arranged with several diamond cutters in New York and Los Angeles to have nine of the rectangular pieces of Sumitomo synthetic diamond faceted (figure 19). These pieces varied from 0.34 to 0.39 ct, and from 3.55 × 3.54 × 1.63 mm to 4.00 × 3.76 × 1.62 mm. We arranged for one piece to be faceted as a round brilliant, which yielded a 0.08-ct stone

Figure 19. Four of the synthetic diamonds that we had faceted from the rectangular pieces of the material. The round single cut weighs 0.08 ct and measures 2.80 × 2.80 × 1.69 mm. The step-cut faceted pieces weigh between 0.16 and 0.24 ct and measure between 3.48 and 3.84 mm in maximum dimension. Photo © Tino Hammid.

measuring 2.80 × 2.80 × 1.69 mm. The weight retention after cutting was 22%, and the depth percentage was 60%. The remaining eight pieces were faceted in a square step cut. In these instances, we instructed the cutter to facet the synthetic diamonds so as to retain maximum weight while fashioning as attractive a stone as possible. These faceted synthetic diamonds range in weight from 0.16 to 0.24 ct. The largest of them measures 3.84 × 3.63 × 1.72 mm. The weight retention for these stones after cutting varied from 49% to 64%, and the depth percentage from 43% to 52%. Considering the cost of the pieces of synthetic diamond we used and the approximate cutting cost, the price per carat of this type of Sumitomo synthetic diamond would be equal to or slightly exceed the price of a natural diamond of similar hue and clarity.

If Sumitomo at some future time were to release the rough crystals themselves, the weight retention of a faceted stone would certainly be much higher than we obtained in faceting the rectangular pieces and might, therefore, be cost effective. The approximately 0.8-ct faceted round brilliant that we examined briefly was identified as having been cut from a 1.7-ct rough crystal. Because we had no information on how this round brilliant was cut from the rough, we were interested in estimating the weight of the round brilliants that could be cut from the three crystals that Sumitomo loaned us.

Because of the blocky shape of these crystals with their blunted top and bottom surfaces, we felt it would be impractical to try to saw them and to fashion more than one faceted stone from each. Thus, they could be considered much like a recutting project on an "old-style" faceted stone. In examining the three crystals, the GIA Proportionscope was used to verify sufficient thickness above and below the octahedral girdle plane for fashioning a Tolkowsky cut, which would yield the largest stone. Accordingly, a 62% depth was selected in our calculations to retain the greatest amount of weight. Note that this is in contrast to the standard practice of sawing natural octahedral rough and then cutting to slightly spread proportions to retain the greatest weight. By using the standard GIA weight-estimation formula (diameter^2 × depth × 0.0061), the 0.63-ct crystal would yield a 0.32-ct round brilliant with 51% weight recovery; the 1.07-ct crystal, a 0.45-ct stone with 42% recovery; and the 1.05-ct crystal, a 0.57-ct stone with 54% recovery.

After completing the faceting, the cutters had some interesting comments on the faceting behavior. An attempt was made to cleave and then saw one of the pieces of synthetic diamond. In doing so, the cutter noted no significant differences between this material and natural diamonds. One cutter observed that the facets on the synthetic diamonds had only one polishing direction. All of them reported that the synthetic diamonds polished easily and seemed to be less brittle than most natural diamonds. However, while some natural diamonds will polish more rapidly if downward pressure is applied to the dop, this was not the case for the synthetic diamonds. Rather, when pressure was applied to the dop, the synthetic diamond would rapidly take all of the diamond powder out of the wheel, which would then need to be refinished before further use.

The synthetic diamonds were free of knots or other defects that might have influenced the polishing. One cutter reported that the synthetic diamonds could be polished on just the coarser portion of his wheel, and did not require polishing on the finer portion as is typical for natural diamonds; this behavior is very unusual. While natural diamonds frequently become very hot during polishing, the synthetic diamonds did not get nearly as hot on the wheel, and they could be touched with the hand soon after being taken off of the wheel. We know that this tendency not to heat up is the result of the superior thermal conductivity of the Sumitomo synthetic diamonds, since they are produced for the very purpose of acting as heat sinks in electronic equipment. However, if the dop was pushed too hard, facets on the synthetic diamonds could be burned as they could on a natural stone, and they would then require repolishing. The cutters also noted that the synthetic diamonds turned a bright orange or brownish orange while they were placed on the wheel. Although some natural intense yellow diamonds will turn orange on the wheel, this color is not nearly as intense as the color displayed by the Sumitomo synthetic diamonds. Finally, we asked the cutters whether, if they had not been told that the stones were synthetic diamonds prior to faceting, they would have noticed some difference during faceting. They reported that they would have suspected that something was different about the diamonds.

We arranged to have only a small number of the Sumitomo synthetic diamonds faceted, and are unable to fully account for some of the observations reported above. Too, there were slight differences in the answers of different cutters to our questions. The cutter at the firm of Lazare Kaplan International, the same company that faceted some of the G.E. gem-quality synthetic diamonds in the early 1970s, did comment that the Sumitomo synthetic diamonds faceted like the G.E. stones.

MEANS OF IDENTIFICATION

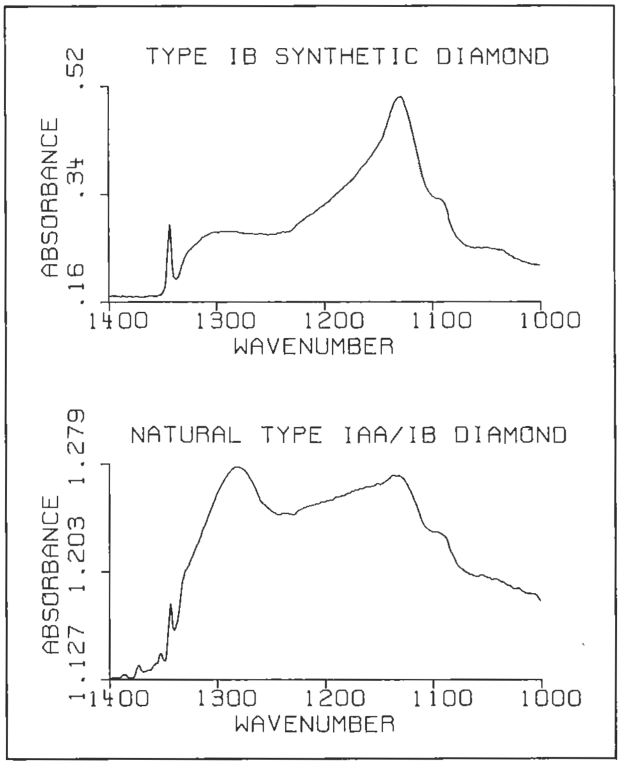
It is important to recognize that when Sumitomo synthetic yellow diamonds meant for industrial uses are faceted as gemstones, they correspond to the type Ib category of natural diamonds which is very rare. We have found that these synthetic diamonds can be distinguished very easily by the jeweler/gemologist using standard gemological techniques. The following diagnostic properties are based on our examination of the Sumitomo synthetic diamonds that we had faceted.

1. **Ultraviolet Fluorescence**
   In examining a small yellow diamond suspected of being synthetic, the most easily observed distinctive feature is the unusual ultraviolet fluorescence. Unlike natural yellow diamonds, these synthetic diamonds are inert to long-wave ultraviolet radiation but fluoresce a greenish yellow or yellow to short-wave ultraviolet radiation.
2. **Spectra**
   In conjunction with the unusual fluorescence behavior, the Sumitomo synthetic diamonds can be readily distinguished from most intense yellow type Ia natural diamonds by the presence of sharp absorption bands in the latter when viewed with a hand spectroscope. The observation of any sharp absorption bands in the violet

and blue portions of the spectrum is enough to confirm natural origin. However, the absence of any bands does not prove the stone is synthetic.

3. **Color**
   Presently the Sumitomo synthetic diamonds are only available commercially in a deep yellow color. At this time, an unknown diamond with a light yellow color is unlikely to be a Sumitomo synthetic diamond, but its spectrum and its reaction to ultraviolet radiation should be tested for the results described above.
4. **Size**
   At present, the precut Sumitomo material available for industrial purposes is quite small, and is likely to yield faceted stones of less than 0.24 ct. This situation may change in the future if the Sumitomo Company releases some of their larger crystals on the market. This possibility seems unlikely at this time according to their statements.

Figure 20. The infrared spectrum of a pure type Ib Sumitomo synthetic diamond is compared here with that of a natural type Ib diamond that has a small amount of type IaA character. The fact that natural type Ib diamonds invariably have some type IaA features in their infrared spectra provides a means of distinguishing them from type Ib synthetic diamonds, which lack these features.



5. **Magnification**
   Further confirmation that a stone in question is a Sumitomo synthetic diamond comes from observations with the microscope. The prominent internal graining, distinct color zoning, metallic flux inclusions, and unusual colorless areas that are present in the rectangular pieces of synthetic diamond may not be seen in faceted stones. Nor is the cross-shaped interference pattern likely to be seen. The two most distinct features seen with the microscope are the "hourglass"-shaped pattern of internal grain lines visible through the pavilion of all of the faceted stones and the surface grain lines on the table facets that phantom the shape of the original parent crystals.

A final verification of the natural or synthetic origin of a yellow diamond is provided by infrared spectroscopy. As shown in figure 20, the infrared spectrum of a natural Ib diamond invariably displays not only Ib-related features but also those due to type Ia nitrogen. The infrared spectra of the Sumitomo type Ib synthetic diamonds lack these Ia features. Therefore, it is our opinion that at the present time the identification of synthetic diamonds from Sumitomo can be made on the basis of standard gemological testing supported, if necessary, by examination with more advanced equipment.

CONCLUSION

The large-scale production of gem-quality synthetic diamonds by Sumitomo Electric Industries forces members of the jewelry industry to reconsider their views regarding the likelihood of such material appearing in the gem marketplace. After some initial concern in the early 1970s, the G.E. synthetic gem-quality diamonds were found to have identifiable gemological characteristics. Moreover, they were only produced in small numbers on an experimental basis at great cost. Since their appearance, the opinion that the commercial production of synthetic gem diamonds at a cost comparable to natural gem diamonds is economically impractical has been widely held and frequently reiterated. The advent of the Sumitomo synthetic gem-quality diamonds may change this situation, and we may see other companies following their lead in this area. However, because diamond-growth conditions in the laboratory are not equivalent to those in nature, the features exhibited by synthetic diamonds will differ from the features of natural diamonds. As new kinds of gem-quality synthetic diamonds are produced, a careful examination of them should continue to identify those characteristics by which they can be recognized. The Sumitomo synthetic diamonds can be readily distinguished by standard gemological tests, but to do so the jewelry industry will need to pay closer attention to documenting the gemological properties described here when working with small yellow diamonds of intense color.

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ART NOUVEAU: JEWELS AND JEWELERS

By Elise B. Misiorowski and Dona M. Dirlam

The Art Nouveau movement, with its startling concepts in design, swept through Europe and the United States in the late 19th and early 20th centuries. The asymmetrical whiplash line which typifies Art Nouveau was manifested in art, architecture, metalwork, textiles, and interior design. Perhaps its most concentrated and refined expression can be seen in the spectacular Art Nouveau jewels, which incorporated more unusual gems and gem materials such as moonstones, horn, ivory, opal, turquoise, and tourmalines into a host of fanciful designs. This article discusses the origins of Art Nouveau and outlines the distinctive interpretations and contributions made by significant Art Nouveau jewelers.

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From the mid-19th century to the beginning of the First World War, an enormous surge of creative energy expressed itself in virtually every aspect of Western culture. There were advances in technology and science, and revolutionary expressions in fine art, music, literature, and the applied arts. In this expansive cultural climate, a style was developed that was as unique as it was short-lived. Art Nouveau, as the movement has come to be known overall, grew out of several factors. Technological advances, brought about by the industrial revolution, improved communications internationally through travel and commerce. Exhibitions of exotic arts and artifacts exposed the artists of the day to stimulating new concepts in design and use of materials. These new ideas then added impetus to an artistic revolt against the dehumanizing influences that were also by-products of the industrial revolution.

This new form of expression was manifested differently and given different names in each country, but all were variations of the new art. An early version was called Arts and Crafts, or Liberty Style, in England and later in the U.S. In France it was called Art Nouveau or Fin de Siècle. It was known as Jugendstil in Germany, Secessionstil in Austria, Palingstil in Belgium, and Modernismo in Spain. Although nearly every country in Western culture manifested this new art in some way, not all of them made significant contributions to jewelry design. For example, Italy was so involved in producing replicas of classic jewels that its artisans produced little if any new-art jewelry, although they acknowledged the movement as *Stile Liberty.* Yet jewelers in England, France, Germany, and the United States played major roles in different developmental stages of the Art Nouveau style. Using more unusual gemstones and materials than their predecessors in the Victorian era or their counterparts in the Edwardian style, the Art Nouveau designers created pieces that are as exciting and fascinating today as they were when the movement first started more than 100 years ago.

THE ELEMENTS OF ART NOUVEAU

Origins of the Movement. Many factors influenced the development of Art Nouveau. Of great importance was the desire to break loose from the heavy, ornate, almost repressive styles that held sway during the Victorian period. Innovations in metal technology during the industrial revolution furthered this rigidity of style by enabling the mass-production of machine-made pieces. In the middle of the 19th century, however, it became fashionable to wear jewelry patterned after ancient Greek, Roman, and Etruscan pieces discovered during the burgeoning of archeology. This historicism gave rise to a romantic revival which saw artists turn away from industry and draw their inspiration directly from nature. In France, interest in the elaborate curved forms of rococo was gradually revived, as a similar revival of interest in the design elements of Gothic and Celtic art was seen in the British Isles. With these revivals came a spiritual yearning for the craft guilds of the Middle Ages. Societies, formed to promote the decorative arts, sponsored exhibits and competitions that acted as further stimuli.

Perhaps the single most important influence on the development of Art Nouveau design, however, was the resumption of trade with Japan in 1854. The exhibits of Japanese art held in the 1860s had a tremendous impact on European artists. When Siegfried Bing (1838–1905) opened a Japanese import shop in Paris in 1871, he further exposed the Parisian artworld to Japanese concepts of design (Weisberg, 1986). The simplicity of Japanese art and the economy of line shown in their interpretation of nature was an immediate inspiration to the Western world. Curve of human form, flow of movement, balanced asymmetry, subtle use of color and shading were aspects of Japanese art that surprised Europe and greatly influenced the manner in which artists viewed and interpreted life forms.

Numerous exhibitions in Europe and the United States displayed artwork and artifacts from many other countries as well, exposing artists to Indian, Arabic, Persian, and Oriental cultures. Exotic species of plants, such as the tiger lily, wisteria, chrysanthemum, bleeding heart, and orchid, often represented in Art Nouveau jewelry, were first introduced to Europe in the 19th century. Art Nouveau became a metaphor for the metamorphosis of the times, translating the myriad influences into a unique form of art that expressed itself in architecture, fabrics, furniture, wall coverings, and perhaps most pervasively, in jewelry.

Art Nouveau Motifs. Among the many recurring images found in Art Nouveau jewelry, the most widely recognized motif is that of a naked or partially clothed woman surrounded by her loose flowing hair, often depicted swimming or in flight, symbolically demonstrating her freedom (figure 1). Nature, associated with fertility and femininity, is unselfconsciously sensual. This eroticism is apparent in the sinuous interpretation of nature in the Art Nouveau line, which expressed movement, passion, vitality, and the youthful vigor of new ideas. Often called the "whiplash line," it represents the common element found in virtually every Art Nouveau design and provided the stimulus for some of the descriptive names for Art Nouveau such as Palingstil, which means "eel style."

Winged creatures of many kinds were also common in Art Nouveau jewelry. The peacock in particular is frequently seen, as are swans, swallows, roosters, owls, and bats. Insects such as the dragonfly and butterfly were special favorites because enamelists could skillfully represent the gauzy transparency of wings in a startlingly realistic manner (figure 2). Scarabs, with their mystical connection to Egyptian lore, were also common subjects, as were grasshoppers, bees, and wasps. Snakes, which were often used in Victorian jewels as stiff symbols of eternal love, acquired sinister new life and movement in Art Nouveau (figure 3). The chameleon and lizard were also represented, as were fish, seahorses, and other sea creatures. A "fascination with the shocking and nightmarish,

Figure 1. Partially clad female figures are one of the most common motifs in Art Nouveau jewelry, as illustrated by these two pendants and brooch designed by Spanish jeweler Luis Masriera. The materials used—cast and enameled gold with opals, sapphires, pearls, and plique-à-jour enamel—are also typically Art Nouveau. These pieces are recent remakes from the original mold. The winged piece is 6.0 × 6.5 cm long. Courtesy of Rita Goodman, Peacock Alley Collection. Photo © Harold & Erica Van Pelt.

Figure 2. This dragonfly brooch with a woman's face carved in ivory shows one of the fanciful forms that Art Nouveau jewelry often takes. Of gold, ivory, plique-à-jour enamel, diamonds, and demantoid garnets, this piece (9 × 8.5 cm) is a recent remake from an original mold by Luis Masriera. Courtesy of Rita Goodman, Peacock Alley Collection. Photo © Harold & Erica Van Pelt.

with things which are not what they appear to be" (Becker, 1985) manifested itself as mythical characters and beasts such as Medusas, griffons, dragons, and chimeras.

The Japanese influence can be detected in a realistic view of nature's cycles and elements. Buds or seedpods, full blooms, and withered drooping flowers expressed birth, death, and rebirth, while miniature landscapes depicted the passage of the seasons. These life cycles allowed for a subtle use of color that was typically Art Nouveau: Spring and summer were shown in verdant greens, delicate pinks, mauves, and lavenders, highlighted by rich magentas and purples; deep reds and oranges mixed with subtle earth tones expressed autumn; and the chill of winter can be seen in cool variations of blue and silver.

Gems and Other Materials Used. These colors were best expressed in Art Nouveau jewelry by the extensive use of enamels. This period experienced a renewed interest in enameling, possibly a consequence of the influx of Japanese artifacts which introduced new or forgotten techniques to the West. A variety of enameling techniques came into vogue, including cloisonné, champlevé, plique-à-jour, and pâte-de-verre. Cloisonné enamel is made by forming small cells, or *cloisons,* with wire on a metal backing and filling them with separate colors of enamel. Champlevé enamel involves hollowing out small areas of metal and filling them with enamel. Plique-à-jour is a difficult technique that produces a stained-glass-window effect. Gold chambers backed with thin copper sheets are filled with transparent enamels. After firing, the copper backing is dissolved in an acid bath, leaving the enamel with the transparency of a pane of glass. Pâte-de-verre, the ancient Egyptian technique of melting ground glass and molding it into complex shapes, was reintroduced and often used in place of gem materials.

The combination of inexpensive materials and expensive gems is typically Art Nouveau. There was extensive use of horn and ivory, both of which could be stained soft colors and polished to give them a bloom and sheen. Metals also were given colored patinas to work within the theme of a piece. Gemstones usually were incorporated into the work as accents and complements to the design rather than as the central focus. Opals were popular gems, as their changing colors suggested an inner life. The subtle colors of moonstone, chalcedony, peridot, amethyst, aquamarine, topaz, demantoid garnet, and tourmaline made these gems popular, while diamonds, sapphires, rubies, and emeralds were generally given the secondary role of accents. Mother-of-pearl, turquoise, lapis lazuli, and malachite were often cut *en cabochon* or used as inlay, while baroque pearls were frequently dangled from pendants and brooches or were used to represent pods or petals.

Some Art Nouveau jewelers continued the age-old practice of incorporating simulants into their jewelry. During this period an imitation emerald triplet was constructed by cementing a rock crystal crown and pavilion with a layer of green gelatin. Called soudé (French for *soldered*) emeralds, one appears as the center stone in a moth pendant by Lucien Gautrait (figure 4). Also during the 19th century, scientists in national museums and universities were attempting to duplicate gems and minerals by growing synthetics. Auguste Victor

Figure 3. Of unknown French origin (c. 1900), this snake necklace demonstrates the grotesque aspects of Art Nouveau jewelry while incorporating two gemstones, black opal and demantoid, that characterize the period. Courtesy of Rita Goodman, Peacock Alley Collection. Photo © Harold & Erica Van Pelt.

Louis Verneuil succeeded in producing the first synthetic gemstone—Verneuil ruby. Crystals of these rubies were on display at the Paris Exposition Universelle de 1900 (1900 Paris Exhibition). It is not surprising, therefore, that some Art Nouveau jewelry contains simulants or synthetics.

The older generation of Victorians regarded this untamed and self-indulgent style as the height of depravity, while the upper-class Edwardians disdained Art Nouveau as decadent and bourgeois. The Edwardian style of lavish but staid monochrome jewels of diamonds, pearls, and platinum, which was developing at the same time, provided a counterpoint to Art Nouveau jewelry, with its use of inexpensive materials, subtlety of color, and highly charged motifs. By 1900, however, according to French designer Henri Vever, "most people of fashion had taught themselves to like Art Nouveau." Those who resisted the infatuation were considered to have no taste (Becker, 1985). Although the modern woman of the time didn't necessarily subscribe to immersing herself in the Art Nouveau style of furnishings and architecture, it was still a safe move for her to "risk her

Figure 4. This gold moth pendant, by French Nouveau jeweler Lucien Gautrait, incorporates a quartz triplet (to imitate emerald) as the center stone. This piece, c. 1900, measures 6 × 5.5 cm. Courtesy of Rita Goodman, Peacock Alley Collection. Photo © Harold & Erica Van Pelt.

reputation for taste by indulging herself in the purchase of a piece of contemporary jewelry . . ." (Battersby, 1968).

While Art Nouveau was one of the first truly international movements, Art Nouveau jewelry tended to acquire the character of each country in which it was fashioned. Thus, to understand the various manifestations of Art Nouveau jewelry, we will examine some of the foremost designers from those countries in which Art Nouveau had a major impact on jewelry.

GREAT BRITAIN

Much of Art Nouveau's early development occurred in Great Britain. Not only was England the first country to experience the industrial revolution, but it was also the most advanced industrial nation throughout the 19th century. Furthermore, its dominant role as a colonizing empire brought new ideas and exotic objects which stimulated artistic as well as scientific and political thought. By the early 1800s, critics were questioning the impact of the industrial revolution on daily life. The Great Exhibition of London in 1851 further strengthened their case. The display of machine-made goods – shoddy and often tasteless – was impetus to the movement. The art community called for a return to the principles of freedom of expression for individual artists and craftsmen. This, they argued, would bring an enjoyment of art to the lives of ordinary people. The Arts and Crafts movement was the expression of this change.

John Ruskin (1819–1900) laid the foundation for the Arts and Crafts movement with his ideas and his writing. In his earliest published work (1843), he tells the artist to "go to Nature in all singleness of heart, and walk with her laboriously and trustingly" (Nevins, 1986).

By the 1850s, a young undergraduate, William Morris (1834–1896), had joined Ruskin's cause. In 1861, Morris started a firm to produce tapestries, wallpaper, textiles, stained glass, and furniture – called Morris, Marshall, Faulkner & Co. – that promoted natural themes. The motifs that Morris used for his wallpapers and fabrics were drawn from simple flowers in his garden: tulips, honeysuckles, lilies, daisies, anemones, marigolds, larkspurs, and carnations (Nevins, 1986).

The Arts and Crafts movement also promoted the formation of guilds and art schools, where craftsmen were trained to design, make, and decorate the object from beginning to end. For the first time, women were also involved in the design and fabrication of jewelry and jeweled objects. Shunning precious metals and expensive gemstones, they used humble materials and enameling to produce strong yet simple pieces.

Although Ruskin established the first cooperative, the Guild of St. George, in 1871, Charles R. Ashbee (1863–1942), a former architect and a self-taught silversmith and jeweler, was the most influential designer of the Arts and Crafts movement. He founded the School of Handicraft in 1888; out of his work, his theories, and his guild evolved guidelines for other groups (Hinks, 1983).

Ashbee is particularly famous for his interpretations of the peacock motif, making use of turquoise-colored enamels or abalone (figure 5). He often set the feathers with gemstones from the expanding British empire: pearls from India, opals from Australia, moonstones from Ceylon (Sri Lanka), and diamonds from South Africa (Armstrong, 1977). These continued to be favorites of the Art Nouveau jewelers. Ashbee's sensuous use of plant motifs, moths, and other insects heralded the onset of Art Nouveau themes.

While the Arts and Crafts movement of the 1880s was the catalyst for the whole European and American artistic revolution, it was Arthur Lazenby Liberty (1843–1917) who translated its esoteric design into fashionable jewels. After apprenticing as a draper, Liberty joined the Farmer and Rogers' Great Shawl and Cloak Emporium in Regent Street in 1862. This was the very same year of the International Exhibition in Kensington, where the major attraction was the Japanese section. Farmers and Rogers bought the bulk of the Japanese exhibit and opened the Oriental Warehouse, which Liberty managed for many years before he opened his own shop, the East India House.

Liberty saw the talent and potential of the Arts and Crafts designers, and commissioned exclusive designs for his fabrics (figure 6) and later for silver and other metalwork. He began importing Art Nouveau objects from the Continent around 1897, notably some of the Jugendstil metalware from the German firm of Kayser. When this proved successful, he launched his own line of metalwork in the late 1890s under the trade name Cymric.

An important aspect of the Cymric style of English Art Nouveau jewelry was its revival of Celtic art. The Celts, who had inhabited West Central Europe, invaded the British Isles about 250

Figure 5. Founder of the Guild of Handicraft in London, Charles Ashbee is known for his use of the peacock motif. This example is of gold, silver, coral, and abalone (c. 1900). Courtesy of the Jesse & Laski Gallery, London.

B.C. Their art displayed distinctive features of knots, curving lines, and geometric interlacing. Archibald Knox (1864–1933) was largely responsible for the inclusion of Celtic art and the success of the Cymric style (figures 7 and 8).

During this period, the Murrle, Bennett & Co. jewelry firm produced a distinctive range of jewelry. Some pieces in silver had a hammered finish with tiny bump-like rivets and were often set with mother-of-pearl or amethyst. Also typical were gold jewels with a matte sheen set with turquoise and matrix, opal, amethysts, or baroque pearls. The lines often used the Celtic interlacing or consisted of gold wires draped over a stone.

In Scotland, Charles Rennie Mackintosh (1868–1928), architect and designer, led the Glasgow School, a pioneering group of architects and designers who greatly influenced the decorative arts in Great Britain and America, and in Western Europe. Mackintosh exerted a formative influence on jewelry design in Austria, even though he himself designed only a few pieces of jewelry. His best-known design is one of birds flying through storm clouds with rain drops of pearls.

The Art Nouveau movement in England, though, in the words of author Graham Hughes (1964), "was almost stillborn because of British

Figure 6. This printed cotton (c. 1896) demonstrates how Liberty and Co. adapted the Oriental design elements that had so much influence on the decorative arts during this period. Photograph courtesy of the Smithsonian Institution Traveling Exhibition Service.

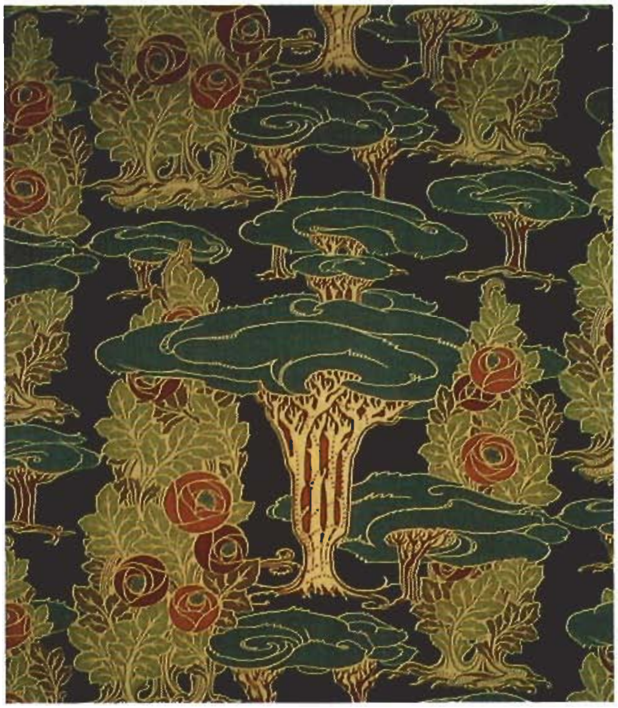

Figure 7. Famed English designer Archibald Knox created this 18K gold and opal necklace for Liberty and Company (c. 1900). Courtesy of the Jesse & Laski Gallery, London.

reticence: as a nation we do not indulge in orgies of visual fun." While the British set the stage in terms of design influence, materials used, and emphasis on craftsmanship, the British reserve prevented the total indulgence in Art Nouveau that ultimately gave it such great impact. The greater freedom of artistic expression in France enabled the French to develop the basic concepts embodied in the Arts and Crafts movement in England into the full sensuality, lyricism, and fancifulness seen in works by Lalique and others.

Figure 8. Knox designed this gold "waist clasp" for Liberty and Co. (c. 1901). Created as a monogram E.R. (Edward Rex) in honor of King Edward VII, it well exemplifies the whiplash line. Courtesy of the Jesse & Laski Gallery, London.

FRANCE

French Art Nouveau jewelry is generally considered to represent the style in its purest form. For innovation, imagination, quality of workmanship, and mastery of techniques, the French Art Nouveau designers are unsurpassed.

French jewelers were inspired by gothic and rococo designs as well as by design concepts recently introduced from Japan. There is also some evidence that the avant-garde of the Parisian cafe society had been experimenting with drugs for some time in their ongoing search for new experiences and new sources of inspiration (Armstrong, 1977). This experimentation may have contributed to some of the bizarre combinations of insects, animals, and humans that are frequently seen in French Art Nouveau jewelry: women's serene faces emerging from monsters' jaws, winged sea serpents, or the baleful glare of a Medusa's head writhing with snakes.

Through the theater and the artistic salons, the "emancipated" women of the 1880s and '90s also acted as inspiration to the artists of the day. Sarah Bernhardt, whose flamboyant stage performances took Paris by storm, commissioned bold jewelry for the stage. Loïe Fuller danced with diaphanous veils. And Cléo de Mérode let her hair flow loose while she danced.

Dozens of French jewelers designed in the Art Nouveau style, but the one who contributed the most overall in terms of innovative design and use of materials was René Lalique.

René Lalique. Lalique was born in 1860 in Ay on the river Marne. He was apprenticed at 16 to Parisian jeweler Louis Aucoc, from whom he learned the traditional jewelry-making techniques. After two years with Aucoc, he went to England and studied at Sydenham College. In 1880, he returned to Paris and for the next five years worked as a designer of jewelry, fans, fabric, and wallpaper. He established his own business in 1885, and was subsequently commissioned by Sarah Bernhardt to make some jewels for the stage.

Figure 9. René Lalique is credited with being the first Art Nouveau jeweler to use horn as a material in jewelry. This orchid diadem (14.5 × 16.0 cm, c. 1903) also includes ivory, topaz, and gold. Courtesy of the Calouste Gulbenkian Museum. From the Lalique exhibit organized by the International Exhibitions Foundation, Washington, DC.

In 1895, Siegfried Bing converted his Japanese import shop into a store that featured art, textiles, jewelry, glass, and furniture in the new style. He named it *La Maison de l'Art Nouveau,* thus giving the movement its name and serving to bring prominent artists of the time into the public eye. Among these were Lautrec, Bonnard, Mucha, Tiffany, Mackintosh, Beardsley, and Lalique. Also at this time, Lalique submitted jewels to a competition at the Salon de la Société des Artistes Français. One of these, a cloakclasp, was "arguably the first Art Nouveau jewel to use a naked female" (Becker, 1985). Critics raved about his work, especially praising his unusual style and technique, which promised to rejuvenate the art of jewelry making.

Lalique reached the pinnacle of his success at the 1900 Paris Exhibition. Lalique's pavilion, designed entirely by himself, had soft gray carpets and gray gauze drapes against which hung black velvet bats. The front was framed with a wrought iron grille depicting partially clothed winged women. The pavilion served as a perfect showcase for his jewels, which were displayed in cases on white watered silk and ground glass. His exhibit caused an immediate sensation, and for it Lalique won a grand prize and the rosette of the Legion of Honor. After that, Lalique was inundated with international commissions. His largest came from the Armenian banker, Calouste Gulbenkian, for whom Lalique produced a series of 145 pieces from 1895 to 1912. These jewels, perhaps Lalique's most fantastic and unusual pieces, can be seen today at the Gulbenkian Museum in Portugal. Unfortunately, the price of fame for Lalique was to see his work endlessly copied and imitated. This plagiarism and cheap commercialization disillusioned Lalique, and once the commission to Gulbenkian was completed, he ceased making jewelry and turned all of his talent to glassmaking (Becker, 1985).

Lalique's pieces overall are dramatic and theatrical, with motifs drawn from nature that are full of an underlying sexual tension. His women are beautiful, sensual, flowing nudes that are often fantasy creatures with wings or tails, part insect or fish. Lalique was innovative in his use of materials and is credited with being the first to use the material horn in his jewels. Over the years, he produced many brooches, combs, pendants and tiaras of horn, which he carved, stained, enameled, and polished, often studding the pieces with gold and gemstones (figure 9). Much of his work incorporates glass, either in one of the enameling techniques that were being experimented with at that time, or as pâte-de-verre. This "glass paste" could be given a matte or shiny surface, ideal for faces, flowers, or other figures. Lalique was also fond of opals and moonstones (figure 10). Many of his pieces use faceted moonstones with diamonds to create a subtle play of sheen and sparkle. Opals were used as symbolic water accents or as eyes in a peacock's tail (figure 11). In some cases, Lalique used large slices of opal as a background for intricately chased and enameled gold.

Lalique was a primary force in Art Nouveau jewelry. His jewels are without equal for originality, technique, and integration of materials, and they served as a beacon for other jewelers to follow. Although literally hundreds of other French jewelers and craftsmen manufactured Art Nouveau jewels, many produced but a single piece, so that

Figure 10. This flower thistle pendant of enameled gold, moonstone, sapphires, and pâte-de-verre shows how adept Lalique was at mixing his materials. The piece, which measures 8.4 × 8.2 cm and is dated at c. 1900, is from the Lalique Exhibit organized by the International Exhibitions Foundation, Washington, DC. Courtesy of the Calouste Gulbenkian Museum.

Lalique's great volume of works is all the more astonishing.

Henri Vever. The grandfather of Henri Vever (1854–1942) founded the Maison Vever, a leading Parisian jewelry firm. Henri and his brother Paul took over the firm in 1881, and made innovative changes in the design and manufacture of their jewelry. Like Lalique, Henri Vever also won a grand prize at the 1900 Paris Exhibition. His firm commissioned designers such as Eugene Grasset and Etienne Tourette. Vever was unusual as an Art Nouveau jeweler in that he continued to use rubies, emeralds, sapphires, and diamonds in profusion rather than the less expensive gems and materials favored by Lalique and others. The firm of Vever was also known for their haircombs of horn in organic motifs with plique-à-jour enamels and freshwater pearls. Vever's work, however, generally showed more reserve than Lalique's (figure 12), possibly because Vever catered to a more conservative clientele (Battersby, 1968). Henri Vever was also a prolific writer and critic of Art Nouveau; his three-volume work on 19th-century jewelry, *La Bijouterie Française au XIX Siècle* (1906–1908), contains much information about the leading Art Nouveau jewelers.

Georges Fouquet. In the 1880s, another Parisian firm, Fouquet, also began to use Art Nouveau

Figure 11. Opals were frequently used in Art Nouveau jewels. This female figure and swan necklace by René Lalique incorporates black enameled gold, opals, amethysts, and plique-à-jour (c. 1899). Courtesy of Lillian Nassau and the Metropolitan Museum of Art. From the Lalique Exhibit organized by the International Exhibitions Foundation, Washington, DC.

motifs, but the jewelry was stiff and lacked the movement and grace usually associated with the Parisian style. In 1895, Georges Fouquet (1862–1957), son of the founder, took over the firm and made major changes. Collaborating with Desrosiers, an independent designer, Georges Fouquet produced some very fine pieces, primarily in gold with enamel and gemstones. Much of his work is characterized by lines of diamonds or other gemstones placed along curves for emphasis (figure 13). In later pieces, tiny flakes of gold and colored foil were added to his translucent enamels to give an extra sheen.

Fouquet also employed Alphonse Mucha (1860–1939), the celebrated poster artist, to design jewelry specifically for the 1900 Paris Exhibition. Their first collaborative project was the snake ring-bracelet executed as a commission for Sarah Bernhardt to wear on stage. This elaborate piece is noted especially for its opal inlay. The partnership of Fouquet and Mucha, which lasted only two years, produced dramatic, strange, largely unwearable pieces, suggestive of ancient Byzantium. Characterized by clusters of gem pendants dangling asymmetrically from fantastic diadems and necklaces, Mucha's designs for jewelry are beautiful on paper but impractical for general wear.

Fouquet continued to work in Art Nouveau motifs, however, manufacturing Desrosiers's more feasible designs, until around 1908. After this, he "lapsed into a more subdued semi-abstract Edwardian style, leaving naturalistic excesses behind him" (Becker, 1985).

Other French Art Nouveau Jewelry Designers. Several other large French jewelry houses also produced jewels in Art Nouveau style. Boucheron made sculptured pieces of chased, enameled gold set with gems and pâte-de-verre. A gold belt buckle with two lionesses biting into a carnelian above a green pâte-de-verre lion's head exemplifies Boucheron's style. Chaumet also expanded his style to include Art Nouveau jewels, although few of his pieces exist today. Once the fashion was over, most of these Nouveau jewels were disassembled and their precious components reused (Becker, 1985). Cartier produced a few pieces but only as commissions. They were mostly symmetrical, stiff renditions of popular plant motifs, using gold, plique-à-jour, and precious stones. Cartier primarily catered to the Edwardian taste for elaborate monochromatic jewels.

Figure 12. Henri Vever designed this "Bretonne" pendant of enameled gold, inlaid opal, amethyst, and diamonds for the 1900 Paris Exhibition. Private collection.

GERMANY

In Germany, the new style was called Jugendstil after the new arts magazine *Jugend* (youth), which promoted the latest trends. Jugendstil was manifested in two distinct versions. The first version, popular prior to 1900, was influenced by naturalism, Japanese art, and the English floral style. In this version, German jewelers also imitated French jewelry with an adeptness that made it difficult to distinguish German pieces from those of French origin. These were principally produced in the town of Pforzheim, which has been largely devoted to the manufacture of jewelry since the 16th century.

One of the most interesting designers of this particular version of German Art Nouveau jewelry

Figure 13. Note the use of gems to outline and highlight this sea serpent corsage ornament fabricated by Georges Fouquet using enameled gold, plique-à-jour, emeralds, and diamonds with freshwater and saltwater pearls (c. 1902). Private collection.

Figure 14. This brooch of enameled gold, baroque pearls, diamonds, rubies, amethysts, and topaz shows the French influence on early German Art Nouveau jewels. Named "Tintenfisch und Schmetterling" (Octopus and Butterfly), it was designed by Wilhelm Lucas von Cranach and executed by Louis Werner for the 1900 Paris Exhibition. Courtesy of the Schmuckmuseum, Pforzheim, Germany.

was Wilhelm Lucas von Cranach (1861–1918). He left his occupation as a forester and came to Berlin as a portrait and landscape painter in 1893. Soon thereafter, he began to design jewels, which were manufactured in Berlin by Louis Werner and ultimately displayed at the 1900 Paris Exhibition. Von Cranach's designs are influenced both by his understanding of nature and by a gothic fascination with mythic beasts. His most famous piece, "Tintenfisch und Schmetterling," is of an octopus with butterfly wings (figure 14).

The second version of Jugendstil was a softened, geometric style that developed out of the Darmstadt colony, which was founded in 1897 under the patronage of the Grand Duke Ludwig of Hesse. As the grandson of Queen Victoria, the Grand Duke made frequent trips to England, where he became familiar with the Arts and Crafts movement and William Morris. It was his dream to form an ideal environment for artists and artisans to develop their crafts. He realized this aspiration by commissioning the Austrian architect Joseph Maria Olbrich (1867–1908) to organize and design the buildings for the colony. In 1899, the colony was officially opened and young designers, architects, artists, and artisans from all over the world came to join it under the direction of Olbrich. Jewelry designs from the colony were submitted to Theodor Fahrner (1868–1929), a Pforzheim jeweler, who did the actual manufacturing. The pieces themselves were made of silver with enamelwork and cabochon opals, agates, and mother-of-pearl, following the principle of making artistic jewelry available to all social classes (figure 15). This fashionable, affordable jewelry brought the colony into the public eye, and the new designs helped to change Jugendstil from the earlier flowery, representational motifs to the abstract, biomorphic style that ultimately led to the development of Art Deco in the 1920s and '30s.

Figure 15. Theodor Fahrner executed the jewelry designs of many prominent German artists. This silver brooch is a good example of the softened geometrics and affordable materials that popularized Jugendstil jewels (c. 1902). Courtesy of the Jesse & Laski Gallery, London.

OTHER EUROPEAN DESIGNERS

Spain. Although England, France, and Germany had the greatest impact on the Art Nouveau movement in jewelry, other countries in Europe also produced important designers. Spain's Art Nouveau movement was largely confined to architecture; yet one jeweler in particular, Luis Masriera (1872–1958), made significant pieces in the Art Nouveau style. After viewing Lalique's work at the 1900 Paris Exhibition, Masriera returned to Barcelona and closed his shop for six months, during which time he melted down his entire stock of traditional jewels and feverishly designed and manufactured jewelry in the Nouveau style. When he reopened his shop, the display of his jewels caused such a sensation that his entire new stock was sold out within a week. Masriera's adaptations of French Nouveau jewelry frequently incorporated winged nymphs with flowers in their hair, emerging from gem-set frames or borders (again, see figure 1). The female figures often have plique-à-jour enameled wings, and the borders of their draped clothing are occasionally set with diamonds. Although these figures are lithe and free, they are fully clothed and quite chaste, perhaps out of respect for Spain's conservative religious principles. Some of them represent religious icons of angels or the Virgin Mary surrounded by jeweled halos. One of Masriera's most distinctive jewels is a pendant portraying the medieval heroine, Isolde, in a jeweled crown against a plique-à-jour gothic window (see cover). This was undoubtedly inspired by the Wagnerian opera Tristan and Isolde, which was enjoying enormous popularity in Europe at that time (Becker, 1985).

Belgium. Belgium played a leading role in the Art Nouveau movement in architecture and interior design. The Belgian designers provided a buffer between the flamboyant French and reserved English styles, serving to integrate and meld the two extremes. Henry Van de Velde (1863–1957), architect and designer, worked to integrate the applied arts so that they harmonized with one another. He turned to jewelry as yet another outlet for this expression. His jewelry was abstract with a strong, pseudomorphic line that was suggestive of plant growth. Van de Velde's work was most admired in Germany, which motivated him to live and work there after 1899.

Philippe Wolfers (1858–1929), Belgium's most distinctive jewelry designer, worked more in the literal French Nouveau style rather than in the abstract interpretation seen in Van de Velde's works. Wolfers's work is eerie and highly original. He was trained as a jeweler by the family firm in the 19th-century tradition, learning all aspects of jewelry making. Impressed by the exhibitions of Japanese art that inundated Europe in the 1870s, Wolfers changed his jewelry designs from stiff, fussy ornaments to sweeping, realistic portrayals of nature.

When the first ivory tusks arrived from the Belgian Congo in 1892, Wolfers began carving ivory in flower forms which he introduced at the International Exhibition at Antwerp in 1894. He also used carnelian, opal, and tourmaline, skillfully carved by his artisans into flowers or animals.

Wolfers's jewels are haunting and unusual, producing some of the same shock effect as Lalique's. He contrasts soft, sensuous forms with bizarre and harsh figures (figure 16). From 1897 to 1905 he produced a series of 109 Art Nouveau jewels, each of which was titled and had a plant, insect, or animal motif. After 1910, as Art Nouveau waned, Wolfers became more of a sculptor, eventually ceasing to make jewelry altogether.

Austria. In Austria, as in Germany, artists felt stifled by the historicism that had dominated art and architecture in the first half of the 19th century and yearned to express themselves in a

Figure 16. This Eve and serpent pendant was fashioned from gold, carved rose quartz, opals, enamel, pearl, and diamonds, with a fancy yellow diamond drop, by Philippe Wolfers. The piece, manufactured c. 1905, measures 7.5 × 13.5 cm. Courtesy of Lillian Nassau.

streamlined, updated fashion. In 1897, a group of artists broke away from the traditional teaching of the Vienna Academy and formed their own group, calling it the Vienna Secession. Austria, like Germany, was also influenced by the Arts and Crafts movement in Great Britain and particularly by Mackintosh's Glasgow School (Waddell, 1977). By the mid-1890s, the Vienna Secession began to manifest a cubic, rectilinear form of design in art and architecture that was to become their hallmark style. Until the early 1900s, Art Nouveau jewelry in Austria was still modeled after the naturalistic French style, offering the ubiquitous dragonflies, butterflies, and women with swirling tresses. After 1900, a founding member of the Secessionists, Josef Hoffman (1870–1956), formed the Wiener Werkstatte (Viennese Workshop) with Koloman Moser (1868–1918). They patterned their workshop after the guilds that were prevalent in England, with one major difference: Where the British guild members were primarily artists that had no training in the jewelry arts, the members of the Wiener Werkstatte were formally trained artisans, highly skilled in the decorative arts.

Hoffman's jewelry designs were fabricated by the artisans at the Wiener Werkstatte under his close supervision. Because of his admiration for the work of the Scottish craftsman Charles R. Mackintosh, Hoffman's designs reflect the same ultra-stylized flowers and leaves, joined by long, gently curving lines, of the Glasgow School. Hoffman made his jewelry in silver (figure 17) or gold-plated silver set with cabochon agates, malachite,

Figure 17. A gold-plated silver brooch fabricated by the Wiener Werkstatte from a design by Josef Hoffman shows the influence of the Glasgow School (c. 1910). Courtesy of the Schmuckmuseum, Pforzheim, Germany.

Figure 18. This waterlily pendant of enameled gold with diamonds and a cabochon sapphire is from the workshop of Peter Carl Fabergé. While for the most part his jewelry was designed to please the conservative Edwardians, this balanced little jewel exemplifies the lyric line of Art Nouveau (c. 1900). Private collection.

or mother-of-pearl. These gems were enhanced by enamels, in dark colors or contrasting geometric patterns of opaque black and white.

Hoffman had many colleagues in Austria who lent their own interpretation to the Art Nouveau style. Overall, their jewels are fabricated of silver worked with hammering, chasing, and enameling techniques and set with opals, agates, mother-of-pearl, lapis lazuli, and malachite. Their geometric patterns and bold contrasts of color are a far cry from the soft, sensual French Art Nouveau jewels, another indication of the developing Art Deco style.

Russia and Scandinavia. Although not strictly Art Nouveau jewelry designers, Peter Carl Fabergé (1846–1920), the celebrated Russian court jeweler, and Georg Jensen (1866–1935), the renowned Danish jeweler and metalsmith, must be mentioned. Fabergé is known best for his elaborately jeweled and enameled decorative objects, such as the Imperial Easter Eggs, which were in vogue as gifts among the nobility at the turn of the century. Most of the wearable jewelry from Fabergé's workshops was in the Edwardian style. However, a few of his pieces are decidedly Art Nouveau in design, using enamel, gold, diamonds, sapphires, and other gemstones in simple flower motifs that exhibit the distinctive Art Nouveau whiplash line (figure 18). While these pieces are not particularly innovative or distinctive, the fact that Fabergé, a conservative jeweler with a royal clientele, made Art Nouveau jewels at all demonstrates the far-reaching influence of the movement as a whole.

Unable to support himself as a sculptor, Georg Jensen turned to his former craft of metalsmithing. In 1904, he opened his own shop and produced silverware and jewelry characterized by plump abstract organic shapes and accented with amber, garnet, citrine, malachite, moonstone, and opal.

Figure 19. Georg Jensen's distinctive style of plump plant forms is evident in this chased silver brooch accented by amber and chrysoprase (c. 1908). Courtesy of Ira Simon, Chicago.

His inspiration came from the Lalique exhibit at the 1900 Paris Exhibition, coupled with his own interpretation of Viking motifs and a childhood love of nature (figure 19). Jensen's pseudomorphic shapes and curvilinear designs were rooted in Art Nouveau, but his work transcended the period. It gained in popularity as his style evolved into a streamlined version of Art Nouveau, which was more in keeping with the trends of the 1920s and '30s (Lassen, 1980).

UNITED STATES

A dramatic shift occurred in jewelry making in the United States when the U.S. government assigned a duty on imported jewelry in 1850. With the imposition of the duty, to protect the metalsmiths, jewelry centers arose quickly and a distinctive American style began to emerge. Two major developments characterize the new-art movement in America: the role of Louis Comfort Tiffany in glass and jewelry, and the rise of the Arts and Crafts movement in Chicago.

Tiffany. The three most popular exhibits at the 1893 World's Columbian Exposition in Chicago were the Japanese, the British Arts and Crafts, and the work by the Tiffanys – the famous Tiffany and Company of New York and Louis C. Tiffany's Glass and Decorating Company. Together, the two Tiffany firms won 55 awards.

Louis Comfort Tiffany (1848–1933) was born into the well-established jewelry firm, Tiffany and Co., that his father Charles Lewis had founded. Apparently, it was clear early on that Louis would be an artist and not the businessman his father had been. After studying in Paris for two years, he visited Spain and North Africa; in the course of his travels, he acquired a taste for Oriental and Moorish art.

While Louis was traveling, his father hired George Frederick Kunz as Tiffany's first gemologist in 1877. The elder Tiffany encouraged Kunz to travel throughout the world to add not only diamonds but also colored stones to the store's inventory. As Kunz describes his activities at Tiffany, "In those first days, very naturally a large part of my interest was engaged in this problem of discovering and introducing one after another these lovely semiprecious stones in which no jewelers of the time were even slightly interested. I remember once showing some of these gems to [noted writer] Oscar Wilde, who was himself a connoisseur and had a not uninteresting collection of his own. Oscar Wilde said 'My dear fellow, I see a renaissance of art, a new vogue in jewelry in this idea of yours. Bah! who cares for the conservatives! Give them their costly jewels and conventional settings. Let me have these broken lights – these harmonies and dissonances of color' " (Kunz, 1927).

Figure 20. This iris corsage ornament of gold, sapphires (from Montana), diamonds, demantoid garnets, and topaz was shown in the Tiffany pavilion at the 1900 Paris Exhibition. Courtesy of the Walters Art Gallery, Baltimore.

But no matter where he traveled or what gemstones he bought, Kunz never forgot his first enthusiasm for America's "semiprecious stones" (Purtell, 1971), especially the matrix turquoise, tourmalines, peridots, freshwater pearls, and newly discovered sapphires from Montana. Kunz organized a collection of American gemstones for the Tiffany exhibit at the Paris Exhibition of 1889. This undoubtedly had a major impact on the new-art designers and jewelers because it showed them a whole new world of colored stones. His second major exhibit, composed of gemstones from around the world, won him a grand prize at the 1900 Paris Exhibition (figure 20).

In 1889, Louis Tiffany began a close business association with Siegfried Bing, who became his agent in Paris. That same year, Tiffany was also made director of design at Tiffany and Co. In the

Figure 21. This Peacock necklace (c. 1906) was designed by Louis C. Tiffany and manufactured by Julia Munson Sherman. It contains opals, amethysts, sapphires, demantoids, rubies, and emeralds. The reverse side is exquisite cloisonné enamel on gold. From The "Lost" Treasures of Louis Comfort Tiffany, *by Hugh McKean. Copyright © 1980 by Hugh McKean. Published by Doubleday & Co., Inc.*

Tiffany and Co. studio, he worked on designs that included "art" jewelry, now known as Tiffany Studio jewelry. There, he could draw on the storehouse of colored stones acquired by Kunz. According to Sataloff (1984), Louis Tiffany "used every stone to its greatest advantage, just as he had combined colors of glass to their advantage." Not only was his goldwork sinuous and fluid, but he also made great use of baroque pearls and unusual colored stones such as demantoid garnet, turquoise (he even convinced Tiffany and Co. to buy a mine in Arizona), lapis lazuli, and opal.

Julia Munson Sherman was responsible for the production of Tiffany Studio's jewelry. An admirer of William Morris, she had studied the Arts and Crafts workers in England. Working in ceramics, metal, and enamels at the Tiffany Studio, Julia Munson Sherman was the one who developed the techniques for the enamels Tiffany used in jewelry. In 1903 she became head of the Tiffany and Co. jewelry department, where she executed Louis Tiffany's jewelry designs. Because she did not sign any of the pieces, her key role at Tiffany's has only recently become known (Novas, 1983).

Tiffany's pieces have been aptly described as "an unusual mixture of handwrought Arts and Crafts and the organic motifs of Art Nouveau, with an emphasis on unusual materials chosen for colour and effect rather than intrinsic value . . . he drew on his favorite Oriental and Byzantine motifs and was dedicated to fine workmanship in all aspects of his jewelry" (Becker, 1985). An example is the Peacock necklace shown at St. Louis in 1904 and the Paris Salon of 1906 (figure 21).

Another leading New York firm, Marcus and Company, produced Art Nouveau jewelry characterized by enamels in vibrant colors such as blue-green, dark green, and deep pink that were used to compliment gemstones. Although the use of strong colors gave the Marcus and Co. pieces a distinctive character (figure 22), this jewelry also borrowed motifs from the French floral Art Nouveau and sometimes included coils of metalwork or a soft curving gold line.

Arts and Crafts Movement in Chicago. Chicago was the most receptive of American cities to the reforming principles of the British Arts and Crafts movement because it coincided with cultural and social reforms already under way. Several prominent British exponents of the Arts and Crafts movement, such as Ashbee, visited Chicago and lectured at the Chicago Art Institute.

The Chicago Arts and Crafts Society was founded in 1897. The society's creative use of natural materials and simplifications of line and ornament embodied the Arts and Crafts movement. At the beginning of the new century, Chicago could claim a school of metalsmiths working within the Arts and Crafts traditions using simple forms and natural materials. While they adhered to the principle that the metal must be worked by hand, it was not considered improper to use machines to eliminate some of the drudgery, such as flattening the metal into sheets. For inspiration, the Chicago metalsmiths turned to American Indians, the American colonial period, or nature. Just as in England, common garden flowers were popular motifs. The jewelry produced by these metalworkers ranged from bold to delicate and reflected the sensual lines and floral motifs of French Art Nouveau as well as the peacock motif and mechanical lines associated with British Arts and Crafts. Moonstones, amethysts, baroque pearls, aquamarines, and opals were the choices for stones. Enameling and acid etching of the metal were also popular (Darling, 1977).

Jewelry making particularly appealed to the growing number of women who were trying their hand at metalsmithing. In Chicago, the first workshops involved in metalsmithing were established by women. Clara Barck Welles (1868–1965) opened one, the Kalo Shop, in September 1900. The Kalo motto—"Beautiful, Useful, and Enduring"—seemed to echo William Morris's adage "have nothing to your houses which you do not know to be useful, or believe to be beautiful" (Darling, 1977). The Kalo Shop specialized in silver jewelry set with pearls, moonstones, topazes, or carnelian, as well as in silver objects from bowls to tea sets.

The demand for handmade metal became so great that Marshall Field & Company created a fully equipped craft shop and metal foundry to augment the jewelry workroom it created in 1904 on the tenth floor of the State Street store (Darling, 1977). These operations were quite similar to those

Figure 22. Marcus and Co. created this dog collar of gold, cabochon rubies, diamonds, and plique-à-jour enamel with nine twisted seed-pearl ropes (c. 1900). Three of the ruby cabochons are synthetic. Synthetic ruby crystals were on exhibit at the 1900 Paris Exhibition and began to be incorporated into jewelry around that time. Photo courtesy of Christie, Manson and Woods International, Inc.

of Liberty & Co. in London. Designers and craftsmen produced jewelry that sold under the company name.

Other American Art Nouveau Jewelers. Certainly, there were other American manufacturers and jewelers producing Art Nouveau pieces. Both books by Sataloff and Becker contain in their lists of makers' marks the lesser-known American jewelers. A number of American manufacturers also mass-produced silver jewels in the French Art Nouveau style, notably Unger Brothers, founded in 1878; William B. Kerr and Co. of Newark, New Jersey; Averbeck and Averbeck of New York; and the oldest, the Gorham Corporation of Rhode Island (Becker, 1985).

On the one hand, this mass production of silver Art Nouveau jewelry accomplished a basic tenet of the Arts and Crafts and Art Nouveau movements by creating beautiful objects that working people could afford. However, this same mass production often focused on the superficial qualities of Art Nouveau, ultimately contributing to its decline.

CONCLUSION

The Art Nouveau movement as a whole was similar to the exotic plant life that much of it depicted. Rooted in the 1880s, the movement budded in the 1890s, came to glorious flower in 1900, had faded by 1910, and was utterly dead by 1915. Over-commercialization of the popular motifs glutted the market and caused Art Nouveau's wane in popularity. The First World War, which devastated Europe from 1914 to 1917, effectively killed the naive romanticism that had given birth to such an ebullient and intensely unique style of artistic expression. Where Art Nouveau had been hailed as an exciting modern trend, it was now damned as "a ludicrous and ephemeral artists' aberration" (Sataloff, 1984). It was as if the public was embarrassed by the emotional excesses that Art Nouveau embodied. Once dead, the movement was buried quickly and without regret. Much of the architecture was demolished, furnishings were replaced, and because they were so representative of the period, women would not wear Art Nouveau jewels once the fashion was over (Klamkin, 1971). After 1914, Art Nouveau gave way to the stark, unemotional geometrics and streamlined stylization of Art Deco.

Although brief, the Art Nouveau movement made a lasting contribution to the applied arts by raising their status in the eyes of the public. Design and construction of buildings, furnishings, jewelry, and textiles were infused with a new level of artistry that has carried through to the present day.

After half a century of disenchantment, the public is again finding beauty in Art Nouveau objects, particularly its jewelry. Artists are adopting some of the motifs and incorporating the Nouveau line into many of their modern designs. A rise in interest can be seen in the number of pieces that have appeared for auction and the popularity of special exhibits such as the one honoring René Lalique that toured the United States in 1986, the "Paris Style 1900, Art Nouveau Bing" exhibit currently touring the U.S., and the upcoming May 1987 exhibit of Lalique jewelry at Goldsmiths Hall, London. These remaining jewels are the embodiment of that ingenuous and exciting time of new beginnings and youthful promise, when all the arts enjoyed an explosion of creativity and artists took themselves to the limits of their imagination and skill.

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NOTES
· AND ·
NEW TECHNIQUES

CONTEMPORARY INTARSIA: THE MEDVEDEV APPROACH TO GEM INLAY

By James Elliott

Using precision inlay (intarsia) techniques, Russian emigré Nicolai Medvedev is creating masterpieces of lapidary work in boxes, candlesticks, clock cases, and jewelry. He uses high-quality lapis lazuli, opal, malachite, sugilite, azurite, tourmaline, and rhodochrosite, among other materials, to create these colorful and precisely constructed pieces. Some of his techniques are explained in a step-by-step procedure used to create the "Camellia" box.

One of the most difficult and labor-intensive forms of lapidary art is gemstone inlay, or intarsia. Very much like mosaic, small, usually flat pieces of gem materials are fitted together and then cemented to a base to form various designs. However, while mosaics are usually done as murals or large panels, intarsia commonly involves smaller surfaces and requires far greater accuracy and precision in fitting many pieces together to produce an intricate design with a smooth finish.

As an art form, intarsia using gem materials flourished throughout Western Europe from the late-17th to the mid-19th centuries. Boxes were one of the most common items produced. Snuffboxes of "hardstone" were made in France as early as 1736 (Cocks and Truman, 1984). The German court of Dresden welcomed goldsmiths and hardstone cutters to produce elaborate snuff and presentation boxes of wafer-thin agate, amethyst, or chalcedony, mounted in gold and often encrusted with gems. Moss agate was used by prominent goldsmith and jeweler James Cox in some of the fancy boxes he manufactured around 1770. Already renowned for their mosaic work, the Italians proved particularly skilled and creative at hardstone intarsia. One of the most interesting pieces in the Gilbert collection of gold boxes is an 11.3-cm (4½ in.) long rectangular box inlaid with agate, chalcedony, lapis lazuli, aventurine, and malachite (von Habsburg-Lothringen, 1983). Gem materials were incorporated into other objects of art or furniture as well, often with precious metals used as attachments and for completion of design.

Today, the technique of intarsia with gem materials is used in many countries, including Germany, Italy, India, and China. Florence, Italy, is generally recognized as the modern center of intarsia work (Sinkankas, 1984). Because of the high cost of labor, however, most intarsia currently on the market lacks detail. In addition, the boxes made of various gem materials are generally plain and often crudely constructed for broad commercial distribution. It is, therefore, with great surprise that we find an artist in New Jersey producing some of the finest and most intricate intarsia ever

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ABOUT THE AUTHOR

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seen. Nicolai Medvedev, an artist trained in Russia, has revived intarsia as an art form, developing new techniques and taking advantage of modern technology. The result is a number of beautifully designed and executed boxes as well as clocks, candlesticks, and intricate pieces for jewelry that have been carefully constructed from fine malachite, lapis lazuli, rhodochrosite, sugilite, and the like (figure 1). One of his most unusual pieces, a malachite box inlaid with sugilite and a tourmaline "flower," demonstrates the precision required in gem intarsia.

FROM ARTIST TO LAPIDARY

Born and raised in Ashkhabad, Turkmenia, USSR, a city near the Iran border, Nicolai Medvedev attended art school and Art College before he was admitted to the prestigious Art Institute in Moscow. In 1980, after five and a half years at the Art Institute, he emigrated to the United States with his American wife.

Once in the U.S., Medvedev began attending art shows. As he traveled, though, he would stop at various lapidary shops, hunting for colorful materials in stone from which he might create pieces of art. Using amateur equipment, he began to fashion boxes out of this material. The colors reminded him of nature's colors, and he was delighted to think that he could create three-dimensional art objects out of stone that would be durable enough to last for centuries. His work continued, and within a few years he had become an accomplished lapidary. To produce the best pieces, though, he knew that he had to find the best rough material. He concentrated on malachite with its varied patterns, the finest lapis from Russia and Afghanistan, gem-quality sugilite, and opal. He experimented with various combinations, trying to show off pattern and color to the best advantage.

In addition to his 12 years of intensive training in Soviet art schools, Medvedev considers the decorative and applied art of his native Turkmenia to be his major source of inspiration. As a child, he was surrounded by the colorfully patterned rugs, clothing, and jewelry of Middle Asia. He particularly loved 19th-century Turkmenian jewelry, and at one time owned one of the finest collections in Russia. Many of the designs and patterns of these ornaments can be seen in his work today. Medvedev has also been influenced by American Indian art, which captured his interest on his first trip to the United States.

Medvedev today has accumulated a large selection of fine rough, much of which has been purchased out of private collections. After carefully selecting the choicest pieces, he slabs each one. As patterns unfold, so too does his artistic eye. He takes great care to match the banded patterns in malachite, and delights in the powerful effect of its brilliant green combined with sugilite or opal. It is at this stage that he begins to see the combinations of pieces that may six months later form a box.

What makes Medvedev's work so extraordinary is not only his use of fine-quality gem materials but also his painstaking craftsmanship and his meticulous attention to detail. Medvedev begins all of his designs from the center. Focusing on a particularly inspiring gem, he then adds complimentary shapes and colors, one after another, to complete the design. Precision, skill, and inordinate patience are required to achieve good results.

One of the most complex pieces Medvedev has created thus far is the "Camellia" box. This six-sided malachite box is trimmed with sugilite inlay and incorporates a flower formed from Maine tourmaline on the lid (figure 2). Although the basic procedure for intarsia has been described by Sinkankas (1984) and others, the following description of the process by which Medvedev created the Camellia box provides some insight into the technical skills and artistry required for fine intarsia.

THE CREATION OF THE CAMELLIA BOX

The initial stage of the construction of this box revolved around design sketches and the accumulation of rough. Preliminary sketches (figure 3) eventually became a final color rendering, showing size, shape, angles, and organization of color to be translated into the gem rough. The leaves for the flower and the material for the greater part of the box were chosen from approximately 35 lbs. (16 kg) of malachite rough. After sawing, approximately $2^{1}/_{4}$ lbs. of pieces were selected on the basis of their chatoyancy and distinct patterns. The centerpiece of the flower was to be in tourmaline, and an 86-ct gem Maine crystal was found. For the flower petals, a 140-gram crystal of watermelon tourmaline from Maine was chosen. All accent areas of the box were to be in sugilite; approximately one-half pound of pieces were chosen from the cutting of 30 lbs. of rough. Finally, six 10-pt. fine white diamonds were selected for incorporation into the

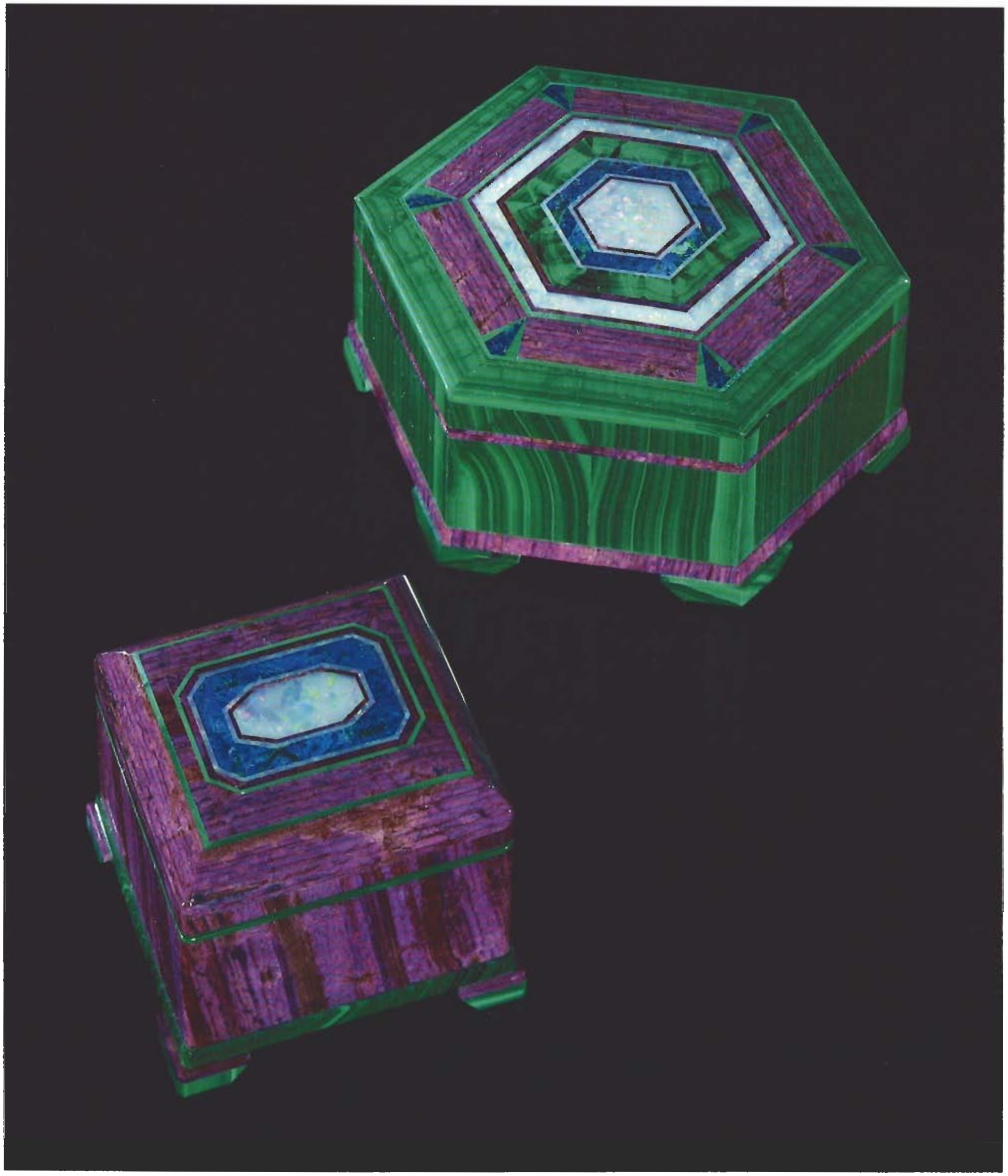

Figure 1. Nicolai Medvedev has carefully created a number of boxes, clocks, and pendants using select pieces of colorful gem materials. These two boxes—of sugilite, malachite, lapis lazuli, and opal—are particularly fine examples of this contemporary intarsia. Photo © Harold & Erica Van Pelt.

design. With these materials assembled, the technical fashioning began.

First, the tourmalines were cut. Since the box was to be a hexagon, it was decided that the center stone would be faceted in that shape. The 86-ct rough yielded a 23-ct flawless gem. The watermelon crystal was cross-sectioned, and the sections were polished on both sides and then beveled on a 45° angle to intensify the color of the tourmaline.

Next, the 18K gold mounting needed to house the center stone and the sections was built by Dave Woods, a New Jersey jeweler, from Medvedev's

Figure 2. The Medvedev Camellia box (12.9 × 11.4 × 7.9 cm) consists of finely matched pieces of malachite and sugilite with a 23-ct faceted Maine tourmaline (removable for use as a pendant) in the center surrounded by six watermelon tourmaline sections. Photo © Harold & Erica Van Pelt.

design. The mounting for the center stone included a female locking mechanism to allow it to be removed from the box and worn as a pendant. Once completed, the gold base plate was anchored to the onyx body of the box lid by means of six gold pins.

The third stage consisted of cutting, trimming, and grinding the malachite and sugilite inlay (figure 4). Medvedev maintains five Raytech saws, each of which runs 24 hours a day. The trimming step alone can take up to a week to accomplish. First, six malachite leaves (each approximately 3 mm thick) were prepared by matching the patterns and then trimming the pieces into shape. Next, six background sections were cut and fit along with smaller pieces to form the sides of the lid. Last, the sugilite was cut and trimmed. The 88 separate pieces of malachite and sugilite that form the box lid and the 33 pieces that cover the sides, bottom, and legs were finally assembled and attached to an onyx base using 330 Epoxy.

To soften the inlay angle from gold to onyx base, Medvedev first used Ray-Tel 260 grit diamond lap to grind away the hard edge and then Ray-Tel 325 grit Nu-Bond to even all edges, finishing off with Ray-Tel 600 Silicon Carbide to leave a gentle curve downward from the gold center to the edge of the lid.

The fourth stage was the polishing of the various surfaces. This was accomplished over 90% of the total box with Linde A compound. This stage alone took approximately one week to complete. A final wash of pure acetone was administered to render all surfaces perfectly clean.

The polishing stage can be particularly difficult and frustrating, and can account for up to 60% of the construction time required for any one piece (figure 5). Many months have been spent accu-

Figure 3. These preliminary pencil sketches, which show the original "camellia" concept as well as the placement of the faceted tourmalines and other components of the flower, marked the first stage in the construction of the Camellia box.

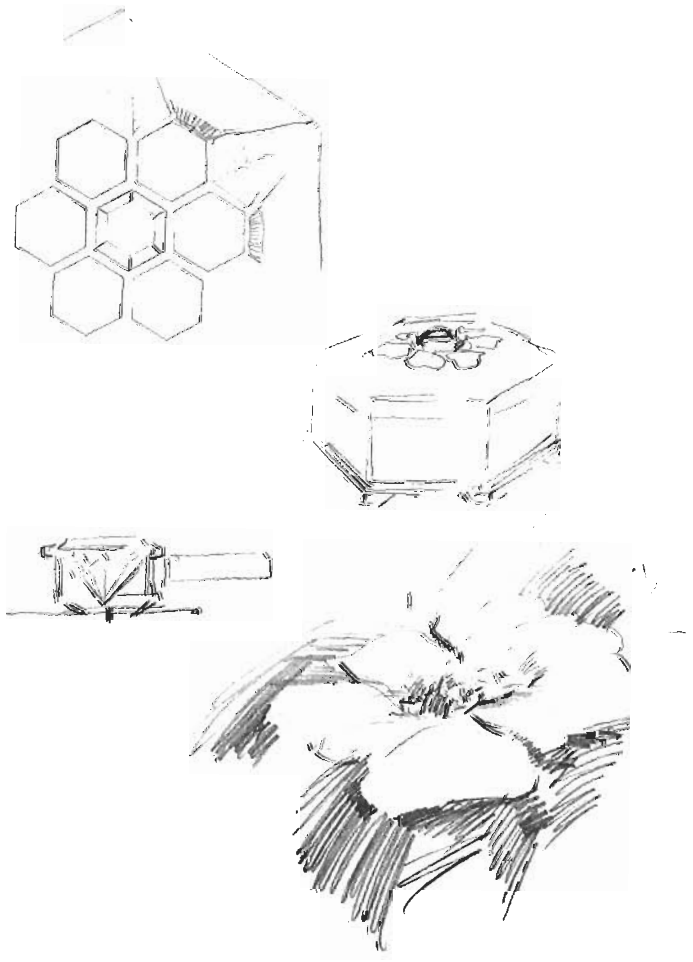

Figure 4. Once the slabs of malachite and sugilite were selected from several pounds of material, Medvedev proceeded to cut and trim the malachite to carefully fit the design of the box.

mulating the finest gem materials and arranging them in a detailed, unique design. Thus Medvedev exercises great care when polishing his slabs, lest he accidentally break any one of the crucial components of his design.

The fifth stage was the working of wood veneers into the box interior. Walnut, pecan, cherry, and mahogany were chosen. Each piece was hand sanded, moving from a coarse to fine grit, and then polished with beeswax to protect the wood from moisture and to preserve the original color. The pieces were then cut and trimmed before they were layered into the box and secured, again with 330 Epoxy. The outer layer of the body is 3½ mm lower than the inner layer to provide a lip with which to secure the lid of the box.

The final stage was the mounting of slices, gemstones, and diamonds. In order not to damage the sections, 22K pins were fitted to the mounting as a prong-type mechanism. The center stone was fitted with a diamond at the end of each point as accent and protection. The center pendant was then locked into position and the Camellia box completed.

The final box, which measures 12.9 × 11.4 × 7.9 cm deep (5 × 4½ × 3 in.), required more than

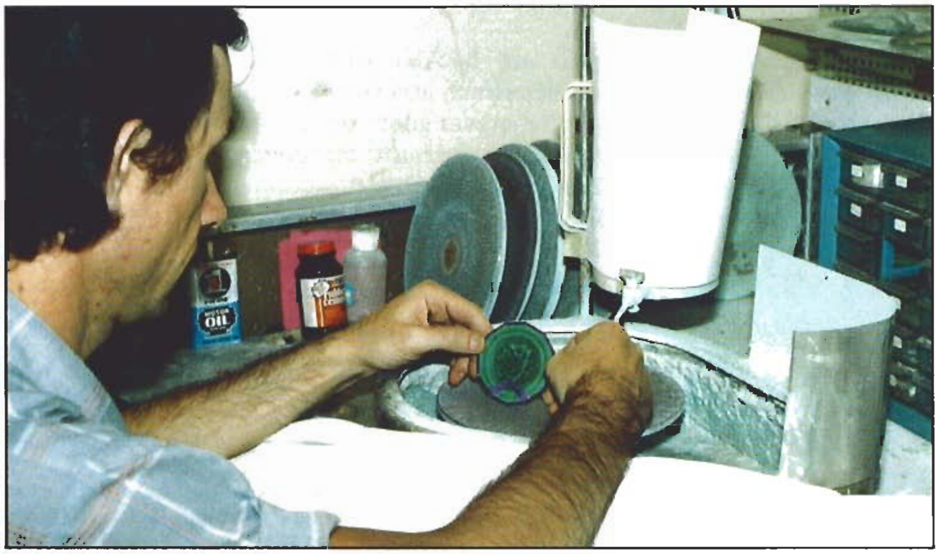

Figure 5. Polishing is the most time consuming—and potentially most hazardous—stage in the construction of fine intarsia. Should any one of the carefully chosen and matched pieces of banded malachite or patterned sugilite break, it could mean starting over almost completely on the project.

Figure 6. These pendants illustrate another variation of Medvedev's intarsia work. The pendants, which average 4–5 cm (1½–2 in.) long, represent different combinations of fine rhodochrosite, lapis lazuli, malachite, sugilite, and opal. Photo © Harold & Erica Van Pelt.

six months to complete. The materials used were selected from over 65 lbs. of rough malachite and sugilite and 786 ct of tourmaline. Unlike the Renaissance boxes of hardstone intarsia, which required many artisans to complete, the Camellia box was designed and executed almost totally by Nicolai Medvedev.

SOME NOTES ON OTHER MEDVEDEV PIECES

Medvedev has been able to complete a small collection of boxes, pendants, and other objects of art each year. The pendants are particularly interesting (figure 6). Special pieces of opal, or cross-sections of azurite-malachite stalactites, are surrounded by other complementary materials. The opals are backed with obsidian to produce a doublet effect, and then the entire piece is backed with whatever gem material was used as the final framing on the front. The pendants average 4–5 cm (1½–2 in.) long and seldom exceed 3 mm in thickness.

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Gem Trade LAB NOTES

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AMETHYST with Brazil Twinning Visible without Polarized Light

To our surprise, a beautiful, nearly flawless, free-form natural amethyst submitted to the New York laboratory showed evidence of Brazil twinning when immersed, even in unpolarized transmitted light (figure 1). When viewed along the same direction (parallel to the optic axis) in polarized light, it displayed the spectacular twinning evident in figure 2. *RC*

Figure 1. Twinning was evident in this natural amethyst (immersed) even with unpolarized transmitted light.

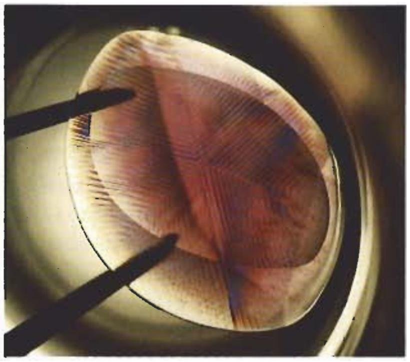


Figure 2. With polarized light, the twinning in the stone shown in figure 1 is spectacular.

Synthetic AMETHYST with Inclusions Typical of Hydrothermal Origin

Although synthetic amethyst is grown hydrothermally, we have not previously seen inclusions that are characteristic of the same hydrothermal process used to grow synthetic emeralds such as Biron and Regency. In New York, however, we recently encountered a stone with a wedge-shaped two-phase inclusion attached to a low-relief quartz crystal (figure 3) that closely resembles the inclusion in a Biron synthetic emerald pictured on page 164 (figure 11) of the Fall 1985 issue of *Gems & Gemology*. Nailhead spicules similar to those that are typical of hydrothermal synthetic emeralds have been reported in synthetic amethysts. However, the closest to such inclusions we have encountered to date are the somewhat acicular crystals shown in figure 4. *RC*

Figure 3. This spicule with quartz crystal cap seen in a synthetic amethyst closely resembles an inclusion seen in the hydrothermally grown Biron synthetic emerald, which appears on page 164 of the Fall 1985 issue of Gems & Gemology. *Magnified 45×.*

Figure 4. These spicules are the closest counterparts to the nailhead spicules typical of hydrothermal synthetic emerald that the lab has seen thus far in a synthetic amethyst. Magnified 20×.

ANDALUSITE with Growth Bands

Among a group of valuable study stones recently donated to GIA in New York by a local dealer is a 20-ct emerald-cut andalusite that shows

---

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

distinct curved growth, or color, bands (figure 5). Curved growth bands are usually a sure sign that the stone is a synthetic. However, andalusite is not, to the best of our knowledge, produced synthetically. In addition, there were numerous unquestionably natural inclusions in this stone to prove its natural origin. *RC*

Figure 5. Curved color bands are seen here in natural andalusite. Magnified 20×.

Faceted CLINOHUMITE

Recently donated to GIA in Santa Monica was a 0.39-ct cut stone and a 1.72-ct rough crystal of the mineral clinohumite (figure 6). The refractive indices were determined to be $\alpha = 1.631$, $\beta = 1.642$, and $\gamma = 1.668$, thus indicating the biaxial positive nature of the material. The specific gravity was approximately 3.18. No absorption spectrum was visible with the hand spectroscope. Although there was no reaction to long-wave ultraviolet radiation, both pieces fluoresced a moderate to strong chalky orangy yellow to short-wave U V radiation. X-ray powder diffraction provided a pattern that matched ASTM pattern no. 14-7 for clinohumite. Although a few examples of faceted clinohumite have been recently identified by our Los Angeles laboratory, cut stones of this material are still considered rare. *CF*

Figure 6. This 1.72-ct rough crystal and 0.39-ct faceted stone are fine examples of gem-quality clinohumite.

Saint Valentine's DIAMOND

What a unique Valentine's Day gift for the inclusion enthusiast! The photo shown in figure 7 was sent to us by Mr. A. De Goutière of Victoria, B.C. It shows a distinctive cloud-like inclusion that proves conclusively that this is a diamond with a heart. Although we have seen a great number of fancifully shaped inclusions, this is the first heart-shaped one that has ever come to our attention. *CF*

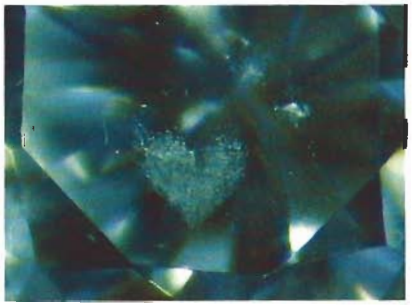


Figure 7. Note the heart-shaped cloud in this 0.015-ct brilliant-cut diamond. Magnified 12×.

Imitation EMERALD: Synthetic Spinel-and-Glass Triplets

In the early part of this century, imitation emeralds were constructed by attaching a colorless quartz crown to a colorless quartz pavilion with a green cement. These quartz triplets were called soudé emeralds after the French term *émeraude soudée* (soldered emerald). A more recent type of quartz triplet is thought to have been introduced into the market in the early 1920s. These assembled stones

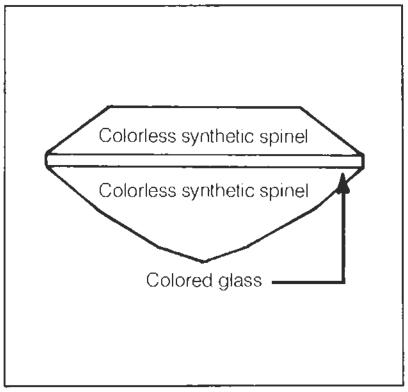


Figure 8. This 11.66-ct imitation emerald and the other variously colored stones are synthetic spinel triplets that use sintered colored glass instead of cement. The drawing shows the construction of these triplets.

are similar to the earlier type with the exception that the unstable cement was replaced by what is believed to have been a layer of colored sintered lead glass.

Recently submitted for identification to the Los Angeles laboratory was a similar type of imitation emerald, but one that we seldom have the opportunity to examine. This type of assembled stone was first produced in 1951 by Jos Roland of Sannois, France, and uses colorless synthetic spinel instead of quartz for the crown and pavilion. Known as *soudé sur spinelles*, these synthetic spinel triplets were produced in various colors by sintering the desired color of glass to the colorless crown and pavilion (see figure 8). The assembled stone that we recently tested was an 11.66-ct green emerald cut.

When examined with a polariscope, this stone exhibited a moderate "cross-hatched" appearance and snake-like bands (caused by anomalous double refraction), both of which are typical of synthetic spinel. When the table of this stone was tested with a refractometer in conjunction with monochromatic light equivalent to a sodium vapor lamp, a multiple reading was observed (figure 9): a strong reading at 1.724 (the synthetic spinel) and a weaker one at 1.682 (the center glass layer). A few other shaded areas between these two were also observed. The yellowish green glass layer was 0.5 mm thick; we obtained a refractive index of approximately 1.682 when we directly tested this area.

Using hardness points, we estimated the hardness of the glass layer to be around 4 on the Mohs scale, which is consistent with the hardness of many high-refractive-index lead glasses. When the stone was examined with a GEM spectroscope unit, no bands or lines were observed.

When the stone was examined with a microscope, faint evidence of a separation plane was seen in the form of small flattened, rounded, and irregularly shaped gas bubbles that were most visible when fiber-optic illumination was used. When we looked at the stone perpendicular to the girdle, in either dark-field or fiber-optic illumination, the thick glass layer was obvious because of its rounded edges and very strong irregular swirl marks. The yellowish green color of the glass layer and the colorless nature of the crown and pavilion were readily revealed when the stone was immersed in methylene iodide and viewed in a direction parallel to the girdle plane.

This stone exhibited an interesting reaction to long-wave ultraviolet radiation. When viewed nearly perpendicular to the girdle with the stone's table closest to the radiation source, the crown showed a strong chalky yellow-white fluorescence, the glass layer was inert, and the pavilion showed a strong pure yellow (not chalky) fluorescence. However, when the culet was positioned nearest to the light source, an opposite reaction was observed: The pavilion now showed a strong chalky yellow-white fluorescence, the glass was still inert, and the crown exhibited a strong pure yellow (see figure 10). This interesting phenomenon is probably caused by the glass layer restricting the amount of long-wave ultraviolet radiation that reaches the portion of the stone that is not directly facing the radiation source. When exposed to short-wave ultraviolet radiation, the assemblage was

Figure 9. Multiple refractive index readings of synthetic spinel and the fused glass center.

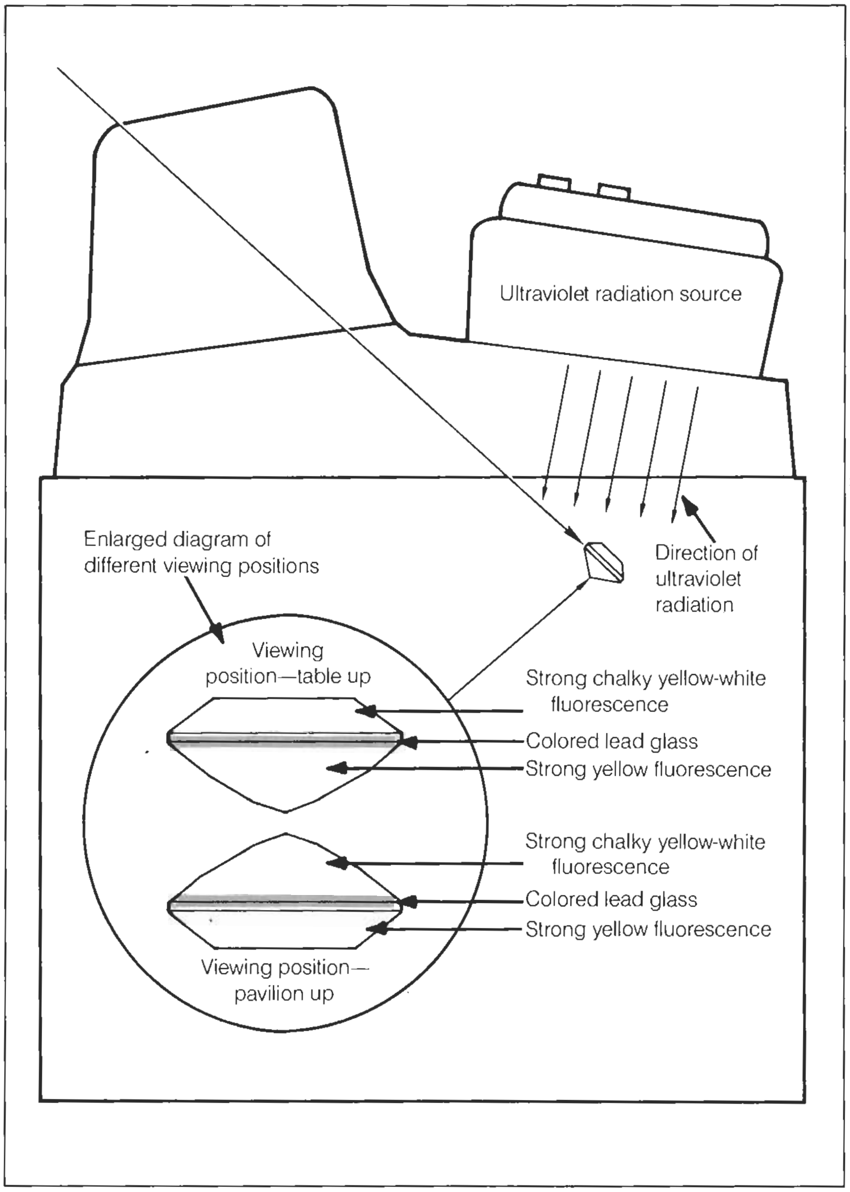


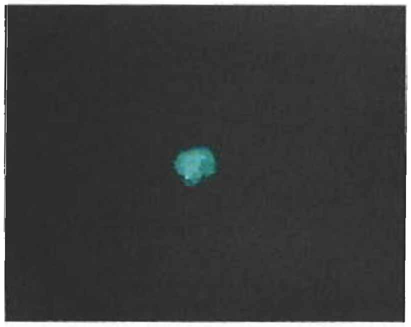
Figure 10. This drawing shows how the reaction to long-wave ultraviolet radiation of a synthetic spinel triplet differs depending on the proximity of different sections of the stone to the radiation source.

observed to be nearly inert. When the stone was exposed to X-rays, an extremely weak, barely perceptible, chalky green fluorescence was seen and there was no phosphorescence. *RK*

Synthetic EMERALD with a "Breadcrumb" Inclusion

We had occasion in New York to test a hydrothermal synthetic emerald of unknown manufacture that weighs approximately 9 ct. A large white "breadcrumb" inclusion, similar in appearance to those seen in synthetic amethyst, was easily visible at 10× magnification (even though figure 11 was taken at 45×). We have not previously described this type of inclusion in a synthetic emerald. *David Hargett*

Figure 11. A "breadcrumb" inclusion such as this is not usually seen in synthetic emerald. Magnified 45×.



Imitation LAPIS LAZULI

Figure 12 shows a strand of attractive 8-mm blue beads that resemble lapis lazuli and were sold as dyed howlite. We had never before seen dyed howlite in any color other than a turquoise blue. The polished half in figure 13 shows the depth of dye penetration. From tests performed on this bead, we determined the specific gravity to be 2.85, and the birefringence of approximately 0.18 to be derived from the refractive indices of 1.50 and 1.68. These properties match those of dolomite, not howlite. *RC*

Eroded Natural PEARLS

The New York laboratory recently examined the button-shaped natural pearl (12.6 × 12.8 × 10.1 mm) with a threaded metal insert that is shown in figure 14. The pattern around the insert matches that of the pearl cup (figure 15). Evidently, over the years, skin acids have eroded the areas near, but not protected by, the cup—a sort of slow-action stencil. We have previously reported a similar situation (*Gems & Gemology,* Summer 1986, p. 235) with a large cultured pearl on a conventional pearl cup. In the Winter 1983 issue of *Gems & Gemology,* another eroded pearl was pictured on page 235; in this case, however, the erosion was extremely bad and took

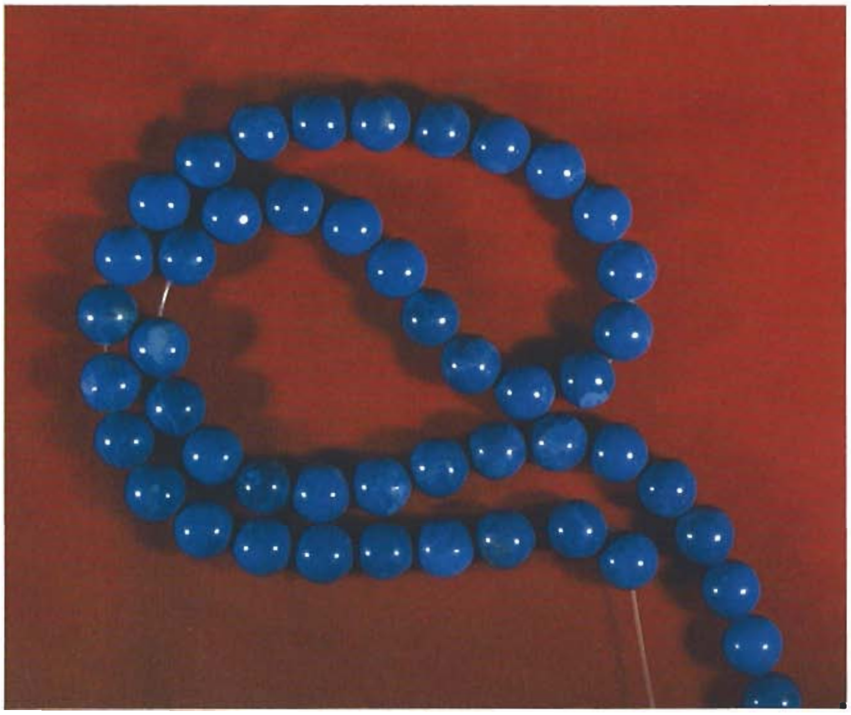


Figure 12. These 8-mm beads of dyed dolomite were originally represented to be a dyed howlite imitation of lapis lazuli.

Figure 13. Note the shallow penetration of dye in this polished half of one of the dyed dolomite beads shown in figure 12. Magnified 15×.

Figure 14. The base of this natural pearl has been eroded, probably by skin acid. The button-shaped pearl measures 12.6 × 12.8 × 10.1 mm.

Figure 15. This metal banding undoubtedly acted like a stencil to produce the erosion pattern seen on the pearl in figure 14. Magnified 10×.

place beneath the eight prongs, rather than beside them. *RC*

Imitation PEARLS, "Coque de Perle"

In recent weeks, the Los Angeles laboratory was asked to identify a material that is frequently offered for sale as "Mabe pearl," or sometimes as "Nautilus pearl." Figure 16 shows the front and back views of what resemble blister pearls that have been mounted as earrings. The lustrous gray oval hemi-cylindrical bead is cemented to a mother-of-pearl base. With magnification, we observed parallel transverse ridges, which do not occur in true blister pearls that have been formed by any of the various pearl-producing mollusks. This particular structure resembles in appearance the growth pattern of the chambered nautilus, and these attractive "blisters" have actually been cut from the central pearly whorl of the nautilus shell. These sections are more commonly known in the trade as "Coque de perle" (which translates approximately to "Shell of the pearl"). *KH*

Cat's-eye PETALITE

Several translucent to opaque, weakly chatoyant pink cabochons reported to be cat's-eye analcime from South Africa were donated to GIA during the ICA (International Colored Stone Association) Congress in Idar-Oberstein last year. One of these cabochons is illustrated in figure 17. The mineral analcime (an-

Figure 16. These 15.0 × 12.5 × 9.0 mm "Coques de perle" are imitation pearls that were worked from a Nautilus shell.

alcite), which forms in the cubic system, is a hydrous sodium aluminum silicate with the formula $NaAlSi_2O_6 \cdot H_2O$. For this material, Webster reports a refractive index of 1.487, a specific gravity of 2.22 to 2.29, and a hardness around 5 to 5$^1/_2$. Analcime, a member of the zeolite group, is generally known to gemologists as a rare, small, colorless faceted collector's stone.

The 20.3-ct pink cabochon we examined showed a spot refractive index reading of 1.51, a specific gravity of approximately 2.34, and (on the basis of hardness points used on the back of the stone) a hardness of approximately 6$^1/_2$. Exposure to short-wave ultraviolet radiation revealed a weak dull red fluorescence, and exposure to long-wave U V radiation revealed an extremely weak dull red fluorescence with several "veins" of moderate to strong chalky white fluorescence. Testing with a polariscope showed an aggregate reaction. No bands or lines were observed when the stone was examined with a hand spectroscope. On the basis of these properties, the chatoyant pink cabochon was identified as petalite. Petalite is a lithium aluminum silicate with the formula $LiAlSi_4O_{10}$; it has been reported to occasionally show chatoyancy. X-ray powder diffraction analysis on a similar cabochon showed a pattern that matched the standard ASTM pattern for petalite. *RK*

Figure 17. This 20.3-ct pink petalite, which shows weak chatoyancy, was originally represented as analcime.

Figure 18. These unusual 8.5-mm beads proved to be pyrite in quartz.

PYRITE in Quartz

The New York Gem Trade Laboratory recently examined the necklace of dark beads shown in figure 18. Although the beads are not spectacular in appearance when worn, they are fascinating when viewed with the microscope. They consist of a myriad of randomly oriented pyrite crystals in a transparent to translucent near-colorless quartz matrix. Where the pyrite has been exposed on the surface by polishing, the bright metallic flashes provide an interesting effect (figure 19). The continuing popularity of bead necklaces encourages the use of unusual new materials. *RC*

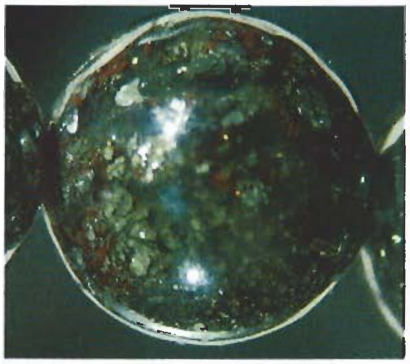


Figure 19. The quartz beads shown in figure 18 appear dark because of the heavy concentration of pyrite inclusions. Magnified 15×.

FIGURE CREDITS

Dave Hargett took the photos in figures 3 and 4, 11-13, and 18-19. Clayton Welch is responsible for figures 1, 2, 5, 14, and 15. Mr. A. De Goutière kindly supplied figure 7. Figures 8, 9, 16, and 17 are the work of Shane McClure. Figure 6 is © Tino Hammid. The drawings in figures 8 and 10 were prepared by Joni Takeshita.

Editorial Forum

ABSTRACT REBUTTAL

An abstract of an article of mine ("Colour Filters and Gemmological Colorimetry") was published in the Spring 1986 issue of your journal. I wish to comment on several statements made by your reviewer.

1. It was reported that two of the filters fit on the light source of the spectroscope unit and that the resulting illumination approximates to a CIE Source 'A'. This is clearly not so. The filters which perform conversions to either CIE Source 'A' and CIE Source 'C' are hand-held slide-mounted filters and are to be used only with the higher-wattage lamp and the 240V mains power supply.
2. The suggestion is made that the combination of lamp, power supply and filter may or may not approach that of CIE Source 'A' and that this possibility needs to be tested. It seems to the author, who is a physicist as well as a gemologist, that if he states that a particular condition is met, then that fact should only be challenged in the light of contrary experimental facts: Otherwise his treasured scientific probity is impugned. As a matter of record, each of the combinations selected are calibrated to *attain,* not approach, the CIE Source 'A', using standard light sources traceable to the National Physical Laboratory of the U.K.
3. The CIE chromaticity diagrams are said to have "mysterious entries" for the filters' color coordinates. A second glance at the table listing the filters would have revealed at once that these mysteries are simply the acronyms of the named filters.
4. The complaint is made that the dominant wavelength loci on the CIE diagrams are shown as straight lines where they should be curved lines. The reviewer "suggests that this incomplete knowledge of the CIE System on the author's part undermines an otherwise convincing plea for adoption of CIE-based techniques in gemology. . . ."

   It would appear that it is she and not the author who must be charged with this lack of knowledge. In all CIE chromaticity diagrams these loci are always straight lines, as they are in all color order systems including that of the European DIN-6164 System. In the American Munsell System, when the associated color sample coordinates are plotted on CIE chromaticity diagrams, the Munsell samples of constant Hue fall upon curved lines. Here the reviewer is treating Munsell Hue as identical to dominant wavelength. It is not.
5. The reviewer feels that the new comparison prism spectroscope described and illustrated is "out of place" in this article. This instrument was designed as a color science teaching aid for gemologists in order to facilitate simultaneous comparisons of pairs of spectra from any of the 38 CIE-calibrated filters in the set. As color perception is above all a comparison phenomenon, this inclusion is far from being an irrelevant "aside."
6. An objection is raised to the textual omission of any reference to the GIA ColorMaster and the GIA's use of it for gemstone color measurement. Again, a second glance at the table listing the filters would have revealed that there has been no such omission.
7. A final complaint is made that the author unfortunately uses many terms employed in color science which are unfamiliar to gemologists. The sober fact is that if gemologists wish to improve their professionalism by gaining some understanding of color production, perception and measurement, they will be obliged to acquire familiarity with such terms. Indeed, that was the message of the article.

J. B. Nelson, Ph.D.
McCrone Research Associates,
Ltd., London

First of all, I would like to extend an apology to Dr. Nelson for having conveyed—quite unintentionally—such a negative impression of his article, and for impugning his knowledge of color science when, in fact, it was I who made the error. As mentioned in his item 4, I did, indeed, confuse constant hue lines (curved) with dominant wavelength lines (straight). My error was inexcusable. In fact, this error had already been brought to my attention by Dr. W. N. Hale, Jr., chairman of the

ASTM Committee on Appearance of Materials, and a correction and apology were in preparation for printing in *Gems & Gemology* when we received Dr. Nelson's letter.

With respect to Dr. Nelson's second objection, the implication is the result of a typesetter's error. The statement "Unfortunately, the light sources used with the spectroscopes vary somewhat in composition . . ." suggests, in direct contradiction to his claim, that the instruments used by Dr. Nelson were variable and needed checking. This is *not* what I had intended. The sentence, as I originally wrote it, should have read "the light sources used with spectroscopes vary somewhat. . . ." This was simply meant to be a warning to other gemologists, with spectroscope light units other than the type described by Dr. Nelson, to be certain that the resulting source-plus-filter they obtain is correct. A light source quite different from that recommended by Dr. Nelson and for which this filter set was designed may have been provided with their instrument.

I agree with Dr. Nelson that gemologists need to become more familiar with color science terminology. However, the gemological literature still lacks basic information on color science whereby gemologists can acquire such knowledge. Gemologists, especially in the United States where most are practicing jewelers, look to academic foundations such as the GIA and the Gemmological Association of Great Britain to provide them with the knowledge they need to keep up-to-date in gemology, whether through basic educational programs or through the journals that are published. While the British are more scholarly in their approach to gemology, *Gems & Gemology* focuses more on the fundamental needs of the jeweler-gemologist for routine gemological grading and identification. It was with this latter focus in mind that I commented on Dr. Nelson's use of color science terminology.

The remaining objections cited by Dr. Nelson arose primarily out of problems of an editorial nature. While his article is admirable technically and with respect to its aim, I found it difficult to read and comprehend. As I stated in my original review, Dr. Nelson's article "manages to convey the very real need for education in color science in gemology, and the color filters—or some similar system—sound as if they could be of assistance in such an educational effort." I recommend the article to anyone seriously interested in the application of color science to gemology.

Carol M. Stockton, G.G.
GIA—Santa Monica, CA

THE "SYNTHETIC" CONTROVERSY

In the Summer 1986 issue of *Gems & Gemology* (p.107), I suggested that gemology would be better served if the word *synthetic* were never used as a noun and that, as an adjective, it should carry its original meaning of "man made." Responses published in the Fall 1986 issue of the journal indicated that I had committed a cardinal sin, and Dr. Nassau charged me with violating both gemological (and gemmological) tradition. His contention was that the restricted mineralogical definition for *synthetic* has been *consistently* used by gemologists with the meaning of "man-made equivalent of the natural." To further bolster his case, he claimed the support of B. W. Anderson, R. Webster, and R. Liddicoat.

This caused me to review their writings, and I found that Anderson (*Gem Testing*, 9th ed., p. 99) had written that "there is no warrant for using the term in this restricted sense . . ." and that Webster (*Gems*, 3rd ed., p. 328) had written that "such a strict definition is not acceptable in general practice." The writings of Liddicoat (*GIA Handbook*, 9th ed., p. 328) confirmed these sentiments, e.g., "Strontium Titanate . . . is unique among synthetic gem materials in that there is no natural counterpart. . . ." and "Synthetic Garnet . . . duplicates the garnet structure, but not composition. . . ." It is difficult to conceive how these writers could have been more explicit.

I would submit that Webster and Anderson were probably the last important gemological writers who were actively concerned that modern gemology was an eclectic science developed for the benefit of and supported by the jewelry trade. Gemology, to them, was not a subdivision of mineralogy. As a consequence, they astutely recognized the folly of trying to impose strict mineralogical jargon on the trade and on the public. Thus, their clear pronouncements.

Since their passing, their message appears to have been lost and precisely the opposite has occurred. The tail is now wagging the dog and the present "scheme" of classifications (synthetic, fake, simulant, paste, cultured, etc.) is not working well because of fundamental flaws. Revision is sorely needed and I would be remiss if I did not press for it.

W. W. Hanneman, Ph.D.
Castro Valley, CA

ERRATUM

On page 138 of the Fall 1986 issue, in the article on the separation of natural from synthetic amethyst on the basis of twinning, the sentence regarding zoning in synthetic stones should read "the zoning observed in most synthetic stones is limited to darker and lighter shades of purple and wedge-shaped or straight zones of citrine color. . . ." *Figure 18 in that article illustrates these different zones of color.*

BOOK REVIEWS

Jeffrey M. Burbank, Editor

NATÜRALICHE UND SYNTHETISCHE RUBINE

*By Karl Schmetzer, 131 pp., illus., publ. by E. Schweizerbart'sche Verlagsbuchhandlung, Stuttgart, West Germany, 1986. US$22.50**

Dr. Schmetzer, who is well known worldwide for his prolific gemological writings, has come up with a very interesting monograph on rubies. Written in German, the book provides information on how to separate natural rubies from synthetics.

The author begins with some basic but necessary crystallographic and mineralogic descriptions of corundum. Then he explains the five common methods of synthetic ruby crystal growth, providing good sketches and summary tables. The material used in the author's investigation (some 900 natural stones and 350 synthetics) is briefly introduced, as are the various testing methods: microscopy, UV-visible spectroscopy, UV fluorescence, goniometry, chemistry, and infrared spectroscopy. The distinctive features – inclusions or structures – used in separating natural and synthetic stones under the microscope are explained. The ultraviolet transparency test (the "Bosshart test") is also discussed.

The main body of the book is dedicated to a detailed description of both natural and synthetic rubies from various sources. Those inclusions (such as rutile and boehmite) and structures (twinning and growth features) that reveal a natural origin are discussed and illustrated with a wealth of photographs and diagrams. Probably the most original part of this book is its description of the characteristic features for rubies from specific major localities and a few minor ones – totaling 15 in all. This is followed by a similarly organized section on the particularities of 11 different types of synthetic rubies.

In this otherwise excellent book, there are two minor drawbacks. First, while synthetic crystal growth is well described, the author gives no overview of the geologic formation of ruby in a natural environment. Second, in several instances the color photographs are somewhat dull or so out-of-focus that they do not show distinctly what is referred to in the caption. Of course, the fact that this book is in German will also be a problem for many readers.

Overall, Dr. Schmetzer's book is an outstanding "state-of-the-art" work, providing practical information as well as hints on how to separate, with basic equipment, natural rubies from synthetic rubies, and how to determine – when possible – the geographic origin of a particular natural stone.

EMMANUEL FRITSCH
GIA Research Department

THE MAGIC OF MINERALS

*By Olaf Medenbach and Harry Wilk, transl. by John S. White, 239 pp., illus., publ. by Chilton Book Co., Radnor, PA, 1986. US$35.00**

The Magic of Minerals is one of the most beautiful "coffee table" books on minerals that has ever been produced. Since this book was first published in 1977 under the title *Zauberweltder Mineralien*, it has only been available in German. Now, thanks to the translation work of John Sampson White of the Smithsonian Institution, an English version has been published.

This book is impressive in every respect. Its unusually large format and beautiful cover assure its prominence in any home or office. But, as with any good book, it is what is inside that truly sets it apart. The photography by Olaf Medenbach, a mineralogist by training, is stunning. As one scans the pages of the book, a mineral enthusiast will recognize many familiar old friends, for Dr. Medenbach's photographs have graced the covers of numerous magazines and books.

What non-German-speaking mineralogists have missed before the completion of this English translation is the excellent text by Dr. Harry Wilk. Dr. Wilk has included a surprisingly comprehensive introduction to mineralogy for a "coffee table" book. The major portion of the book is devoted to historical and mineralogical descriptions of 110 minerals. Each of these well-written descriptions is accompanied by one of Dr. Medenbach's superb photographs.

Interspersed among these descriptions are seven sections. The first section, "The Crystalline Nature of Matter," discusses the basics of mineralogy, along with a concise description of the formation of the earth. In the second section, "The Structure of Minerals," Dr. Wilk gives a historical perspective to the internal structure of minerals and, in doing so, introduces the reader to everything from unit cells to silicate structures in very brief terms. The logical continuation of this discussion is found in the third section, "Symmetry of the External Crystal Forms," an introduction to crystallography. As with the other topics that Dr. Wilk covers, this discussion of crystallography is concise and simple. The next section, "Physical Properties," provides a detailed description of the color of minerals and light phenomena, of particular interest to the gemologist. In his petrological approach to the "Occurrence and Origin of Minerals," Dr. Wilk describes pegmatites, pneumatolytic mineralization, and hydrothermal mineral formation. The final two sections include a brief but interesting discussion of the origins of the "Names of Minerals" and the "Systematic Classification of Minerals."

It is difficult to find fault with such a well-produced book, and the detractions that I found were minor. The interspersing of the mineral descriptions with the seven sections tends to be confusing. Also, although the minerals are presented in order according to Dana's system, it is not until the final section of the book that the classification of minerals is discussed. There are a few mineral spellings that I found unfamiliar. These include adamine rather than adamite, indigolite rather than indicolite, and aktinolite rather than actinolite. The latter case is obviously a remnant of the German spelling and it is entirely possible that the others are as well. As I noted at the outset, given the overall excellent quality of this book, these criticisms must be considered trivial. *The Magic of Minerals* is a must for anyone with an interest in minerals who wants to bring converts to the mineral kingdom.

PETER C. KELLER
Associate Director
Los Angeles County Museum
of Natural History

OTHER BOOKS RECEIVED IN 1986

Descriptions of Gem Materials, *by Glenn and Martha Vargas, 190 pp., publ. by the authors, Thermal, CA, 1985, US$10.00.** This third edition of a valuable reference brings up to date the Vargas' pioneering work on facetable minerals. The book lists alphabetically some 320 natural minerals and 54 man-made gem materials, and supplies in a concise manner their gemological properties, alternate names, pronunciation (although sometimes the authors' notion of the "correct" pronunciation is arguable), and cabochon and faceting characteristics.

Although the book is intended to be used as reference for identifying the myriad faceted stones on the market, it is hampered by its lack of visuals, such as color plates, halftones, or line drawings. Nevertheless, it bears witness to the astonishing number of natural materials that can be converted into gems, and is an excellent catalogue raisonée for lovers of novelty gemstones, as well as for students of mineralogy.

Jewelry: How to Create Your Image, *by Jorge Miguel, 119 pp., illus., publ. by Taylor Publishing Company, Dallas, TX, US$19.95.* Mr. Miguel, a Brazilian-born jewelry designer and former professional soccer player, has written a book devoted to jewelry as fashion, or, more precisely, to fashion advice about jewelry. Yes, this is the sort of book that deals with topics such as "What jewelry complements different hair colors" and "How a woman's skin tone affects the way her jewelry looks" and "Which shapes and styles of jewelry flatter different body types." There is a built-in irony in Mr. Miguel's effort to avoid dating his subject by giving "sound advice on buying jewelry to outlast the trends of fashion," since the very concept of jewelry is predicated on "fashion." Perhaps more ironic are the photographs in the book that attempt to show how jewelry "flatters" a woman's appearance. These photographs are not very flattering at all. More to the point, this book's audience is the jewelry consumer, not the jewelry designer, though both may be wise to take the proffered advice with care. Of course, jewelry salespersons will find Mr. Miguel's advice of interest, since these very considerations—fashion, flattery, color coordination—are often what enhance or even make a sale.

The New Jewelry: Trends & Traditions, *by Peter Dormer and Ralph Turner, 192 pp., illus., publ. by Thames and Hudson, New York, NY, US$35.00.** All jewelry artists should be aware of this popular volume (a staple of many bookstores), which chronicles both in written words—and, more emphatically, in photographs—the "dazzling burgeoning of many kinds of ornament." The book's three main divisions betray its emphasis on the *art* of jewelry, as opposed to its *craft*. These sections are: "Expression and Design," "Jewelry as Image," and "Jewelry as Theatre." The authors thus promote their notion of jewelry as miniature sculpture, and illustrate this concept admirably, with photographs that dramatize the impact—and unwearability—of some of the more avant-garde pieces.

Although the book attempts to show the possibilities inherent in adornment when pushed to its limits, *The New Jewelry* is also a practical reference, with biographies of prominent jewelry designers and an appendix of museums with modern-jewelry collections. What is hard to gauge is this book's role as a lasting reference, since the jewelry it discusses is so much of the moment. Whether the design and theory illustrated here prove durable can only be tested by time.

Opals: Rivers of Illusions, *by Alina Loneck, 64 pp., illus., publ. by Gemcraft Pty. Ltd., East Malvern, Victoria, Australia, 1986, US$6.95.** This slim book attempts to provide a comprehensive treatment of opal in what amounts to an essay-length volume. Ms. Loneck, an English jewelry designer currently residing in Australia, has managed to distill her subject down to a mere 64 pages and nevertheless cover such topics as "Historical Context," "Optical Properties," "Chemical Composition," "Opal-Bearing Areas," "Fashioning, Synthesis, and Classification," and "Prospecting." Although the book's very brevity cannot recommend it as an encyclopedic reference, it is a very good pocket volume for the opal novice, and contains a generous amount of information for its modest size.

Treasures of the British Museum, *by Marjorie Caygill, 240 pp., illus., publ. by Harry N. Abrams, Inc., New York, NY, 1985, US$29.95.** This handsomely produced book,

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**This book is available for purchase at the GIA Bookstore, 1660 Stewart Street, Santa Monica, CA 90404.*

full of many color and black-and-white photographs, is an excellent armchair introduction to the treasures found in the British Museum. It is of interest to gemologists because it includes a chapter on the famous Hull Grundy jewelry collection – a chapter that, although brief, features a stunning double-page spread illustrating some of the collection's most beautiful brooches.

Of interest to horologists is the "Clocks and Watches" chapter, which provides a sampling (although largely via black-and-white photos) of some of the treasures of the museum's Clock Room. Because so much of the museum's collection is of ancillary interest to gemologists, this book should prove fascinating reading. The chapter on the Royal Cemetery at Ur, for example, features some beautiful photographs of gold artifacts, and in almost every other chapter, an item of ancient jewelry is certain to crop up. Although not a primary reference, this is still an ideal volume for the bookshelf or coffee table.

A Time to Watch, *by Jac Zagoory and Hilda Chan, 200 pp., illus., publ. by ChiuZac Ltd., New York, NY, 1985, US$88.00.** Although peppered with an occasional short essay on the evolution of the wrist watch, this sumptuous volume pretends to be nothing less than a purely visual celebration of its subject matter. It is perhaps for this reason alone that the volume is so expensive, since its photographs are in no small measure the result of some attentive artistry. Many of the masterpieces of Rolex, Cartier, Tiffany, Patek Philippe, and others have been displayed across full pages, in photographic compositions that find the timepieces in fanciful, if not baroque, settings. Some may be splayed across an elaborate parquet table, others planked down on a block of ice, one perched atop the Chrysler building, another hovering in the firmament as if doing battle in "Star Wars." The net result, unfortunately, is to detract from the beauty of the timepieces themselves, and call attention to the busy ingenuity of the photographic compositions, which, given the subject matter of this book, probably could have been better used elsewhere.

Struck by Lightning, *by Les Taylor, 183 pp., illus., publ. by Jon the Printer Pty. Ltd., Ashmore, Queensland, Australia, 1985, US$10.00 (approx.).** In gemological literature there is a body of work that has become a genre unto itself – the "miners' tales" that once were the province of the oral tradition but now make their mark, with considerable force, in the literary realm as well. Les Taylor's book is undeniably of this ilk – reflections on Australian opal mining that, in the author's words, are "concerned with a general approach to the stone, portraying in simple, broad terms its types, its commercial position, and the people who live their lives in or close to the world of opal." In fact, the stated priority is reversed, since it is undeniably the human side of opal mining that has engaged Mr. Taylor here.

Taking the book on its own terms, the reader will discover that *Struck by Lightning* distinguishes itself from its many literary cousins by its engaging style, which is full of the flavor of the Australian idiom – in itself a feature to recommend reading. And while many similar tracts of gemological folklore are famously rife with typographical errors, bad prose, and misinformation, this book sets itself apart through its literacy and sincere tone. Some of Mr. Taylor's stories may verge on the apocryphal (though he avers all are true), but, whatever the case, he has succeeded in recounting a wealth of human lore, garnered over his 30 years in the opal business. As an indication of the book's allegiance to its folk roots, it should be noted that some 40 pages of *Struck by Lightning* are stories written in doggerel verse.

JEFFREY M. BURBANK
Santa Monica, CA

GEM NEWS

John I. Koivula, *Editor*
Elise Misiorowski, *Contributing Editor*

COLORED STONES

Amblygonite treatment. Pale, straw-colored amblygonite from Tanzania, which was quite common a few years ago at gem and mineral shows, has recently reappeared on the market. This time it is a pale green color, thanks to irradiation. Jonté Berlon Gems of Fallbrook, California, brought the pieces, which range in size from 5 to 15 ct, to our attention. The Research Department at GIA has obtained samples of both untreated and irradiated material for further study. The color stability of this treated material is not known at this time. As reported by Patricia Gray, GIA Research.

Bicolored beryl. Mike Ridding of Silverhorn jewelers in Santa Barbara, California, reported to *Gems & Gemology* on a new find of beryl from an old locality in Minas Gerais, Brazil. The location, close to Coronel Murta, near Araçuaí, produced approximately 400 kg of beryl in the early 1960s. Then, in late 1985, a second beryl strike produced another approximately 100 kg from the same site. The beryl crystals from this strike are quite attractive, with intense orange centers that grade to a pleasing green rim. Some crystals are at least 20 cm long. The orange-colored zones are of faceting quality; small stones cut from these areas are light in color. The remaining material is most suited for gem carving. Mr. Ridding also reports that some of this material is heat treated in Brazil, which turns the green rims blue and the orange cores pink.

Electrically treated chalcedony. Virtually all so-called "black onyx" is the result of sugar-sulfuric acid chemical treatment of chalcedony, and agates can be stained to just about any color using a wide variety of dyes. One of the more clever chalcedony "improvement" methods involves the staining and electrolysis of pale off-white to cream-colored translucent material to produce not only a pleasing body color but also an attractive internal dendritic pattern as well. In this process, copper salts are dissolved in water to a point of saturation, and the precut chalcedony is stained a blue-green color through sustained immersion. Once the chalcedony is the desired shade, an electric current is passed through it and the ionic copper solution begins to break down. As the in-place electrolysis proceeds, a native copper dendrite begins to form, radiating outward from the center of electrical contact. The result, as shown in figure 1, is quite attractive. Although only a few examples of this treatment have been observed over the last two decades, it now seems to be resurfacing. Once this material is seen it is not forgotten, but, until now, no photographs have ever been provided to aid the gemologist in the visual identification of this relatively uncommon enhancement. Gem News wishes to thank Mr. Gerhard Becker of Idar-Oberstein, West Germany, for supplying us with this sample for study.

Green sphene. A gem and mineral collector living in Tijuana, Mexico, reports that a type of green sphene, thought to be colored by chromium, is being marketed as "Mexican Emerald." The sphene is found in the territory of Baja California, Mexico, near San Quintin, in a very limited area and a small deposit. The stones are a rich green color with many flaws, which in part mask some of their high dispersion. This dispersion, as well as the fact that sphene is "over-the-limits" of the standard refractometer, should provide sufficient information for any gemologist to identify it. As reported by Patricia Gray, GIA Research.

Important new amazonite find. A new pocket of amazonite was found in June 1986 in the Crystal Peak District of Teller County, Colorado. The pocket, named the Keyhole Vug, was reported to be approximately 8 × 6 × 2 feet. It has yielded amazonite crystals of solid green color and luster intermingled with small white cleve-

Figure 1. This chalcedony has been treated with electricity, which produced the dendritic pattern in the copper salt-treated subject. Photo by John I. Koivula.

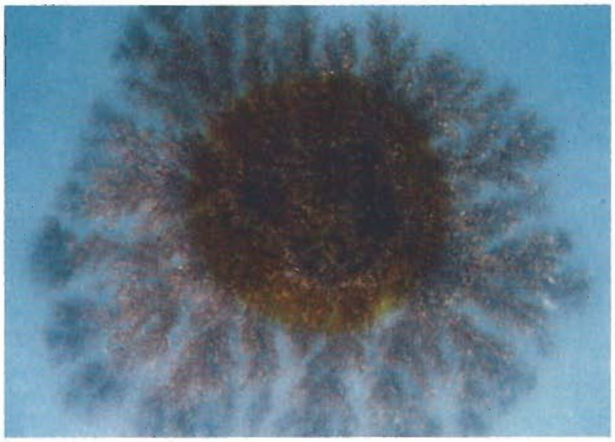

Figure 2. These approximately 7-cm (2$^{3}/_{4}$ in.) birds, carved from red and green tourmaline and mounted in gold with diamond accents for use as a pin, were featured at Intergem '86 in Idar-Oberstein, Germany. Courtesy of F. A. Becker, Idar-Oberstein. Photo ©Harold & Erica Van Pelt.

landite rosettes. There was no smoky quartz associated with the amazonite in the pocket, although the presence of small circular holes on the specimens suggests that quartz had once been present and had been selectively etched away. Specimens of this material are expected to be shown at the Tucson Gem & Mineral Show in February 1987. (*Mineral News*, October 1986)

Intergem Idar-Oberstein '86. Fine green and pink tourmalines from West Africa were popular items at the recent Intergem '86, held in Idar-Oberstein, Germany last September. A variety of new cuts were also featured, as was a new variation on gemstone carvings: Birds and animals delicately carved from tourmaline and other fine gem materials have been mounted in gold for use as jewelry (figure 2). Another highlight of the show was a 1954 Mercedes Benz 300SL carved from rock crystal with accents in rubies, gold, and diamond.

Kenyan rubies exported to Thailand. As reported to Gem News by Karim Jan of Tsavo Madini Inc., in Costa Mesa, California, Thai gem dealers are buying large lots of Kenyan ruby and exporting them to Bangkok, Thailand, for heat treatment.

Anyone familiar with Kenyan rubies knows that they often have very beautiful color but are also just as often clouded to a milky translucency by excessive amounts of fine particulate exsolution rutile. According to Mr. Jan, the Thais are heat treating these "cloudy" African stones using the same method that is also used on Sri Lankan geuda. The change produced by heating these Kenyan gems is rumored to be quite dramatic: The gems go in translucent and come out transparent. Because of the Kenyan rubies' excellent color and fluorescent character, once clarified they look like Burmese material. The best of these treated Kenyan rubies are said to be visual equals to the finest Burmese gems.

Metavariscite. Bart Curren, a gemologist at GIA, recently loaned Gem News a most unusual cabochon for examination (figure 3). The cabochon was cut by Mr.

Figure 3. After gemological testing, this unusual cabochon was discovered to be metavariscite. Photo ©Tino Hammid.

Figure 4. These elbaite tourmalines from a new site in Minas Gerais, Brazil, often make striking mineral specimens. The specimen measures approximately 12 cm. Photo by Mike Ridding.

Curren from the core of a light green opaque variscite nodule. The finished cabochon (18 × 14 × 4 mm) was a very pleasing translucent "chromium" green color reminiscent of fine jadeite and not at all characteristic of variscite. Although the refractive index and specific gravity of the cabochon seemed a little low for variscite, they were still within the accepted ranges. However, the color and translucency suggested that additional testing might be worthwhile. X-ray powder diffraction performed by Chuck Fryer revealed that the cabochon was metavariscite, the monoclinic dimorph of variscite. Dr. Emmanuel Fritsch investigated the cause of the beautiful green color spectrophotometrically. The metavariscite absorption spectrum exhibited two very intense absorption bands, at 430 nm and 620 nm (which together cause the color), leaving a deep transmission window in the green (520 nm). "Chromium" lines are present at 684 and 686 nm. Infrared spectrometry revealed an additional absorption band at 1043 nm in the near-infrared, probably associated with Fe^{2+}.

New find of elbaite tourmaline. In May of 1986, a new deposit of elbaite tourmaline was discovered in the state of Minas Gerais, Brazil. Mike Ridding, of Silverhorn jewelers, also reported the following information to Gem News. The tourmalines from this new deposit may have limited gem potential because they are highly included. However, they make striking mineral specimens because of their often undamaged groupings and interesting color gradations, as demonstrated by the 12-cm specimen shown in figure 4. The pegmatitic matrix associated with these tourmalines consists mainly of albite feldspar and lepidolite mica. The area where the tourmalines are found is located near the old and still actively producing Cruzeiro mine at Havra da Paderneira, Municipio de Aqua Boa, in Minas Gerais.

ANNOUNCEMENTS

The American Gem Society Conclave for 1987 will be held in San Francisco on April 23–28. This year's theme is "San Francisco '87: Your Golden Gate to the New Technology of Success." GIA President Bill Boyajian will be the featured theme speaker. Classes and seminars will be presented primarily at the Fairmont Hotel, with some at the Stanford Court and Mark Hopkins Hotels. For further information contact Laurie Hudson, marketing manager and primary conclave planner, (213) 936-4367.

The International Colored Gemstone Association will hold their annual Congress in Bangkok, Thailand, on May 18–20, 1987, at the Shangri-La Hotel. An estimated 500 delegates are expected to attend, representing all aspects of the colored gemstone industry. Those interested in attending the 1987 ICA Congress should contact the ICA administrative office at: 22643 Strathern Street, Canoga Park, CA 91304. Telephone: (818) 716-0489. Telex: 820801.

GEMOLOGICAL ABSTRACTS

Dona M. Dirlam, Editor

COLORED STONES AND ORGANIC MATERIALS

Color centers in sodalite. P. S. Pizani, M. C. Terrile, H. A. Farach, and C. P. Poole, Jr., *American Mineralogist*, Vol. 70, No. 11/12, 1985, pp. 1186–1192.

The authors investigated the origin of color in natural blue sodalite ($Na_4Al_3Si_3O_{12}Cl$) from the Itabira district in the state of Bahia, Brazil. They submitted sample stones to various types of radiation and heat treatment. The techniques of electron spin resonance (ESR), nuclear magnetic resonance (NMR), ionic thermal currents (ITC), optical absorption, and electrical conductivity were used.

When the temperature of a sample of natural sodalite is maintained at 450°C for one hour, the blue color bleaches out. Exposure to a flux of X-rays for five minutes restores the original color. Two MeV (Mega electron volts) electrons from a linear accelerator produce the same result. When heated to bleaching at 600°C and then irradiated for five minutes, natural samples acquired a "blue-rose" color. Exposure to sunlight or incandescent light removes the rose component (when the rose component alone is present, the stone is sometimes called "hackmanite").

The pink component is due to absorption at 530 nm. The color center responsible for that coloration is an electron substituting for a chlorine ion in the center of a tetrahedron of sodium ions, as previously discovered. The blue coloration is due to two absorptions at 600 and 645 nm. They both bleached at 450°C. At room temperature, however, it would take 10 million years to bleach half the color.

The present experimental results contradict two former hypotheses for the origin of color: the formation of colloidal sodium particles, and the substitution of SO_4^- for Cl^-.

The two absorption bands are supposed to be due to centers formed when an X-ray knocks an electron off an

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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 we feel 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. Opinions expressed in an abstract belong to the abstracter and in no way reflect the position of Gems & Gemology *or GIA.*

oxygen ion and displaces the ion to an interstitial position in the lattice. It is hypothesized that O^- as an interstitial site with aluminum as its nearest neighbor is responsible for one band and similarly O^- near a silicon is responsible for the other. *EF*

Eocene amber from the Pacific coast of North America. G. E. Mustoe, *Geological Society of America Bulletin,* Vol. 96, No. 12, 1985, pp. 1530–1536.

Mustoe examined amber from two localities on the Pacific coast of North America: Tiger Mountain, near Issaquah, Washington (8 km east of Seattle) and Coalmont, British Columbia, Canada. Although both deposits are small, the presence of fossils and undisturbed stratigraphic sequences makes them excellent for understanding the evolution of amber-producing plants during the early Tertiary.

In his introduction, the author first reviews the history of amber research and then describes these two localities. He proceeds by discussing experiments conducted on the Pacific Northwest amber to piece together an evolutionary history of the resin-producing plants. He concludes that North American amber forests may not have become extinct; rather, the trees may have simply produced less resin as the climate changed and temperatures lowered prior to the onset of the Ice Age. *Patricia A. Gray*

Gahnospinelle aus Sri Lanka (Ghanospinel from Sri Lanka). K. Schmetzer and H. Bank, *Zeitschrift der Deutschen Gemmologischen Gesellschaft,* Vol. 34, No. 3/4, 1985, pp. 92–97.

The authors investigated various blue, bluish violet, and violet spinels from Sri Lanka to clarify and confirm the data published by Anderson, Payne, and Hey in 1937. Chemical analyses on these spinels show the main components as Al_2O_3 and MgO, with variable ZnO and fairly low FeO. The samples readily represent intermediate members of the aluminum-spinel solid-solution series, with the highest zinc (Zn) sample consisting of end members spinel $MgAl_2O_4$ (62.4%), gahnite $ZnAl_2O_4$ (33.5%), and hercynite $FeAl_2O_4$ (4.1%). The refractive indices and densities for the spinels studied vary from 1.716 to 1.754 and from 3.60 to 4.06, respectively. Neither the absorption spectra nor the inclusions provide any conclusive means to separate normal gem spinels from zinc-rich gahnospinels. Anderson (1964) and his co-workers (1937) defined gahnospinel on the basis of physical properties; the present work has added chemical analyses for further confirmation. Six photographs of inclusions are also provided. *MG*

Hard luck in a hard place. C. Kremkow, *Goldsmith,* Vol. 169, No. 4, 1986, pp. 32–34 and 37–38.

U.S. jewelry manufacturers use opal because it gives jewelry an individual look and is available in almost any quantity in calibrated sizes. However, sales of high-quality stones have been slow and opal has been primarily a low-end, high-volume market. Recently, though, opal has shown signs of becoming fashionable again. Designers are using more opal in their work, especially as inlay. Art Nouveau jewelry, which frequently incorporates opal, is currently enjoying a revival.

During the years of low sales, little prospecting was done for opal in Australia. The two major Australian opal-producing areas, Coober Pedy and Mintabie, are showing signs of being worked out, and there is some question as to whether Australia will be able to respond to an increase in demand. Although filing a claim is relatively easy and cheap, it costs about $1000 a week to work one. Thus, most miners cannot afford to prospect for new areas. Coober Pedy and Mintabie represent 90% of the world production of opal, and no new finds have been discovered in years. Although most miners feel there is still plenty of opal in the ground, no one knows where. Desperate miners in Coober Pedy have started a grass-roots movement to persuade the South Australian government to subsidize new exploration.

If opal production shrinks to the level of deposits such as Andamooka, once an important source that now produces insignificant amounts, there would be a severe shortage of opal on the world market. The recent 30% increase in the price of good, commercial-quality white opal indicates that supply problems are already here. The price increase mostly affects the rough sizes needed to cut the calibrated stones used by U.S. manufacturers. Cutting factories in Hong Kong buy most of the rough opal from Australia and virtually set the prices of rough and cut opal. Mainland China has also entered the market. Last December, China bought millions of dollars in rough, and now they are trying to gain production rights to the mines. This added competition for rough is partly responsible for the increase in prices.

Price increases are expected to continue, and opal will not be as readily available as in the past. One fact is clear: The production of the Australian opal mines can no longer be taken for granted. *Barton C. Curren*

Star opal. E. Spendlove, *Rock and Gem,* Vol. 16, No. 9, 1986, pp. 36–39.

The Spencer opal mine in eastern Idaho is known for producing opal with a strong play of color suitable for fashioning triplets. This mine also produces a variety of opal that, when properly oriented and fashioned into a triplet, displays a three- or six-rayed star. This type of opal is not known to occur anywhere else in the world.

Stars in crystalline materials such as corundum or quartz are caused by needles of another mineral (commonly rutile) that are oriented along prism planes in the host material. However, this explanation does not account for the stars found in opal, since it is a noncrystalline (amorphous) form of silica.

In this article, Spendlove refers to another article, "Star Patterns in Idaho Opals," by J. V. Sanders (*Australian Lapidary Magazine*, February 1977). Using an electron microscope and a goniometer (a mechanical device that allows a stone to be tilted and turned under a focused beam of light), Sanders found that the particles in Idaho opals were arranged in a smooth, very regular hexagonal pattern. A series of three planar faults (a dislocation in the structure of a mineral), equally inclined at an angle of 70° to the layers of silica spheres, produces a three-rayed star. A six-rayed star appears when an extra set of planar faults is present. The size of the particles limits the color range and types of star seen. Three-rayed stars, typically in cool colors (blues and greens) are produced by smaller particles. Larger particles result in warmer-colored (orange and red) six-rayed stars.

Australian opal is also made up of silica spheres arranged regularly in a hexagonal pattern. However, the spheres are stacked and faulted in a random manner with no planar faults. While this random structure can produce spectacular play of color, it does not lend itself to the formation of stars.

The author also cites his article in the September 1984 issue of *Rock and Gem*, which discusses the orientation and preparation of star opal triplets.

Barton C. Curren

Tsavorite. C. R. Bridges, *Jewelers Quarterly*, 3rd quarter, 1986, pp. 12–13 and 16–17.

If one of the greatest problems in marketing new gemstones to the public is lack of romance and lore, Campbell Bridges is working hard on the solution. His latest article about tsavorite focuses on the adventurous and vivid aspects of this unusual gem's East African origins, in a personal narrative style reminiscent of H. Rider Haggard, author of *King Solomon's Mines*. After a brief amble through some prospecting and mining information, the author speculates about why emerald commands such a high market value and tsavorite doesn't. Retail jewelers especially will find valuable tales and descriptions here for glamorizing and promoting this beautiful gemstone. *CMS*

An unusual needle-like inclusion in gem sinhalite from Elahera, Sri Lanka. M. Gunawardene and M. Gunawardene, *Journal of Gemmology*, Vol. 20, No. 2, 1986, pp. 98–99.

The authors describe hollow crystal channels in a faceted sinhalite from Elahera, Sri Lanka. The channels were partially filled with iron oxide, while other portions were completely transparent. Analysis of the iron oxides showed Fe and Si present. No pattern was obtained when X-ray diffraction was done. The needles were oriented to the three main orthorhombic crystal axes. The authors conclude that the hollow needles probably formed during growth and were filled with iron oxide and other chemical components from the neighboring rocks. *John I. Koivula*

DIAMONDS

Australia's new Kimberley mine – diamonds down under. J. Mayman, *Goldsmith*, Vol. 169, No. 4, 1986, pp. 50–54.

Award-winning journalist Jay Mayman has been following the story of Australia's Argyle mine since the first diamond finds five years ago. He writes a fascinating story – transporting us to the vastness of Australia's last frontier. He describes the physical setting and the amenities built for the miners, who are brought in for two-week stretches. Then there is the incredible security system, the innovative mining techniques, and the diamond-bearing lode which runs the length of the valley floor, a 1600-m pipe of olivine lamproite rock up to 600 m wide.

With Argyle's output of 25 million carats a year, its claim to the richest grade of any diamond mine known, and its production of rare pink diamonds, the speculation about future marketing agreements when the De Beers contract is up for renewal makes for intriguing reading. *Anne Riswold*

Diamond life. B. Lidstone, *Canadian Jeweller*, Vol. 107, No. 4, 1986, pp. 32–36.

Using personal interviews interspersed with unattributed vignettes, Lidstone reveals the concerns of Canada's wholesale diamond dealers. Most of the men interviewed believe that a code of honor, represented by the Hebrew word *mazel*, still plays a powerful role in the trade. However, some feel that the code is being undermined by the so-called "Briefcase Brigade," a group of diamond dealers from Antwerp and Tel Aviv. With minimal overhead and questionable customer service, these independent entrepreneurs radically undercut the prices of established, domestic wholesalers.

Canada's diamond wholesalers face several other formidable problems, such as the high cost of security, fluctuations in international currency, and national taxes that leave only a small margin of profit. Many are concerned about the current variation in grading scales, and weak appraisals. A Montreal wholesaler believes that inflated evaluations cause high insurance rates, which are reflected in the wholesalers' prices, causing the trade to lose many potential customers. "I hope somebody will act for the protection of the consumer and the jeweller," he comments in the article. "The consumer could be getting much more for his money."

Despite the problems and risks involved, many of the wholesalers in this article remain optimistic. Comments one: "We sold more larger stones this past fall than in many years. De Beers advertising is taking hold, and the larger-stone business has picked up considerably."

SAT

Examination of the surface features of Argyle diamonds from Western Australia. G. A. Tombs and B. Sechos, *Australian Gemmologist,* Vol. 16, No. 2, 1986, pp. 41–44.

Kimberlite pipes have long been believed to be the only type of primary deposit in which diamonds are found. However, unlike the diamonds from the USSR and Africa, diamonds from the Argyle Series and Kimberley area of Western Australia are found in lamproite pipes. Like kimberlite, lamproite is thought to be only a transporting medium and not the original rock type in which the diamonds formed. A question is raised by the authors as to whether the high potassium content of lamproite under molten or plastic conditions could be responsible for the unusual surface features of Australian diamonds.

Like diamonds from other sources throughout the world, Australian diamonds have a bright oily appearance. However, diamonds from Argyle usually consist of highly misshapen crystals with heavily etched and corroded surfaces. Etch channels are sometimes so deep that they almost sever the crystals, completely warping their morphology. Along with etch channels are hexagonal etch patterns that at depth show development of trigons. Trigons are also present on the crystal faces of Australian diamonds, but they tend to have truncated corners, as compared to African crystals which usually have trigons with sharp distinct corners. Experiments with the etching of diamonds have indicated that it is possible that the hexagonal pattern seen on the surface of Australian diamonds could be the result of the truncation of trigons by etching agents under various conditions and different times either before or after their ascent to the surface.

This article provides some interesting insights as well as some impressive color photomicrographs of the unusual surface features of Australian diamonds. However, the chronological order of the formation of Australian diamonds and the development of their intriguing surface characteristics remain a mystery.

Barton C. Curren

Glacial diamonds: America's oldest jewelry import. A. J. Maslowski, *American Jewelry Manufacturer,* Vol. 34, No. 4, 1986, pp. 54–56.

During the past century, a surprising number of gem-quality diamonds have been recovered from the Great Lakes region. Most geologists believe that these diamonds originated in kimberlite pipes in what is today northern Wisconsin, Michigan, and possibly Ontario. During the last Great Ice Age, slow-moving yet powerful glaciers scraped the diamonds from their beds and transported them southward. As the climate warmed, the glaciers retreated northward, leaving the diamonds scattered among millions of tons of rocks and boulders.

Most of the glacial diamonds were discovered during the late 1800s, when streams near the Great Lakes were panned for gold. Although the majority of these diamonds are insignificant, the existence of several fine, gem-quality stones such as the 21.25-ct Theresa and the infamous yellow Eagle (16.25 ct) indicate the possibility of untapped diamond resources in North America.

SAT

The Hope diamond. I. Balfour, *Indiaqua,* Vol. 38, No. 2, 1984, pp. 127–138.

This article traces the convoluted history of the famous Hope diamond. It starts with an account of the original stone from which the Hope was most likely cut—the 110-ct blue diamond sold by Tavernier to King Louis XIV of France, who later had it recut to a 69-ct heart shape known as the "Blue Diamond of the Crown." During the turmoil of the French Revolution, this diamond was stolen from the Garde Meuble in Paris.

The first reliable documents on the 44-ct oval stone that was eventually named the Hope go back to early 19th-century London, which was at that time the great clearing house for the jewels of the deposed French aristocracy. The Hope family acquired the stone in 1830, and disposed of it in 1901. Pierre Cartier acquired the stone in 1909, when it came onto the market again. Balfour attributes a lot of the tragic tales linked to the Hope to Cartier's invention.

Socialite Evalyn Walsh McLean bought the stone from Cartier in 1910. Following Mrs. McLean's death, Harry Winston acquired the Hope along with the rest of her jewels in 1949. He presented it to the Smithsonian in 1958, where it remains on display.

The De Beers Research Laboratory examined the stone when it was on loan for an exhibit in Johannesburg in 1965. Balfour states that it was found to be a "very strong type IIa diamond." If this is actually the case, then the Hope is a curious exception to the rule that natural blue diamonds belong to type IIb. *BFE*

Panna mine revisited. S. M. Mathur, *Indiaqua,* Vol. 44, No. 2, 1986, pp. 23–27.

The diamond fields of southern India were the primary producer of diamonds before diamonds were discovered in Brazil in 1725. However, production at these fields ceased long ago. The Panna District, located in Madhya Pradesh State in north-central India, is the only area in India that is currently producing diamonds. The Majhgawan mine (a kimberlite pipe operated by the government through the National Mineral Development Corporation, or NMDC) has contributed 15,000 of the 20,000-ct total production of the Panna district. About 80% of these diamonds have been of gem quality. The stones are generally small, averaging only 0.5 ct; stones over 10 ct are rare, and only 65 (most of gem quality) have been recovered in the last 15 years, the largest being 29.25 ct.

Shallow diggings can be found all around Panna. They are operated by individuals who are licensed by the

Madhya Pradesh state government on a yearly basis. These mines, unlike Majhgawan, exploit alluvial gravels or thin conglomerate layers. Some of the largest stones from the Panna district have come from these shallow workings. The pits generally are not deep, but sometimes miners must dig down 5–7 m before diamond-bearing material is found. The gravel is usually found in fissures in the sandstone or as a thin layer on top of a sandstone bed. The conglomerate underlies a sandstone layer that is 1–2 m thick. Deeper gravels occur along the Paisuni River. A deep alluvial quarry, operated by NMDC at Ramkheria, produced 1,700–2,300 ct annually before operations were shut down as unprofitable in 1980.

Another kimberlite diatreme at Hinota was explored but was deemed not to be economically viable. Diamonds were also found in a complex peridotite-pyroxenite-gabbro at Angor, but this too was abandoned as unprofitable. *Barton C. Curren*

GEM LOCALITIES

Gem minerals from the Embilipitiya and Kataragama areas in Sri Lanka. P. C. Zwaan, *Australian Gemmologist,* Vol. 16, No. 2, 1986, pp. 35–40.

The author briefly describes the gem deposits at two recently recognized locations in Sri Lanka. The first is at Embilipitiya, about 75 km southeast of Ratnapura. Here gem minerals occur as irregular, eroded crystals in the soil, and not in alluvial gravels as is the case at other, better known gem localities on the island. Gem minerals reported from this deposit include colorless orthopyroxene, reddish brown enstatite, blue cordierite, and kornerupine in various brownish yellow to green hues. Quartz and scheelite are also found, along with spinel and almandine.

The second new deposit is in the Kataragama area, about 150 km east of Ratnapura. The gem minerals also occur in the soil but in this instance they are found as well-formed crystals. Here occur corundums, spinels, and garnets in various colors, as well as yellowish brown tourmaline, green apatite, reddish brown sphene, and green actinolite, diopside, and spodumene. Gemological properties for some of the minerals from both areas are provided. *JES*

Gems and minerals of the U.S.S.R. E. Root, *Lapidary Journal,* Vol. 40, No. 8, 1986, pp. 42–47.

The author first comments on the widespread interest of the Soviet public in minerals, especially mineral specimens. As far as jewelry is concerned, Soviet citizens wear a great deal of amber as well as synthetic stones in light settings. He then describes the main Soviet displays of minerals and gemstones, highlighting the A. Y. Fersman Mineralogy Museum of the USSR Academy of Sciences in Moscow, the rhodonite-decorated arches in the Moscow subway, and the Kremlin State Armoury.

During a visit to the official trade organization, Almazjuvelirexport, the author saw nicely cut natural zircon and chrome diopside. Of special interest were pieces of very fine rough synthetic emeralds. A table and a map list the localities of interesting Soviet mineral specimens and gem materials. *EF*

Minerals and gemstones of Pakistan. C. Kovac, *Australian Gemmologist,* Vol. 16, No. 2, 1986, pp. 57–59.

This is a brief update on the gem and jewelry industry in Pakistan, which dates back 5,000 years. The gemstones being used today in Pakistan's thriving gem industry come from two main sources: the Gemstone Corporation of Pakistan, which operates all the mines in the country for the state; and tribal people, including refugees and smugglers from neighboring Afghanistan.

Emerald is the most commercially important gem mined in Pakistan today. It is recovered from a number of talc-carbonate-schist sites in the Swat valley. Aquamarine, morganite, and topaz are mined from pegmatites in the far northern areas of the Kohistan District, and further exploration is under way in even more remote areas of the Himalayas and the Northwest Frontier. Mining these areas is difficult because of their high altitudes, harsh weather, and inaccessibility.

Ruby is being mined in the Hunza valley; chrome diopside and spinel in various colors are found in association. Garnet (pyrope, hessonite), tourmaline, quartz, agate, jasper and other chalcedonies, turquoise, sodalite, serpentine, and nephrite are reportedly found at various locations throughout the country.

The author concludes that in the future we can expect to hear much more about commercial gemstone mining in Pakistan. *RCK*

Opal from Mexico. E. Gübelin, *Australian Gemmologist,* Vol. 16, No. 2, 1986, pp. 45–51.

This article presents a fairly comprehensive overview of opal from Mexico, covering historical use, geographic distribution, geologic formation, mining, cutting, and gemological properties.

The existence of opal in Mexico was known in the times of the Aztecs and Mayans, when opal was used both in jewelry and as a decorative stone. The opal is mined from deposits located in the mountainous highlands of the states of Hidalgo, Querétaro, Guanajuato, and Nayarit; the most important deposits commercially are located in Querétaro. This material is of eruptive and volcanic origin, forming under relatively higher temperatures than Australian opal and consisting primarily of cristobalite spheres.

The Querétaro deposits, which are representative of the Mexican deposits in general, are described in some detail. Mining is primarily open cast. A great number of opal types are found in these deposits, including the translucent to opaque milky Lechoso opal, water opal, and the well-known fire opal, which includes yellowish (sherry) and orange-red (cherry) colors. Lesser-known types include the translucent blue Azules opal, Lluvisnandos (rain-fire) opal, and Contra Luz opal, which displays a play of color in transmitted light.

Gemological properties include an R.I. ranging from 1.36 to 1.43, an S.G. of 2.00, and a hardness normally a little under 6. Inclusions in Mexican opal include chalcedony, cristobalite, goethite, hornblende, kaolinite, limonite, opal, quartz, and matrix.

Several fine photographs and photomicrographs accompany the article. *RCK*

A preliminary geochemical study of sedimentary gem deposits. M. S. Rupasinghe and C. B. Dissanayake, *Chemie der Erde,* Vol. 44, No. 2, 1985, pp. 281–298.

The geochemical abundances of 22 elements have been measured in the <0.63 μm fraction of two gem-bearing gravel fields from Sri Lanka: Ratnapura and Elahera. These abundances are compared to those in the probable source rocks, which are metamorphosed basic igneous rocks. The variations in element abundances with depth are also reported.

The Elahera gem field is enriched in Li, Na, K, Mg, Ca, and Mn, as compared to Ratnapura. This reflects the relative abundance of these elements in the source rocks, especially the presence of carbonates in the Elahera area. *EF*

Review of the geology of the gemstones of Sri Lanka. M. B. Katz, *Australian Gemmologist,* Vol. 16, No. 2, 1986, pp. 52–56.

The author summarizes field observations and current theories of origin dealing with the famous sedimentary gem deposits of Sri Lanka. The major gem fields of Ratnapura and Elahera are located within the Highland Group of metasedimentary and metaigneous rocks of Archaean-Proterozoic age. Few gemstones are found in place within the host rocks; rather, the vast majority occur as secondary deposits in sediments eroded from the host rocks. The gem minerals are thought to have resulted from a combination of geologic events involving widespread metamorphism and metasomatism of the Highland Group rocks. *JES*

Au pays des aigues-marines—Itinéraire minéralogique de Teófilo Otoni a Medina, Brésil (In the land of aquamarine—Mineralogical itinerary from Teófilo Otoni to Medina, Brazil). J. Cassedanne, *Monde et Mineraux,* No. 74, July–August 1986, pp. 8–13.

This is the first article in a series dedicated to aquamarine-containing pegmatites of Brazil. The two traditional classifications of pegmatites (descriptive and genetic) are detailed, and the shallow depth of formation (1.5–3.5 km) of gem-bearing pegmatites is emphasized. Crystallization of aquamarine occurs in the late stages of the magma differentiation, at a temperature of 250°–400°C. Only 1% of these formations have pockets, and even when a pocket is found it won't necessarily contain gems.

Although aquamarine is common in pegmatites, few deposits have produced more than 100 kg. Primary deposits are generally at the top or on the slopes of granitic inselbergs, deeply altered by erosion. Actually, more than 70% of aquamarine is produced from alluvial or eluvial secondary deposits. The author distinguishes three types of aquamarine pegmatites, and explains their chemical zonation. He gives some prospecting guides (such as the presence of tripyramidal quartz) and describes the mining (basically by small groups of laborers). *EF*

The Urucum pegmatite, Minas Gerais, Brazil. J. P. Cassedanne, *Mineralogical Record,* Vol. 17, No. 5, 1986, pp. 307–314.

This article summarizes the mineralogy of the Urucum pegmatite, which became famous in the 1960s as an important source of gem beryl and spodumene. The pegmatite is located several kilometers east of Galileia. It consists of a large, lenticular body about 20 m thick running east-southeast with a steep westerly dip. The pegmatite is distinctly zoned with very coarse-grained minerals near the central core. Gem minerals occur near the central portion of the pegmatite. Crystals of gemmy morganite beryl up to 25 cm across and spodumene crystals of 2 kg have been recovered. The pegmatite occurrence of a variety of minerals, both common and unusual, is also briefly described. *JES*

INSTRUMENTS AND TECHNIQUES

Observation and differentiation of natural and synthetic quartz using laser tomography. K. Sato, *Australian Gemmologist,* Vol. 16, No. 2, 1986, pp. 72–80.

Distinctive features of natural and synthetic quartz are discussed. The author claims that laser tomography, a sophisticated light-scattering method, is the only "viable" nondestructive test to separate natural from synthetic stones. A very detailed description of the polysynthetic Brazil-law twinning structure in natural quartz is given, and its light-scattering properties are explained. Light scatterers in synthetic quartz are of a different nature: "breadcrumb" inclusions, as well as the "cobble pattern" (also known as "streamline") seen in this material.

One wonders at the value of this sophisticated method for the detection of twinning when a polariscope will do just as well. *EF*

JEWELRY ARTS

Crafting with pure gold. S. P. Adler, *Aurum,* No. 25, 1986, pp. 42–47.

The author, Stephan Adler, is a jewelry designer and cofounder of the Byzantium Gallery in New York. The gallery offers modern interpretations of Moghul Indian, Egyptian, and Renaissance jewels, fashioned in 22- and 24-karat gold with gemstones. Adler itemizes some of the difficulties of working with pure gold. Besides being expensive, it scratches and bends easily, making it unsuitable for bracelets and rings that must withstand abuse during wear. Other problems include "drag" when a design is stamped out and the fact that the "flash point" of pure gold is very near its melting point, which makes certain techniques of gold working very difficult. The author successfully weaves into the text historical points about the use of jewelry in ancient civilizations that have inspired his designs. These points of interest plus 22 color photographs of his jewels and examples of the above-mentioned problems make this an entertaining and informative piece. *EBM*

JEWELRY RETAILING

AJM interviews Helene Fortunoff—where U.S. jewelry makers fail. *American Jewelry Manufacturer,* Vol. 34, No. 9, 1986, pp. 30–46.

Issuing a warning to U.S. jewelry manufacturers, prominent retailer Helene Fortunoff points out major industry problems. With regard to quality marking and trademarking, too many jewelry items are improperly stamped. Sometimes there is no karat or fineness stamp, and very often there is no trademark.

The lack of quality control is another problem that Fortunoff addresses. She asserts that consumers will not continue to buy earrings with posts that fall out, or plating that peels or chips. Neither are retailers willing to absorb the costs of replacing and repairing shoddily made items. The frustration of retailers is compounded by the fact that foreign goods, although usually superior in marking and quality control, often do not offer the styling they want.

Acknowledging the fierce price battles between manufacturers and retailers, Fortunoff concedes that she is willing to pay higher prices if manufacturers will improve their items. Otherwise, she believes, the entire industry will suffer. *Anne Riswold*

Creating a line and controlling it—all the way to the counter. P. Brams, *American Jewelry Manufacturer,* Vol. 34, No. 9, 1986, pp. 48–66.

Peter Brams is a major designer of popularly priced 14K gold earrings. He has 1,500 accounts, and in the spring of 1985 he sold 95,000 pairs of earrings. Emphasizing that today's manufacturer must have marketing and merchandizing skills, he first outlines and then proceeds step by step—beginning with the design and creation of a line—through each aspect of the business. He goes into some detail with figures and percentages.

Today's retailer is buying in depth and is demanding much more' from the manufacturer. The successful manufacturer has to have the nerve to try new looks—in quantity—and be able to develop his line in a specific direction. Gambling as he is, the manufacturer also has a greater need to control his product in the store. He has to work with the retailer on profit margin, and he must be able to analyze the buyers' selling-through figures, balance stock, and get involved in advertising.

This is an important article for anyone considering dealing with the big retailers. *Anne Riswold*

A jeweler's guide to female hands. J. S. Philby, *Modern Jeweler,* Vol. 85, No. 5, 1986, pp. 46–51.

Balance and proportion are objectives jewelers should strive for when selecting jewelry for the female hand. This article (the second in a series of three) discusses four basic hand types and the preferred jewelry shapes for each: long, thin fingers; long, broad fingers; short fingers; and average fingers. The hand with average fingers has design freedom and can wear any shape of stone and more than one ring as long as proportion is maintained. Average wrists can also wear any variety of bracelet but must maintain balance between bracelets and rings. Hands with long, thin fingers need jewelry that adds width, preferably pieces that are broader on the side, and that add height and width or extra volume. Rings with large stones are good. Wide or hinged bracelets are best to camouflage thin wrists. Hands with broad fingers need delicate or simple rings so that the fingers will appear smaller. Philby advises against wearing more than one ring on such a hand. Pear or marquise cuts work well to draw eyes away from finger width. Bracelets should be understated. The hand with short fingers is the most difficult. For larger cut stones, pear or marquise shapes are good. Other choices are rings with thin bands or small stones set lengthwise. Small, uncomplicated bracelets that deemphasize a wide wrist are recommended. This article is generously illustrated with photos of rings and bracelets appropriate for each type of hand. *Judi Fioti*

SYNTHETICS AND SIMULANTS

Pearls without oysters. P. Read, *Canadian Jeweller,* Vol. 107, No. 9, 1986, p. 16.

The Spanish island of Majorca, which lies in the Mediterranean Sea, has long been the source of top-quality imitation pearls. They are produced by a unique process that begins with a glass bead that has been formed on a clay-coated wire. The glass beads are then given numerous coatings of a substance called "pearl essence," which is apparently the secret behind the creation of such a fine product. The essence consists of guanine crystallites, a substance extracted from the scales of the herring. It is also possible that another substance, such as mica platelets coated with titanium dioxide, may also be used effectively. In the final production step, the beads are dipped in cellulose acetate and cellulose nitrate to bring out the iridescent effect produced by the guanine solution. Colored pearls can be created by incorporating dye into the essence.

The author concludes by discussing some identifying characteristics of the Majorica imitation pearl, such as coating irregularities at the drill hole, a very smooth, regular surface, and an absence of the natural or cultured pearl structure under magnification. Majorica imitation pearls are also relatively soft, so he recommends that care be taken to prevent scratching.

The article is a good review of an excellent pearl imitation. However, the title, "Pearls Without Oysters," could be misleading. *Mary Hanns*

MISCELLANEOUS

Instant heirlooms. L. Harris, *Connoisseur,* Vol. 216, No. 893, 1986, pp. 108–111.

Harris's article was chiefly written as a preview to the centenarian jewelry and decorative objects that were displayed last June at the Grosvenor House Antiques Fair in London. All of the items for sale at this fair were scrupulously examined by various committees of the British Antique Dealers' Association, who guaranteed a full refund should any item later prove to be a fake or something other than what it had been represented to be.

The result of this scrutiny was a sumptuous display of jewels and bric-a-brac of royalty, millionaires, or "simple swells." The text is alluring in its description, although it is difficult to see why the author interjected the statement that "Whether or not a stone in fact comes from India's fabled mine is no more subject to scientific proof than a woman's statement that she believes every single word of the Holy Gospel."

The article is accompanied by many excellent photos, including an intriguing mystery clock, Art Nouveau jewelry, and a carbuncle (cabochon garnet) and diamond flexible bracelet. *SAT*

Mineral photography. J. A. Scovil, *Rocks and Minerals,* Vol. 61, No. 2, 1986, pp. 70–73.

Scovil discusses the equipment needed and basic techniques used to take close-up photographs of mineral specimens. Only 35-mm single-lens reflex cameras are considered in this article. A camera with a through-the-lens light meter is preferred, since the meter compensates for filters, extension tubes, and bellows. The standard 55-mm lens does not focus close enough to take effective close-ups of mineral specimens. A macro lens is the optimum choice for close-up photography. It is designed to focus much closer and to obtain up to a life-size image; since the optics are designed for close-up work, it generally produces a sharper photograph. Macro lenses are usually available in 50-mm and 100-mm focal lengths. The 100-mm lens gives the photographer more working distance with slightly better perspective and representation of the subject, but a 50-mm macro lens gives a higher magnification with less extension and slightly better depth of field. A macro zoom lens does not allow as close a focus and has a lower optical quality than a true macro lens.

If a macro lens is not available, the photographer can use extension tubes or bellows, both of which fit between the camera and the lens, thereby extending the focal length and allowing a shorter focusing distance. Extension tubes are generally sold in a set of three different lengths which can be used in any combination. Bellows are larger and more awkward to use but are much more versatile than extension tubes. Good-quality bellows allow independent movement of the camera and lens, and also allow the camera and lens to be moved as a single unit.

Vibrations can also be a problem when using exposures of a few seconds. A sturdy camera mount, such as a heavy-duty tripod, is necessary for close-up photography. A cable or air release can also be very useful.

It is regrettable that the author does not discuss lighting to any significant degree. However, by reading this article and practicing with the techniques and equipment discussed, the amateur photographer should be able to obtain attractive photographs of his or her favorite mineral specimens. *Barton C. Curren*

Treasure troves of America. J. C. Zeitner, *Lapidary Journal,* Vol. 40, No. 5, 1986, pp. 27–41.

Subtitled "the hobbyist's guide to 'jewels' of the American museum circuit," this article addresses the point that museums are no longer used exclusively by scientists and scholars. Rather, they are increasingly becoming involved with the communities they serve by offering special exhibits, classes, and lectures as well as tours and field trips. The author also notes that gifts, donations, and loans from "amateur hobbyists" and collectors have had a major impact on every museum. Fifteen museums are singled out for their innovative community involvement. Some of them are opening new halls or exhibits, while others are notable but simply unappreciated.

An entire page is devoted to the new Ann and Perkins Sams Collection of Gems and Minerals, which is housed in the Lillie and Roy Cullen Gallery of Earth Sciences at the Houston Museum of Natural History. The Sams collection was put together in only about four years with the help of Paul DeSautels, former curator of the gem and mineral collections at the Smithsonian Institution.

An unauthored pictorial titled "Collections at a Glance" precedes this article. It contains very brief information about six museums and, more importantly, the names and addresses of 41 gem and mineral collections in the U.S. and Canada. *Patricia A. Gray*

Index to Volume 22

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SUBJECT INDEX

This index gives the first author (in parentheses) and *first page* of the article, Editorial Forum, or Gem Trade Lab Notes (GTLN) section in which the indexed subject occurs. The reader is referred to the author index for the full title and the coauthors, where appropriate, of the articles cited. The pages covered by each issue are as follows: Spring (1–66), Summer (67–128), Fall (129–190), Winter (191–260).

AUTHOR INDEX

This index lists, in alphabetical order, the names of authors of all articles that appeared in the four issues of Volume 22 of *Gems & Gemology*, together with the inclusive page numbers and the specific issue (in parentheses). Full citation is provided under the first author only, with reference made from joint authors.

Indexes prepared by Dona Dirlam