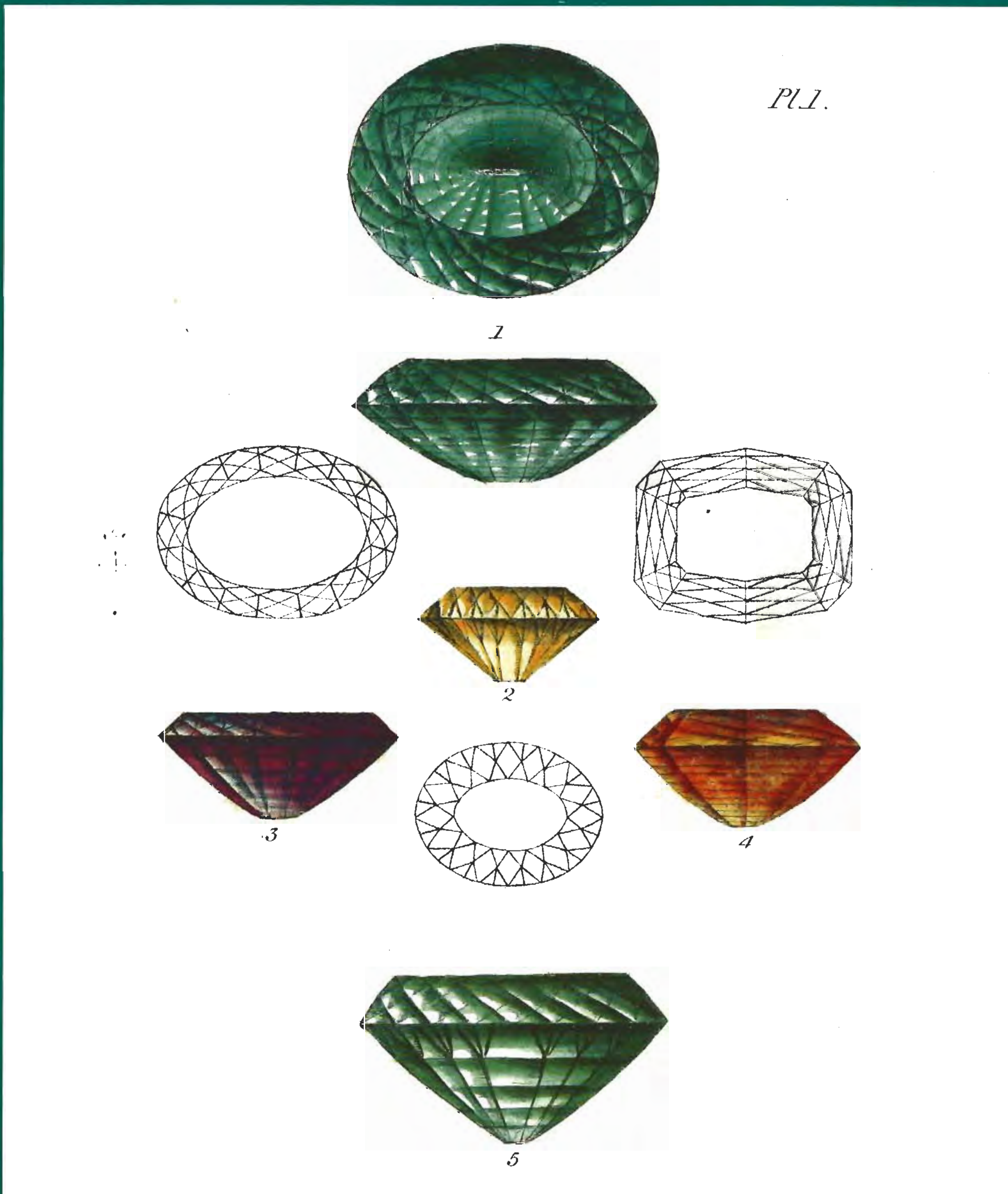
Gems & Gemology

VOLUME XXV SPRING 1989



The quarterly journal of the Gemological Institute of America

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Gems & Gemology

TABLE OF CONTENTS

ABOUT THE COVER: This hand-painted plate is the frontispiece for John Mawe's 1813 A Treatise on Diamonds and Precious Stones. *Shown are: top, "the plane and profile of a blue topaze in the author's possession"; center, "the finest chrysoberyl"; left, "a perfect amethyst"; right, "a superlatively fine topaze"; bottom, "an aqua-marina." John Mawe is one of the major authors of early gemology; his and many other rare, unusual, and important works are included in the John and Marjorie Sinkankas Library, which is now accessible to the public for the first time as part of the Richard T. Liddicoat Gemological Library and Information Center. The development of the Sinkankas collection and the many fascinating publications it contains are the subject of the lead article in this issue.*

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Gems & Gemology

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MANUSCRIPT SUBMISSIONS

Gems & Gemology welcomes the submission of articles on all aspects of the field. Please see the Suggestions for Authors in this issue of the journal, or contact the editor for a copy. Letters on articles published in *Gems & Gemology* and other relevant matters are also welcome.

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THE GEMS & GEMOLOGY MOST VALUABLE ARTICLE AWARD

ALICE S. KELLER Editor

It is hard to believe that the "new" *Gems & Gemology* is now entering its ninth year. In that time, we have gone from an original subscriber list of 1500 to almost 10,000. The demand for back issues has been so strong that many of the early issues in this new format have been out of print for years; complete volumes are available only for 1986 to the present. The journal is now translated into both Italian and Japanese, and more than one-fourth of our subscribers come from outside the United States.

Interestingly, there have been very few major changes in the format of the journal during this period; the dynamics of gemology itself have kept us contemporary. We are fortunate to have not only an extraordinarily capable editorial team (you will see the names of Chuck Fryer, John Koivula, and Dona Dirlam at the top of the masthead of the premier Spring 1981 issue—as well as on this one), but also a diverse, dedicated group of authors who provide the information that many of you have called "indispensable." It is again a pleasure to honor three of these individuals with the *Gems & Gemology* Most Valuable Article Award for 1988: Charles E. Ashbaugh III, first place, for "Gemstone Irradiation and Radioactivity"; William E. Boyajian, second place, for "An Economic Review of the Past Decade in Diamonds"; and Keith Proctor, third place, for "Chrysoberyl and Alexandrite from the Pegmatite Districts of Minas Gerais, Brazil." In fact, all four of Mr. Proctor's articles on gem deposits in Minas Gerais (the first appeared in Summer 1984) have won an award. These authors will receive cash prizes of $500, $300, and $100, respectively. Brief biographies appear below.

CHARLES E. ASHBAUGH III

Mr. Ashbaugh is facilities supervisor of the Nuclear Energy Laboratory at the University of California, Los Angeles, as well as president of Nuclear Theory & Technologies, a consulting company. He has an M.S. in nuclear engineering from UCLA and is a licensed professional nuclear engineer for the state of California. Chuck Ashbaugh first began irradiating gemstones in 1976 and has served as a consultant on that topic.

WILLIAM E. BOYAJIAN

As president of the Gemological Institute of America, Bill Boyajian heads the nonprofit educational organization of the jewelry industry. During his 13-year career at the Institute, he has distinguished himself as an educator, author, and accomplished speaker. His articles have appeared in many trade journals, and he is a contributing editor to GIA publications. A native Californian, Mr. Boyajian received his B.A. in economics from Fresno State University.

KEITH PROCTOR

As president of Keith Proctor, Precious Gems, of Colorado Springs, Colorado, Mr. Proctor is actively involved in the wholesale importing of colored gemstones and the design of custom-made jewelry. He is well known for his collection of museum-quality minerals with special emphasis on gem crystals, many of which he obtained during his extensive travels in the mining regions of Brazil. Mr. Proctor received an M.S. in molecular biology from the University of Colorado.

THE SINKANKAS LIBRARY

By Dona M. Dirlam, Elise B. Misiorowski, Juli L. Cook, and Robert Weldon

The world-renowned Sinkankas collection of books and other publications is now available to the public as part of the Richard T. Liddicoat Gemological Library and Information Center at GIA Santa Monica. Acquired by noted author and lapidary John Sinkankas and his wife Marjorie over the course of 40 years, the approximately 14,000 items include virtually all of the major works related to the study of gems and jewelry. This review of the important works in the Sinkankas library also serves to highlight the historical development of gemology – in art, in culture, and as a science.

ABOUT THE AUTHORS

Ms. Dirlam is senior librarian, Ms. Misiorowski and Ms. Cook are research librarians, and Mr. Weldon is slide librarian in the Richard T. Liddicoat Library and Information Center of the Gemological Institute of America, Santa Monica, California.

Acknowledgments: The authors wish to thank Marjorie and John Sinkankas for their invaluable assistance with the preparation of this article; Mary Murphy Hammid, Vandall King, and Neil Letson for input on the manuscript; and the Smithsonian gem collection staff for assistance with illustrations. Ruth Patchick was invaluable in typing the drafts of the manuscript.

Gems & Gemology, *Vol. 25, No. 1, 1989, pp. 2–15*

A major event in both the literary and gemological worlds occurred in January 1988, when the unique collection of books, reprints, pamphlets, and illustrations that comprised the John and Marjorie Sinkankas Gemological Library was purchased by the Gemological Institute of America. Accumulated over a period of nearly 40 years, the Sinkankas collection grew into the largest gemological library in existence, and became the standard to which all others are compared (figure 1).

The Sinkankas collection combined with the GIA library forms the nucleus of the state-of-the-art Richard T. Liddicoat Gemological Library and Information Center, which has just opened at the Santa Monica GIA campus. Now that the Sinkankas materials are accessible to the public, we want to familiarize the gemological community with the development of the collection and the highlights of this remarkable resource.

THE DEVELOPMENT OF THE SINKANKAS LIBRARY

The library first took form in the late 1940s and early 1950s, when John Sinkankas returned to his interests in the earth sciences following World War II. These interests were of long standing: His mineral collecting activities began at age seven, when he first wandered into one of the famous zeolite-producing quarries of Paterson, New Jersey, the city of his birth. Subsequent family excursions to the American Museum of Natural History in New York City led him to the splendors of the Morgan Gem Hall and its rough and cut gemstones. Here, he saw the famous blue topaz egg faceted by Anthony Esposíter that inspired him to turn to lapidary work after the war. As Captain Sinkankas gained proficiency on the wheel, he began writing for *Rocks & Minerals* magazine, taking up editorship of the Amateur Lapidary section in 1951. These articles attracted the attention of D. Van Nostrand Company, who in 1957 published the first edition of his *Gem*

Figure 1. This display shows some of the exceptional books in the Sinkankas collection. Included among the thousands of items in this collection are many of the rarest and most important works in gemology, dating from the early 16th century. Virtually every gem material is represented, as are jewelry, gem lore, synthetics, and many other related topics.
Photo by Robert Weldon and Shane McClure.

Cutting—A Lapidary's Manual. In the course of writing, Sinkankas greatly expanded his personal library as he sought books that would shed light on lapidary techniques used by others, types of gemstones and their properties, sources of rough, and other matters necessary to provide a well-rounded and authoritative text.

The post–World War II period was an excellent time to collect books, as a war-torn Europe was eager to rebuild. European bookshops were more than willing to exchange books for relatively small sums of money and regularly supplied them to established collectors in the United States. Among the most active were Dr. Mueller of Phoenix, Arizona, whose jewelry establishment still exists; Dr. H. C. Dake, the late founder and editor of *The Oregon Mineralogist*; and Dr. Daniel Willems of Chicago, who issued numerous catalogs of gem books which in themselves are now collectors' items. The Sinkankases obtained books from all of these individuals, as well as from many other sources and from bookshops worldwide.

In the late 1960s, the Sinkankases purchased all of the foreign-language books in the extensive collection of B. D. Howes, owner of the prominent Los Angeles jewelry store of the same name. Many of the classic antique books on engraved gems that are now in the Sinkankas collection were acquired in this move; in this category alone, the collection holdings far exceed those in many major art libraries. Other purchases reflected the expanding interest in books other than those purely on

Figure 2. John Sinkankas is seen here in the office of Peri Lithon, the Sinkankases' rare-book enterprise. He is surrounded by rebinding presses and other paraphernalia of his book-restoring projects. Photo by Robert Weldon.

gemstones, but all of them relate to the central theme of gem materials.

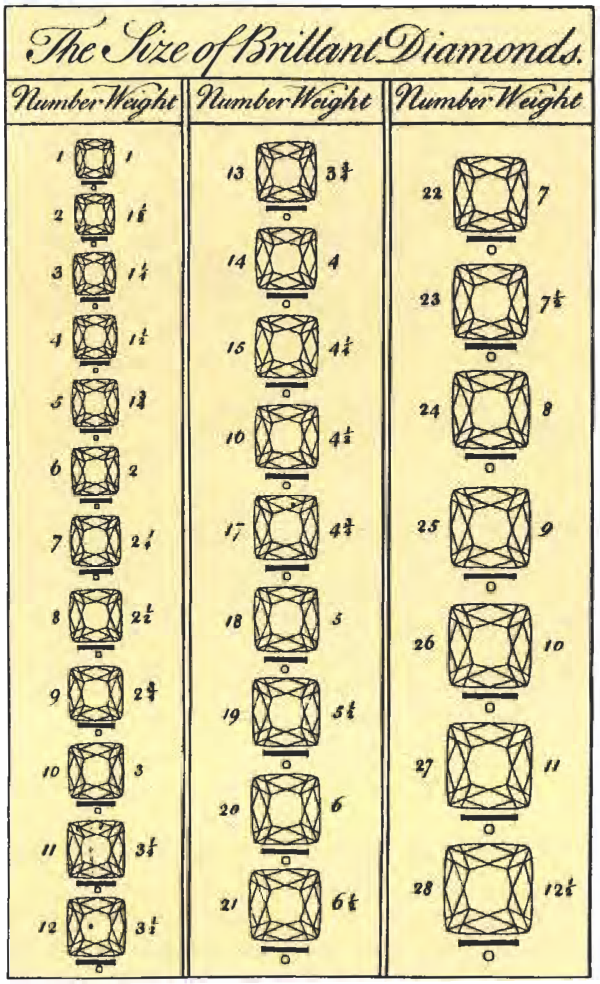
In the course of collecting, Sinkankas wrote nine books on gemologically related subjects. His first, *Gem Cutting,* is now in its third edition and was recently chosen by the USSR for translation into Russian. The two-volume *Gemstones of North America* and his most recent, the monumental *Emerald and Other Beryls,* are now classics. Because even his early works are still in demand, formerly out-of-print books are now being reissued with slightly different titles: *Field Collecting Gemstones and Minerals* and *Sinkankas's Standard Catalog of Gem Values* are now available.

An offshoot of the Sinkankases' collecting activity was their formation of an antiquarian book enterprise in the earth sciences, Peri Lithon Books (figure 2), in 1971, when their first catalog was issued (the latest is number 88). The business gave them many more opportunities to encounter books that could fill gaps in the collection as well as provide numerous editions and variants.

Before starting Peri Lithon, Sinkankas devoted much effort to the cutting of very large faceted stones, thus becoming the country's pioneer in this area (Gray, 1988). Among his larger classic pieces are the 4,000- and 7,000-ct (figure 3) faceted quartz eggs in the Smithsonian Institution collection (reflecting his early determination to cut an egg like the 1,463-ct blue topaz he saw as a boy in the American Museum of Natural History) and the world's largest faceted golden beryl, a 2,054-ct gem that is also in the Smithsonian.

Currently, Sinkankas is concentrating his energy on the compilation of a comprehensive gemological bibliography. This mammoth reference tool will not only list, but also describe, the thousands of books, articles, and pamphlets that he has personally examined and/or verified, including works written in all Western languages and Russian. However, he still takes time to repair and bind books, does his own watercolor and pen-and-ink

Figure 3. When John Sinkankas faceted this 7,000-ct quartz egg in 1963, it was one of the largest of its kind. It is now housed in the Smithsonian Institution and its image serves as the logo for the Sinkankas bookplate, which appears in each book in the collection. Specimen courtesy of the Smithsonian Institution; photo by Robert Weldon and Shane McClure.



The Tables of Diamonds.

Wt.	Price	Wt.	Price	Wt.	Price
Cr	£ s d	Cr	£ s d	Cr	£ s d
1	8:0:0	3 5/8	105:2:6	6 1/4	312:10:0
1 1/8	10:2:6	3 3/4	112:10:0	6 3/8	325:2:6
1 1/4	12:10:0	3 7/8	120:2:6	6 1/2	338:0:0
1 3/8	15:2:6	4	128:0:0	6 5/8	351:2:6
1 1/2	18:0:0	4 1/8	136:2:6	6 3/4	364:10:0
1 5/8	21:2:6	4 1/4	144:10:0	6 7/8	378:2:6
1 3/4	24:10:0	4 3/8	153:2:6	7	392:0:0
1 7/8	28:2:6	4 1/2	162:0:0	7 1/8	406:2:6
2	32:0:0	4 5/8	171:2:6	7 1/4	420:10:0
2 1/8	36:2:6	4 3/4	180:10:0	7 3/8	435:2:6
2 1/4	40:10:0	4 7/8	190:2:6	7 1/2	450:0:0
2 3/8	45:2:6	5	200:0:0	7 5/8	465:2:6
2 1/2	50:0:0	5 1/8	210:2:6	7 3/4	480:10:0
2 5/8	55:2:6	5 1/4	220:10:0	7 7/8	496:2:6
2 3/4	60:10:0	5 3/8	231:2:6	8	512:0:0
2 7/8	66:2:6	5 1/2	242:0:0	8 1/8	528:2:6
3	72:0:0	5 5/8	253:2:6	8 1/4	544:10:0
3 1/8	78:2:6	5 3/4	264:10:0	8 3/8	561:2:6
3 1/4	84:10:0	5 7/8	276:2:6	8 1/2	578:0:0
3 3/8	91:2:6	6	288:0:0	8 5/8	595:2:6
3 1/2	98:0:0	6 1/8	300:2:6	8 3/4	612:10:0

Figure 4. These two pages from Jeffries's 1750 A Treatise on Diamonds and Pearls *show sizes and weights for old-mine-cut diamonds together with corresponding tables of value per carat. This is one of the first works ever published on the commercial evaluation of gem materials.*

drawings of gems and minerals, and helps his wife in her operation of Peri Lithon. Versatile and disciplined yet with a delicious sense of humor, John Sinkankas is a true Renaissance man—and a legend in his own time.

THE SINKANKAS COLLECTION

The Sinkankas collection consists of approximately 14,000 publications. It boasts numerous one-of-a-kind books as well as all editions of some of the most important treatises in the field—an invaluable resource for tracing the development of knowledge in gemology. To provide some idea of the scope of the collection, and also of the literature in this dynamic field, we have described below a number of the rarer and more important works represented in a variety of subject areas. Information provided by the Sinkankases in a report on the collection and in the Peri Lithon catalogs has been incorporated (Sinkankas and Sinkankas, 1971–1989; Sinkankas, 1985).

Diamonds. There is a considerable amount of information on the properties of diamond, on diamond deposits worldwide and, most extensively, on South Africa. Several dozen works in Russian focus on Siberian diamond deposits and diamonds in general. Diamond technology is represented by many books on industrial diamonds and their applications in industry as well as by several books on diamond cutting. One of the earliest works on the commercial aspects of cut diamonds is the David Jeffries 1750 classic, *A Treatise on Diamonds and Pearls,* which establishes guidelines for evaluating and pricing these highly prized gem materials (figure 4). It may also be one of the

Figure 5. The frontispiece of volume 2 of G. F. Williams's 1902 The Diamond Mines of South Africa *depicts the author's collection of rough diamonds.*

earliest discussions of diamond-cutting styles and processes. This book was so widely used during its time that copies are often badly worn.

A rarity is a special deluxe edition of Gardner F. Williams's two-volume *The Diamond Mines of South Africa,* 1902, of which only 100 copies were issued. Not only does Williams relate the history of diamonds and their discovery in South Africa, but he also provides a detailed explanation of the mining operations and the various influences involved in the diamond market. The many illustrations in this book document the gems (figure 5), personalities, and mines of South Africa in the late 1800s. Sir William Crookes, the famous British chemist, is represented in his small but epochal 1909 book, *Diamonds,* which is based on his visits in 1896 and 1905 to the South African diamond mines and his research into the nature of diamond and its properties. Also present is the now-classic *Genesis of the Diamond,* written in 1932 by Gardner Williams's son Alpheus.

Jades. This portion of the collection is important because of the completeness of its coverage. All 13 books by Stanley Charles Nott, the noted jade authority, are represented, including the seldom-encountered *Voices from the Flowery Kingdom* (1947). Among the many attractively illustrated books on jade collections is the rare 1925 photographic encyclopedia of jade carvings by De Tanner. *Nephrit und Jadeit,* written in 1880 by Heinrich Fischer, is a well-known but seldom-seen historical source book on jade. Also remarkable is the volume privately published in 1900 by Reginald Heber Bishop that was the forerunner of the gigantic, two-volume set describing his jade collection. Of special interest is the early description in French of the jade sources of Khotan (in what is now Turkestan), written by Jean Pierre Abel-Remusat in 1820. This section also encompasses a broad variety of nonbook materials related to jade, from recent auction catalogs to reprints of articles on the question, "What is jade?"

Pearls. Several outstanding books and popular treatises delve into the subject of pearls, their history, art, lore, and science. Not only does the collection include personal accounts of those involved in the pearl industry, but it also provides thorough coverage of saltwater and freshwater natural and cultured pearls. George F. Kunz and Charles Stevenson's *Book of the Pearl,* first published in 1908, stands out as one of the most comprehensive works ever written on the subject (figure 6). The text discusses pearls in ancient times as well as pearl fisheries of the world, including the Persian Gulf, the South Pacific, Australia, and the Mississippi River. An invaluable chapter discusses famous pearls and pearl collections. Kunz continued to research and write extensively on pearls as well as other gems; most of his published works are represented in the collection.

Another classic is *Pearls and Pearling Life,* written by noted London gem expert Edwin W. Streeter in 1886, at a time when pearls were equal in value and popularity to diamonds. Also included are several technical papers and treatises on freshwater pearl mollusks, such as those by the U.S. Bureau of Fisheries, as well as a considerable amount of material on Ceylonese (Sri Lankan) pearls and fisheries. Other works in the Sinkankas collection provide specific details on now-famous pearls. An example is Bram Hertz's description of the Hope pearl in his 1839 *Catalog of the Collection of Pearls and Precious Stones Formed by Henry Philip Hope.*

Beryl. John and Marjorie Sinkankas spent 15 years researching and collecting the documentation for his outstanding work, *Emerald and Other Beryls* (figure 7), published in 1981 and now out of print. In the process, the Sinkankases amassed hundreds of publications with entries on beryl that now represent what is probably the most complete beryl reference file ever compiled. It, too, is included with the Sinkankas library, as are all of the reference cards created in the course of this research.

Figure 6. This frontispiece showing the pearl-adorned Czarina Alexandra Feodorovna of Russia is from Kunz and Stevenson's 1908 Book of the Pearl, *which remains the definitive reference on pearls.*

Other Gem Materials. Virtually every important gem material is well represented in the Sinkankas collection. It is especially strong, however, in gem materials that usually have the weakest representation.

One of the rarest works on amber, *The Tears of the Heliades or Amber as a Gem,* written in 1896 by W. A. Buffum, provides the first documentation on amber of Sicily (figure 8). Nathaniel Sendel's 1742 classic on insect and various other inclusions in amber is the first major monograph ever published on this topic. It may also be one of the first accounts of falsified inclusions in amber, including in one of its plates a fake specimen of a modern lizard pressed in amber.

Notable, too, are some very fine works on ivory, including Kunz's 1916 classic, *Ivory and the Elephant.* This book is remarkable for its information on modern and fossil ivories as well as for its discussion of the cultural aspects of ivory carving and ornamentation in various countries. G. C. Williamson's 1938 *Book of Ivory* describes the use of ivory for other than personal adornment, such as for dice, in Christian art, and for caskets. Also represented is the splendid 1930 Odell Shepard book, *Lore of the Unicorn,* which contains much on minor varieties of ivory.

Although relatively little has been written about coral, the Sinkankas collection contains many attractively illustrated modern books on the

Italian coral industry. One famous early work, written in 1864 by H. Lacaze-Duthiers, examines the history of the material as well as its production in the Mediterranean (figure 9).

Also featured are a number of works on ornamental and building stones, including the elegant 1883 and 1886 volumes by noted American author Sarah Burnham. Since many opaque gem materials such as lapis lazuli, malachite, and serpentine have been used as decorative stones, these books are a fascinating resource that is often overlooked by gemologists.

Tektite and meteorite references are particularly strong. Interestingly, tektites and moldavites are currently enjoying a rise in popularity. This changing nature of what is in vogue is one of the reasons that a library must be richly diverse. Who could have predicted this interest in such unusual gem materials? Fortunately, the Sinkankases' skillful collecting gives us that reservoir from which to draw.

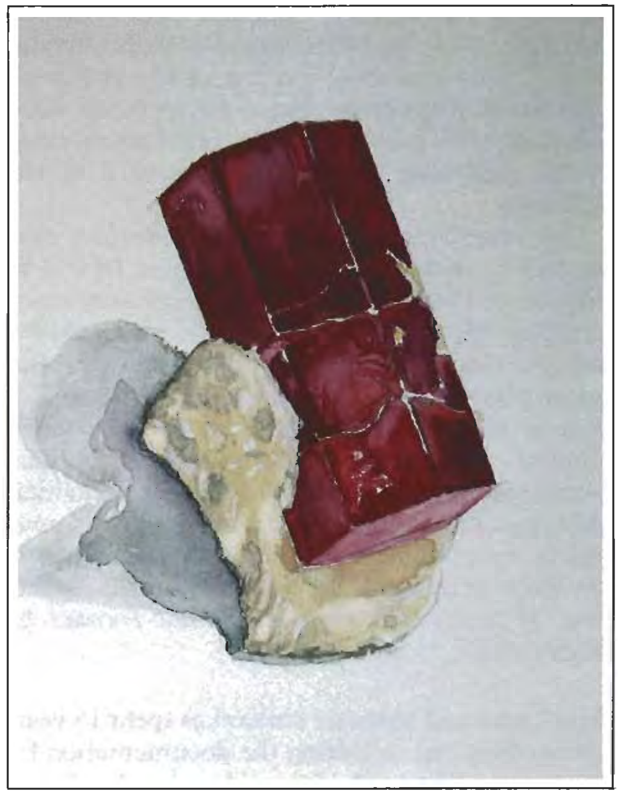


Figure 7. John Sinkankas painted this watercolor rendering of a red beryl crystal to illustrate his monumental 1981 book, Emerald and Other Beryls.

Jewelry. This major section includes histories of jewelry, descriptive books on ethnic and period jewelry, and instructional texts on jewelry design and manufacture. An excellent reference on French Art Nouveau designs in particular is the three-volume set on 19th-century French jewelry published in 1906–1908 by Parisian jeweler Henri Vever (figure 10). Equally impressive is the privately printed *Catalogue of the Collection of Jewels and Precious Works of Art, the Property of J. Pierpont Morgan*, compiled by noted English art connoisseur G. C. Williamson in 1910. In mint condition, this huge volume is one of only 150 released.

Books describing crown jewels are especially valuable both in chronicling certain large gems through history and in establishing the use, value,

Figure 8. Amber is especially well represented in the Sinkankas collection. Titled "The Necklace of Galatea," this exquisite illustration of multicolored amber is the frontispiece for Buffum's 1898 Tears of the Heliades.

fashion, and technology of gemstones and jewelry during specific periods. Most of the important works on crowns and coronation regalia of European royalty are included in the Sinkankas collection. Of particular note are the rare pamphlet on the crown jewels of Scotland that was written in 1839 by Sir Walter Scott; a copy of Germain Bapst's 1889 book on the history of the French crown jewels; the seldom-seen 1942 work by Rudolf Cederström on the crown jewels of Sweden; and the recent, comprehensive *History of the Crown Jewels of Europe,* by Lord Twining. Several books and catalogs describe the exquisite jewels and bibelots fabricated by the workshop of Peter Carl Fabergé, the great jeweler to the czars of Russia.

Figure 9. Rich color and fine detail are characteristic of the illustrations in Lacaze-Duthiers's classic 1864 book on the natural history of coral.

Figure 10. This Art Nouveau hair ornament, depicting a rooster holding an amethyst in its beak, was fabricated by René Lalique for display at the 1900 Paris Exposition. A black-and-white photograph of this piece appears on page 725 in volume 3 of Henri Vever's unparalleled La Bijouterie Française au XIXe Siècle. *Photo courtesy of the Calouste Gulbenkian Museum, Lisbon, Portugal.*

The Sinkankas collection also includes almost every volume ever written on rings. These range from a book in Latin by Johann Kirchmann, written in 1623, to the still-important Charles Edwards's *History and Poetry of Finger-Rings,* published in 1855. Other significant volumes include the detailed *Finger-Ring Lore,* first published by William Jones in 1877, and Kunz's 1917 classic, *Rings for the Finger.*

Engraved Gems. This section, which encompasses literature on intaglios, cameos, cylinder seals, and scarabs, includes works from the 16th century to the present. Important collections of engraved gems, such as those of French courtesan Madame de Pompadour and the English Duke of Marlborough, are detailed in beautifully illustrated volumes. Early works include writers such as Macarius, Chiflet, Gorlaeus, Gori, De Wilde, and Maffei, as well as the famous P. J. Mariette, whose 1750 book provides the first adequate report on the technology of gem engraving. The notorious Rudolph Erich Raspe, best known for his fabulous account of Baron Munchausen's adventures, is represented by a 1791 catalog of gem impressions manufactured by Tassie's of England.

Also included are the complete set of 11 books by noted 19th-century authority Rev. Charles W. King, of England. Many of these are still considered primary sources for information about ancient glyptic art. The Sinkankas collection also contains a rare, 1841, two-volume set by James Prendeville describing purportedly ancient engraved gems that were in the collection of Prince Stanislas Poniatowski of Poland. Although many of these pieces were later proved to be clever forgeries, the catalog is nevertheless noteworthy in that its actual photographic prints are among the earliest to appear in any gemological treatise.

The beginning of the 20th century is marked by the appearance of the three-volume set written by Adolf Furtwängler of Germany, which is still one of the most important works of all time on engraved gems. This careful historical treatment includes an extensive annotated bibliography that covers all aspects of the topic, as well as many plates of impressions made directly from the engraved gems themselves (figure 11).

Figure 11. Filled with plates of impressions made directly from engraved gems, Furtwängler's three-volume Die Antiken Gemmen, *from 1900, is one of the most important works in the field. Cameo courtesy of Mary Wildman; photo by Robert Weldon.*

Lapidary Arts. Few books on the actual cutting and polishing of gem materials were written before modern times, because highly skilled tradespeople refused to share the knowledge that guaranteed their livelihood. Some generalized statements, such as the 1906 *Gem-Cutter's Craft* by Leopold Claremont, purport to reveal "secrets," but they actually say little that would be of help to a beginner. Because of Sinkankas's special interest in, and publications on, the lapidary arts, his collection contains virtually all of the books written in Western languages since the end of the 19th century that bear on lapidary work and its technology, including studies of material properties and how these influence cutting. Here is to be found the landmark 1921 work on polishing phenomena by Sir George Beilby, *Aggregation and Flow of Solids,* in which he describes the experiments that led to the famous "Beilby flow" theory of surface polish on gemstones and other hard materials.

Gemstone Lore. Much of gem lore goes so far back into antiquity that the origins of many tales and legends, superstitions, and magical imputations can no longer be traced. Yet, many books have delved deeply into this subject. One of the great resources on Indian lore, for example, is the two-volume set of *"Mani-Mala," or a Treatise of Gems,* written by Sourindro Mohun Tagore in 1879–1881. The text is a compilation of information on Indian gemstones and their lore gleaned from ancient Sanskrit texts. Written tandem in four languages—English, Bengali, Hindi, and Sanskrit—this is an exceptionally important gem reference.

The Sinkankas collection contains other major works in this area, including 20th-century Egyptologist E. A. W. Budge's books on scarabs and amulets, Kunz's 1913 *Curious Lore of Precious Stones* and 1915 *Magic of Jewels and Charms,* the 1922 work by Isidore Kozminsky, and Léonard Rosenthal's beautifully illustrated 1924 *Au Jardin des Gemmes* (figure 12). A number of original editions of the books on magical jewels by Dame Joan Evans are in the collection, as are several works on gemstones of the Bible. Early lapidary treatises that have much to say on the magical virtues of gems are discussed in Lynn Thorndike's 1923 *History of Magic and Experimental Science.*

Figure 12. This exquisite illustration by Léon Carré is one of 12 color plates from the 1924 deluxe edition of Au Jardin des Gemmes *by Léonard Rosenthal. It depicts a mythical scene of a stone lion with luminescent emerald eyes guarding the tomb of King Hermias (220 B.C.).*

Other topics represented include crystal gazing and bezoars, the animal calculi deemed to be protection against poisoning.

History, Adventure, Biographies. Much of the excitement of gems comes from the intrigue and adventure that surrounds these small objects of great value. This collection contains many stories of gemstone smuggling and fraud, personal accounts of travels, and biographical works on famous persons involved in diamonds and colored stones. Included are several books on the scandal of the Marie Antoinette necklace, such as *The Story of the Diamond Necklace,* written in 1867 by Henry Vizetelly. This two-volume work recounts the curious disappearance of an extremely valuable diamond necklace that was allegedly sold to Marie Antoinette in 1785 for nearly 1,600,000 francs. The French queen denied ever having ordered such a necklace, and the discoveries of deceit and fraud that followed resulted in the most celebrated trial in 18th-century France.

Perhaps the greatest travel books in gemology are those by renowned French gem merchant Jean Baptiste Tavernier, who wrote *Les Six Voyages* in three volumes, 1676–1679 (figure 13). These books

Figure 13. Taken from Les Six Voyages de Jean Baptiste Tavernier, *this 1679 engraved portrait depicts Tavernier, also known as Knight Baron d'Aubon, at the age of 74. The facing page shows native miners selling gems to Tavernier during one of his journeys.*

chronicle Tavernier's journeys into Turkey, Persia, and the East Indies in the mid-1600s. Although he bought and sold many items, his most notable transactions involved diamonds. One of the blue diamonds that passed through his hands is reputedly the parent stone of the notorious Hope. Also included is a splendid two-volume set of Sir Richard F. Burton's *Explorations of the Highlands of Brazil*, 1869, in which he recounts his experiences in the alluvial diamond mining districts. Another classic is the 1892 account by Lord Randolph Churchill, father of Winston Churchill, of his personal adventures in Africa, including his meetings with De Beers–founder Cecil B. Rhodes and a description of the diamond-mining industry in South Africa.

There are dozens of autobiographies that feature the trade experiences of gem dealers, miners, jewelers, and others connected to the gem industry. Emerald mining in Colombia is the subject of several of these, including Russ Anderton's *Tic-Polonga*, 1953. Other exciting and true stories of adventure in the gem trade appear in the many books by Louis Kornitzer, who wrote his first, *Trade Winds*, in 1933, and his last, *Jewelled Trail*, in 1940. Also included are biographies of persons who made notable contributions to the earth sciences, from a book on Russian pegmatite expert A. E. Fersman to George Merrill's 1924 *The First One Hundred Years of American Geology.*

Synthetics and the Art of Synthesis. This category features Henri Moissan's famous 1897 monograph on the electric furnace, in which he claimed to have synthesized diamond – a claim that was later discredited. A major treatise on the early synthesis of ruby is the colorfully illustrated 1891 work by Edmond Fremy, *Synthèse du Rubis*, in which he details his successful attempts to grow small, but undoubtedly true, synthetic rubies. The gemologist is sure to appreciate Fremy's depiction of the synthesis apparatus as well as numerous examples of flux-grown synthetic rubies (figure 14). Both the 1914 and 1926 editions of Hermann Michel's *Künstlichen Edelsteine* (*Synthetic Gemstones*) contain a great deal of information on separating natural gems from their synthetic counterparts. The addition in the 1926 version of a discussion of pearls and cultured pearls is another example of the major changes that can occur in gemology over the course of a very few years, changes that can often be detected in the various editions of a single book.

General Gemology. A large portion of the library consists of publications that treat all aspects of gemology, including some of the earliest known treatises. Represented are all editions of Boetius De Boodt's *History of Gems and Stones*, first published in Latin in 1609; Thomas Nicols's *A Lapidary or, the History of Pretious Stones: With*

Cautions for the Undeceiving of All Those That Deal with Pretious Stones, 1652, the first gemology text known to be written originally in English; and Robert Boyle's *An Essay about the Origine and Virtues of Gems,* from 1672 (figure 15). In addition to De Boodt, the complete works of several other important authors are available, including Lewis Feuchtwanger, Max Bauer, Edwin Streeter, and G. F. Herbert Smith (14 editions!).

An added benefit to so complete a collection is the access to the illustrations that decorate these books. Long before photography became a means of visual communication, paintings of the mineral specimens and gems served this purpose. The hand renderings and prints found in these pages are often works of art so exquisite that they almost overshadow the photography that has replaced them (see cover).

Mineralogy. In his research on gem cutting, Dr. Sinkankas quickly realized that a sound library on mineralogy was vital to understanding the physical properties that affect the behavior of minerals when they are cut. The very early treatises, such as Theophrastus's 1746 *Peri Lithon* (*Book of Stones*) and Albertus Magnus's 1591 *De Mineralibus* (*Book of Minerals*), actually devoted much more space to gem materials than to other classes (Adams, 1938). Most such writers were far more familiar with gemstones (including those thought to possess magical or medicinal properties) than they were with ores or minerals that had no economic applications at the time.

Along with the 1746 edition of Theophrastus and an original copy of Albertus Magnus (as well as the surprisingly scarce Dorothy Wyckoff 1967 English translation), the collection includes a fine 1881 color reproduction of the 13th-century illuminated manuscript, *Lapidario del Rey D. Alfonso X,* and several printings of *Speculum Lapidum* (*Mirror of Stones*), by Camillus Leonardus, first published in Latin in 1502. A great rarity is the two-volume *Elementos de Orictognosia,* written by Andrés Manuel Del Rio in Mexico City, 1795, the first book on mineralogy by a resident of the Americas. Other famous mineralogical works include the 16th-century treatise by Aldrovandi, as well as books by Cesi, Forsius, Guido, Henckel, and Sage.

The collection is exceptionally strong in crystallography, and features René Just Haüy's 1784 historic work in which he gives the first non-destructive systematic tests for gems based on their physical properties. Also represented are W. H. Miller's 1839 *Treatise on Crystallography,* a complete 18-volume set of the original 1918 *Atlas of Crystal Forms* by Victor Goldschmidt, and works by Fedorov, Schrauf, and Boldyrev.

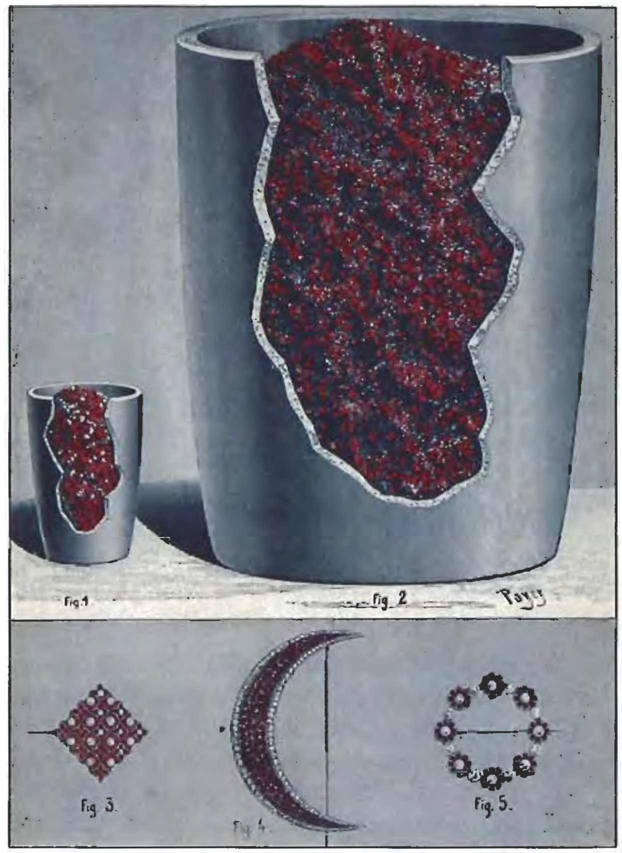


Figure 14. This plate from Edmond Fremy's 1891 Synthèse du Rubis *shows cutaway views of two crucibles containing flux-grown synthetic ruby crystals. Three pieces of jewelry set with flux-grown synthetic rubies are also featured. This plate serves as an important reminder that synthetic ruby has been used in jewelry for just about 100 years.*

Mineral Localities. The coverage in this category is excellent. Included are a number of files with pamphlets, reprints, and extensive monographs of mineral localities worldwide, as well as many government papers.

Sinkankas's two-volume *Gemstones of North America* is the classic reference for this continent. It is not surprising, then, that the collection provides publications on almost every state in the

Figure 15. These title pages are from three early books on gemology and mineralogy (clockwise from the upper right): Robert Boyle's 1672 An Essay About the Origine and Virtues of Gems, *a 1717 edition of Camillus Leonardus's Latin* Speculum Lapidum *(*Mirror of Stones*), and Thomas Nichols's 1652* A Lapidary or, the History of Pretious Stones, *which is the earliest known work on gems written in English. Photo by Robert Weldon.*

U.S.A., with the fullest detail given to California, Arizona, and Colorado. There are also some excellent treatises on mineral localities of the eastern United States, most notably Hamlin's 19th-century books on Maine tourmaline. Many South American, Asian, and European countries are represented by authors such as Sowerby, Mawe (figure 16), Jameson, Lacroix, vom Rath, and Monticelli.

General Reference. Numerous books have also been assembled in fields that are secondarily related to gemology. One of the earliest, and perhaps most famous, academic treatises is Pliny's *Natural History.* The collection contains 29 different editions of this work by the Roman scholar formally known as C. Plinius Secundus, who died in the eruption of Mt. Vesuvius in 79 A.D. One of the Latin editions dates to 1525, and there are translations in several different languages. Other related fields, such as art, aerial geology, federal geologic surveys, general travels, and basic sciences, are also represented.

NOTES REGARDING THE PRESERVATION AND FUTURE OF THE LIBRARY

The reality of the Sinkankas collection also poses questions about the upkeep and security of this storehouse of information. In our role as relatively "short-term" caretakers of this invaluable resource, it is our responsibility to create guidelines and procedures that will enhance and preserve it. As Marge Sinkankas stated so well during a planning meeting, "No one really owns a 350-year-old book. You are merely a custodian of it for 20 or 30 years, and are given the opportunity of protecting it during that time." Our vision is that generations of scholars will continue to benefit from the treasure trove of information, illustrations, and related data contained in this unique collection.

In the event of earthquake or fire, for example, the library staff will implement a disaster preparedness plan established in conjunction with other major libraries in the Los Angeles area. In addition, an extensive sprinkler system has been installed. Water-damaged books can be restored; books destroyed by fire cannot.

Another important problem is that of climate control. Inadequate temperature and humidity can, in time, take their toll on books and documents. Temperature studies indicate that the cooler manuscripts and books are kept, the better they are preserved (White, 1979). In addition, temperature should remain as constant as possible, day and night; fluctuations could cause condensation on the paper, warping of covers, and other damage. High humidity accelerates the deterioration of paper, and also encourages insect and fungus activity. Conversely, low humidity causes books to become brittle and desiccated, thus imperiling their survival if they are frequently opened. According to studies on the subject, an optimum temperature for books is 72°F, with an optimum relative humidity of 50% (Banks, 1978). To maintain the proper environment, the Sinkankas collection is housed at GIA in a separate air-controlled room.

Protecting the library from vandalism or theft is also of paramount importance. Policies that ensure the careful use and storage of books and manuscripts are being instituted. In addition, we require that users of the library view a videotape that details proper handling of books and documents. The separate room for the Sinkankas collection is also secured with its own alarm system.

ACCESSIBILITY

The conversion of GIA's library into a state-of-the-art information center has been described in GIA's Alumni Association magazine *In Focus* (Dirlam, 1988). Access to information in the GIA library is possible through telephone calls and letters as well as through visits to the Santa Monica campus. Resident students enrolled in classes at the Santa Monica campus have the additional privilege of checking out books and journals from the circulating collection of the library. Students and the gemological community are invited to use the Sinkankas collection in a special study area, by appointment. While the rare books cannot be removed from the library, photocopying will be available. GIA's computer-interactive network, GIA-Net, offers another dimension for those desiring gem or jewelry information. Once the computer cataloging of the Sinkankas collection has been completed, the resulting database will be accessible via GIA-Net.

Over the course of four decades, John and Marjorie Sinkankas brought together what is considered the finest collection of books and other publications on gems ever assembled. As part of the Richard T. Liddicoat Information Center, this collection not only serves as an invaluable resource, but also broadens our perspective of the wealth of knowledge, depth of history, and exquisite beauty that is gemology.

EDITOR'S NOTE: For further information on the Sinkankas collection or the Richard T. Liddicoat Gemological Library and Information Center, please contact the authors at GIA, 1660 Stewart St., Santa Monica, California 90404. Phone: (213) 829-2991, x361.

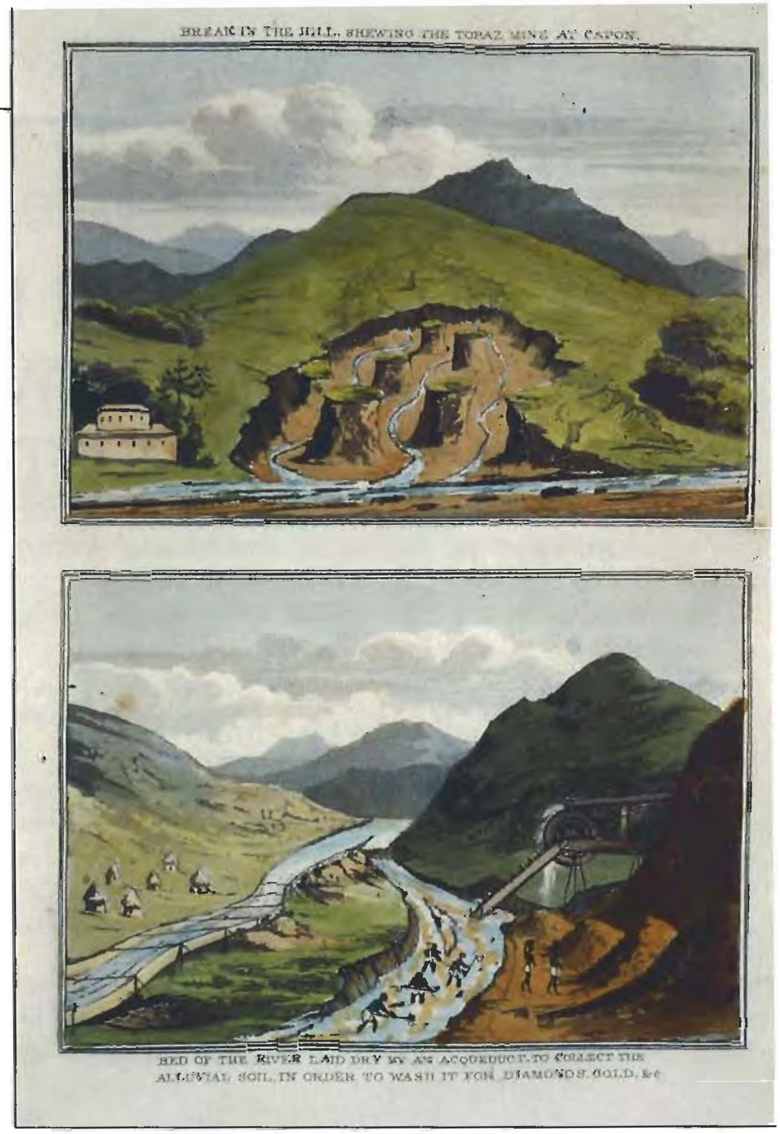


Figure 16. These hand-painted illustrations from John Mawe's 1804 Travels in Brazil *show (above) a topaz mine at "Capon," Brazil, and (below) alluvial mining operations for the recovery of gold and diamonds.*

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THE GUJAR KILLI EMERALD DEPOSIT, NORTHWEST FRONTIER PROVINCE, PAKISTAN

By Gary W. Bowersox and Jawaid Anwar

Over the last decade, Pakistan has developed into an important source for many gem materials. A number of localities have been identified for emeralds in particular. This article reports on the emerald deposits in the valley of Gujar Killi, located in the Northwest Frontier Province. The occurrence, mining, and gemological properties are described. Reserves appear to be good, and increased mining activity suggests strong production for the near future.

ABOUT THE AUTHORS

Mr. Bowersox is president of Gem Industries, Inc., P.O. Box 89646, Honolulu, Hawaii. He has 16 years of experience in Pakistan and Afghanistan. Mr. Anwar is chief geologist for the Gemstone Corporation of Pakistan, Peshawar.

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Gems & Gemology, *Vol. 25, No. 1, 1989, pp. 16–24*

The lush green valley of Swat, often called the Switzerland of the Middle East, is on the historic "silk route" that carried conquerors and commerce alike between Europe and Asia over the centuries. Gujar Killi, a side valley of Swat, is only 3 km long and has no roads. Yet it is a gemologist's dream: remote, safe, lush in vegetation, scarce in population, and apparently rich in emeralds.

It was not until 1981 that Sabir Zada, a local landowner, found an emerald crystal while digging into a hillside. Shortly thereafter, an exploration team under the supervision of the Gemstone Corporation of Pakistan (Gemcorp) located the deposit and acquired the mining rights from the government of Northwest Frontier Province.

Since 1981, thousands of carats of gem-quality emeralds have been recovered from this locality. According to Kazmi et al. (in press), Gujar Killi is the second largest emerald deposit in Pakistan – exceeded only by the Mingora deposits elsewhere in the Swat District, and clearly surpassing the deposits identified at Barang and Khaltaro. Although the crystals tend to be dark, some cut very fine stones (figure 1). The rough usually ranges from 1 to 10 ct, but crystals as large as 197 ct have been recovered. One such large crystal, a 188-ct specimen, is shown in figure 2.

LOCATION AND ACCESS

The Gujar Killi emerald deposit is located near the small village of Gujar Killi (lat. 34°49′40″N and long. 72°35′10″E) in the Swat District. It lies at an aerial distance of about 24 km (15 mi.) east-northeast of Mingora and 140 km northeast of Peshawar (figure 3). The mine is at an elevation of 2,057 m (6,750 ft.) above sea level.

The mine is reached by traveling approximately 2 1/2 hours by car on a paved and partially unpaved road from Mingora to the village of Bazar Kot, at the edge of Gujar Killi Valley, and then walking 3 km (about 45 minutes) to

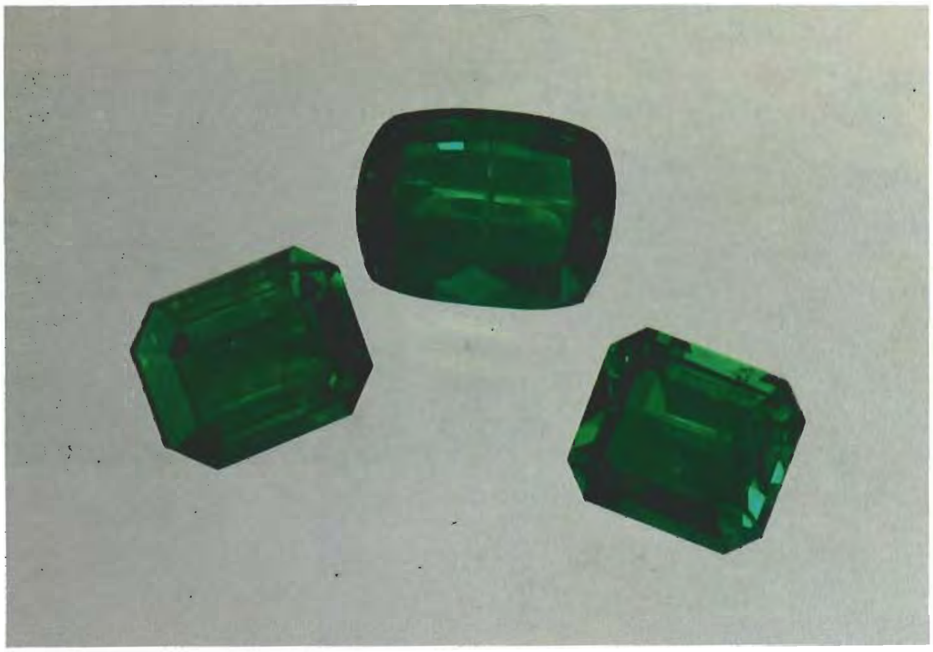


Figure 1. These three faceted stones (4.49 ct total weight) represent some of the fine emeralds found at the Gujar Killi deposit, Northwest Frontier Province, Pakistan. In general, the emeralds from this locality range from medium to dark bluish green. Photo © Harold & Erica Van Pelt.

the deposit (figure 4). It is normally closed from December through March because of snow.

GEOLOGY

The special geologic conditions required for their formation make high-quality emeralds one of the rarest of all gem materials (Snee and Kazmi, in press). Because beryllium, the major constituent of beryl, is geochemically incompatible with chromium, the primary coloring agent of emerald, a unique set of geologic circumstances is needed to bring these two elements together. In Pakistan, the special situation that produced emerald began with the collision of the Indian and Asian continental plates in Cretaceous and Tertiary time. Not only did this "suturing" of India and Asia ultimately produce the Himalaya Mountains, but it also brought together chromium- and beryllium-bearing rocks that are now exposed across northern Pakistan (Snee and Kazmi, in press).

The Gujar Killi emerald deposit occurs in the Mingora ophiolitic melange of the Indus Suture Melange Group (Kazmi et al., 1986). Rocks in this ophiolitic melange are sandwiched between Saidu graphitic schist in the form of discontinuous lenses, sheets, and blocks that range from 6 m to 300 m long and 3 m to 200 m wide. Talc chlorite schist is the dominant material in the ophiolitic melange, but four subunits are easily differentiated on the basis of mineralogic composition: talc schist, talc carbonate schist, carbonate talc schist, and carbonate. Because the nature and distribution of these subunits are related to the occurrence of emerald at Gujar Killi (figure 5), they are briefly described below.

Talc Schist. This white and grayish green to whitish green subunit (figure 6) is highly schistose, folded, and well jointed. Two outcrops measuring 20 × 4 m and 30 × 10 m are found in the

Figure 2. Pakistani gem dealer Akbar Khan is seen here holding a 188-ct rough emerald found at Gujar Killi. Such large stones are not uncommon from this locality. Photo © G. Bowersox.

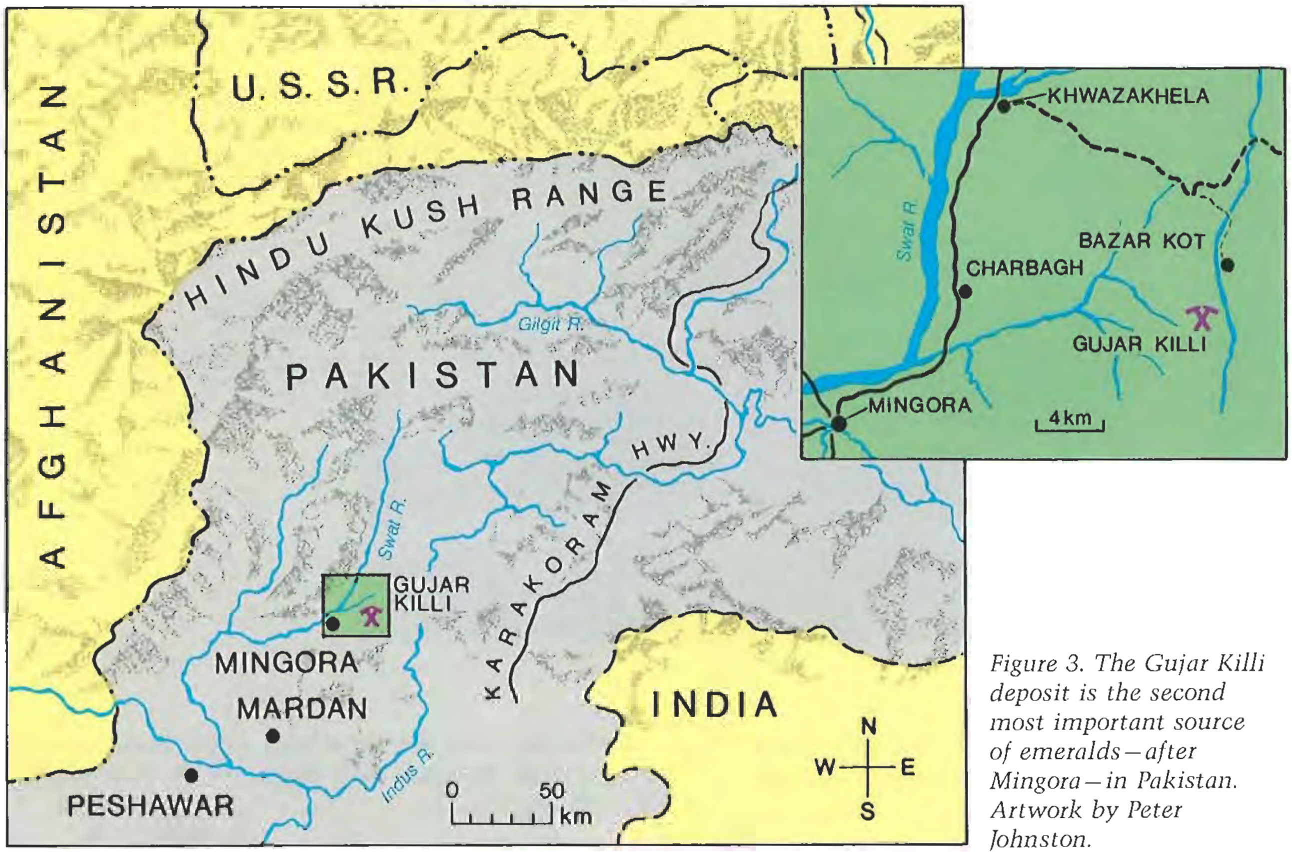
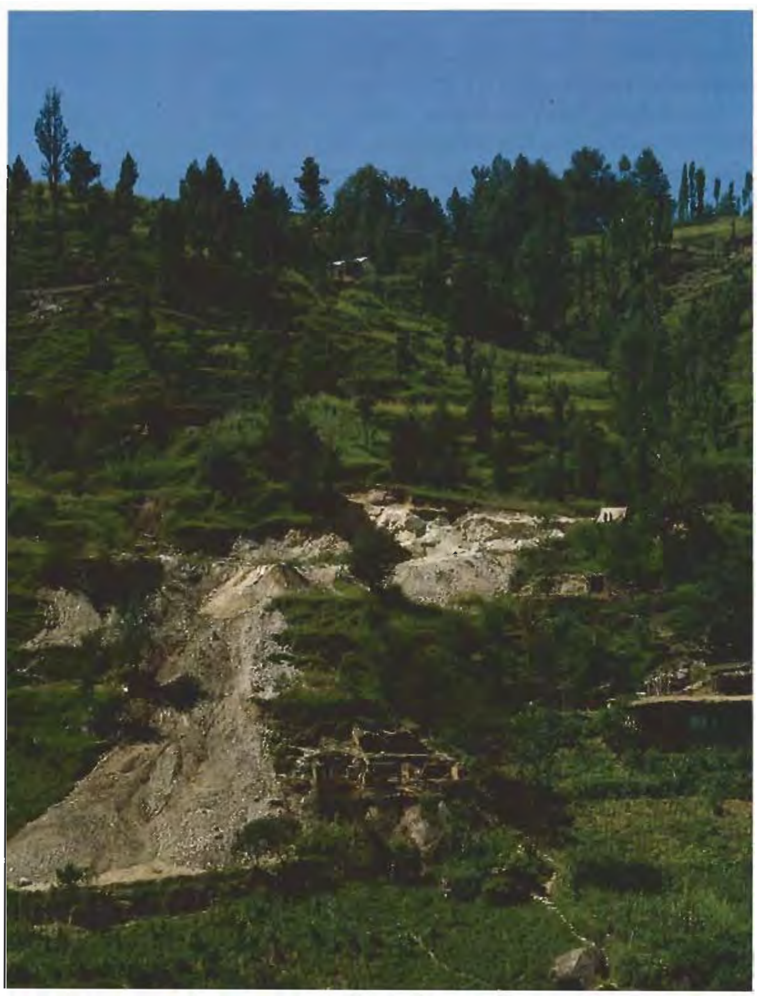


Figure 3. The Gujar Killi deposit is the second most important source of emeralds—after Mingora—in Pakistan. Artwork by Peter Johnston.

Figure 4. Because Gujar Killi Valley has no roads, the deposit can only be reached by foot, through lush vegetation. Photo © Gemcorp.



northwestern and southeastern part of the mineralized ophiolitic body in the mine area. The unit is composed almost entirely of talc with accessory amounts of quartz, magnesite, chlorite, muscovite, and fuchsite. The talc occurs as flakes, lenses, and sheaves in the groundmass, as well as veins and veinlets. Veins of milky white quartz, commonly shattered, cross-cut the talc-schist foliation, with fuchsite present at the contacts and within fractures of the quartz veins. Small fragments of chloritic schist and graphitic schist are also found in this unit.

Talc Carbonate Schist. This brownish green to yellowish green subunit occurs in lenses and sheets. It contains the same macroscopically identifiable mineral constituents as the talc schist plus limonite and the carbonates siderite and calcite. Lenticular bodies of flakey talc form the bulk of the rock, while carbonates occur in the groundmass as well as in the veinlets. Quartz veins are common and cut across the foliation. Mica is disseminated throughout. The many limonite patches show the effects of weathering and the leaching of iron-bearing minerals by oxidation. Small xenoliths, 2 to 3 cm in diameter, are also occasionally observed.

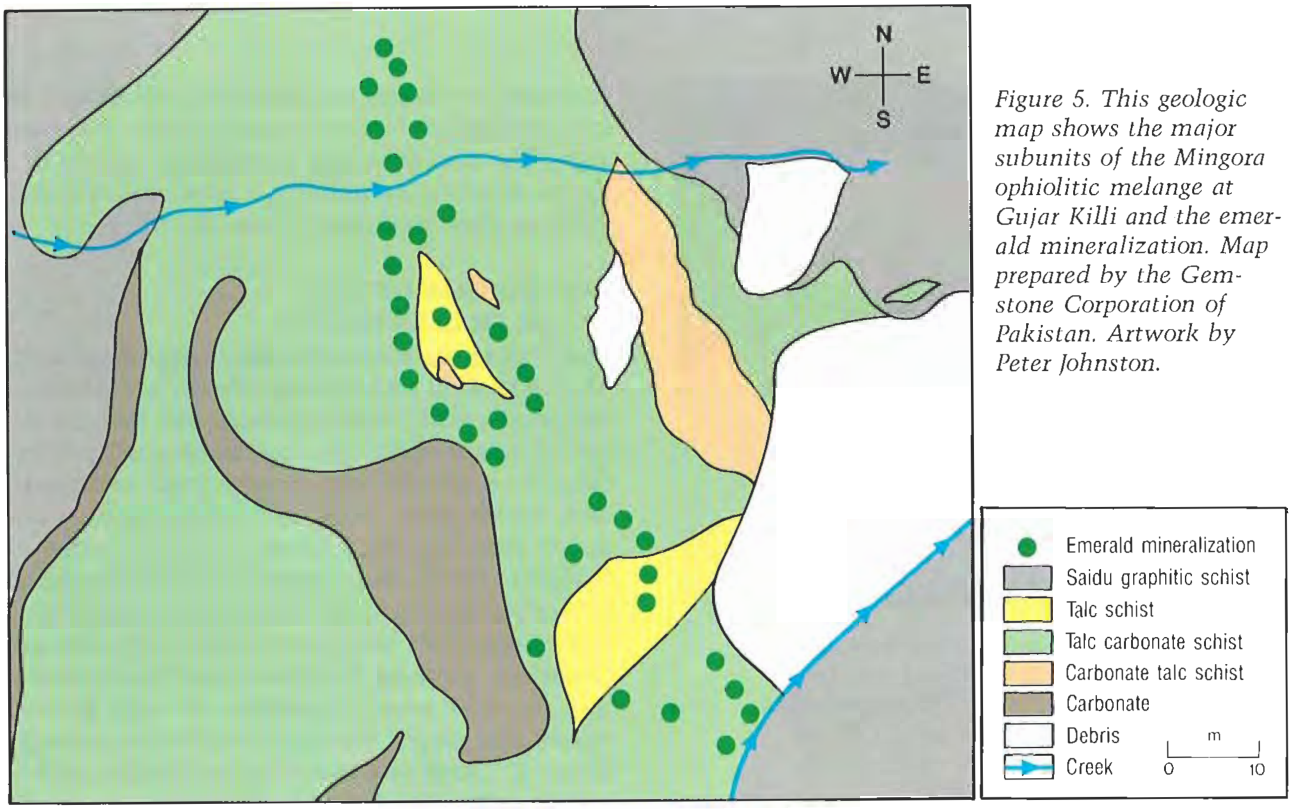


Figure 5. This geologic map shows the major subunits of the Mingora ophiolitic melange at Gujar Killi and the emerald mineralization. Map prepared by the Gemstone Corporation of Pakistan. Artwork by Peter Johnston.

Carbonate Talc Schist. This yellowish brown to greenish brown subunit is composed primarily of the carbonates siderite, magnesite, and calcite, with accessory talc, quartz, muscovite, fuchsite, and limonite. Talc occurs along joints and fractures as flakes and sheets. Cross-cutting quartz veins are common. Muscovite is disseminated throughout the unit. The rock is extensively limonitized and looks "rusty." In the northeastern part of the mine area, a 40 × 10 m block of carbonate talc schist is exposed with talc carbonate schist.

Carbonate. Grayish brown, massive, hard, nonfoliated blocks are common. These range from 3 m to over 60 m in dimension. The carbonates dolomite, siderite, magnesite, and calcite are the principal constituents, with minor quartz, muscovite, fuchsite, chlorite, talc, and limonite. Quartz veins are abundant.

No pegmatites have been observed in or around the mine area to date.

EMERALD OCCURRENCE

Emerald mineralization occurs in a northwest-southeast trending body of the ophiolitic melange that dips 30° to 50° to the northwest. The exposed body measures about 90 m × 80 m, out of which 40 m × 10 m was initially proved to be mineralized. The mineralized block is composed primarily of talc schist and talc carbonate schist. Recently, a 4 m × 150 m mineralized zone was located about 200 m north of the existing zone. It is hoped that further exploration in the area and removal of the soil cover will show that mineralization is continuous between the proven zones, with prospects of locating additional mineraliza-

Figure 6. Talc schist, a major subunit at Gujar Killi, is the source of some of the emerald mineralization. Photo © G. Bowersox.

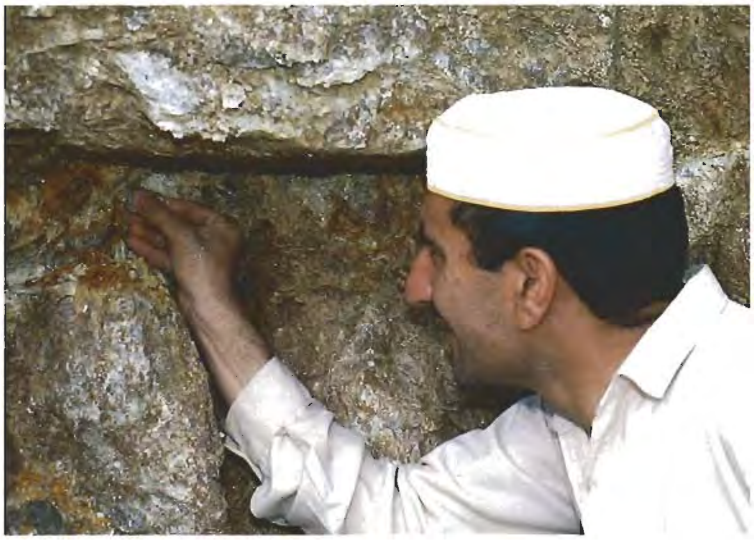


Figure 7. Emerald mineralization, here indicated by Pakistani gem merchant Azzi Ulla Safi, is most common where limonitized veins intersect in the talc schist or talc carbonate schist. Photo © G. Bowersox.

tion in the southern and northern extensions of the ophiolitic melange.

Emerald mineralization is structurally controlled. A number of northwest-trending faults, with cross-cutting joints and fractures, traverse the mineralized block. Along major faults, fractures, and joints, fault breccia with shattered quartz as well as calcite nodules are commonly observed. The fault, fracture, and joint planes are extensively limonitized. Emerald mineralization is largely confined to these crisscrossing limonitized planes and is most favorable where they intersect (figure 7). According to Snee and Kazmi (in press), the schistose chromium-rich host rocks were derived from "primitive" oceanic rocks that were trapped between the Indian and Asian plates and ultimately included in melange zones that formed when the plates collided. The conditions for emerald mineralization were completed when metamorphism and postmetamorphic faulting produced the pathways in the melange zones that enabled the infiltration of beryllium-bearing solutions from nearby Indian-plate continental rocks.

Emerald is usually found as scattered isolated crystals in the talc-rich sheared joints, fractures, and faults. Only rarely does it occur in pockets, bunches, or aggregates. It is commonly associated with quartz veinlets and rhombohedral calcite nodules (Kazmi et al., in press). Occasionally the emeralds are found in alignment with foliation, but rimmed structures around calcite are common. The miners believe that the appearance of a greenish coloration in talc is a good indicator that they are close to emerald mineralization.

DESCRIPTION OF THE GUJAR KILLI EMERALDS

Physical Appearance and Gemological Properties. The Gujar Killi emeralds usually occur as hexagonal prisms with basal pinacoids; the authors observed few well-formed, specimen-quality crystals. The emeralds range in color from medium to dark bluish green, with most of the stones even darker than the Mingora emeralds (illustrated in Gübelin, 1982). The gemological and chemical properties, discussed below, indicate that emeralds from Gujar Killi have particularly high iron and chromium contents. The gemological properties of this material were determined on eight faceted stones that ranged from 0.36 to 0.95 ct (see, e.g., figure 8). These properties are reported in table 1 and described below.

As measured with a Duplex II refractometer, refractive indices for all eight stones were surprisingly consistent, with 1.589 for the extraordinary ray and 1.599 for the ordinary. These values are within the range of refractive indices determined by Dr. Edward Gübelin (in press) for emeralds from this locality. However, the corresponding birefringence of 0.010 is slightly higher, by 0.001, than the maximum birefringence of 0.009 recorded by Dr. Gübelin.

Specific gravity was determined with heavy liquids to be approximately 2.71. By the hydrostatic method it was found to be 2.72.

All stones were inert to both long- and short-wave ultraviolet radiation. This is consistent with emeralds that have a high iron content.

The white-light absorption characteristics of the eight Gujar Killi emeralds were studied by means of a Beck prism spectroscope. The results were consistent across all the stones, with all showing the same chromium-related absorption lines and bands in the same nanometer positions relative to the scale. A strong, close pair of lines at approximately 683 and 680 nm, and another strong pair at 642 and 639 nm, comprised the sharp absorption features, while a relatively strong band between 625 and 585 nm was also present. Individual iron-caused absorption lines were not observed in the blue, but a general absorption extending

Figure 8. These are two of the eight Gujar Killi emeralds examined to determine gemological properties. Photo by Robert Weldon.

from approximately 430 nm down through the lower limits of the visible region was evident.

When viewed parallel to the optic axis, the color observed in each of the eight emeralds was consistently an intense, very slightly yellowish green; as is the case in the direction of single refraction, no dichroic color shift was observed when a Polaroid analyzer was held over the stones and rotated in a full circle. When viewed perpendicular to the optic axis, the color was also intense, with two dichroic colors observed: a very slightly yellowish green and a bluish green. Although the color is intense, the pleochroism observed with a Polaroid analyzer could only be described as moderate. With a dichroscope, however, the two dichroic colors were obvious when viewed in any direction other than parallel to the optic axis.

TABLE 1. Gemological properties of emeralds from Gujar Killi, Pakistan.[a]

Color	Dark to medium bluish green
Refractive Index	
Extraordinary ray	1.589
Ordinary ray	1.599
Birefringence	0.010
Specific gravity[b]	2.71 (2.72 by hydrostatic method)
Reaction to U.V. radiation	Inert to both long- and short-wave
Absorption characteristics	Strong, close pair of lines at approximately 683 and 680 nm; strong pair at 642 and 639 nm; relatively strong band between 625 and 585 nm; general absorption from approximately 430 nm to lower limits of visible region
Dichroism	Moderate: very slightly yellowish green and bluish green
Chelsea color filter reaction	Very weak to weak red
Internal characteristics[c]	Veil-like partially healed fractures composed of numerous minute secondary two-phase fluid inclusions

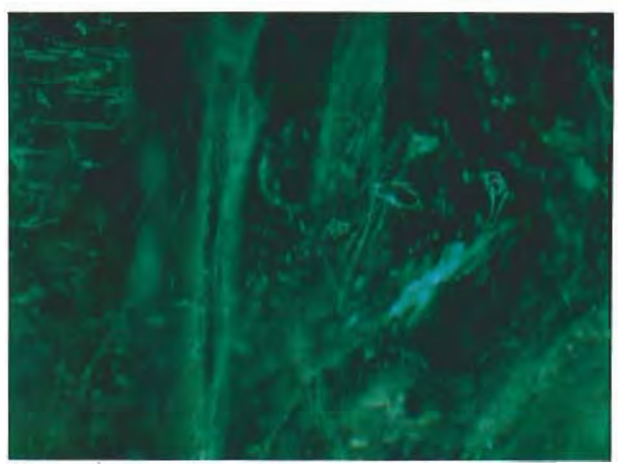
[a]Properties listed were obtained from eight faceted stones ranging from 0.36 to 0.95 ct.
[b]Determined with heavy liquids.
[c]Only those found in all eight emeralds are listed.

Each of the eight Gujar Killi emeralds was placed on the tip of a fiber optic illuminator and examined in several directions with a Chelsea color filter. The appearance of the emeralds through the filter can best be described as a very weak to weak red, which once again can be related to the presence of iron. When the stones were examined from different directions, it could be seen that the intensity of the red varied from nonexistent to weak and seemed to be strongest at facet junctions.

Internal Characteristics. All eight faceted stones were carefully examined between the magnification range of 10× to 50× with a standard gemological microscope using a variety of illumination techniques. The inclusions observed, although they do not appear to be locality specific, are nonetheless useful in determining the natural origin of these emeralds.

The only internal feature evident in all eight emeralds was the presence of fluid inclusions (figure 9). For the most part, these took the form of veil-like partially healed fractures composed of

Figure 9. Primary and secondary fluid inclusions in this typical pattern were observed in all of the eight Gujar Killi emeralds examined with the microscope. Photomicrograph by John I. Koivula; magnified 25×.



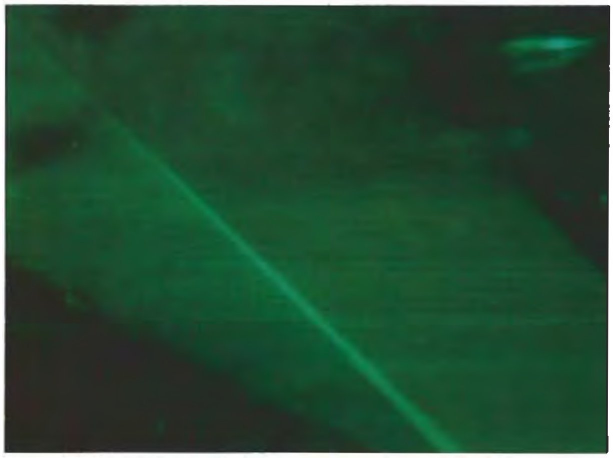


Figure 10. Growth zoning parallels the prism face of this Gujar Killi emerald. Photomicrograph by John I. Koivula; magnified 30×.

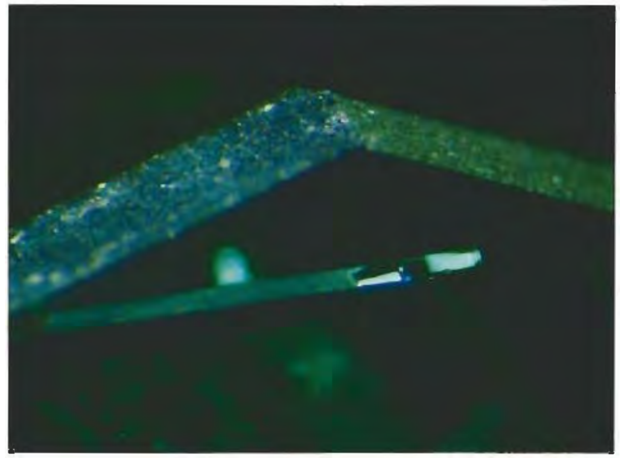


Figure 11. A foreign substance partially fills this hollow tube in a Gujar Killi emerald. Photomicrograph by John I. Koivula; magnified 20×.

numerous minute secondary two-phase fluid inclusions. Some slightly larger primary two-phase inclusions were present as well. In one emerald, a thin-film layer of ultra-thin two-phase fluid inclusions was observed in a plane perpendicular to the optic axis. Although no detailed chemical analysis of the fluids could be performed, careful observation revealed no visible fluid immiscibility or fluid carbon dioxide phases in any of these gems.

When shadowing was used, one stone displayed a very subtle form of growth zoning (figure 10) that paralleled the prism faces of the original crystal. In another stone, a hollow tube broke the surface of the crown near the girdle (figure 11). It was partially filled with what appeared to be dirt, polishing compound, or talc.

No mineral inclusions of the type previously described in Pakistani emeralds (Gübelin, 1982 and in press) or in other emeralds found in a schist environment were observed in any of the stones examined.

Chemistry. Hammarstrom (in press) reports the results of 11 microprobe analyses of a sample of Gujar Killi emerald (table 2). Like the emeralds from four other Swat Valley mines that she analyzed, the Gujar Killi specimen was notable for high magnesium, iron, and sodium contents relative to emeralds from other world localities (Hammarstrom, in press, table 6.7), although the Gujar Killi specimen had less iron than the other Pakistani samples (a Mingora specimen, at 0.91 wt.%, was the highest). Hammarstrom also reports that Pakistani emeralds are among the richest in chromium, and the Gujar Killi sample showed the highest value for this oxide among all of the Pakistani samples tested. Many of the emeralds display color zoning that appears to correlate directly with variations in chromium content. Otherwise, she found that the Gujar Killi specimen was similar to emeralds from other schist-type deposits.

CUTTING

Most Gujar Killi emerald rough has good crystallization, and the surfaces take a good polish. Some of the large crystals, however, have fine cracks that can hinder cutting. In addition, talc inclusions may give the faceted stone a pitted appearance

TABLE 2. Summary of 11 microprobe analyses of a Gujar Killi emerald (in wt. %).[a]

Composition	mean	s.d.[b]
SiO_2	62.3	1.3
Al_2O_3	13.5	0.4
FeO	0.25	0.02
MgO	2.57	0.05
CaO	0.01	0.01
Na_2O	1.88	0.03
K_2O	n.d.[c]	
TiO_2	0.02	0.02
MnO	0.01	0.02
V_2O_3	0.09	0.02
Cr_2O_3	1.65	0.28
F	n.d.	
Cl	n.d.	
BeO (calc)[d]	13.0	
BeO_2[e]	11.63	

[a]*As reported in Hammarstrom (in press).*
[b]*s.d. = standard deviation.*
[c]*n.d. = not detected.*
[d]*Average of BeO values calculated for each microprobe analysis assuming an ideal 3 Be cations per 18-oxygen beryl formula unit. This represents the maximum BeO content theoretically possible for the analyses, assuming stoichiometry.*
[e]*BeO values reported by Snee et al. (in press).*

(Kazmi et al., in press). A greater concern is the overcoloration of the crystals caused by the high chromium content. In smaller stones, to avoid a blackish green gem and produce a good yellowish green finished piece, the cutter should window the stone out. Because of the overcoloration, however, this material is excellent for cutting small, 0.10–0.35 ct, stones.

Cutting may also be hindered by the presence of a colorless tube or hexagonal column – usually, in the authors' experience, less than 3 mm in diameter regardless of the size of the stone – parallel to the c-axis near the center of many of the crystals. This is probably due to a lack of chromium. The cutter must experiment with these stones to work around – or with – the zoning for the best result in the finished gem.

MINING AND PRODUCTION

Because the Gujar Killi emerald deposit becomes snowbound in winter, it is operational only about eight to nine months a year. It is largely an open-cast mine worked via benches (figure 12). Some underground mining has been carried out to prove continuation of mineralization at depth, and so far about 30 m below the surface has been shown to be potentially productive.

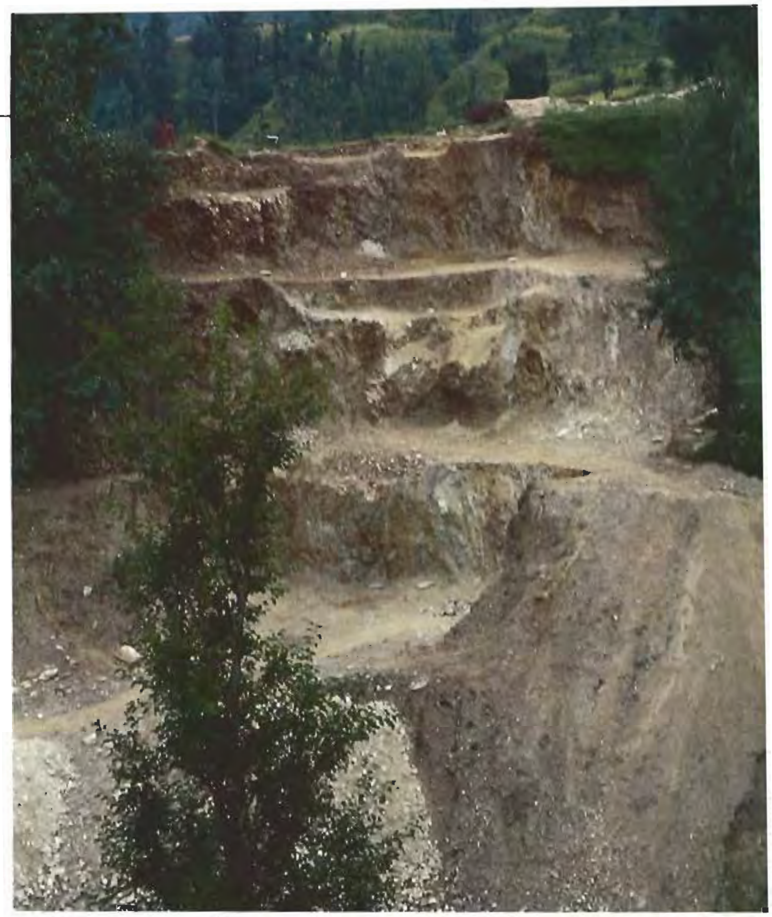


Figure 12. A series of benches characterize the open-cast workings at the Gujar Killi mine. Photo © G. Bowersox.

The rocks are generally soft and can be easily removed manually with pneumatic drills (figure 13). Explosives are seldom used except to break up compact and massive blocks of carbonate rock. The open-cast mining is generally safe except for some slope stability problems caused by water seepage.

After the emeralds are removed from the talc, they are washed (figure 14) and then sent for sorting to the operation at the Mingora mine. Local inhabitants supply most of the labor for the Gujar Killi mining operation. They otherwise lead a typical village life supplemented by farming – primarily potatoes and maize – on terraced fields. There is little independent mining; for the most part, activity at the mine is strictly supervised by government security guards.

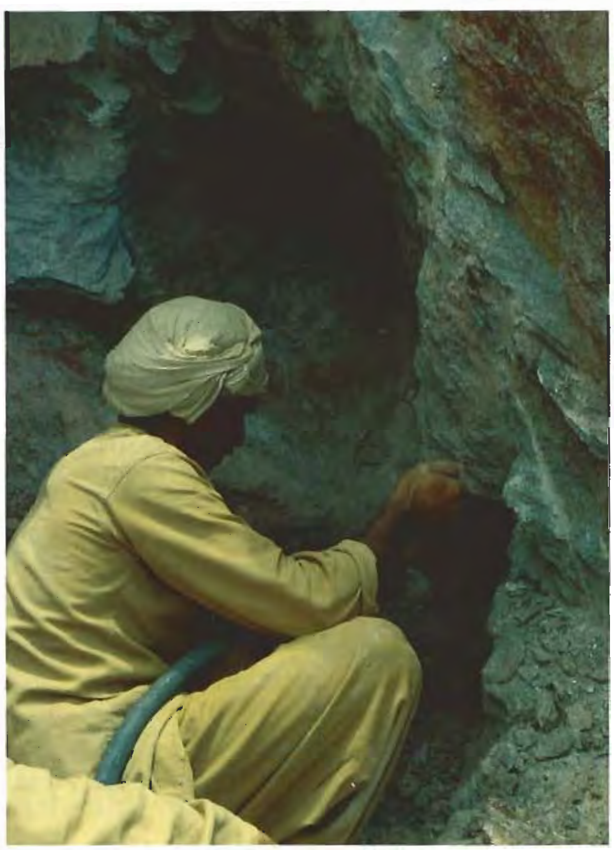


Figure 13. Miners use pneumatic drills to remove the relatively soft host rock at Gujar Killi. Because of the lack of roads, the compressor was carried to the site part by part and then reassembled at the mine. Photo © G. Bowersox.

Figure 14. Emeralds are washed from the talc at Gujar Killi before they are sent to the Mingora mine for sorting. Photo © G. Bowersox.

The deposit has been worked actively since 1982. The production of rough emerald from the mine since it began operation through the 1987–1988 fiscal year is given in table 3, as reported in official documents of the Gemstone Corporation of Pakistan. The radical increase in production in 1988 resulted because more miners were hired to work a second deposit. Current geologic studies by Gemcorp indicate the existence of many other emerald veins, so it is expected that both the quantity and the quality of emerald will improve during the next few years.

CONCLUSION

The Gujar Killi deposit is the second most important source of emeralds in Pakistan. Like the neighboring Mingora deposits, emeralds occur in subunits of the Mingora ophiolitic melange, in talc-rich sheared joints, fractures, and faults.

TABLE 3. Production of rough emerald at Gujar Killi from 1981 through August of 1988.[a]

Fiscal year	Total production (ct)[b]
1981–82	2,808
1982–83	2,053
1983–84	2,015
1984–85	1,330
1985–86	3,456
1986–87	5,939
1987–88	28,646

[a]As reported by the Gemstone Corporation of Pakistan.
[b]Approximately 5%–10% of this material is considered gem quality.

Gemological and chemical testing indicates particularly high contents of iron and chromium. The chromium appears to be responsible for the overcoloration that characterizes much of the Gujar Killi emerald.

Currently, mining is controlled by the Gemstone Corporation of Pakistan, with local inhabitants supplying the labor. It is largely an open-cast operation. At the time of writing, two deposits are being worked and production is good. Reserves appear to be excellent and potentially extensive.

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NOTES
· AND ·
NEW TECHNIQUES

BERYL GEM NODULES FROM THE BANANAL MINE, MINAS GERAIS, BRAZIL

By Anthony R. Kampf and Carl A. Francis

Bicolored (aquamarine-morganite) beryl from a 1986 discovery at the Bananal mine is described. Most of the cutting material was of carving grade, but a small percentage of the crystals contained faceting-quality morganite gem nodules. This is the first published report of gem nodules of a species outside the tourmaline group. Much of the Bananal morganite is of a pleasing orange to pink-orange color that changes to pink on extended exposure to heat or sunlight. The inclusions in the nodules appear to be limited to muscovite crystals, while the rest of the material (both aquamarine and morganite) contains two- and three-phase inclusions, but little or no muscovite. The cause of the gem nodules is not established, but it may relate to the presence of the same type of variation in mosaic texture observed in some color-zoned tourmaline crystals.

The term *gem nodule* is well known among tourmaline miners and cutters. It refers to a small, typically 2 to 30 mm in diameter, rounded mass of water-clear gem material that occurs in the central portion of an otherwise flawed crystal. In the case of the very gemmy pencil-like crystals of tourmaline, "nodules" may actually be prism sections up to several centimeters long with crudely hemispherical ends. Nodules of both types may be opaque, but interest is focused on transparent nodules which are highly prized as cutting material. Occasional references to gem nodules have been made in the gemological and mineralogical literature (e.g., Shepard, 1830; Sinkankas, 1955, 1959; Dietrich, 1985; Proctor, 1985; and Francis, 1985), but gem nodules have heretofore not been reported outside of the tourmaline group. Recently, however, a new find of gem-quality beryl in Minas Gerais, Brazil, has yielded a number of fine gem nodules.

OCCURRENCE

In January 1986, a group of miners made a significant discovery at the Bananal mine, near Salinas, Minas Gerais, Brazil. From a single pocket they recovered about 500 kg of bicolored (aquamarine-morganite) beryl crystals and crystal fragments. Because the pegmatite had been thoroughly altered to kaolinite, the material was recovered by wet sieving (C. Barbosa, pers. comm., 1988). Most of the crystals were moderately to heavily included; yet, according to Michael Ridding (pers. comm., 1989), about 100 kg were excellent carving rough (see figure 1). More importantly, a number of gem nodules of faceting quality were recovered. A

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Gems & Gemology, *Vol. 25, No. 1, 1989, pp. 25–29*

Figure 1. This Bananal morganite carving depicts four faces of the Egyptian queen Nefertiti. The carving, designed and executed by the firm F. A. Becker, Idar-Oberstein, Germany, weighs 610 ct and is 5 cm tall. Courtesy of Ramsey Gem Imports, Inc.; photo by Shane McClure.

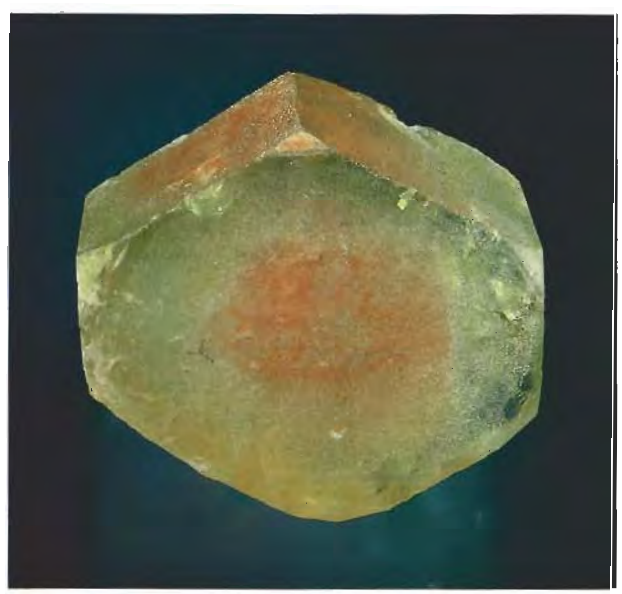
discovery of about 400 kg of similar bicolored beryl was reportedly made at this mine in the early 1960s (Koivula and Misiorowski, 1986). This material apparently corresponds to the orange beryl that Sinkankas (1981) mentioned. It is not clear whether gem nodules were found at that time, but at least some of the material from the earlier discovery was of faceting quality.

DESCRIPTION

The Bananal mine beryl gem nodules occur at the centers of tabular, bicolored crystals. The rims of the crystals are a pale to medium green to blue-green aquamarine, while the cores are morganite commonly of a distinctly orange hue. A few crystals with a complete set of hexagonal prism faces and a basal termination were found (figure 2), but most of the material recovered was in the form of partial crystals and irregular fragments. The relatively complete crystals have diameter-to-thickness ratios of about 2 to 1 and rim-to-core radius ratios between 1 to 2 and 1 to 4. The largest crystal observed by the authors (figure 3) is 18.5 cm across, but most are fist size or smaller. The morphology is simple, with the basal pinacoid {001} and prism {100} predominating, and the dipyramid {112} sometimes also present. Surface etching is quite common, giving the crystals a frosted appearance. A few crystals, including the large one noted above, have lustrous faces. The external features of the crystals are consistent with crystallization in a pegmatite pocket.

The nodules are limited to the morganite portion of the crystals; the nodule surface coincides with the aquamarine-morganite color boundary. As has been generally noted for tourmaline nodules (e.g., Proctor, 1985, p. 97), the more flawed outer portions of these crystals can often be readily broken away to expose the nodules. The crystal in figure 3 possesses an extremely large gem nodule, 12.5 cm in diameter, that is quite clear except for inclusions of muscovite with occasional trails of minute bubbles. Muscovite inclusions are characteristically present in most of the faceted stones and facetable rough from this occurrence, and the only facetable material was in the gem nodules (J. Ramsey, pers. comm., 1988). The largest

Figure 2. This beryl crystal from the Bananal mine exhibits the basal pinacoid {001}, prism {100}, and dipyramid {112} forms. Note the frosted faces which have resulted from surface etching. The crystal is 11 cm across. Courtesy of Hyman and Beverly Savinar; photo © Harold & Erica Van Pelt.



fine faceted stone from this discovery, 461 ct, contains the muscovite inclusion in figure 4.

The aquamarine rind of the large crystal is much more heavily flawed than the nodule. Many two- and three-phase (liquid-gas and solid-liquid-gas) inclusions and internal basal cleavage fractures were observed. These cleavage fractures appear to radiate away from the central nodule, giving the impression of a radiating lamellar texture. This is further reflected by a somewhat lamellar texture on the external cleavage and fracture surfaces. No muscovite inclusions were observed in the rind portion of this crystal.

The vast majority of the crystals recovered did not contain gem nodules (M. Ridding, pers. comm., 1988). The crystal pictured in figure 2, for example, is moderately included throughout, with two- and three-phase inclusions in both the morganite core and the aquamarine rind. Internal basal cleavage fractures were not prominently developed in this crystal, and no muscovite inclusions were observed. It has also been reported that some of the morganite carving material from this occurrence exhibited cloudy or hazy areas, apparently the result of numerous minute inclusions of unknown identity (M. Ridding, pers. comm., 1988).

It is not uncommon for the larger faceted morganites to exhibit an intense, bright orange color in daylight or fluorescent light and a pink-orange ("padparadscha") color in incandescent light. John Ramsey (pers. comm., 1988) notes that the orange color in the morganite from this occurrence changes to pink of a similar color saturation when the material is exposed to sunlight for an extended period or when it is heated (figure 5). Sinkankas (1981) reported the same behavior in the orange morganite from the earlier production. According to George Rossman (pers. comm., 1988), this is a common phenomenon in morganite: "Millions of years of exposure to the low levels of radioactive potassium in the feldspars and micas of the host pegmatite displaces electrons in the atomic structure of the beryl. The displacement of electrons results in color centers which impart a brown color. The brown color combines with the pink color caused by trace amounts of divalent manganese in the structure, resulting in an overall orange hue. Exposure to sunlight for a few hours is usually sufficient to return the electrons to their original sites, thus eliminating the brown component and revealing the pink color. The pink color will then remain stable under normal conditions."

Figure 3. A morganite nodule is evident in this beryl crystal from the Bananal mine. The entire crystal is 18.5 cm across; the nodule is 12.5 cm in diameter. Courtesy of Hyman and Beverly Savinar; photo © Harold & Erica Van Pelt.

DISCUSSION

In reference to tourmaline nodules, Francis (1985) wrote: "Neither quartz nor beryl, which occur with approximately the same frequency and abundance in the same geological environment, show

Figure 4. This muscovite inclusion was observed in a large fine morganite faceted from a Bananal mine nodule. Photomicrograph by John I. Koivula; magnified 40×.

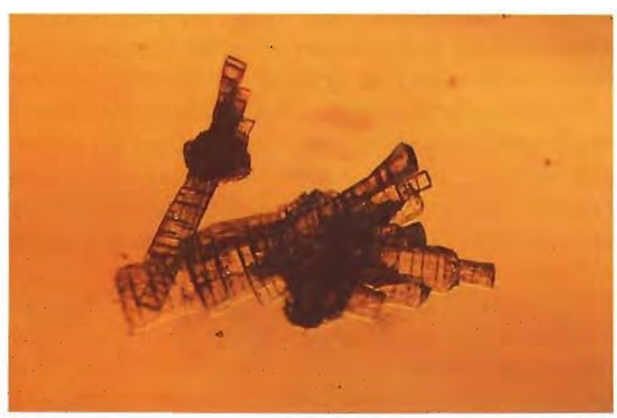


Figure 5. Both of these gems are from the 1986 discovery at the Bananal mine. The 131-ct pink morganite was the same color as the 235-ct pinkish orange stone before exposure to strong Southern California sunlight for approximately one month. Courtesy of Ramsey Gem Imports, Inc.; photo © Tino Hammid.

such nodules nor does any other species known to the writer." In addition to the Bananal beryl nodules described here, several other examples of nontourmaline gem nodules have recently come to our attention. Elvis ("Buz") Gray provided an aquamarine crystal from Raffin Gabbas in the Dgemma region of Plateau State, Nigeria; this 3.5-cm-long crystal is terminated by a basal cleavage plane at the heavily included end and by a gemmy nodule at the opposite end. Mr. Gray also presented small gem nodules of two garnets, a rhodolite from Langusu, Tanzania, and a spessartine from the Little Three mine near Ramona, San Diego County, California. Mr. Gray further reported encountering gem nodules while cutting benitoite from the Benitoite Gem mine, San Benito County, California. Gem nodules are thus known to occur in at least five gem species, two of which (rhodolite and benitoite) formed in environments other than granitic pegmatites. The generality of the phenomenon is thus established, but the genesis of gem nodules has not been explained.

Wagner et al. (1971) studied sections through color-zoned tourmaline crystals by a special X-ray technique known as source-image distortion. This technique is capable of discriminating changes in the texture of the mosaic structure* in single crystals. They determined that "abrupt texture changes are always accompanied by color changes," but that there is "no strict correlation between a particular color and a particular texture." In all of the samples they studied, they discovered that "the core region had a macromosaic** texture containing some small cracks whereas the overgrowth region was composed of lamellar grains." They considered and dismissed several crystal-growth models as explanations for the texture changes. They conjectured that "the texture changes are indicative of some growth parameter such as temperature, pressure, or others."

*Mosaic structure *refers to the fact that all single crystals are actually composed of minute, slightly misaligned crystal "blocks." The misalignment is usually a small fraction of a degree. The fewer the mosaic blocks and the smaller the amount of their misalignment, the more perfect the crystal.* Texture *is used here to refer to the size, shape, and orientation of the minute crystal blocks within parts of the single crystal.*

**Macromosaic structure *refers to a mosaic structure with relatively few randomly oriented microcracks and relatively few only slightly misaligned mosaic grains.*

Although Wagner et al. did not specifically consider or even mention the gem-nodule effect, their study appears to relate directly to this phenomenon. In essence, they found that when a difference in mosaic texture exists between the color zones of a tourmaline crystal, the core of the crystal exhibits less mosaicity and therefore greater crystalline perfection than does the exterior. Their findings are consistent with the typical behavior observed for crystals containing gem nodules: That is, the crystal readily breaks along the boundary between the nodule and the rest of the crystal, and in many instances the outer portion of the crystal breaks away in small fragments to expose the perfectly solid gem nodule core.

The observations made by Wagner et al. appear to fit the gem nodule–containing beryl crystals from the Bananal mine quite well. It is likely that these beryl gem nodules are very similar in nature to tourmaline gem nodules and that their formation resulted from a similar crystal growth variable.

The inclusions contained in the beryl from this occurrence may provide a clue to the origin of the nodules. The muscovite inclusions appear to be limited to the gem-nodule portion of the crystals, while the two- and three-phase inclusions are limited to the non-nodule material. It is widely believed that complex pegmatite formation involves two immiscible fluids, one a silicate melt and the other an aqueous fluid. Growth from an aqueous fluid is likely to yield two- and three-phase primary inclusions, while growth from a silicate melt will generally yield only solid primary inclusions. It is, therefore, tempting to hypothesize that the beryl crystals containing gem nodules were in contact with the silicate melt during that stage of their growth, while the outer portions of the nodule-containing crystals and the crystals without nodules formed in contact with the aqueous phase.

This hypothesis is contrary to the commonly held belief that all well-formed gemmy crystals found in pegmatites have crystallized from an aqueous fluid; however, London (1986) comments that "It appears that pocket-zone aluminosilicate minerals crystallize from hydrous silicate-rich fluids that may be in contact with an exsolving aqueous phase. . . ." It must also be remembered, though, that two- and three-phase inclusions in beryl are commonly secondary, having originated from the intrusion of aqueous solutions along fractures in the crystals. The lack of these inclusions in the Bananal mine nodules could merely reflect the lack of fractures in the nodules.

Without further supportive evidence, the hypothesis above must be regarded merely as conjecture. At any rate, it does not seem to shed light on the formation of gem nodules of nonpegmatitic origin.

SUMMARY

A discovery of bicolored aquamarine-morganite beryl crystals at the Bananal mine in early 1986 yielded much good carving material. A small percentage of the crystals contained morganite gem nodules of faceting grade. This is the first report of gem nodules of a species outside the tourmaline group. Much of the morganite is of a pleasing orange to pink-orange color, reminiscent of material produced from the same mine in the early 1960s. The orange color changes to pink when the material is exposed to heat or sunlight. The inclusions in the nodules are limited for the most part to muscovite crystals, while the rest of the material (both aquamarine and morganite) contains two- and three-phase inclusions, but little or no muscovite. The cause of the gem nodules is not established, but the same type of variations in mosaic texture observed in some color-zoned tourmaline crystals may be responsible.

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"OPALITE": PLASTIC IMITATION OPAL WITH TRUE PLAY-OF-COLOR

By John I. Koivula and Robert C. Kammerling

A plastic imitation opal that shows true play-of-color was advertised as "new" and offered for sale under the trade name "Opalite" at the Gem and Lapidary Dealers Association (GLDA) Tucson show in February 1988. Subsequent gemological testing proved that this material was virtually identical to the plastic imitation opal previously described in the literature that was known to be manufactured in Japan. It is now being marketed worldwide under a new name.

Plastic imitations of natural opal have been known to gemologists for over a decade. These imitations, of Japanese manufacture, show true play-of-color. This effect is produced by the close-packed structure assumed by the minute (150–300 nm) polystyrene spheres during the slow sedimentation process by which the material is formed in the laboratory (Horiuchi, 1978).

Because of the realistic play-of-color, these imitations cannot be separated conclusively from either natural or synthetic opals on the basis of unaided visual observation alone, something that is possible with other forms of imitation opal such as the glass known as "Slocum Stone" (Dunn, 1976). With loose stones, it is a simple matter to separate a plastic imitation solely on the basis of heft. The specific gravity of the plastic counterfeit is so radically different from that of either natural or synthetic opal that the plastic is immediately apparent and no further testing is required. However, most jewelers seldom are asked to identify loose stones, and when these opal imitations are in jewelry, the "heft test" is useless. In this respect, it is interesting to note that the earlier Japanese-produced material reported in the literature was only sold mounted in jewelry. In the majority of cases, then, identification of these plastic imitations requires additional gemological testing.

A series of professional papers (Horiuchi, 1978, 1982; Gunawardene and Mertens, 1983; Gunawardene, 1983) have accurately reported the important identifying properties of plastic imitation opals. Over the past 10 years, this knowledge has helped jewelers and gemologists in the identification of the Japanese product. At the February 1988 GLDA Tucson Gem and Mineral Show, however, a plastic imitation opal "advertised as new" was being offered for sale under the trade name "Opalite." It reportedly was being manufactured in the United States by a company calling itself "Excalibur." In view of our ongoing effort to keep up with new developments in the area of synthetics, enhancements, and imitations, and because of the advertised newness of this material, a closer investigation was warranted.

VISUAL APPEARANCE

Emerald Age Trading Company, which marketed the material at Tucson, provided two polished cabochons that represent, in visual appearance, the two types of this material offered (figure 1). The two cabochons are well polished with flat, polished bases. The larger sample, a 2.63-ct oval that measures 18.26 × 13.20 × 3.37 mm, shows what is commonly referred to as a "pinfire" play-of-color. Across its base, an orange "flash effect" similar to that seen on the flat, polished backs of Gilson synthetic opals was noted. The smaller of the two imitations, a 1.39-ct pear shape that measures 13.08 × 10.22 × 3.42 mm, displays a combination of broad flashes of color and a mosaic pattern as well as a yellowish green "flash effect" across the back.

Both samples are a translucent milky bluish white when viewed in either fluorescent or incan-

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Gems & Gemology, *Vol. 25, No. 1, 1989, pp. 30–34*

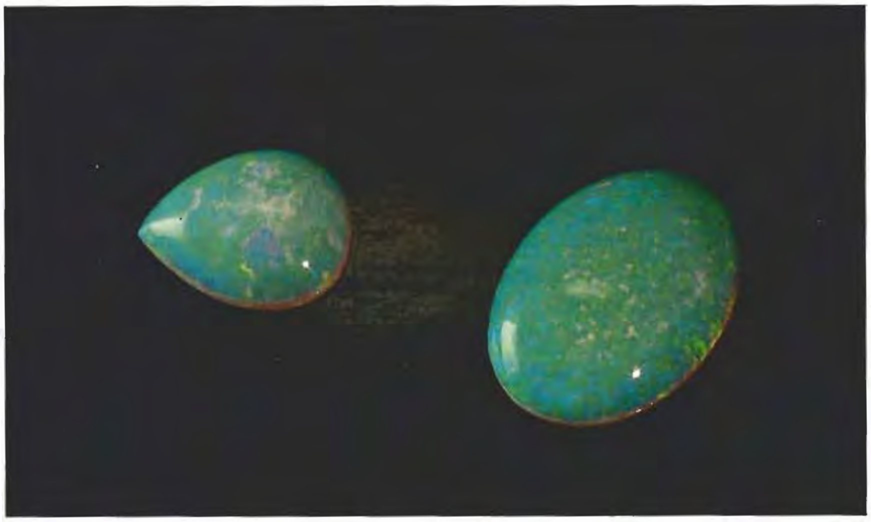

Figure 1. These two cabochons of "Opalite" plastic imitation opal, a 1.39-ct pear-shape and a 2.63-ct oval, were the subjects of this study. Photo by Robert Weldon.

descent surface incident illumination (figure 1). In transmitted light, they appear a translucent pink-orange (figure 2). Similar reactions to transmitted and incident light are also common in natural and synthetic translucent white opals.

Both plastic opal imitations appear to be assembled: A distinct layer of another plastic substance covers at least part of the base on each. This outer layer is probably an acrylic resin, which is coated over the polystyrene imitation opal to increase durability so that it can be used commercially (Horiuchi, 1982). In some areas, the acrylic layer had been polished away, while in others it was easy to see with some magnification, especially with pinpoint fiber-optic transmitted light when the sample was edge-on against a black background (figure 2).

GEMOLOGICAL PROPERTIES

The properties of "Opalite" as determined by the authors on the basis of these two cabochons are provided in table 1 and discussed below.

Refractive Index. Using the spot method and a fiber-optic white light source, we determined the R.I. on the apex of the dome to be 1.51 for each sample. The polish on the bases of both stones was good enough to get a reasonably clear R.I. reading of 1.500 with sodium vapor light.

The polystyrene that makes up the body mass of plastic imitation opals previously reported in the literature has a refractive index of 1.53, while the acrylic resin coating has an R.I. of 1.48–1.49 (Horiuchi, 1982). The intermediate readings obtained on the two "Opalites" are possibly the result of a combination of the two substances where the polystyrene and the acrylic overlayer intermix in a thin stratum along the contact surface.

Because natural opals have refractive indices in the range of 1.37 to 1.47, R.I. is a useful indicator in the separation of "Opalite" from natural or synthetic opal, provided there is no interference from a mounting.

Reaction to Ultraviolet Radiation. When exposed to long-wave U.V. radiation, the bodies of the two cabochons fluoresced a strong, even bluish white, while their edges seemed to glow a very slight

Figure 2. The thin white acrylic layer at the base of the cabochon and the pink-orange appearance of "Opalite" in transmitted light are both visible in this photomicrograph. Magnified 5×.

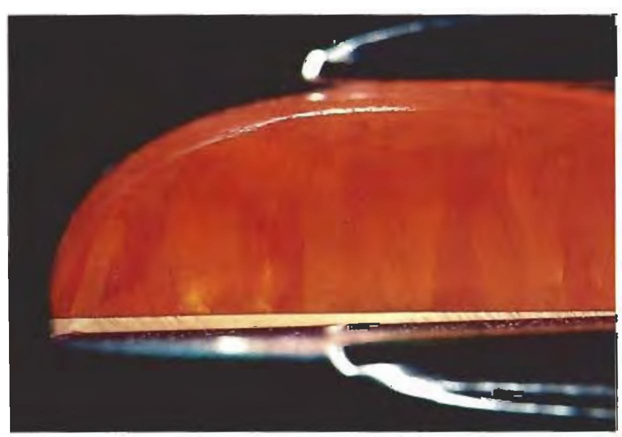

TABLE 1. The gemological properties of "Opalite" plastic imitation opal.

Properties that overlap those of natural opal	
Color	Translucent milky bluish white by surface incident light
Visual appearance	Realistic play-of-color
Polariscope reaction	Moderate anomalous double refraction
Absorption spectrum	General absorption from approximately 537 to 584 nm
Key identifying properties	
Refractive index[a]	Spot reading of 1.51 on apex of the dome; flat facet reading of 1.500 on the base (Na light)
Ultraviolet fluorescence[b]	
Long-wave	Strong, even bluish white; very slight orange at the edges
Short-wave	Weak, superficial chalky blue-white overtone
Specific gravity	1.21 ± 0.01, determined by hydrostatic method
Magnification	May show "honeycomb" or columnar structure.[c] In polarized light, strain knots may also be present. Distinct evidence of assembly is visible.
Hardness	2½

[a] *In the promotional literature for "Opalite," a refractive index range of 1.49 to 1.53 is reported.*
[b] *Testing done in total darkness (darkroom conditions).*
[c] *Observed using fiber-optic illumination and shadowed transmitted light.*

orange. The short-wave reaction was slightly less intense, with a weak, superficial chalky blue-white overtone that was most obvious when the lamp was held very close to the cabochon and the room was in total darkness (darkroom conditions). No phosphorescence was observed in either sample. If fluorescence comparison opals of known origin were used as indicators, this fluorescence could prove useful in separating "Opalite" from natural opal.

Specific Gravity. Both "Opalites" sank fairly rapidly in benzyl benzoate (S.G. of 1.11) but floated slowly to the surface of glycerine (S.G. of 1.26); therefore, specific gravity was estimated at 1.20±0.05. Specific gravity was also determined by the hydrostatic method to be 1.21±0.01 for an average of three runs. This property would easily separate this material from most natural and synthetic opal, which usually has a specific gravity range of 1.99 to 2.25.

Polariscope Reaction. As would be expected from an aggregated plastic, both cabochons exhibited moderate anomalous double refraction that was evident when the analyzer of the polariscope was rotated into the extinct position in relation to the polarizer. When the polariscope was in the light position, no such reaction was observed and the cabochons transmitted the typical pink-orange color referred to previously. Because similar effects have been observed in some translucent natural and synthetic opals, polariscope reaction is not diagnostic.

Visible-Light Spectroscopy. Using a Beck prism spectroscope mounted on a GIA GEM Instruments base unit, we obtained a visible-light spectrum for each sample by transmitting white light through the domes of the cabochons. The pear-shaped cabochon had a broad general absorption band that extended from approximately 537 to 584 nm, while the oval cabochon had an absorption band that ranged from 550 to 580 nm. Both natural and synthetic translucent white opals may show similar absorption features, so visible-light spectroscopy does not provide a method for separation of "Opalite" from opal.

Microscopy. In examining any opal or opal-like material, oblique illumination can be used, together with shadowing and transmitted light, to show specific patches of color-play and how they relate to the overall structural appearance of the substance (Gübelin and Koivula, 1986).

When studied in oblique surface incident light with a standard gemological microscope, the 2.63-ct oval showed a "pinfire" play-of-color pattern (figure 3) that could be easily mistaken for the play-of-color shown by some natural opal. In shadowed transmitted light, the "pinfire" structure was transformed into the highly diagnostic so-called honeycomb or lizard-skin pattern (figure 4) that is always associated with laboratory-grown products exhibiting play-of-color. So, on the basis of this structure, a gemologist would at least associate this cabochon with a man-made material generally, if not a plastic imitation specifically.

The pear shape displayed an abstract combination of broad flashes of color and a mosaic play-of-color in the face-up position under surface incident light (again, see figure 1). In shadowed transmitted light, it showed an irregular structure with only a hint of a vague "honeycomb" pattern correspond-

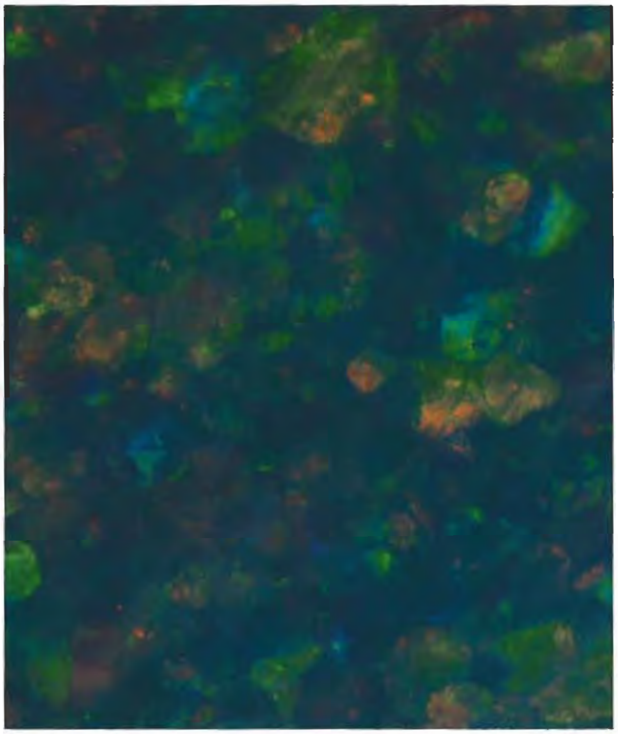

Figure 3. One of the two types of play-of-color known to occur in "Opalite" is shown by this "pinfire" pattern in the oval cabochon. Oblique incident illumination; magnified 15×.

Figure 4. The "honeycomb" structure shown by pinfire "Opalite" when examined with shadowed transmitted light is characteristic of a laboratory-grown material. Magnified 15×.

ing to the play-of-color that, unlike the obvious pattern shown by the oval (figure 4), offers few clues to its identification.

Looking edge-on through each cabochon, using either oblique incident illumination or shadowed transmitted light, we noted a columnar structure in certain directions. Transmitted light reveals this in figure 2. This is similar to the edge-on columnar structure seen in some synthetic opals (Gübelin and Koivula, 1986).

Using polarized light microscopy, we discerned some minor strain knots in both of the cabochons. These are similar to those reported by Gunawardene (1983) in plastic imitation opal, except that they are not as intense in their appearance and are not associated with gas bubbles.

Hardness. The radical difference in hardness between a plastic imitation and a natural or synthetic opal makes hardness testing very useful in this case if it is done carefully (so as not to damage the piece) by a skilled gemologist on an inconspicuous place on the test subject.

With magnification, it can be observed that the fine point of a common sewing needle will readily dent "Opalite" when only the slightest pressure is exerted. Gem-quality natural opals and synthetic opals will not be dented by such a test, although some poor-quality highly porous natural opals may be.

It is interesting to note that the manufacturer's promotional literature, which contains several errors, some quite comical (e.g., "they [opals] also evolve from fossilized aquatic animals and plants such as teeth of sharks, squids and prehistoric creatures which have been deposited in rock seams and hardened for thousands of years"), states that "These Flawless Gem-Quality OPALITES will not scratch or chip easily like their counterpart, the natural opal." While plastics are generally quite tough and resistant to chipping, they are not hard materials. To say that "Opalite," with a Mohs hardness of 2 ½ as determined by the authors, will not scratch as easily as natural opal, with a Mohs hardness of 5 ½–6 ½, is totally untrue.

Thermal Conductivity. Plastics, including "Opalite," feel much warmer to the touch than do

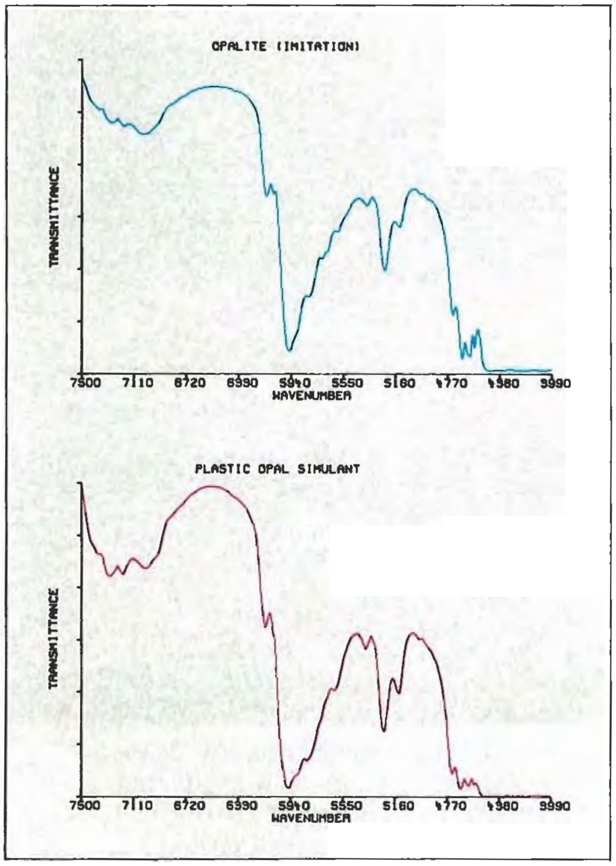

Figure 5. The infrared absorption pattern of "Opalite" (top) is typical of plastic imitation opal and virtually identical to the infrared absorption pattern of a Japanese plastic imitation opal (bottom; GIA collection no. 6873).

natural and synthetic opals. When "Opalite" or any plastic imitation opal is tested with a thermal inertia probe, it usually does not register on the instrument, or it causes the needle to drop slightly lower than its normal "at rest" position. Because natural and synthetic opals do react slightly, in a positive way, thermal conductivity can be useful for spotting plastic imitation opal (Horiuchi, 1982).

Infrared Spectrometry. In the infrared region of the electromagnetic spectrum, plastics, like many organic materials, show unique absorption features that allow them to be recognized and classified (Fritsch and Stockton, 1987). Using a Nicolet 60SX research grade Fourier transform infrared spectrometer, Carol M. Stockton determined the infrared absorption characteristics of the two "Opalite" specimens. Both gave a strong pattern that is typical of plastic imitation opal and that closely matches that of a plastic imitation opal of Japanese manufacture (figure 5) from GIA's reference collection.

Infrared testing, however, is expensive and the equipment is sensitive, but as a last resort an infrared spectrometer will always be able to identify a plastic imitation of opal or of any other gem material.

CONCLUSION

Since we first began this project, we have learned that the "Opalite" plastic imitation opal being sold today is now available throughout the world and is being marketed under the name "Opal Essence." Advertisements for "Opalite" can be found in magazines such as *Accent* (March 1988) and *Jewellery News Asia* (April 1988), and it is being sold in markets such as Korea and Taiwan.

"Opalite" may represent a new production run of imitation opal, but it is not a new manufacturing process. This material is virtually identical to the plastic imitation opals that have been produced in Japan for a decade. A very effective substitute, "Opalite" cannot be identified as an imitation by sight alone. However, numerous optical and physical differences that exist between plastic and opal, such as refractive index, specific gravity, hardness, microscopic appearance, and thermal conductivity, as well as infrared absorption, should serve to make a separation possible even in the most difficult testing situations.

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Gem Trade LAB NOTES

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Transparent Green
AUGITE

In the Fall 1988 Lab Notes section, we reported on opaque black augite that was offered in the trade as Chinese "onyx." Since then, the West Coast laboratory has been asked to verify the identity of a dark green, transparent 8-ct oval brilliant that was reported to be augite. We determined the following gemological properties for this stone: refractive indices of 1.682–1.702; biaxial positive optic character; specific gravity, estimated with heavy liquids, of approximately 3.20; and no reaction to ultraviolet radiation. In the spectroscope, a faint absorption line was visible at 500 nm. When the stone was examined with magnification, we noticed small, transparent, prismatic crystals arranged in a plane, as well as numerous fine short needles, both of unknown identity. The optical and physical properties were consistent with augite, but were still within the range of some other monoclinic pyroxenes. To determine the exact identity, we performed X-ray diffraction analysis; the pattern obtained matched the standard pattern for augite. Thus, the green oval brilliant was identified as augite, but it is a variety we had not seen before. *KH*

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

Figure 1. These three samples of covellite illustrate the varied appearance that this cupric sulphide mineral can show.

COVELLITE

The West Coast laboratory recently received a 24.91-ct cabochon that we identified as covellite. This is the first piece of covellite that the laboratory has been asked to identify in many years. However, every February, at the Tucson Gem & Mineral Show, there are several dealers selling covellite rough, cabochons, and faceted tablets (figure 1).

Covellite, an opaque submetallic cupric sulphide (CuS), is generally a very dark "indigo" blue, sometimes with a purple surface tarnish. It is frequently intergrown with small veins of a "brassy" metallic-appearing mineral such as pyrite and/or chalcopyrite. Covellite, like malachite, is essentially a "sight ID": Once you have seen it, you don't forget its unique appearance. Covellite shows a submetallic luster, a specific gravity of around 4.6, a shade or spot refractive index reading of 1.45, and a Mohs hardness of 1.5 to 2.

Covellite cabochons are inexpensive and are generally sold as a collector's curiosity. The material reportedly is difficult to cut because of its softness. The three covellite cabochons in figure 1 range in weight from 19.66 to 23.64 ct. *RK*

Figure 2. The circular spot on the surface of this diamond results from an unevenly dried coating; it is a common means of detecting such a treatment. Magnified 30×.

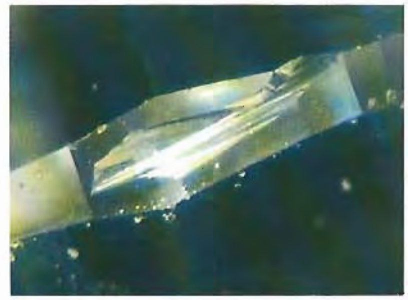


Figure 3. The dark line on the girdle of this diamond reveals the coating at the upper edge of the indented natural. Magnified 45×.

DIAMOND

Coated Diamonds Again Seen in the Trade

Diamonds in the very light to light yellow color range can be "improved" in color by the addition of a grayish or bluish material to the surface. For example a "J" or "K" color can be made to look like a "G" color. Such diamonds also can be treated by fluoride deposition in a manner similar to that used for lens coatings in optics. It has also been reported that this coating may be a flux, similar to that used to paint china. The first article in *Gems & Gemology* on this subject appeared in the Winter 1962–63 issue, pp. 355–364.

Fraudulent or deceptive treatment practices usually subside after they have been exposed by the laboratories or by jewelry organizations. Eventually, though, the trade forgets the warnings, so the practices almost always return. The East Coast laboratory has seen a number of coated diamonds recently. Figure 2 shows a circular mark on the surface of a 1.53-ct round brilliant-cut diamond where a coating dried unevenly; this provides a very typical means of detection. The dried coating can also be seen concentrated on the pavilion along the girdle; figure 3 shows this concentration as a dark line along the top of an indented natural in the girdle. The 1962–63 *Gems & Gemology* article contains many more photographs and is worth reviewing. *DH*

Unusual Inclusions in Diamond

Two diamonds recently seen in the East Coast laboratory were found to have some rather curious inclusions. A 1.06-ct greenish yellow round brilliant contained unusual parallel acicular inclusions (figure 4). These sets of unidentified "needles" formed an angle of approximately 90°.

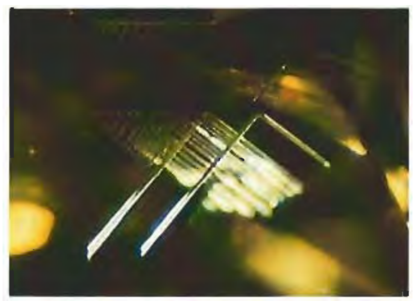


Figure 4. These sets of parallel "needles," which intersect at 90°, are unusual in diamond. Magnified 45×.

The other diamond was a laser-drilled 1.32-ct pear shape. With normal laser drilling, usually only one or two drill holes can be seen. Figure 5 shows what must have been an attempt to eliminate a very obvious inclusion through multiple entries. Numerous drill holes are seen concentrated in a confined area on the girdle of the stone. Figure 6 shows the many laser channels as seen through the crown of the stone; it appears that only one or two actually reached the inclusion. *DH*

Figure 5. Numerous laser drill holes are quite visible on the girdle of this 1.32-ct pear-shaped diamond. Magnified 45×.

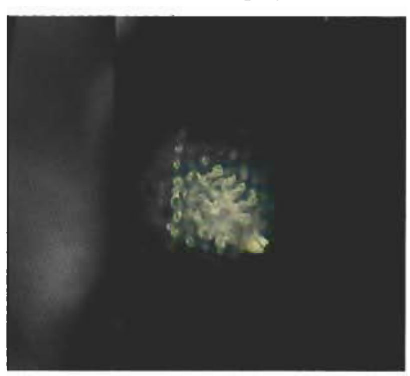
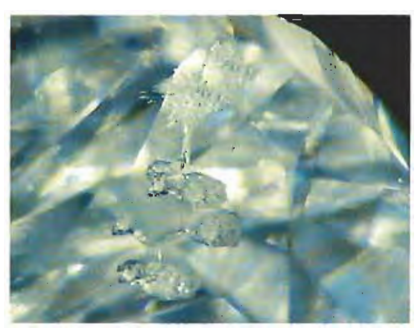


Figure 6. Only one or two of the laser drill holes shown in figure 5 actually reach the inclusion. Magnified 45×.



PEARL

American Freshwater Natural Pearls

The sentimental practice of engraving a date on the metal part of a jewelry gift, formerly quite common, has provided the East Coast laboratory staff with some useful observations. "November 30, 1858" was engraved on the circular gallery wire of the largest undrilled, natural freshwater pearl in a beautiful necklace of 32 undrilled, round freshwater pearls (figure 7). We were intrigued by this date, since the "modern" discovery of *Unio* pearls in American waters was in Paterson, New Jersey, only a year earlier – 1857. According to George Frederick Kunz, in his *Book of the Pearl,* the first undamaged pearl found at this location weighed 93 grains and was sold to Mr. Charles Tiffany (it later became part of the collection of Empress Eugénie of France); the stream is only 17 miles from the Tiffany store. There are 27 graduated pearls, ranging from 5.25 to 11.50 mm in diameter, in the necklace (the other five are in the clasp). The quality and quantity of these pearls suggests that they are American, because Scotland, the only other producing locality, was largely worked out by this time. The elegantly conceived enamel and gold galleries for each of the pearls indicate the respect that the designer had for them. *RC*

Figure 7. This antique necklace and clasp contain 32 undrilled, round freshwater pearls; the largest is 11.5 mm in diameter. They are believed to be American in origin.

Figure 8. The striated bead nucleus is clearly visible on the back of these 8-mm black 3/4 cultured blister pearls; the right pendant shows how the pearls appear from the front.

Cultured Black Pearl Mystery

A jeweler sent our West Coast laboratory a pair of yellow-metal pendants, each set with a cultured black pearl measuring approximately 8 mm in diameter. We were asked to determine what kind of damage the pearls had sustained, since part of the nacre seemed to be missing from the flattened back of each. Figure 8 shows the front of one, which is completely covered by nacre, and the back of the other, where most of the nacre is missing and the striated bead nucleus is visible.

When we examined these two cultured black pearls with magnification, we noticed that there was a heavier accumulation of conchiolin around the flat base of each in the area where the nacre accumulation begins. Furthermore, we could find no evidence that a nacreous layer had ever developed on top of the bead nucleus when the pearl was originally formed. Because this growth formation is characteristic of 3/4 cultured blister pearls, we concluded that this was such a blister pearl. The jeweler, however, claimed that nacre was present on the backs at one time, so we could only speculate that a nacreous backing of some sort was originally present in this area. It does seem strange, though, that the backing would become separated and lost from both pearls at the same time. There was no evidence of any residual glue on either back.

KH

A Large PHOSPHOPHYLLITE Crystal

The East Coast laboratory was recently asked to identify the large blue-green mineral specimen shown in figure 9. Careful gemological testing indicated that the crystal was phosphophyllite. However, crystals of this material are usually small, whereas this specimen measured 7.8 × 5.7 × 2.7 cm and weighed approximately 220 grams (7.7 oz.). The largest phosphophyllites we are aware of are the two 13-cm crystals in matrix that are in the collection of the Smithsonian Institution and appeared in P. Bancroft's 1984 book, *Gem and Crystal Treasures.*

Usually there is no absorption spectrum visible when phosphophyllite is examined with a handheld spectroscope. This crystal, however, because of its mass and the depth of color, displayed a prominent absorption band at 448 nm that is probably related to Fe^{2+}, which contributes to the cause of color in phosphophyllite (*Gems & Gemology,* Summer 1988, p. 97). According to Robert Kane of our West Coast laboratory, George Rossman of the California Institute of Technology reports that "the major band which defines the color of phosphophyllite occurs in the infrared portion of the spectrum at 960 nm and tails down to the visible portion." This band would not be visible in a hand spectroscope.

Phosphophyllite, a zinc phosphate $[Zn_2(Fe^{2+},Mn)(Po_4)_2 \cdot 4H_20]$, comes mainly from two localities: Potosí, Bolivia, and Hagendorf, West Germany. Its refractive indices are 1.595–1.616, specific gravity is 3.10, hardness is 3 to 3 1/2, and reaction to short-wave U.V. radiation ranges from inert to strong violet. Because the material is heat sensitive and it fractures and cleaves easily, it does not lend itself to use in jewelry. This specimen was unusual not only for its large size but also for its attractive vivid blue-green color—usually phosphophyllite is near-colorless to light blue-green. *DH*

Figure 9. This 7.8 × 5.7 × 2.7 cm phosphophyllite crystal is unusually large.

RUBY, VERNEUIL SYNTHETIC with Needle-like Inclusions

Gemologists at the Gem Trade Laboratory sometimes encounter platinum needles in flux-grown synthetics. On rare occasions, we have observed straight twinning or even needle-like inclusions in flame-fusion blue or orange synthetic sapphire (see *Gems & Gemology,* Summer 1984, p. 111). Recently, however, we saw these phenomena in a flame-fusion synthetic ruby for the first time.

The stone in question, a 2.00-ct cushion antique mixed-cut Verneuil synthetic ruby, was examined at the East Coast laboratory. "Needle-like" inclusions, which are actually the edges of straight twinning planes, were readily visible with magnification (figure 10). The strong red fluorescence to short-wave ultraviolet radiation and the curved striae easily proved the material to be synthetic.

Figure 10. Straight twinning planes look like needles when viewed edge-on in this flame-fusion synthetic ruby. Magnified 45×.

It is interesting to note also that the stone was poorly cut and had been quench crackled to make it appear more natural. *DH*

SAPPHIRE

A Large Fine-Color Star

In the experience of the Gem Trade Laboratory, very large "blue" star sapphires are almost always bluish gray, or gray-blue at best. The East Coast laboratory recently identified a natural star sapphire of a "pure" dark blue color. The 204.39-ct translucent oval asteriated cabochon (figure 11) measured 34.40 × 29.15 × 17.34 mm; it is one of the largest star sapphires ever seen by the Gem Trade Laboratory. Pristine, undisturbed silk and the lack of any evidence indicating heat treatment or diffusion proved the stone was of natural color. As is to be expected with the cabochon cut of a star corundum, the uniaxial figure was self-resolving in the polariscope.

At 563.00 ct, the Star of India sapphire, which is in the collection of the American Museum of Natural History in New York, is the largest known gem-quality blue star sapphire in the world. *DH*

Figure 11. This "pure" dark blue star sapphire weighs 204.39 ct.

An Unusual Green Star

A 12.13-ct natural star sapphire of a most unusual grayish green color (figure 12) was recently submitted to the West Coast laboratory for examination. The locality origin of this particular stone is not known, although at the February 1988 Tucson Gem & Mineral Show several GIA employees examined two or three natural green star sapphires that were reportedly from Thailand. In the laboratory's experience, green natural star sapphires are rare.

As expected, a 1.76 spot refractive index was obtained. There was no reaction to short-wave ultraviolet radiation, but we observed very weak dull green fluorescence to long-wave U.V. when the stone was closely examined in a dark room. The presence of iron in this natural green stone was indicated by prominent absorption bands in the blue region of the spectrum. The observed spectrum was the same as the well-documented absorption spectra of dark blue, green, and yellow Australian sapphires described by Richard T. Liddicoat in *The Handbook of Gem Identification*, 12th ed., 1987, p. 142.

Examination with the microscope revealed the following features: strong angular growth zoning and dense concentrations of small particles in a hexagonal arrangement (many particles were also randomly oriented), various examples of "fingerprints" and "healed fractures," and small euhedral crystals of unknown identity. The characteristic absorption and these microscopic features easily proved natural origin. *RK*

Figure 12. The grayish green color of this 12.13-ct natural star sapphire is unusual.

Pink SPINEL From the USSR

The West Coast laboratory received an attractive slightly purplish pink 6.95-ct spinel (figure 13) for examination. This material reportedly came from a deposit in the Pamir Mountains in Tadzhikistan, USSR, the same general area where gem-quality clinohumite is recovered.

Some pink to purple natural spinels exhibit a color change when viewed under incandescent or fluorescent light (see *Gems & Gemology*, Winter 1984, pp. 232–233). This stone, however, did not show such a change. A single refractive index reading of 1.711 was obtained. When the stone was exposed to long-wave ultraviolet radiation, we observed a moderate orangy red fluorescence. The stone fluoresced a very weak orangy red to short-wave U.V. The polariscope revealed a singly refractive reaction with essentially no strain. When this attractive pink spinel was placed over the opening of the iris diaphragm on the spectroscope unit, a very weak red transmission luminescence was observed. The absorption spectrum was essentially the same as the well-known absorption spectrum of fluorescent pink spinels described by Liddicoat in *The Handbook of Gem Identification*, 12th ed., 1987, p. 151.

When this faceted spinel was examined with the microscope, the first impression was that the stone was very "clean." Careful examination revealed faint, tightly spaced, straight parallel growth features. Immersion in methylene iodide showed faint color zoning which appeared to be in alignment with the growth features discussed above. Also observed near the girdle were a few very small to moderately sized transpar-

Figure 13. This 6.95-ct pink spinel is reportedly from the USSR.

Figure 14. This 4.53-ct pink spinel crystal is reportedly from the same locality as the cut stone in figure 13.

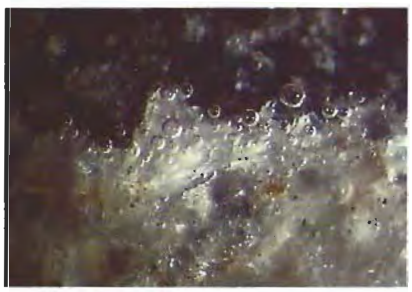


Figure 15. The effervescence to HCl proves that the whitish inclusions reaching the surface of the crystal in figure 14 are carbonates. Magnified 40×.

Figure 16. Mica inclusions were also noted in the 4.53-ct pink spinel crystal. Magnified 25×.

ent, near-colorless euhedral, highly birefringent crystals.

At the same time we examined this stone, the owner donated a 4.53-ct pink spinel crystal (figure 14) from the same locality to GIA's Dr. Byron C. Butler inclusion collection. John Koivula provided the following observations on the three distinct types of inclusions he observed in the crystal. The most obvious inclusions were irregular masses of a translucent whitish material with a fine-grained, almost sugary texture that was reminiscent of massive calcite. Because a small area reached the surface of the crystal, an acid test was carried out. A droplet of 10% hydrochloric acid solution was placed on the exposed portion and the reaction then viewed under the microscope. As shown in figure 15, the effervescence was quite obvious, thus proving the presence of a carbonate, possibly calcite. Another type of inclusion that reached the surface was a platy grouping of near-colorless to whitish crystals (figure 16) that looked like muscovite or a similar mica. These crystals did not react to acid, and when probed with a fine pointed needle, they had the distinctive flaky texture of a mica. Another, less conspicuous type of inclusion, which was not exposed at the crystal's surface, was also platy in habit. These inclusions were opaque and gray with a submetallic luster, and may be either graphite or hematite.

While the color of this material is unusual, all of the gemological properties determined and inclusions observed overlap those known for spinel from other localities.

RK

SYNTHETICS and Other "Modern" Substitutions in Period Jewelry and Reproductions

As we mentioned in the Winter 1988 issue of *Gems & Gemology*, the substitution of simulants for natural gemstones in jewelry has been going on for hundreds of years for a variety of reasons, some legitimate and some not. This matter is one of growing importance to the people concerned with period jewelry. Last issue we discussed (and illustrated) the importance of testing every stone in a piece. A knowledge of the dates when synthetics and various types of cultured pearls first appeared on the market can also be helpful. In addition, "period" pieces should be checked carefully to make sure that they are not just clever reproductions.

The natural-color black cultured pearls seen in figure 17 are clearly

Figure 17. The 12.5-mm long black cultured pearls in these Victorian-era earrings are modern-day substitutes.

substitutions in the attractive pair of Victorian pendant earrings, since natural-color black cultured pearls did not appear on the market until the 1970s. Recently, we also identified cultured pearls in an Art Nouveau necklace; these, too, are substitutions, since this type of cultured pearl was not available before the 1920s.

A synthetic blue sapphire was identified in what appears to be an antique ring made prior to World War I. Because synthetic blue sapphires did not become commercially available until after the war, either this stone is a substitute for the original or the ring is a more recent reproduction. All five of the lozenge-shaped step-cut synthetic blue sapphires shown in the brooch in figure 18 appear to be original stones set in a very convincing reproduction. The old diamond cuts and quality of workmanship give the piece a surprisingly authentic look, but the lack of evidence on the metal that any of the stones had been reset led us to conclude that the piece is a reproduction.

RC

Figure 18. This reproduction of an Art Nouveau pin is set with synthetic blue sapphires; the pin is about 7.5 cm long.

FIGURE CREDITS

Figures 1, 12–14, and the "Historical Note" photo are by Shane McClure. Figures 2–7, 10, 11, 17, and 18 were taken by Dave Hargett. Robert Weldon furnished figure 8. Figure 9 was supplied by Robert Kane. John I. Koivula provided figures 15 and 16.

A HISTORICAL NOTE

Highlights from the Gem Trade Lab 25, 15, and five years ago

SPRING 1964

The Los Angeles laboratory discussed the effects of excessive heat on a diamond, as well as the effect that varying degrees of transparency can have on the brilliancy of a finished stone. A piece of jewelry set with a thin diamond crown over a hollow metal basket to simulate a larger stone is described; the facet junctions of the pavilion were simulated by engraved lines in the metal backing. The detection of cyclotron-treated diamonds, based on the appearance of the color zoning (confined to the surface), was also discussed.

SPRING 1974

Unfortunately, the special contents of this issue precluded a report from either New York or Los Angeles.

SPRING 1984

A number of unusual items appeared in this issue. Iridescent coatings on aquamarine and synthetic emerald were encountered in the Los Angeles lab. Other items described by the Los Angeles staff were a dyed blue, plastic-coated coral bead and a cat's-eye scapolite. New York examined magnetic hematite and a hollow natural pearl. An imitation red beryl crystal was manufactured from flame-fusion synthetic ruby; facets were arranged to simulate a hexagonal prism and then abraded or etched to resemble surface characteristics associated with natural beryl crystals. The prism had even been cemented into a brown sedimentary rock "matrix" that was removed before the crystal was sent to Los Angeles for identification.

This 10.96-mm-high imitation red beryl crystal is actually a flame-fusion synthetic ruby.

Editorial Forum

HEXAGONAL ZONING AND COARSE NEEDLES IN HEAT-TREATED SAPPHIRE

I wish to comment on the two items concerning sapphire that appeared in the Gem Trade Lab Notes section of the Spring 1988 issue of *Gems & Gemology.* With regard to the "Color Zoned" sapphire, I occasionally encounter the feature described and shown in the photograph—dark hexagonal zoning—when I heat treat Australian sapphire. Before treatment the zone would have been very fine, even silk, often with the appearance of a phantom crystal as the lab note speculated it might be. Usually within and outside the zone there is little or no silk. The effect is most often seen in stones of fine light color. After treatment there is a definite intensification of blue in the regions that were originally fine silk, in a manner similar to the blue that results from treatment of Sri Lankan "geuda." Sometimes some silk remains in the zone, giving it a slightly "milky" appearance.

I worry that the first part of the item on sapphire "With Needles," in which it is stated that the presence of "coarse, well-formed undisturbed needle-like inclusions" proves that a sapphire has not been heat treated, may mislead some of your readers. In the course of treating both Australian and Sri Lankan sapphire, I have regularly encountered the odd stone in which coarse silk cannot be removed with treatment. I have just had experience with such a stone, originally a gray Sri Lankan star of 40 ct. Heat treatment resulted in an excellent blue color with greatly improved clarity, but still showing silk in a manner similar to that featured in your article. Neither I nor the Thais could remove the coarse silk from the stone. Stones produced from the Kanchanaburi mine in Thailand also often contain coarse silk after heat treatment.

While the item refers to "undisturbed needle-like inclusions," it is quite difficult to determine what is disturbed and what is not. In Bangkok (and probably elsewhere) a stone having such silk after treatment is sold as untreated, the buyer believing that a treated stone would not have any silk. I suggest that you point out clearly to your readers that it is quite possible for a treated stone to have coarse silk, very similar in appearance to the uncooked stone.

Terry S. Coldham
Sapphex Pty. Ltd.
Sydney, NSW, Australia

LARGEST FACETED COLORLESS QUARTZ IS 8,512 CT

In his article "Faceting Large Gemstones," which appeared in the Spring 1988 issue of *Gems & Gemology,* Michael Gray claims that the largest faceted colorless quartz on record is 7,500 ct. This is incorrect. In 1972, my brother Alex faceted the "Crystal King," an oval brilliant colorless quartz with 196 facets that weighs 8,512 ct. This stone is now, and has been since my brother's death in 1973, in the National Museum in Melbourne, Victoria, Australia. I hope you will correct the error in the technical literature on the subject.

Ron W. Amess
Hampton, Victoria, Australia

GEM SHOW REVEALS PROVENANCE OF LARGE SMITHSONIAN BENITOITE

At times unanticipated secondary benefits derive from attending gem and mineral shows. Such was the case for the Smithsonian at the October 1988 Pasadena (California) show, sponsored by the Mineralogical Society of Southern California. The show featured the mineral benitoite, and the Smithsonian displayed our record-size 7.6-ct faceted gem benitoite (figure 1) as part of the exhibit we brought.

Another guest exhibitor had included in their display a copy of George Louderback's "Benitoite, Its Paragenesis and Mode of Occurrence," *University of California Bulletin of the Department of Geology,* Vol. 5, No. 23, pp. 331–380, 1909. It was open to pages 353 and 354, and the plate that comprised page 353 (figure 2)

Figure 1. This large, 7.6-ct benitoite is in the collection of the Smithsonian Institution. Photo by Robert Weldon.

showed four views of a faceted gem benitoite that very precisely resembled our 7.6-ct gem. On returning home, I obtained a copy of the publication and read that "The largest flawless gem yet obtained weighed a little over seven and a half carats when first cut, though it has since been repolished and brought down to a little below this value. It has a moderately deep blue color and is about 14.5 mm. long, 10.5 mm. wide at the girdle, and 8 mm. deep. It is the property of Mr. G. Eacret of San Francisco. This stone is remarkable in that it is about three times as heavy as the next largest flawless stone so far obtained, and also that it was found in the early days of the mine almost at the surface."

I went to our catalog and was pleased to find that our gem was purchased for $350 with Roebling Funds in 1929 – from G. Eacret! As far as I know, the link between the gem described by Louderback and the wonderful stone in our collection had not previously been established, at least not in official Smithsonian documents. Had it not been for the Pasadena Show, this important history may not have been recorded.

John Sampson White
Curator-in-Charge
Department of Mineral Sciences
Smithsonian Institution
Washington, DC

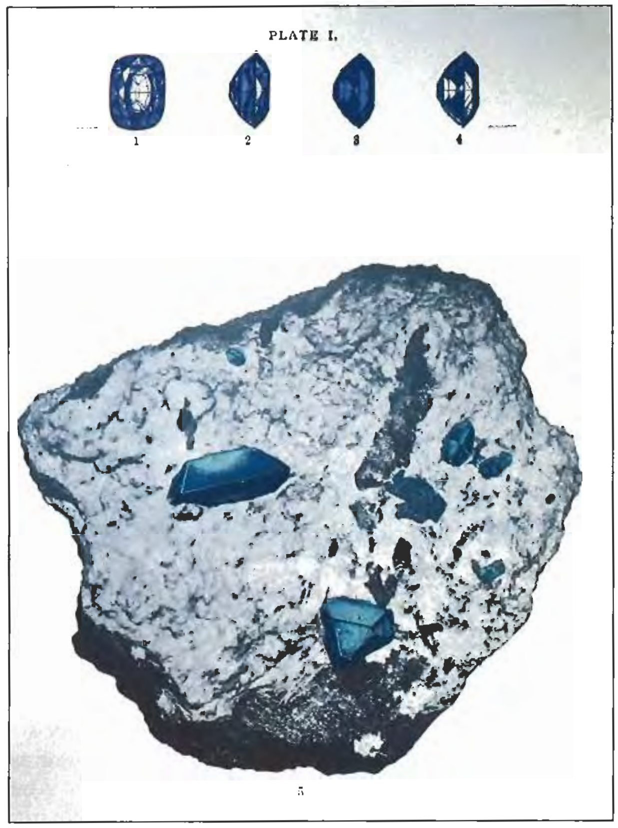


Figure 2. The faceted benitoite in this plate from Louderback's 1909 report on this California gem was recently determined to be an early reference to the Smithsonian Institution specimen shown in figure 1.

AN UPDATE ON THE AVAILABILITY OF HYDROGROSSULAR GARNET

I wish to set the record straight with regard to the current status of hydrogrossular garnet from the Transvaal. In the Spring 1985 Gem Trade Lab Notes, you printed a description of a grossularite carving with a comment on the extreme rarity of this material. You subsequently printed an update in the Fall 1985 issue in which you quoted a letter from Dr. Schreuders of Cape Town to the effect that "The hanging wall of most of the chrome mines is virtually solid grossularite garnet." As is so often the case, the truth of the matter lies somewhere between these conflicting statements.

Dr. Schreuders is certainly accurate in stating that several tons of this material have been mined and that the majority of the production was shipped to the Far East. However, "Transvaal Jade" mining was in its heyday in the 1920s, and finds since then have been sporadic. The only commercial workings situated between Brits and Rustenburg closed down in 1967, when known reserves of the better grade materials were exhausted.

I have visited quite a number of the chrome- and platinum-mining operations in the Brits-Rustenburg section of the Merensky Reef during the last 30 years. However, I have yet to see any indication of hydrogrossular garnet in either the mining or the geological hanging wall of any of these mines. The new generation of mine

Figure 3. The hydrogrossular garnets in this necklace represent the range of colors that once was available from the Transvaal region of South Africa. Photo courtesy of Arthur Thomas.

geologists tend to look blank when I inquire about the occurrence of hydrogrossular, though a chief geologist at one of the platinum mines recalled having a piece in his office many years ago.

The chrome-rich hydrogrossular sometimes occurs in the form of a thin alteration zone around the margins of calc-silicate xenoliths which are themselves rare "plums" in the Bushveld complex magma. This locality has produced a considerable color suite of hydrogrossular as evidenced by the enclosed photograph of a multi-colored necklace [figure 3].

The highly prized translucent emerald-green material is no longer available, nor are the really fine pinks and clean reds, but a range of the other colors may still be obtained from the limited stockpile. For example, it would still be possible to select some good-sized pieces of translucent mottled spinach-green material of the type used for the carving illustrated in your April 1985 issue. Ton lots of opaque sage green and gray-green material are still available, and a few pieces may exhibit bands or patches of somewhat better color.

Arthur Thomas
Benmore, Transvaal

STAR OF ABDEL AZIZ

Mr. Robert Mouawad, the purchaser of the 59-ct D-internally flawless pear-shaped diamond in our auction of October 19, 1988 [illustrated on p. 146 of the Fall 1988 *Gems & Gemology*], has decided to name the stone "Star of Abdel Aziz." It refers to the late King Abdel Aziz, the founder of the Kingdom of Saudi Arabia. The stone fetched $5,560,500.

François Curiel and
Russell Fogarty
Christie's, New York

ANNUAL HUMAN INTAKE OF URANIUM WAS ERRONEOUSLY REPORTED

It has come to my attention that the otherwise excellent article by Charles E. Ashbaugh III, "Gemstone Irradiation and Radioactivity" which appeared in the Winter 1988 issue, contains an error, the source of which is a typographical error in the third edition of my textbook, *Environmental Radioactivity* (Academic Press, 1987). The annual human intake of uranium is 140 pCi rather than 140 nCi as stated on page 127 of my textbook and reproduced on page 211 of the Ashbaugh article.

Merril Eisenbud
Chapel Hill, NC

Gems & Gemology *welcomes letters from our readers on items published in* G&G *and other relevant matters. Please address all such correspondence to the Editor,* Gems & Gemology, *1660 Stewart St., Santa Monica, CA 90404.*

GEM NEWS

John I. Koivula and Robert C. Kammerling, *Editors*

TUCSON '89

Every February the editors of Gems News, along with other gemologists, jewelers, gem collectors, and hobbyists, look forward to a trip to Tucson, Arizona, for the annual Gem and Mineral Show. The show—actually a series of several shows held throughout the city—is an excellent opportunity to see the new, unusual, and exceptional in the world of gems. This year was as interesting as ever.

"Angelite." A reportedly "new" gem material seen at Tucson and advertised prominently in lapidary magazines is called "Angelite." The material is semitranslucent, a medium light blue-gray (figure 1). Standard gemological testing, together with X-ray diffraction analysis, showed that the material is anhydrite.

Garnet. African rhodolites were seen in great profusion this year. Many of these stones, ranging from lighter pinks (sometimes called "rose garnets") to medium to dark reddish purples ("raspberry rhodolite"), reportedly came from the Kangala mine in northern Tanzania. A smaller number of exceptionally fine-colored rhodolites were said to have come from the Mwaki Jembe mine in Tanzania. Also seen were dark brownish to orangy red garnets from Mozambique.

In addition, several gem dealers were offering garnets from the Indian state of Orissa. Most were of a color typically associated with almandine. One such stone (figure 2) would be described using GIA's colored stone grading nomenclature as very dark, moderately strong reddish orange. Other garnets, also reportedly from Orissa, were reminiscent of the colors associated with darker rhodolite garnets from Sri Lanka.

Figure 1. "Angelite," a medium light blue-gray semitranslucent form of anhydrite, was introduced at the 1989 Tucson show. This specimen is 6 cm in the longest dimension. Photo by Robert Weldon.

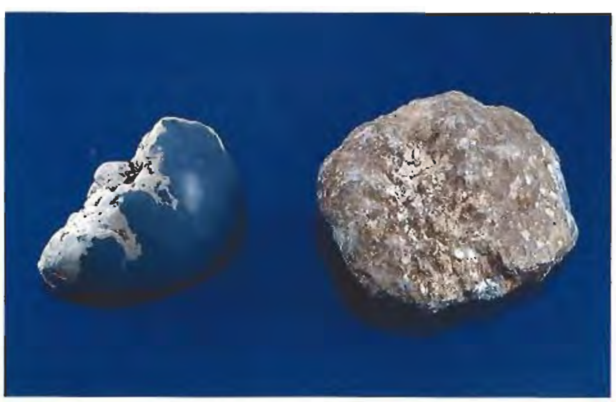


Figure 2. Almandine garnets from the state of Orissa, India, were plentiful at Tucson this year. This representative stone is 10 mm long. Photo by Robert Weldon.

Man-made "inclusion" specimens. Among the gemological novelties seen in Tucson this year were two materials with created inclusions. One was a translucent, flat cabochon of blue-green chalcedony with a large dendritic inclusion of the type that has been produced by soaking porous chalcedony in a copper solution, then

Acknowledgments: The editors would like to thank the following individuals for their assistance in preparing this column: Andrew Christie, Emmanuel Fritsch, Rachel Kadar, Robert E. Kane, and James E. Shigley.

Gems & Gemology, *Vol. 25, No. 1, 1989, pp. 45–51*

Figure 3. Manufactured three-phase inclusions in quartz obtained at the Tucson show were found to consist of water, a gas bubble, and a small faceted red (as in this 3-cm-high crystal) or blue stone. Photo by Robert Weldon.

Figure 4. This 2.5-cm piece is one of several mother-of-pearl gambling chips, reportedly carved in China in the late 18th and early 19th centuries, that were sold both loose and mounted in jewelry at Tucson. Photo by Robert Weldon.

Figure 5. Remarkably good, one-piece plastic cameos, like these 4-cm-high samples, were among the imitations seen at Tucson this year. Photo by Robert Weldon.

applying an electric current to precipitate out a dendrite of elemental copper. The point at which the electric current apparently has been applied is revealed by a small area on the surface of the stone where the copper extends up from the otherwise internal mass.

The other "inclusion" specimens were colorless quartz crystals with man-made "three-phase" inclusions that were brought to our attention by Michael and Pat Gray. In each specimen, thin tubular columns had been drilled in from the base of the crystals. These had in turn been partially filled with a liquid. The final touch—"phase three"—was a minute faceted gem! In one such specimen the solid phase was a dark blue gem; in the other, a bright red one (figure 3). In both specimens, the bases were sealed with what appeared to be a mixture of small quartz fragments and epoxy.

Mother-of-pearl gambling chips. Among the more interesting materials being sold for use in jewelry were antique mother-of-pearl gambling counters (figure 4). According to the promotional literature that accompanied them, these hand-carved pieces were produced during the Ching Dynasty of China for the East India Trading Company and other European merchants. The majority were reportedly made during the reign of Ch'ien Lung (1736–1796). A heavy carved variety cut from relatively thicker mother-of-pearl was crafted during the rule of Chia Ch'ing, in the early 19th century.

Some pieces, custom made for British royalty and nobility, bear a family crest or initials on one side, while the reverse side portrays scenes from Chinese life. Other pieces depict animals, birds, fish, and insects. The counters were produced in various shapes, each denoting a different denomination.

Plastic cameo imitations. Among the interesting imitation gem materials seen were two types of plastic cameos (figure 5), one resembling a shell cameo and the other reminiscent of a Wedgwood piece. Magnification revealed no separation plane between either figure and its background, indicating that they were not assembled from separate components. Rather, it would appear that the cameos were molded in a two-step process, with the figure portion of the mold being filled first, followed by a pouring of the background material. Furthermore, a swirling of the two colors at the base of the shell imitation indicates that the background had been poured before the figure had "set." An examination of various details on both figures suggested that the two pieces could easily have been produced from the same mold.

Synthetic quartz. Hydrothermally grown synthetic amethyst, citrine, and rock crystal quartz were all easily available this year, although some pieces were being sold as natural. Several small rock crystal spheres, pyramids, and obelisks were seen that were flawless except for the seed plate. Interestingly, many of the faceted synthetics had a small portion of the seed plate directly under and exactly paralleling the table facet. This feature betrayed itself by a near-surface layer of so-called breadcrumb inclusions.

Tourmaline from Nigeria. A number of excellent bicolored tourmalines were seen, reportedly from a mine near Kaffi, Nigeria. Most notable were two emerald cuts weighing 20.71 ct and 58.08 ct. The two colors are best described as slightly purplish red and slightly yellowish green, and are of moderate to strong saturation.

COLORED STONES

A beautiful new form of orthoclase. A phenomenal Australian orthoclase feldspar that shows both a unique pattern of aventurescence (figure 6) as well as the traditional adularescence was recently brought to our attention by two separate gem dealers. Maxwell J. Faulkner, of Banora Point, New South Wales, Australia, first showed this attractive new material to us in fall 1988. He had obtained his samples from Lonny Mason, Alice Springs, Northern Territory, Australia. They had named this feldspar "Rainbow Lattice Sunstone" because of the spectrum of colors seen in reflected light and the lattice pattern of the inclusions.

Initial testing of Mr. Faulkner's samples showed that they were orthoclase feldspar containing crystallographically oriented exsolution inclusions of ilmenite and hematite, which are responsible for the colorful aventurescence.

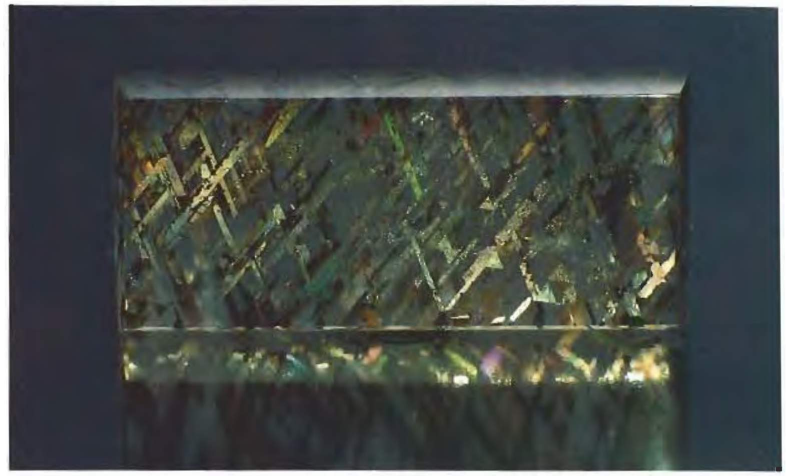


Figure 6. This attractive new Australian orthoclase feldspar, named "Rainbow Lattice Sunstone" by Max Faulkner, shows a unique aventurescence as well as adularescence. Stone courtesy of Bill Vance; photo by Robert Weldon.

Our second exposure to this new aventurescent orthoclase feldspar came through Bill Vance of Hampton, Virginia, who had obtained his material from Darren Arthur of Melbourne, Australia. The feldspars from Mr. Faulkner and Mr. Vance were identical in every respect. According to information provided by Mr. Faulkner, moonstone comes from an area known as the Mud Tank Zircon Field, in the Harts Range area of Australia's Northern Territory, which may be the source of this new material.

New emerald deposit near Nova Era, Brazil. A new deposit of gem-quality emeralds has been found in the Nova Era area of Minas Gerais, Brazil, within several kilometers of the Belmont emerald mine at Itabira and the alexandrite deposit near Nova Era. Reports by David Epstein, Edward Swoboda, and Gerhard Becker, all of whom visited the deposit in late 1988 or early 1989, indicate that thousands of carats of attractive bluish green stones have been produced by this locality at Capoeirana, in the municipality of Nova Era, since concerted mining first began in October 1988. Several stones over 5 ct (see, e.g., figure 7) have been cut.

By January 1989, several hundred independent miners were active at this locality, digging pits and tunnels into the schist (figure 8). A comprehensive report on the deposit is scheduled for an upcoming issue of *Gems & Gemology.*

Record-size spessartine garnet. The existence of a 708-ct transparent, gem-quality, polished spessartine garnet (figure 9) has been reported to Gem News by its owner,

Figure 7. This 7.86-ct emerald is from the new deposit at Capoeirana, near Nova Era. Courtesy of Edward Swoboda; photo by Shane McClure.

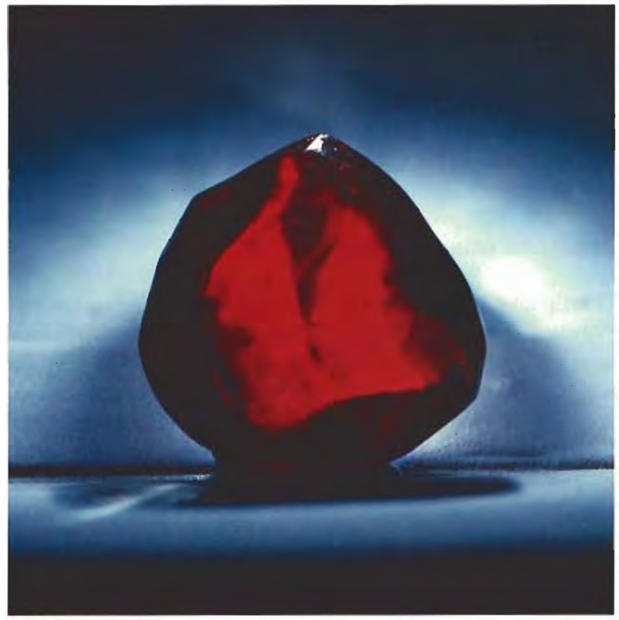
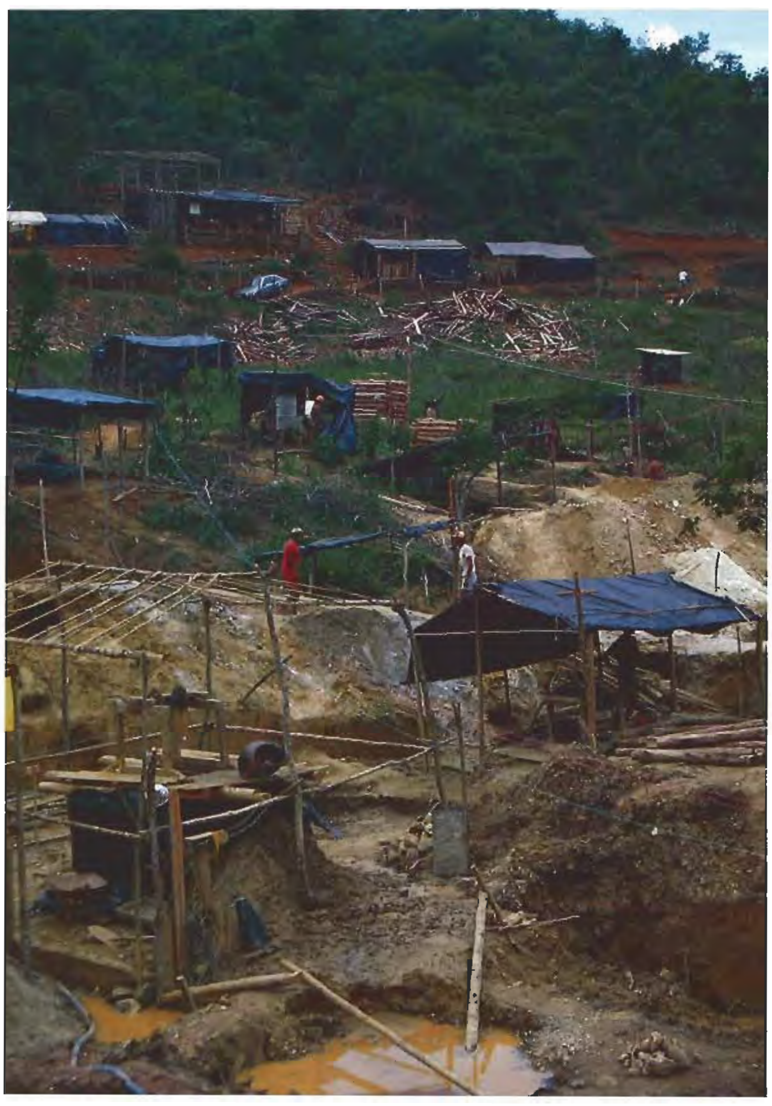


Figure 9. This 708-ct transparent, gem-quality, polished spessartine garnet crystal is thought to be from Brazil. Courtesy of Harrison L. Saunders.

Figure 8. Hundreds of small operations have been set up to search for emeralds at Capoeirana. This January 1989 photo is © Bryan Swoboda.



Harrison L. Saunders of Austin, Texas. According to Mr. Saunders, the rough crystal was acquired from a Brazilian by an American dealer about 16 years ago. When Mr. Saunders purchased the rough garnet he agreed not to facet it, but only to polish the surface.

The polished crystal was subsequently studied by Ed Jonas at The University of Texas at Austin. Dr. Jonas determined the specific gravity to be 4.194; chemical analysis showed that this spessartine contained 16% manganese, 14.2% iron, and a trace of calcium. Our research indicates that this may be the largest polished transparent red gem crystal in the world.

Star almandine garnet from Idaho. The east fork of Emerald Creek in the Idaho Panhandle National Forest near Clarkia, Idaho, is one of two places in the world where star garnets are found with any regularity (the other is India). Every spring since 1974, the stream has been diverted into a metal pipe at the top of the digging area and returned to the streambed at the lower end.

In 1987, 1,027 diggers took out 675 lbs. (305 kg) of garnet, including some very large crystals. In a recent season, five half-pound stones, one a solid dodecahedron, were removed. A group of four permit holders weighed out 16.5 lbs. of garnet from the West Fork in one day.

The Emerald Creek Garnet Area opens for its 16th season on May 27, 1989 (the season ends in September). A $5 permit will allow the removal of up to 5 lbs. of garnet each day, with digging limited to six days, or 30 lbs. of garnet per person each year.

Star rhodolite garnet. While examining some low-quality, facet-grade rhodolite garnet from the Kangala

Figure 10. The Kangala mine in Tanzania is believed to be the source of this unusual 15.60-ct star rhodolite garnet. Courtesy of Barton Curren.

mine in Tanzania, Bart Curren, of Glyptic Illusions in Topanga, California, noticed that some of the material contained oriented long, thin needles of what looked like rutile. The needles appeared to be sufficiently dense that if the rough were properly oriented and cut *en cabochon* asterism might result.

Although star almandine garnets are known from both the United States and India, an East African star rhodolite had not yet been reported, so Mr. Curren cut a sample of the garnet containing the necessary rutile needles *en cabochon*. The 15.60-ct finished stone shows not only pleasing color and a high degree of transparency, but also a very fine four-rayed star (figure 10). Thus far we do not know how much of this material is available.

Wollastonite for carving. White to light greenish gray massive wollastonite (figure 11) is being mined at the White Caps wollastonite deposit in the Viola mining district, 50 miles east of Caliente, Lincoln County, Nevada. According to Gorman Boen, of Gorman Boen Enterprises in Las Vegas, Nevada, the area was first prospected for precious metals before the turn of the century.

The wollastonite, which is marketed as carving material, occurs in the contact zones between altered limestones and volcanics. The wollastonite outcrops for several hundred feet along these contacts, and is compacted into a very tough and fine-grained form nearest the contact borders. Other minerals such as diopside, idocrase, hydrogrossular garnet, and nephrite have been identified with, and sometimes in, the wollastonite. With a good toughness and a hardness of $5^{1}/_{2}$ to 6, wollastonite is an excellent carving material.

Figure 11. Wollastonite, a good carving material, is being mined in Lincoln County, Nevada. The largest slab shown here is 10.5 cm long. Photo by Robert Weldon.

INSTRUMENTATION

New developments in spectroscopy. A recent advance in gemological spectroscopy is the Digital Scanning Diffraction Grating spectroscope (figure 12). The DISCAN spectroscope is the result of a cooperative research and development effort between optical engineer Nicholas

Figure 12. The new DISCAN spectroscope has a crosshair scanner coupled with a liquid crystal display so that an absorption feature can be lined up precisely and its exact numeric position (in nm) read in the digital display window.

Michailidis and GIA GEM Instruments. This desk-model spectroscope unit features a magnified spectral field and a crosshair scanner coupled to a liquid crystal display that allows the user to precisely line up on any absorption feature and read its exact numeric position (in nanometers) in the digital display window. The base of the DISCAN spectroscope allows the use of either direct transmitted or oblique reflected light.

During the search to develop a new-generation visible-light spectroscope, GIA's research-and-development team examined a number of interesting approaches. One of these, shown by its developer, Harold A. Oates of Glen Ellyn, Illinois, uses a small fixed-slit, fixed-focus diffraction grating spectroscope attached to a GIA GEM Instruments VideoMaster camera-monitor system, creating a video spectroscope. William Hanneman, of Castro Valley, CA, is now marketing a version of this instrument.

SYNTHETICS AND SIMULANTS

Recent advances in gem diamond synthesis. At an August 1988 conference on diamond optics held in San Diego, California, Dr. S. Yazu, of Sumitomo Electric Industries, reported that Sumitomo has dramatically increased the size of their cuttable-quality synthetic yellow diamonds beyond the 2-ct weight previously reported in *Gems & Gemology* (Winter 1986, p. 192). According to Dr. Yazu, Sumitomo's high-pressure diamond synthesis facility can now routinely grow cuttable-quality synthetic yellow diamond crystals in the 5-ct range.

Synthetic diamonds by detonation. Scientists engaged in a study of the chemistry of carbon in high explosives at Los Alamos National Laboratory have discovered the formation of synthetic diamonds in the course of a high-explosive detonation. Specifically, the detonation of common TNT (carbon, oxygen, nitrogen, and hydrogen) apparently caused carbon clusters to convert to diamond under 250,000 times normal atmospheric pressure at more than 5,000°F (2,760°C). The primary research was done by Los Alamos scientist Roy Greiner while on sabbatical at West Germany's Fraunhofer Institute for Propellants and Explosives. He returned to Los Alamos with the carbon soot residue caused by the chemical reactions of detonation, and had it analyzed with an electron microscope by David Phillips. Twenty percent of the carbon was found to have turned into diamond, a result that was repeated in a number of follow-up experiments. This is the first report of the formation of diamonds caused by the reactions in an explosion. The project is administered by the Los Alamos Advanced Munitions Office.

Synthetic diamond vs. cubic zirconia. Dr. Russell Seitz, of the Harvard Center for International Affairs, has informed GIA that the announcement by the Soviet Union of the successful synthesis of a 2-*kilogram* (not carat) "synthetic diamond" (Gem News, Winter 1983, p. 243) is really about a very large piece of high-optical-quality cubic zirconia.

The original press release came from a Soviet Institute specializing in radio frequency–heated crystal growth. Dr. Seitz saw a photograph of the 2-kg crystal, which had the typical appearance of a rough crystalline chunk of skull melt–grown cubic zirconia. The confusion, apparently unintentional, arose from the fact that there is no clear distinction in the Russian language between the words *simulant* and *synthetic*.

Emerald imitation from quartz. Dr. Henry A. Hänni of the Swiss Foundation for the Research of Gemstones, Zurich, Switzerland, reports that two quartz imitations of rough emeralds were recently identified as fakes in their Zurich laboratory. The two imitation emeralds weighed 228.4 and 94.6 grams, respectively. As can be seen from the photograph of the larger sample (figure 13), they are somewhat convincing to the unaided eye. Careful examination of the two crystals showed that they had been broken and glued back together with a green substance. X-ray powder diffraction was used to identify the material itself as quartz, while the green binder was identified as an epoxy resin by means of infrared spectroscopy. A film of glue over the outside surfaces of the two repaired fakes had been used to create a layer of mica flakes and other bits of crushed matrix in an effort to give the pieces a more natural look and hide the evidence of assembly. According to Dr. Hänni, the purchaser who bought these two fake emeralds in "southern Africa" took a serious financial loss.

In a separate communication, Bill Vance of Hampton, Virginia, reported seeing similar emerald imitations—formed by gluing broken quartz crystals together with a green substance—on a recent trip from Namibia through South Africa. Mr. Vance reported that acetone (fingernail polish remover) easily revealed the dye, and that the stones did not "feel right" when held.

Heat-treated lepidolite? Massive specimens of lepidolite mica, fashioned to have the morphology of single-crystal materials, have been seen at various gem and mineral shows for several years now, perhaps in response to the "crystal consciousness" movement. This year, however, a new twist may have been added. Kenneth Scarratt, managing director of the Gem Testing Laboratory of Great Britain, gave GIA one of these "fashioned" lepidolites that was uncharacteristically dark in color, somewhat resembling massive sugilite. Some vendors of this material state that a color alteration had been effected through heat treatment. As time permits, experiments will be carried out to determine if and how the material is altered.

Imitations from Africa. Bill Vance also reported that in Swakopmund, Namibia, fake diamond octahedra made of synthetic cubic zirconia had been sold to unsuspect-

Figure 13. This 228.4-gram (1142-ct) quartz imitation of emerald proved to be a costly mistake for the person who purchased it in southern Africa. Photo courtesy of Dr. Henry A. Hänni.

ing diamond buyers for as much as US$4,000–$5,000. Also noted was green bottle glass, cut to imitate rough tsavorite grossular garnet, being offered as tsavorite by street peddlers.

"Reconstructed" azurite-malachite. Blaise Harper of Pahrump, Nevada, has kindly shared with Gem News the process used to make "stabilized azurite-malachite block," a new form of compressed and plastic-impregnated azurite and malachite that is just now entering the market. First, chalky-looking porous azurite and malachite nodules are placed in a steel die-set type of mold. Then a hydraulic ram powered by a 600-ton press compresses the nodules into a dense block that is stabilized using the same pore-filling treatment techniques commonly used to stabilize turquoise. The compressed block that results from this process, together with samples of the rough starting material, are shown in figure 14.

The resulting product shows good color, polishes well, and has a toughness that allows it to be readily cut into cabochons. The rough azurite and malachite used in this stabilization process come from Arizona's Prescott-Jerome mining district. Enough material is available to allow several thousand pounds of the compressed azurite-malachite block to enter the market each year.

Figure 14. A block of compressed azurite-malachite, approximately 6 cm in its longest dimension, is shown here with rough azurite and malachite similar to that used to make it. Photo by Robert Weldon.

Synthetic amethyst alert. The International Colored Gemstone Association reports that 20,000 ct of synthetic amethyst are now arriving in New York from Korea every month. Potential buyers should be wary of amethyst being offered for sale at 10% or 20% below current market value. This situation occurred previously with some purportedly "Uruguayan" amethyst that was also offered at bargain prices and was subsequently identified as synthetic.

Mr. Francisco Muller Bastos should have been included in the list of people who received a perfect score on the 1988 *Gems & Gemology* Challenge. We regret the error and congratulate him on his achievement.

IN MEMORIAM: IRWIN MOED, 1918–1988

Irwin Moed, of Theodore and Irwin Moed Inc., died in a tragic automobile accident on October 9, 1988. The Moed firm was one of the first diamond dealers in New York to undertake production and distribution of irradiated diamonds. The open manner in which Irwin and his father presented irradiated stones was an inspiration to anyone who has dealt with the firm, and is always welcome in a highly competitive trade.

Irwin Moed was instrumental in GIA's acquisition of its first Geiger counter, and he and his father donated one of the first treated "raspberry red" diamonds to GIA for study. The absorption spectrum of this stone appears in all GIA illustrations of hand-spectroscope spectra. Additionally, the firm has made available suites of stones that continue to be used in every GIA residence gemology classroom. GIA's Research Department owes a debt of gratitude for study stones loaned and donated.

The business of Theodore and Irwin Moed Inc. will be continued by Irwin Moed's wife and son.

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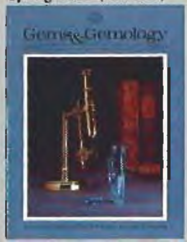

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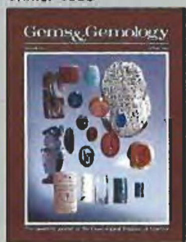

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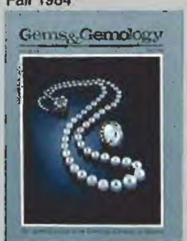

Winter 1984

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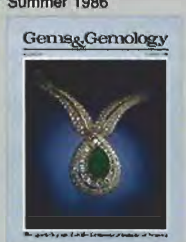
Summer 1986



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Gems & Gemology

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GIA has encouraged continuing education for decades. Now, under a newly implemented program called Continuing Education, GIA will formally recognize your many advancements and achievements in the ever-growing field of gemology. The *Gems & Gemology* Challenge is an opportunity for you to test your gemological knowledge *and* be recognized for your dedication to gemology as part of GIA Continuing Education. By taking the Challenge and passing with a score of 75% of better, you will earn a GIA Continuing Education Certificate—acknowledging your successful completion of the test. Those readers who receive a perfect score (100%) will also be recognized in the Fall issue of *Gems & Gemology.*

The following multiple-choice questions are based on material published in the four 1988 issues of *Gems & Gemology.* Feel free to refer to those issues to find the single best answer and then mark the appropriate letter on the card provided in this issue (photocopies or other facsimiles of this card will not be accepted). Return the card with your answers (be sure to include your name and address) by Monday, August 21: Don't forget to put sufficient postage on the card (15¢ in the U.S.). All entries will be acknowledged.

Hundreds of subscribers have successfully met the Challenge in the past. Join the ranks of those achievers or meet the Challenge once again!

Note: Questions are taken only from the four 1988 issues. Choose the single best answer for each question.

1. The key identifying characteristics of Kyocera's new synthetic star ruby are
   - A. spectrum and S.G.
   - B. inclusions and spectrum.
   - C. R.I. and U.V. fluorescence.
   - D. U.V. fluorescence and inclusions.

2. Three-phase (solid, liquid, and gas) inclusions in sapphire indicate that the stone
   - A. is synthetic.
   - B. has been irradiated.
   - C. has not been heat treated.
   - D. has not been diffusion treated.

3. From 1979 to 1983, U.S. imports of polished diamonds
   - A. fell by half.
   - B. remained stable.
   - C. more than doubled.
   - D. increased at a moderate pace.

4. "Honey" to yellow tones of amber owe their color to
   - A. ion pair transitions.
   - B. multiple color centers.
   - C. intervalence charge transfer.
   - D. delocalization of electrons.

5. One of China's greatest potential gem resources is
   - A. sapphire.
   - B. ruby.
   - C. emerald.
   - D. jade.

6. The Kalimantan diamond deposits are notable for their high number of
   - A. blue diamonds.
   - B. cubic diamonds.
   - C. industrial diamonds.
   - D. gem-quality diamonds.

7. Typically, most of the grains in the iridescent orthoamphibole from Wyoming are
   - A. slate gray.
   - B. golden or dark brown.
   - C. mottled green.
   - D. red, with occasional violet.

8. Inclusions observed in the Hematita alexandrites include
   - A. talc and hematite.
   - B. amatite and bakelite.
   - C. apatite and fluorite.
   - D. tourmaline and quartz.

9. The generic term for a defect that causes light absorption, particularly one that is produced by irradiation, is
   A. color center.
   B. delocalization.
   C. transition metal ion.
   D. intervalence charge transfer.

10. Separation of natural and synthetic alexandrite by infrared spectroscopy is especially useful when the stone
   A. is mounted.
   B. has no inclusions.
   C. shows no fluorescence.
   D. contains platinum platelets.

11. Which of the following was among the four top diamond producers (in terms of total rough mined) for 1987?
   A. Brazil
   B. Namibia
   C. the USSR
   D. South Africa

12. Heat treatment of amethyst from Pau d'Arco
   A. produces "greened" amethyst.
   B. lightens the original color.
   C. produces the best red citrine color.
   D. produces a light golden citrine color.

13. With respect to the possible health hazards of radioactive gemstones, we need be concerned only with
   A. nuclides.
   B. beta particles.
   C. alpha particles.
   D. gamma radiation.

14. Most of the cat's-eye chrysoberyls on the gem market today come from
   A. Brazil.
   B. the USSR.
   C. Sri Lanka.
   D. East Africa.

15. A green color in diamond is usually the result of
   A. irradiation only.
   B. irradiation and dyeing.
   C. irradiation and annealing.
   D. laboratory-induced irradiation.

16. A 15.97-ct Burmese ruby was sold at auction in 1988 for a record price of
   A. $500,000.
   B. $2.5 million.
   C. over $3.5 million.
   D. nearly $5 million.

17. When fashioning large colored stones, the cutter usually begins with the
   A. table.
   B. crown.
   C. girdle.
   D. pavilion.

18. The most common varieties of opal found at Opal Butte (Oregon) are described as
   A. contra luz and broadflash.
   B. fire and crystal.
   C. rainbow and hyalite.
   D. hydrophane, blue, and fire.

19. The current overall world leader in the production of amethyst is
   A. Sri Lanka.
   B. Namibia.
   C. the USSR.
   D. Brazil.

Good Luck!

20. Special machinery is needed to facet gemstones that weigh more than approximately
   A. 100 ct.
   B. 1,000 ct.
   C. 2,000 ct.
   D. 10,000 ct.

21. Pink pyrope owes its color essentially to the presence of trace amounts of
   A. iron.
   B. titanium.
   C. chromium.
   D. manganese.

22. The gemstone most often irradiated in a nuclear reactor is currently
   A. topaz.
   B. diamond.
   C. sapphire.
   D. tourmaline.

23. Along with India, the earliest worked diamond deposits were probably in
   A. Nepal.
   B. China.
   C. Borneo.
   D. Sri Lanka.

24. The diffracted color in an opal depends on the
   A. size of the stone.
   B. size of the spheres.
   C. strength of opalescence.
   D. size of the color centers.

25. The physical theory that describes the cause of color in most metals and semiconductors is called
   A. band theory.
   B. ion pair transition.
   C. iron charge transfer.
   D. intervalence charge transfer.

BOOK REVIEWS

Elise B. Misiorowski and
Loretta Bauchiero, Editors

JEWELRY OF THE 1940s AND 1950s

*By Sylvie Raulet, 332 pp., illus., publ. by Rizzoli International Publications, New York, 1988. US$100.00**

This large, lavishly produced book addresses a period of jewelry design that has heretofore been overlooked by many jewelry historians. Spanning two important decades, the book examines the transition from the solid, geometric lines of Art Deco to the rich, fluid diversity of the modern period.

Raulet focuses primarily on the *haute joaillerie* of France, devoting relatively few pages to pieces from other countries. She not only provides historical background, but also distinguishes noteworthy styles of jewelry and mountings, as well as the prominent designs, of this turbulent period.

The section on jewels created by famous painters and other artists is especially interesting, despite the occasionally cumbersome biographical information. The section on watches and accessories describes the ingenious vanity/cigarette cases, compacts, and elaborate timepieces of the period. It is a bit disconcerting, though, to find an early Mickey Mouse watch by Ingersoll in the company of so many finely jeweled specimens. The book also contains a biography section, a select bibliography, a brief glossary, and an index.

Although the text does offer useful and interesting information, it is often vague, tedious to read, and condescendingly ethnocentric. There is no mention of the term *retro*, coined in the 1970s by François Curiel of Christie's, to define the distinctive jewelry produced between the late 1930s and the end of World War II.

Perhaps the greatest strength of the book lies in its 546 illustrations (235 in color). Nicely reproduced, they reveal the diversity and creativity of a time period shaped in turn by war, reconstruction, and prosperity.

SALLY A. THOMAS
Seattle, WA

COLOR ENCYCLOPEDIA OF GEMSTONES 2nd Edition

*By Joel E. Arem, 280 pp., illus., publ. by Van Nostrand Reinhold Co., New York, 1987. US$53.95**

Arem has successfully compiled a tremendous amount of information into an important resource for the advanced collector in particular, but also as a reference for the practicing gemologist. Following a comprehensive introduction that simply, yet accurately, explains often-complicated concepts such as crystal structure, the book provides basic information on almost all of the mineral species and synthetics that have been cut into gems.

After 10 years of ongoing research, Arem provides some new information in this second edition. The gem section has been expanded from 210 species in the first edition to 250 species in this volume. New sections of special interest include "Thermal Properties," "Color Measurement and Specification," and "Gemstones from the Laboratory." For speed and convenience, the author presents a number of comprehensive listings, including: "Mineral Groups of Gemological Interest," "Gemstone Species and Ornamental Materials," and "Trade Names of Synthetics."

The book's format works well for quick and easy reference, especially with an expanded index that also includes gemstone varieties. Unfortunately, a few reference tables are poorly placed and may cause some confusion. The organization of the updated and revised full-color plates is better in this edition than the first. The quality of the color prints has also been improved.

This edition of the *Color Encyclopedia of Gemstones* is well written and meticulously worked through so that the information is readily available and easy for the average reader to understand. Because of the quality of both the information and the color photographs, this book is an asset for any library.

LORETTA BAUCHIERO
Collection Curator
GIA, Santa Monica

ANTIQUE AND TWENTIETH CENTURY JEWELLERY, A GUIDE FOR COLLECTORS 2nd Edition

*By Vivienne Becker, 319 pp., illus., publ. by N.A.G. Press Ltd., Colchester, Essex, Great Britain, 1987. US$45.00**

A lot of information is packed into this modest book on the jewelry styles that were popular in Western Europe during the last 200 years. Having done the research for us, Becker distills her findings into tidy categories that are easily referenced. The book is well indexed, provides a bibliography for further research, and has illustrations for almost every nuance discussed.

Although the book itself is not chronological, each of the 22 chapters follows one topic, such as diamond brooches, chronologically through its period of popularity. Subheadings within each chapter further delineate the history of the style, outside influences, techniques and materials used, prevalent motifs, and important designers or design houses.

An extensive chapter titled "Cocktail Jewellery of the 1940s" has been added to the otherwise virtually unchanged text of the previous edition. For this chapter, 22 new color plates and 13 new black-and-white photographs have been provided to illustrate Becker's vivid descriptions of the post–World War II "retro" style. This is an important update, as "retro" jewelry is currently enjoying a resurgence of popularity, and there are few references to it in the literature. This chapter gives us clues to help identify this style, which is appearing with greater frequency at auction and estate sales.

Clearly written and intelligently laid out, this is a very useful book for all those interested in antique and period jewelry.

ELISE B. MISIOROWSKI
Research Librarian
GIA, Santa Monica

OTHER BOOKS RECEIVED

Jewelry & Gems: The Buying Guide, *by Antoinette L. Matlins and Antonio C. Bonanno, 206 pp., illus., publ. by GemStone Press, South Woodstock, VT, 1987, US$14.95.** This inexpensive "book of the basics" is efficiently arranged in four parts. The first section provides practical knowledge in such areas as gem-cutting styles, popular settings, and the proper way to use a 10× loupe. In the second part, on diamonds, the authors elaborate on the many nuances of judging cut, color, and clarity, and show how these factors—combined with carat weight—determine the value of individual diamonds. The section also includes a table comparing the various color grading systems for diamond, a discussion of diamond substitutes, and questions designed to aid the consumer in buying a diamond. The colored gems portion covers gemstone lore, the determination of a colored stone's value by the "4 C's," and synthetic, imitation, and treated gems. The fourth section addresses such subjects as how to select a jeweler and a gemologist-appraiser, and includes a word of caution concerning investment-for-profit in gems. A center section of color plates depicts the better-known gems, and the reader will find the numerous charts, diagrams, tables, and reference lists helpful. Aside from a few typographical errors such as "adventurine" for aventurine, a few gemological mistakes such as referring to amber as "petrified" instead of fossilized, and the use of a few debatable terms such as "semiprecious," this book provides a helpful bridge between the jewelry industry and the buying public.

JOHN I. KOIVULA
Chief Gemologist, GIA

Mineral Museums of Europe, *by Ulrich Burchard and Rainer Bode, 269 pp., illus., publ. by Walnut Hill Publishing Co., 1986, US$49.50.** In this well-structured and methodically laid out book, the authors provide a guide to the mineral collections of Western Europe. Each museum is described under four headings: general information, historical notes, exhibits, and the minerals themselves. The general information appears in the upper right corner of the page, where it can be spotted easily. For each museum, the authors provide the address, telephone number, location, hours, fees, and name of the curator. Historical notes cover the origins of each museum and profile important collectors and curators. The exhibits section gives the spatial dimensions for the various galleries and describes the thematic arrangement of the exhibits. Finally, noteworthy mineral specimens are listed along with their localities and, as applicable, the display cases where they can be found. These minerals are further categorized by quality designations: excellent, good to very good, and rarities. Over 100 color photographs, most of them taken by Bode, richly illustrate this volume. The result is "a unique selection of some of the most beautiful minerals from classic, but often abandoned, localities." Many black-and-white photographs and illustrations of collectors, curators, and the various collections further augment the text. Indexed and cross-referenced, this is truly a "Baedeker" for mineral enthusiasts traveling in Western Europe.

EBM

Descriptions of Gem Materials, 3rd edition, *by Glenn and Martha Vargas, 180 pp., illus., publ. by Glenn and Martha Vargas, Thermal, CA, 1985, US$15.00.** This well-planned book contains a wealth of information for gem cutters, particularly those interested in rare and exotic gemstones. The compact format gives the physical and optical properties of 450 gem materials, which are divided into two basic sections, one for natural gems and the other for synthetics and simulants. Further sections provide tables of hardness, specific gravity, refractive index, and a glossary of important names and terms used in gemology. An index of alternate, varietal, and incorrect names is included, as is a bibliography. New to this edition are the derivations of mineral names. The book could be improved by providing more information on the various localities of gem materials. To a buyer of rare and unusual gems, this is an important consideration. Nevertheless, a gem cutter will find this book a useful, quick reference for nearly all gemstones available.

ARTHUR T. GRANT
President
Coast to Coast Rare Stones
Hannibal, New York

The Jade Kingdom, *by Paul E. Desautels, 118 pp., illus., publ. by Van Nostrand Reinhold Co., New York, 1986, US$37.95.** Desautels presents an interesting and colorful introduction to the world of jade. Well researched, the book attempts to cover every aspect of this fascinating and revered gem. In so doing, however, it simply skims the surface. Jade localities, gemology, cutting, and carving, as well as centuries of lore from several cultures, are condensed into a mere 118 pages. The first three chapters address the definition of jade throughout history and the gemological testing of jade and its substitutes. While the first chapter is particularly well written, it was disappointing to see a discussion of hardness points in the first main section of the chapter on testing, especially since there is no caution about the potential damage they can cause. The geology of worldwide sources of jade is touched on in chapter four. This is followed by specific chapters on Chinese jade and its symbolism, and jade from Central America, New Zealand, and the rest of the world. A chapter on the cutting and carving of jade concludes this slim volume. Although not the final word on this subject, as a basic reference *The Jade Kingdom* is a succinct and highly readable discussion of this ancient gemstone.

EV TUCKER
Anchorage, Alaska
and EBM

The Gemological Institute of America extends its sincerest appreciation to all of the people and firms who contributed to the activities of the Institute through donations of gemstones and other gemological materials. We are pleased to acknowledge many of you below.

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GEMOLOGICAL ABSTRACTS

Dona M. Dirlam, Editor

COLORED STONES AND ORGANIC MATERIALS

The amber ark. G. O. Poinar, Jr., *Natural History*, Vol. 97, No. 12, December 1988, pp. 42–47.

Dominican amber, known for the well-preserved vertebrate animals it often contains, offers new clues to the theories of evolution and continental drift in Central America and the Greater Antilles (the islands of Cuba, Jamaica, Hispaniola, and Puerto Rico). Poinar describes a specimen he examined that contains a tiny adult frog encased in resin some 30 to 40 million years ago. He continues by explaining that Dominican amber is extremely clear and possesses a high quality of preservation, allowing for accuracy in the identification of flora and fauna.

One of Poinar's goals in studying inclusions in Dominican amber is to "reconstruct the forest ecosystem of the Tertiary period (from about 25 to 40 million years ago) in this part of the Caribbean" based on species he identifies. The evidence produced by his studies supports some geologists' views that during the Tertiary period the islands that now comprise the Greater Antilles were part of a contiguous archipelago between North and South America, and were pushed to their present-day positions through the action of plate tectonics.

Four remarkable color photographs of Dominican amber specimens accompany the text, together with a map of present-day Central America and the theorized positions of the Greater Antilles 35–40 million years ago. *JLC*

The American Golden. L. M. Agee and E. F. Borgatta, *Lapidary Journal*, Vol. 42, No. 9, December 1988, pp. 80–90.

This article provides a detailed report on the acquisition and fashioning of the 22,892.5-ct (finished weight) yellowish topaz known as the American Golden. From

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.*

an approximately 26-lb. waterworn cobble emerged a stone that now measures 173 mm × 149 mm × 92 mm. The stone has 62 crown and 110 pavilion facets, and the table is oriented perpendicular to the cleavage plane. The American Golden was donated to the National Museum of Natural History (Smithsonian Institution) in Washington, DC, on May 4, 1988. Seven illustrations, four in color, accompany the text. *WRV*

Certitude de la détermination de l'origine des gemmes (Certainty of the determination of the origin of gems). H. A. Hänni, transl. into French by F. Roche, *Revue de Gemmologie a.f.g.*, No. 97, 1988, pp. 4–5.

This carefully worded article deals with the difficult problems of reporting on the geographic origin of gemstones. The many factors that should be considered are listed. The author emphasizes that, even with meticulous observation and comparison to a large number of well-documented stones, any interpretation can only be stated cautiously. Ways of obtaining basic knowledge in this matter are proposed, and the limitations and difficulties one would encounter are listed. The author then provides the reader with the precise wording of the two standard conclusions that his laboratory, the Swiss Foundation for the Study of Precious Stones, issues on their reports. *EF*

Gemmology Study Club lab reports. G. Brown and J. Snow, *Australian Gemmologist*, Vol. 16, No. 11, 1988, pp. 424–429.

This compilation of brief reports first describes a pair of plastic hololith rings. One that visually resembles lapis lazuli had a 1.69 S.G., a 1.55 spot R.I., and a Mohs hardness of 3, but an S.G. of 1.50. Magnification revealed that it probably had been manufactured by breaking the surface; and a concave circumferential "mold mark" on the inner surface. The other ring, a malachite imitation, also had a 1.55 spot R.I. and Mohs hardness of 3, but with a 1.50 S.G. Magnification revealed that it probably had been manufactured by trephining (drilling) the piece from a block of filled plastic, with the banding produced by including opaque plastic particulate fillers in very carefully controlled layers within a thermosetting plastic matrix.

Also reported on is a "bronze"-colored chatoyant nepheline cabochon from Korea. Gemological properties include a 2.53 S.G., a 1.55 spot R.I., a vitreous luster, broad chatoyancy of moderate intensity, and no fluorescence or diagnostic absorption spectrum. Examination with a microscope revealed that the chatoyancy was due to reflection of light from fine, parallel, tube-like inclusions.

Other materials examined include a cabochon of dumortierite in quartz; an elephant ivory necklace of African provenance; a ring-set diamond that cleaved badly when it was dropped into a sink; a strand of gray plastic imitation pearls with an artificial nacre that is considerably more radiopaque than the plastic from which the beads were formed; and a synthetic spinel triplet with a junction plane below the girdle. *RCK*

Gemmology Study Club lab reports. G. Brown and J. Snow, *Australian Gemmologist*, Vol. 16, No. 12, 1988, pp. 464–470.

Plastic-impregnated Brazilian opals are the first of several interesting specimens examined, described, and illustrated by the authors. It was noted that transmitted light, alone or in conjunction with lateral illumination, might be used to detect polymer-like fracture fillings in such treated opals.

The next item covered is "Lapis Nevada," an ornamental material with pink thulite, yellow-green epidote, green diopside, and white to lavender scapolite as its major constituents. It has a distinctive appearance, a Mohs hardness of 5 to 7, an S.G. of 2.83, and a variable spot R.I.

An unusual metallic cabochon consisting of bismuthinite, magnetite, chalcopyrite, quartz, and calcite is described, followed by a report on Emmaville emeralds. X-ray fluorescence scans revealed vanadium as the major chromophore in emeralds from this Australian locality. Also covered are an imitation of a mabe cultured pearl, reportedly constructed from a flattened hemispherical section of the shell of a Philippine land snail; a bicolored cryptocrystalline quartz ring in which the brown component is aventurescent, while the green component contains green mossy dendrites; an amethyst crystal with a movable bubble in a large two-phase inclusion; brownish mottled dyed calcite beads; and a partly devitrified green glass containing gas bubbles and whitish spherical aggregates that morphologically resemble wollastonite. *RCK*

Gold coral re-evaluated. G. Brown, *Australian Gemmologist*, Vol. 16, No. 12, 1988, pp. 472–474, 476–477.

Gold coral is harvested from the Makapuu Bed off the Hawaiian island of Oahu. This relatively costly material has been imitated by bleaching black coral with a 30% aqueous hydrogen peroxide solution. The treated material may be distinguished by a rough, abrasive surface; the presence of radially arrayed spines; and the superficial distribution of the bleached areas.

The author proceeds to describe the appearance of several necklaces of gold coral that displayed some interesting anomalies: The material had an atypical yellowish brown color, and the surfaces of both the beads and the limb segments had longitudinal grooves as well as an uncharacteristic greenish blue iridescence. Spot R.I. determinations gave readings of 1.60, 0.03 to 0.04 higher than the accepted values for gold coral. Low-power magnification revealed that the material had been impregnated and coated with a plastic; higher magnification revealed small bubbles in the thin plastic coating of some beads.

This well-illustrated article should prove most useful in identifying both bleached black coral and plastic-impregnated gold coral.

RCK

A new type of twinning in natural sapphire. K. Schmetzer, *Journal of Gemmology*, Vol. 21, No. 4, 1988, pp. 218–220.

Two twin laws have been observed in natural corundum: contact twins on the basal plane *c* (0001), or on the positive rhombohedron *r* $(10\bar{1}1)$. Polysynthetic lamellar twins according to the second law are also commonly encountered in faceted gem corundums.

Several inclusions of isolated corundum crystals appearing as part of a lamellar twinning on $(10\bar{1}1)$ have been observed in about 50 natural sapphires from Sri Lanka. Since this twinning structure can be described as a combination of a single contact twin and lamellar polysynthetic twinning on the rhombohedral plane, it is classified as combined rhombohedral twinning. Such a feature has been observed so far only in natural corundum. Six photomicrographs illustrate the article.

EF

The New Zealand aurora shell: A unique organic gem material. G. Brown and A. J. McCabe, *Australian Gemmologist*, Vol. 16, No. 11, 1988, pp. 401–407.

The first part of this article deals with McCabe's "discovery" of iridescent New Zealand mussel shell in the remains of a Maori fire at Te Wae Wae beach on South Island. This led to several years of searching beaches around the country for usable iridescent shell. The second half of the report deals with the gemology of what is known variously as Aurora Shell, Fiordland Colour Mussel, and New Zealand Kuku Shell, the highly iridescent, nacreous shell of the New Zealand green-lipped mussel, *Perna canaliculus.*

Gem-quality shell reportedly comes from only three localities on South Island. Polished specimens of iridescent shell nacre examined had the following properties: visual features – pale brownish body color with a patchy color distribution and strong iridescent flashes seen when rotated under overhead illumination; diaphaneity – translucent; Mohs hardness – 3–4; fracture – splintery; S.G. – 2.75–2.8; spot R.I. – 1.52–1.53; U.V. fluorescence – pale bluish white to long wave, very pale bluish white to short wave; no diagnostic visible-light absorption spectrum.

The authors note that finished pieces of jewelry fashioned from this shell are either plastic coated (giving a spot R.I. of 1.54) or composites consisting of shell nacre and a pink polyester resin base. According to the manufacturer, all of the shell that appears in jewelry (composites or otherwise) is dyed, with a variety of dye colors being used. *RCK*

Quartz: The starter stone. D. A. Hiss, *Jewelers' Circular-Keystone*, Vol. 160, No. 2, February 1989, pp. 385–392.

As part of *JC-K*'s continuing series of articles on gemstones of the world, the quartz family is highlighted in this issue. As with other articles from this series, it could be described as a microcosm of the topic, yet succinct and informative for the jeweler or quartz enthusiast. Considering the wealth of information that exists on quartz varieties, trade names, and synthetics, as well as on mining localities and history, one is pleased to find it so cleverly synopsized here. Seventeen color photographs help illustrate some of the more notable varieties, typical inclusions, and quartz enhancements that one is likely to encounter in the trade. For those readers interested in the metaphysical aspects of quartz, a section on "Quartz as Healer" is also included. *RW*

DIAMONDS

Famous diamonds of the world XXXIII: The Tiffany. I. Balfour, *Indiaqua*, Vol. 49, No. 1, 1988, pp. 119–122.

The Tiffany jewelry company is known for its taste in fine diamonds. It is not surprising, then, that one of the most famous bears the prestigious name. In its rough state, the Tiffany diamond, an intense yellow octahedron, weighed 287.42 ct; in 1878, it was cut to a 128.51-ct cushion-shape brilliant under the supervision of George F. Kunz.

Balfour explains that the exact year the Tiffany rough was discovered is questionable because of the lack of "precise information" and accurate record keeping at the South African diamond mines prior to 1888. On the basis of a brief account of early diamond-mining history, Balfour concludes that the Tiffany must have originated in the mine claims of the French Company. This is supported by the fact that the rough was shipped to France in 1878, where it was cut. He estimates that it was found in either 1877 or 1878. In the course of this discussion, Balfour provides a fascinating account of the power struggle involving the French Company that eventually led to the formation of De Beers Consolidated Mines in 1888.

Throughout its history, the Tiffany diamond has been on display at the Tiffany store in New York and at numerous exhibitions in the United States and Europe. Possession of the diamond remains with the Tiffany company despite rumored attempts to sell the gem.

JLC

Famous diamonds of the world XXXIV: The De Beers diamond. I. Balfour, *Indiaqua*, Vol. 49, No. 1, 1988, p. 123.

Ian Balfour reports that the De Beers diamond, at 234.50 ct, is the fourth largest cut diamond in the world. Since this article was printed, the De Beers diamond has become fifth on the list, as the recently completed 407.48-ct triolette-cut diamond sometimes called the Incomparable is now the second largest.

The De Beers diamond was found at the Kimberley mine in March 1888, a 439.86-ct light yellow octahedron. It was subsequently cut to its current 234.50-ct cushion shape. Balfour mentions that the De Beers diamond has been confused with a diamond called Victoria 1, but claims that they are actually one and the same.

An unsuccessful attempt to auction the De Beers diamond was made in May 1982 at Sotheby's in Geneva; apparently the $3.16 million top bid did not meet the reserve set for the stone. It has since been sold to a private buyer. *JLC*

GEM LOCALITIES

Bamboo coral: A new precious coral from Hawaii. G. Brown, *Australian Gemmologist,* Vol. 16, No. 12, 1988, pp. 449–454.

Beginning with a brief historical review of coral sources and recovery methods, this article reports on the occurrence and gemology of bamboo coral, *Lepidisis olapa.* Bamboo coral occurs in association with both pink and gold coral in the Hawaiian Archipelago. It is harvested at a rate of 150 kg per year by deep-diving submersibles at depths of 300–470 m.

Bamboo coral has a distinctive appearance, consisting of opaque, white, inflexible, slightly curved calcareous internodes 3–7 cm long, and translucent, dark brown, flexible horny nodes 0.2–1 cm long. These two components are gemologically distinctive. The internodes are composed of white calcite that is longitudinally striated. The calcite has a Mohs hardness of 3–4, uneven fracture, subvitreous luster, 2.70 S.G., spot R.I. of 1.63 to 1.65, fluoresces bluish white to long-wave U.V. and pale bluish white to short-wave U.V., and is soluble in HCl. The nodes are composed of brown organic gorgonin that is also longitudinally striated. The gorgonin has a Mohs hardness of 2–3, splintery fracture, resinous luster, 1.38 S.G., spot R.I. of 1.56, is inert to both long-wave and short-wave U.V., and is insoluble in HCl.

The author states that bamboo coral consisting of both nodes and internodes should be relatively easy to identify in jewelry, but that an item formed from only the internode could be difficult or impossible to separate conclusively from white corallium corals. This well-written article also includes a very useful table that compares the properties of Hawaiian corals: bamboo, pink, gold, and black. *RCK*

Gem tourmaline on Kangaroo Island. J. L. Keeling and I. J. Townsend, *Australian Gemmologist,* Vol. 16, No. 12, 1988, pp. 455–458, 470.

This article reports on the history and geology of Dudley Pegmatite on Kangaroo Island, Australia, and on the gemological properties of tourmaline recovered from the pegmatite.

Tourmaline was reported from the deposit as early as 1898. Although the quantity recovered over the years is not known, blue, green, and "watermelon" varieties have been mined. After early pockets were worked out, the deposit was used as a source of feldspar, quartz, and kaolin clay for the pottery industry.

This investigation included tourmalines from dumps of old workings, pockets, and the South Australia Museum. The gemological properties of dark blue, pale to dark green, and pink/green "watermelon" tourmaline from this locality are reported. This is an interesting account of one of the few recorded occurrences of gem-quality tourmaline in Australia. *RCK*

Gems around Australia. H. Bracewell, *Australian Gemmologist,* Vol. 16, No. 12, 1988, pp. 459–463.

This article is an informal report of a trip taken by the author and her husband to a variety of both better- and lesser-known gem deposits in Australia. Beginning in New South Wales, the first visit was to the Torrington tin lode, where topaz, beryl, smoky quartz, and fluorite may be found. Not far from this site is Emmaville, where emerald has been mined commercially.

The next stops on the journey were in Queensland, where many gem materials, in addition to the well-documented opal and sapphire, are recovered. One of these is chrysoprase, which has been mined commercially at Marlborough. In the north of the state, at Mt. Surprise, commercial quantities of aquamarine are found in vugs in association with smoky quartz or feldspar crystals. At Mt. Hay, fossickers dig for thunder eggs; and north of Muttaburra, waterworn quartz, agate, and petrified wood are found in abundance.

Additional gem-producing areas of Queensland and the materials they produce include Chudleigh Park station (peridot, sapphire, zircon, and moonstone), Agate Creek (agate and thunder eggs), Cloncurry (chrysocolla), and Kuridala (amethyst). *RCK*

Sapphire-bearing ultramafic lamprophyre from Yogo, Montana: A ouachitite. H. O. A. Meyer and R. H. Mitchell, *Canadian Mineralogist,* Vol. 26, Pt. I, 1988, pp. 81–88.

The authors report on their detailed mineralogic and petrographic examination of the sapphire-bearing Yogo lamprophyre dike located in the Judith River basin in central Montana. The authors point out that the Yogo dike is unique in that it is the only known igneous dike from which sapphires are actually mined *in situ.*

The authors found that the dike rock consists of "subhedral grains of phlogopite and clinopyroxene set in a finer groundmass of mica, clinopyroxene, titaniferous magnetite and apatite with a mesostasis of chlorite, calcite, serpentine, and rare K-feldspar." A titanium and aluminum–containing diopsidic augite pyroxene also occurs as polycrystalline aggregates and is believed to be of low-pressure origin. The phlogopite mica crystals appear to have been distorted during incorporation in the host rock and subsequently further deformed and altered.

On the basis of their research, the authors have classified the Yogo lamprophyre as a ouachitite. It was also determined that the sapphires are xenocrysts and occur as an accessory phase. Eight figures and five tables accompany the article. *JIK*

An unusual ruby from Nepal. H. Bank, E. Gübelin, R. R. Harding, U. Henn, K. Scarratt, and K. Schmetzer, *Journal of Gemmology,* Vol. 21, No. 4, 1988, pp. 222–226.

The identification of a fine-quality 1.288-ct ruby as both natural and Nepalese is described in this note. A detailed discussion of some potentially misleading growth zoning and spindle-like features is especially helpful. The conclusion was based largely on the presence of phlogopite (identified by energy-dispersive chemical analysis) and of liquid, gas, and/or solid inclusions characteristic of previously studied rubies of Nepalese origin. Ten optical photomicrographs and an EDX spectrum of a phlogopite inclusion illustrate the discussion. *CMS*

INSTRUMENTS AND TECHNIQUES

The EW-120SG electronic densimeter. G. Brown and J. Snow, *Australian Gemmologist,* Vol. 16, No. 11, 1988, pp. 422–423.

This report, by the Instrument Evaluation Committee of the Gemmological Association of Australia, evaluates an electronic balance designed specifically to "assay" the precious metal content of jewelry by determining its specific gravity.

The densimeter's three-step process is as follows. First, the precious metal object is weighed on the lid of the instrument; the weight, which is shown on the display, is then manually entered into the memory. Next, the object is weighed in the instrument's hydrostatic weighing tank; this second weight is not displayed but, rather, every 1.5 seconds the densimeter calculates and displays the S.G. The final step is to consult tables provided which correlate S.G. to precious metal content.

The instrument proved to be accurate for "assaying" 24-, 18-, and 9- karat yellow and white golds, but it failed to identify either plated or rolled golds. Another limitation is that only an average of the readings is given. Because this instrument will not distinguish gemstones from metal, it can only be used on nonstone jewelry. It was also determined to be much more accurate for heavier objects than for lighter ones. While not designed for this purpose, the instrument was shown to be useful in rapidly and accurately determining the specific gravity of a number of loose gem materials, as long as they weighed more than 10 ct (2 grams, the lowest operating limit stated by the manufacturer). *RCK*

Fluorescence from pearls of freshwater bivalves and its contribution to the distinction of mother oysters used in pearl culture. T. Miyoshi, Y. Matsuda, and S. Akamatsu, *Japanese Journal of Applied Physics,* Vol. 27, No. 1, 1988, pp. 151–152.

Fluorescence spectra of white pearls from various mother oysters have been obtained with a pulsed nitrogen laser operating at 337 nm. The fluorescence intensity of the Japanese freshwater pearls from *Hyriopsis shlegeli* (Ikecho) shows a peak at about 410 nm, while pearls of saltwater oysters (*Pinctada fucata* [Akoya oyster], *Pinctada margaritifera* [black lip oyster], *Pinctada maxima* [yellow lip oyster], and *Pteria penguin* [mabe]) have peaks at wavelengths longer than 430 nm. This difference makes it possible to distinguish among bivalve pearls of fresh- or saltwater origin. This result also applies for pink, orange, and gray, but not brown, freshwater pearls. Pearls of *Pinctada penguin* and *Pinctada margaritifera* can be distinguished by a peculiar fluorescence peak at 620 nm under 400 nm excitation wavelength. *EF*

The identification of a natural ruby by electron spin resonance (ESR). D. R. Hutton and G. J. Troup, *Australian Gemmologist,* Vol. 16, No. 11, 1988, pp. 399–400.

This brief report covers the identification of a ruby, purportedly purchased in China, using ESR spectrometry. The procedure used was to run the ESR spectrum of a natural Burma ruby and that of a "synthetic (boule) specimen," and then run the spectrum of the stone being investigated. Based on the similarity of the unknown's spectrum to that of the Burmese stone, the authors conclude that the unknown is of natural origin. They also state in their conclusion "that ESR spectrometry is far more accurate than microscope optical investigation" and question how many natural rubies have been misidentified as synthetic using optical microscopy.

While the authors' identification of this particular specimen may be correct, it is unfortunate that they chose to use only one natural stone and one melt synthetic. At the very least, one or more flux-grown synthetics should have been examined, as it is known that some of these contain iron, an element that appeared in the ESR spectra of the Burmese stone and the unknown but not in the spectrum of the melt synthetic. *RCK*

JEWELRY ARTS

Authenticating Tiffany jewelry. J. Zapata, *Jewelers' Circular-Keystone,* Vol. 159, No. 8, August 1988, pp. 227–230.

Although useful for determining the provenance of a piece, trademarks can nevertheless be confusing. Here, Tiffany's archivist demystifies the several trademarks that appear on jewelry and jeweled objects made by Tiffany & Co., past and present. The author explains why, in some cases, a small plaque with the Tiffany stamp on it is attached to the piece rather than the piece itself being stamped. In addition, she also clarifies what additional marks, such as a beaver or a globe, signify.

Well written and illustrated, the article also provides bibliographic sources for further reference. It would be wonderful to have this type of focused coverage for other jewelers and their trademarks as well. *EBM*

The elegant Edwardians. J. Jonas, *Jewelers' Circular-Keystone*, Vol. 159, No. 8, August 1988, pp. 220–225.

Jewelry from the brief (1890–1914) but opulent Edwardian age is described in this short but informative article. The period was named for British King Edward VII (who reigned from 1903 to 1910). His extravagant and sophisticated lifestyle was copied by other royalty and the leisure classes of the time. The refined elegance of Edwardian life was best exemplified by its jewelry: Lacy delicate mountings of platinum were set with a profusion of diamonds and pearls, often accented with colored gems or pastel-colored enamels.

In this article, which appears in the quarterly "Heritage" section of *JC-K*, Ms. Jonas skillfully weaves design, materials, workmanship, and history into a glittering tapestry that introduces us to this exceptional period. This era established platinum for use in jewelry, the briolette and marquise cuts for gems, the "dog-collar" necklace, and the "sautoir." Seven photographs augment the well-presented text. *EBM*

Enameling: Ancient art, enduring beauty. T. Paradise, *Jewelers' Circular-Keystone*, Vol. 160, No. 2, February 1989, pp. 326–332.

This is a concise historical review of the art of enameling. In the first half of the article, the author briefly chronicles the development of enameling from its discovery around 1500 B.C. through the end of the 19th century, touching lightly on the cultures that added most to the technical evolution of the art. The second half of the article covers general techniques and materials used by enamelists. Particularly useful is a glossary that provides definitions, pronunciations, and some schematic diagrams for 30 enameling terms. Jewelers who deal with antique and period jewelry and jewelry history students will find this helpful as a quick reference tool.

This article is one of five in this edition of "Heritage," a welcome new section that will appear every three months. Other titles in this issue include "All that glitters . . ." by E. Weber—a description of several unusual materials found in antique jewelry; "Georgian style: exquisite & opulent" by J. Rosenberg—an overview of jewelry styles worn primarily during the 18th century; "Antique jewelry, 2500 BC to 2000 AD" by F. Sandmel and J. Sataloff—a broad sketch of the various influences that shaped the development of jewelry through history; and "Confessions of a collector" by L. Williams—basic guidelines for starting a collection of antique and period jewelry. *EBM*

SYNTHETICS AND SIMULANTS

Alexandrite: Natural or synthetic? H. Bank, E. Gübelin, U. Henn, and J. Malley, *Journal of Gemmology*, Vol. 21, No. 4, 1988, pp. 215–217.

The authors describe the identification of a natural alexandrite on the basis of potassium-rich aluminosilicate inclusions, probably potassium feldspar. They conclude that solid metal inclusions that had deceptively suggested synthetic origin of the gem were remnants of cutting and polishing discs. Photomicrographs and an energy-dispersive chemical spectrum of the identifying inclusion accompany this note. *CMS*

ESR and optical spectra of Mn^{2+} sapphire. R. Liebach, J. Dobbie, D. R. Hutton, and G. J. Troup, *Journal of Gemmology*, Vol. 21, No. 4, 1988, pp. 227–231.

This relatively technical article includes a description of the manufacture of Mn^{2+}-containing (pink) synthetic sapphire and its characterization by optical and electron spin resonance (ESR) spectroscopy. The optical spectrum illustrated is clearly distinct from that of (Cr^{3+}-bearing) synthetic ruby. Comparison of the ESR spectra of the Mn^{2+} synthetic sapphire to those of Fe^{3+}- and Cr^{3+}-bearing blue and yellow sapphires likewise reveals markedly different features, although the authors suggest that weak Mn^{2+} lines may be discernable in the spectrum of the natural yellow sample illustrated. They conclude with a comment that Mn^{2+}-containing synthetic sapphire is unlikely to be produced commercially. *CMS*

The gemmological characteristics of Inamori synthetic cat's-eye alexandrite chrysoberyl. J. I. Koivula, E. Fritsch, and C. Fryer, *Journal of Gemmology*, Vol. 21, No. 4, 1988, pp. 232–236.

The properties of 12 Inamori synthetic cat's-eye alexandrites are reported, including basic gemological properties; spectra in the ultraviolet, visible, and infrared; and X-ray diffraction. The gemological properties are essentially the same as those reported by R. E. Kane in the Fall 1987 issue of *Gems & Gemology*. Spectrophotometry in the near-ultraviolet revealed the lack of the Fe^{3+} feature commonly found in natural alexandrites. In addition, infrared spectra indicated a lack of water in the synthetics. X-ray diffraction produced a typical chrysoberyl pattern. The authors conclude that only microscopy and/or U.V. spectra can conclusively identify this new synthetic material. Five color photographs and a U.V.–visible spectral graph illustrate the features discussed. *CMS*

The Pool Emerald$_{(t)}$. G. Brown and J. Snow, *Australian Gemmologist,* Vol. 16, No. 12, 1988, pp. 443–449.

The Emerald Pool Mining Company (Pty.) Ltd. of Australia markets the "Pool Emerald" worldwide. According to some of the promotional literature, this material is either "natural gem quality stones, or the treated Pool Emerald$_{(t)}$ which are designated by a suffix to disclose their treated nature." The material is marketed in three grades based on the relative absence of inclusions. The source of the rough emerald from which the "Pool Emerald" is reportedly produced is said to be the Emerald Pool Mine, formerly known as the Emerald Gem Mine, located 16 km southwest of the Poona Emerald Field in Western Australia.

In this well-illustrated report, the authors describe the gemological properties of the "Pool Emerald": diaphaneity—transparent in top two qualities, transparent to translucent in the commercial quality; luster—vitreous; color—moderate to strong green, with a slight bluish secondary hue; S.G.—2.75 ± 0.05; R.I.—ω = 1.574, ϵ = 1.569; birefringence—0.005; pleochroism—ω = bluish green, ϵ = yellowish green; Chelsea filter reaction—red; long-wave and short-wave fluorescence—inert, but some specimens glowed a faint red in intense transmitted white light; absorption spectrum—features attributable to both chromium and vanadium.

Magnification revealed a number of characteristics, some of which, along with the refractive indices, the authors conclude are diagnostic. These include planes of reflective gold particles, some small grayish white "breadcrumb" inclusions, tapering growth tubes terminated by low-relief phenakite crystals, intersecting or angular growth features, and (rarely) segments of a seed plate.

The authors conclude that the "Pool Emerald" is a hydrothermally grown synthetic with properties virtually identical to those of the Biron product. They suggest that impurity-free crushed material from the Emerald Pool Mine is used as the feed source—with vanadium doping—to produce synthetic emeralds in gold-lined pressure vessels. *RCK*

A Verneuil sapphire with induced fractures. G. Brown and S. M. B. Kelly, *Australian Gemmologist,* Vol. 16, No. 11, 1988, pp. 419–421.

Beginning with a review of separate reports by John Koivula and Bob Kane on Verneuil synthetics with induced fingerprint inclusions, the authors go on to describe their investigation of a faceted synthetic sapphire with induced, natural-appearing filled fractures. The listed gemological properties of the specimen are consistent with those in the literature for flame-fusion products. Magnification revealed curved color banding; induced internal fractures "healed" by a whitish "soap scum" solid material; and iridescent, surface-breaking, air-filled fractures.

On the basis of the diffused nature of the color banding, the resemblance of the fracture-filling material to that of the acetanilide "healing" described by Koivula, and the absence of solid fillings in surface-breaking fractures, the authors identify the specimen as a Verneuil synthetic sapphire with induced, partly healed fractures. Furthermore, they believe the fracturing/filling resulted from a heat-treatment process aimed at color improvement and/or the diffusion of the color banding. *RCK*

TREATMENTS

Some aspects of the heat treatment of ruby. S. J. A. Currie, *Australian Gemmologist,* Vol. 16, No. 11, 1988, pp. 417–419.

In a small town outside Chanthaburi, Thailand, the author observed the preparatory steps taken for heat treatment of ruby. Of particular significance in this account is his description of the colorless, nonviscous liquid that was added to the crucible and his hypothesis as to its composition.

One of the gemstone treaters demonstrated the properties of this liquid by placing a cupro-nickel coin in it. After about 30 seconds, a brown gas could be seen and the liquid began turning green-blue. The reaction accelerated for about two minutes, during which time significant quantities of nitrogen peroxide were produced. When the coin was removed and washed, it was seen to be very bright.

The person giving the demonstration stated that there were only three ingredients to the solution, which had a slightly sour smell, produced no noticeable irritation around or under a fingernail when a finger was dipped into it, and left only a slight brown stain on the skin. Currie hypothesizes that the major constituent of the solution was nitric acid, the second ingredient was water, and the third was a chloride to activate the nitric acid, possibly sodium chloride, common salt. He further suggests that the nitric acid provides oxidizing conditions for converting ferrous iron to ferric iron, while the chloride assists in volatizing this base metal at high temperatures. As of this writing, he has been unable to test his theory on untreated ruby rough. *RCK*

Treatments used on spodumene: Kunzite and hiddenite. K. Nassau, *Colored Stone,* Vol. 1, No. 7, 1988, pp. 16–17.

This short article about spodumene treatment deals with the influence of irradiation and heat on this gem, and reviews some of its basic properties and characteristics. Irradiation of kunzite produces a deep green spodumene, because of the change of Mn^{3+} to Mn^{4+}; this color fades rapidly. In stones from Madagascar, the change can be accompanied by the formation of a brown color center, which also fades rapidly. Some intense orange to yellow spodumene has been produced by irradiation in a nuclear reactor, but has been found to be radioactive. Heating of spodumene does not create any color but generally helps to bleach the various color centers. Color can be restored in light- or heat-bleached kunzite by first irradiating the stone and then gently fading the brown or green color. *EF*

Violet emeralds? H-W. Schrader, *Journal of Gemmology,* Vol. 21, No. 4, 1988, pp. 237–251.

Various researchers have observed that neutron (and, in one instance, X-ray) irradiation of both natural and synthetic emeralds brings about a color change of a somewhat unstable nature. Dr. Schrader describes the resulting colors as "smoky" to "violet," with optical absorption features superimposed on the original chromium bands. Those specimens that turn violet generally fade in daylight to the lighter smoky color in about five months. He suggests that a color-center mechanism similar to those known for smoky quartz or amethyst may be the cause of the effect in emerald. The 40 quantitative chemical analyses provided for one representative sample of each type emerald studied demonstrate the replacement of silicon by aluminum and iron, which Dr. Schrader suggests would "form color centers when subjected to intense radiation." Graphs of the chemical data are provided for all the specimens analyzed (16 natural, eight flux, and six hydrothermal emeralds) by electron microprobe. *CMS*

MISCELLANEOUS

The birthstone story. D. Federman, *Modern Jeweler,* Vol. 88, No. 1, January 1988, pp. 55–60.

In this article, David Federman traces the roots of the birthstone tradition. As early as 3000 B.C., in ancient India and Babylonia, Vedic astrologers were consulted for advice on which gemstones would best influence one's ruling planets (the exact position of the planets at one's birth). The concept of birthstones spread to Western civilization by means of the confusingly documented breastplate of Aaron, which was decorated with 12 gemstones that were eventually correlated to the 12 signs of the zodiac. The modern birthstone list used by jewelers today was developed in 1912. The author notes that this list was "the source of much controversy" at that time, when even gem expert George F. Kunz outlined the dangers of tampering with such an ancient tradition.

Two inserts accompany the article. One discusses the history of the breastplate of Aaron and the correlation of its gemstones to the zodiac. The other describes how one jeweler has incorporated ancient Vedic astrology into his designs by charting the client's horoscope and prescribing gemstones to wear based on that chart.

A chart included with the article outlines the changes in birthstones from ancient Hebrew times through the 20th century. This could be a useful sales tool for the retail jeweler.

It would be an added benefit if articles of this nature included a reference list or a list of further reading for those whose interest has been aroused.

JLC

Brilliance, windows and extinction in gemstones. R. W. Hughes, *Gemological Digest,* Vol. 2, No. 1 and 2, 1988, pp. 10–15.

Hughes discusses the optical characteristics controlled by the pavilion angles of faceted gemstones. Emphasizing the importance of cutting in the evaluation of colored gemstones, Hughes pays particular attention to "extinction" or "black-out." Windowing and brilliance are also discussed.

Hughes points out that inclusions and fluorescence tend to scatter light within gemstones, thereby reducing the amount of extinction. He fails to mention, however, that these features interfere with the transmission of light and reduce a stone's brilliance as well.

The article presents some useful information which, along with diagrams, will help readers understand the pavilion optics of cut stones. It is unfortunate, though, that the author never mentions the effects that a gem's crown features (crown angle and table percentage) can have on its optics; a stone's brilliance, extinction, and even windowing can be significantly affected by these other factors. *BCC*

Museum Idar-Oberstein. S. Frazier and A. Frazier, *Lapidary Journal,* Vol. 42, No. 9, December 1988, pp. 41–57.

Although this article focuses mainly on the modern *Edelsteinmuseum* (gemstone museum) in Idar-Oberstein, it also includes interesting information on the surrounding area, historical deposits, and local dealers. The extensively referenced text is accompanied by six illustrations (two in color), including a 15th-century woodcut of a water-driven cutting mill.

WRV

Suggestions for Authors

GEMS & GEMOLOGY is an international publication of original contributions (not previously published in English) concerning the study of gemstones and research in gemology and related fields. Topics covered include (but are not limited to) colored stones, diamonds, gem instruments, gem localities, gem substitutes (synthetics), gemstones for the collector, jewelry arts, and retail management. Manuscripts may be submitted as:

Original Contributions—full-length articles describing previously unpublished studies and laboratory or field research. Such articles should be no longer than 6,000 words (24 double-spaced, typewritten pages) plus tables and illustrations.

Gemology in Review—comprehensive reviews of topics in the field. A maximum of 8,000 words (32 double-spaced, typewritten pages) is recommended.

Notes & New Techniques—brief preliminary communications of recent discoveries or developments in gemology and related fields (e.g., new instruments and instrumentation techniques, gem minerals for the collector, and lapidary techniques or new uses for old techniques). Articles for this section should be about 1,000–3,000 words (4–12 double-spaced, typewritten pages).

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All material, including tables, legends, and references, should be typed double spaced on 8½ × 11" (21 × 28 cm) sheets. The various components of the manuscript should be prepared and arranged as follows:

Title page. Page 1 should provide: (a) the article title; (b) the full name of each author with his or her affiliation (the institution, city, and state or country where he/she works); and (c) acknowledgments.

Abstract. The abstract (approximately 150 words for a feature article, 75 words for a note) should state the purpose of the article, what was done, and the main conclusions.

Text. Papers should follow a clear outline with appropriate heads. For example, for a research paper, the headings might be: Introduction, Previous Studies, Methods, Results, Discussion, Conclusion. Other heads and subheads should be used as the subject warrants. For general style, see *A Manual of Style* (The University of Chicago Press, Chicago).

References. References should be used for any information that is taken directly from another publication, to document ideas and facts attributed to—or facts discovered by—another writer, and to refer the reader to other sources for additional information on a particular subject. Please cite references in the text by the last name of the author(s) and the year of publication—plus the specific page referred to, if appropriate—in parentheses (e.g., Liddicoat and Copeland, 1967, p. 10). The references listed at the end of the paper should be typed double spaced in alphabetical order by the last name of the senior author. Please list only those references actually cited in the text (or in the tables or figures).

Include the following information, in the order given here, for each reference: (a) all author names (surnames followed by initials); (b) the year of publication, in parentheses; (c) for a *journal*, the full title of the article or, for a *book*, the full title of the book cited; and (d) for a *journal*, the full title of the journal plus volume number and inclusive page numbers of the article cited or, for a *book*, the publisher of the book and the city of publication. Sample references are as follows:

Daragh P.J., Sanders J.V. (1976) Opals. *Scientific American*, Vol. 234, pp. 84–95.

Liddicoat R.T. Jr., Copeland L.L. (1967) *The Jewelers' Manual*, 2nd ed. Gemological Institute of America, Santa Monica, CA.

Tables. Tables can be very useful in presenting a large amount of detail in a relatively small space, and should be considered whenever the bulk of information to be conveyed in a section threatens to overwhelm the text.

Figures. Please have line figures (graphs, charts, etc.) professionally drawn and photographed. High-contrast, glossy, black-and-white prints are preferred.

Submit black-and-white photographs and photomicrographs in the final desired size if possible.

Color photographs—35 mm slides or 4 × 5 transparencies—are encouraged.

All figure legends should be typed double spaced on a separate page. Where a magnification is appropriate and is not inserted on the photo, please include it in the legend.

MANUSCRIPT SUBMISSION

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