GEMOLOGICAL ABSTRACTS

DONA M. DIRLAM, EDITOR

COLORED STONES AND ORGANIC MATERIALS

The beryl suite of gems. B. Jones, *Rock & Gem*, Vol. 20, No. 12, December 1990, pp. 36–42.

In a detailed description of the major beryl producing areas of the United States, the author focuses on the New England states and southern California. Mr. Jones begins by describing some of the varieties of beryls, such as maxixe, morganite, aquamarine, and heliodor. Goshenite is also mentioned, but not in great detail.

Then, the author turns to beryls from southern California, particularly, San Diego County's Pala district. Here he talks about Pala's three major sources: the White Queen mine on Hiriart Hill and the mines on Tourmaline Queen Mountain and Pala Chief Mountain. While the Himalaya mine today is noted for producing the best-quality tourmalines from southern California, it has also produced fine-quality morganite. On rare occasions, the two gems occur in the same specimen.

America's earliest sources for beryl, Jones explains, were in New England, particularly in Maine, New Hampshire, and Connecticut. No longer a major producer of beryls, New England does remain as the historical locality for these gems. This locality has been overshadowed by the major discoveries of beryls in Brazil. Maine pegmatite crystals, Jones tells us, were astoundingly big, although impure and opaque. Some crystals weighed more than 20 tons and were so large that miners had to actually tunnel into them during the mining process. Jones concludes with a detailed description of the various mines of distinction throughout New England. Five photographs, three in color, help illustrate this article. *Ron Conde*

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.

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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.*

Gem-quality chrysoprase from Haneti-Itiso area, central Tanzania. K. A. Kinnunen and E. J. Malisa, *Bulletin of the Geological Society of Finland*, Vol. 62, No. 2, 1990, pp. 157–166.

Gem-quality, apple-green, Ni-bearing chalcedonic silica occurs as veins in silicified serpentinite in the Hanetiand hydrated opals (3.8–4.9 wt.% physically absorbed water) present blue iridescence due to a less dense packing of silica spheres; they occur in claystones. The infrared, X-ray diffraction, and DTA patterns all show that the substitution of Al for Si in the tetrahedral network is a function of the Al_2O_3 content.

R. A. Huddlestone

DIAMONDS

Electron microscopic study of inclusions in small diamonds occurring in Liaoning. X. Xiao and G. Liu, Abstract, 15th General Meeting, International Mineralogical Association, June 28–July 3, 1990, Beijing, China, pp. 361–363.

Inclusion minerals in small diamonds from Liaoning province, China, were found to consist of Al-rich chromite, K-feldspar, and quartz. The mineralogic composition of these phases is similar to that of acidic igneous rocks. These phases are quite different from the peridotitic-suite and eclogitic-suite mineral inclusions that are commonly found in diamonds. *JES*

The end of an era. R. Scott, *British Jeweller & Watch Buyer,* Vol. 58, No. 6, February 1991, pp. 32–35.

It is the end of an era for a "breed of 'garimpeiros,' or prospectors" who still work the old diamond mines in the Brazilian rain forest region called Chapada Diamantana which became a national park in 1985. The old prospectors are allowed to continue their antiquated mining activities, but the end of the era is due to two factors: (1) because the work is labor intensive and the money meager, most young people will not go into the business; and (2) the new breed of prospector has also brought the new technology that is more lucrative but more damaging to the environment. Accompanied by seven black-and-white and color photographs, this is an interesting article on one lifestyle that is dying and another that is replacing it. *RT*

Lifetime Achievement Award, William Goldberg. D. Federman, *Modern Jeweler,* Vol. 89, No. 12, December 1990, pp. 35–44.

Modern Jeweler has awarded its seventh Lifetime Achievement Award to diamond dealer William Goldberg. His lifetime devotion to the American diamond trade is as well known as his strict cutting standards. David Federman chronicles Mr. Goldberg's rise from a failed diamond cutter to a giant in the diamond business. Also included are discussions of successes he has had with diamonds such as the Queen of Holland and the Premier Rose. Special attention is placed on his six-year term as president of the Diamond Dealers' Club (of which he is now treasurer) and his tireless resolve at trying to raise the New York diamond trade to the level of Antwerp and Tel Aviv. There is an interesting special segment focusing on William Goldberg's top diamond cutter, Herbert Lieberman, and his experience with a 255.61-ct rough diamond that later became the 89.01-ct Guinea Star. *CPS*

Nitrogen-defect aggregation characteristics of some Australasian diamonds: Time-temperature constraints on the source regions of pipe and alluvial diamonds. W. R. Taylor, A. L. Jaques, and M. Ridd, *American Mineralogist,* Vol. 75, No. 11/12 1990, pp. 1290–1310.

This 20-page article is an in-depth study of the conditions of formation of 50 diamonds from northwest (Argyle, Ellendale) and eastern (Copeton) Australia, as well as from Kalimantan, Borneo. Using Fourier transform infrared spectroscopy (FTIR), the authors determined total nitrogen concentrations and the amounts of A nitrogen aggregates (a pair of substitutional nitrogen atoms), B nitrogen aggregates (presumably four clustered nitrogen atoms), and platelets (an extended defect presumably of carbon atoms) in these stones. A aggregates turn into B aggregates plus platelets with time of residency in the earth's mantle (ranging from 0.4 to 1.6 billion years), increasing temperature (ranging from 1050° to 1300°C), and increased nitrogen concentration (which ranged from 10 to 1220 ppm for the stones in this study). The Argyle eclogitic diamonds, known to have a relatively short residence time in the mantle (0.4 billion years) and to have been submitted to an average temperature of 1255°C during that time, were used to refine the thermodynamic constants of the nitrogen aggregation reactions.

Ellendale diamonds, although geographically close to those from Argyle, were found to be significantly younger. Remarkably, some diamonds from Ellendale (northwest Australia) and Kalimantan seem to have a similar time-temperature history, which strongly suggests that those diamonds share a common origin and have been dispersed only by recent tectonic processes.

The authors conclude that a diamond population can be characterized by its nitrogen content, extent of aggregation of A aggregates, and extent of platelet degradation. In some favorable cases, such information may help determine the geographic origin of some diamonds. Since the method used is nondestructive, this process could potentially be extended to some faceted gem-quality diamonds. *EF*

Silicon carbide cluster entrapped in a diamond from Fuxian, China. I. S. Leung, *American Mineralogist,* Vol. 75, No. 9/10, 1990, pp. 1110–1119.

Silicon carbide occurs in both hexagonal (alpha-SiC) and cubic (beta-SiC) polymorphs. The hexagonal form (moissanite) is a rare accessory mineral in some kimberlites, while the cubic form (which has no accepted mineral name) has been reported from a sedimentary shale and a carbonaceous chondrite meteorite, but has never been fully characterized. An inclusion in a small

(1.3-mm in diameter) octahedral diamond crystal from the Fuxian diamond mine near Dalian, Liaoning Province, was found to contain SiC, and represents a well-documented occurrence of both SiC polymorphs. The inclusion contains four blue-green, hexagonal SiC crystals overgrown by younger, colorless grains of cubic SiC. This multicrystalline cluster is surrounded by a thin layer of K-Al-Si-rich glass that contains minute calcium carbonate and calcium sulfate crystals. The phases were all characterized by petrographic, SEM-EDX, and single-crystal X-ray diffraction techniques.

The inclusion is bounded by unusual curved surfaces, which suggests that the included minerals formed before they became entrapped in the growing diamond crystal. The presence of SiC polymorphs in natural diamond provides evidence that SiC may be an important carbon-bearing mineral in the earth's mantle. Estimates by other researchers indicate that the source of the Fuxian kimberlite in which the SiC inclusion may have crystallized may be deeper than 250 km and in a reducing geological environment. *JES*

GEM LOCALITIES

Colored pectolites, so-called "Larimar" from Sierra de Baoruco, Barahona province, southern Dominican Republic. K. Bente, R. Thum, and J. Wannemacher, *Neues Jahrbuch für Mineralogie Monatshefte,* No. 1, 1991, pp. 14–22.

White, greenish, light bluish, and blue pectolite from the Sierra de Baoruco have been studied in detail by a variety of instrumental analysis methods. Properties include $\alpha \sim 1.59$, $\gamma \sim 1.63$; $\underline{D}$ 2.84g/cm^3, H.$\leq$ 6. Chemical analyses and cell parameters are given for the four varieties. The pectolites form part of the alteration products in a picritic basalt of Upper Cretaceous age; it is believed that they formed at a temperature below 240°C. The greenish tints are related to color centers, while the blue color is probably due to vanadium.

R. A. Huddlestone

Gemstone prospects in Central Nigeria. J. Kanis and R. R. Harding, *Journal of Gemmology,* Vol. 22, No. 4, 1990, pp. 195–202.

The authors describe several gem localities in central Nigeria, from which a number of gem materials have begun to emerge over the past 10 years. Published material on the region, however, is limited, and this account is based to some extent on recent visits by the senior author, Mr. Kanis. Among the localities described is the Rafin Gabas Hills district in western Plateau State, from which greenish and yellowish gem-quality beryl and "blue to very deep blue" aquamarine have been produced over the last eight years. Topaz and quartz are also found, accompanied by a variety of accessory minerals. As mining exhausts surface deposits, the difficulty of hard-rock mining may make further exploitation impractical.

Not far away, near the town of Keffi, are tourmaline-bearing pegmatites, of which there are some 20 known. Although mining is sporadic, the potential for significant production exists. A wide variety of colors of gem-quality tourmaline have already been produced.

The Jemaa district in southwest Kaduna State has yielded sapphire for more than 20 years, but only since the development of heat treatment have the stones been of much commercial value. The sapphires are basalt related, with deposits similar to those of Australia, Thailand, and Kampuchea. The same deposits also contain deep red to orange and near-colorless gem-quality zircon.

The authors describe the regional and local geology for each of these deposits, including accessory minerals. Complete chemical analyses for four zircon samples (inductively coupled plasma emission spectroscopy and neutron activation analysis) are provided. Locality photographs also accompany the text. *CMS*

INSTRUMENTS AND TECHNIQUES

Bead buyers and parcel pickers filter set. R. K. Mitchell, *Journal of Gemmology,* Vol. 22, No. 4, 1990, pp. 212–214.

Mr. Mitchell describes and evaluates a set of four filters marketed by Hanneman Gemological Instruments for parcels of stones or strings of beads to see if they contain a single kind of gem material. In general, the author found that the filters were to some extent useful but, as with all such filters, considerable care must be exercised, especially if the stones or beads are different colors within the same gem species. They cannot be relied on to provide evidence in every case. *CMS*

Gemmological visual aids. J. Eadie, *Journal of Gemmology,* Vol. 22, No. 4, 1990, pp. 207–209.

The author describes visual aids for teaching crystallography to gemologists. These include models for demonstrating axes of symmetry, twinning, and light vibration and polarization. Both students and teachers of gemology will appreciate such three-dimensional aids. Six photographs illustrate the three models described. *CMS*

"Letter to the Editor" from Dr. H. A. Hänni, *Journal of Gemmology,* Vol. 22, No. 4, 1990, pp. 250–251.

Dr. Hänni's letter is in response to readers' requests that he provide absorption spectra to illustrate points made in his 1990 *Journal of Gemmology* article on Kashmir sapphires. Accordingly, he provides representative polarized spectra for Kashmir, Ceylon, Burma, and Pailin sapphires over the range of 300 to 500 nm. *CMS*

Reappraisal of infrared spectroscopy of beryl. C. Aurisicchio, O. Grubessi, and P. Zecchini, Abstract, 15th General Meeting, International Mineralogical Association, June 28–July 3, 1990, Beijing, China, pp. 421–423.

The present study involves a detailed investigation of the infrared spectra of beryls, which have a complex crystal chemistry. Main substitutions involve divalent and trivalent ions for Al in the octahedral site, and Li ions for Be in the tetrahedral site. Both substitutions require the entry of alkali (Na,K,Cs,Rb) ions along the "channels" in the crystal structure, which are made up of six-membered rings of Si tetrahedra. Water molecules may be present at several positions along these same channels. The effects of these substitutions on the unit-cell dimensions allows for the definition of three beryl series according to the ratio of (c/a) unit-cell dimensions. These three series are the "octahedral," "tetrahedral," and "normal" beryls. Absorption bands in the 3800–3400 and 1200–500 wavenumber regions are correlated with these three beryl series. Assignments are suggested for absorption bands based on the observed substitutions. Only more research will determine whether this three-beryl series will have direct gemological significance. *JES*

Water in beryl—a contribution to the separability of natural and synthetic emeralds by infrared spectroscopy. K. Schmetzer and L. Kiefert, *Journal of Gemmology,* Vol. 22, No. 4, 1990, pp. 215–223.

Infrared spectra obtained from 75 samples of natural emerald and 28 samples of synthetic emerald (flux and hydrothermal) were obtained and studied by the authors with the intent of finding additional criteria to distinguish between natural and synthetic material. Features in the range of 3500 to 3800 cm^{-1} associated with H_2O and OH in beryl were found to be useful in making this distinction in all cases studied. With spectra grouped into five types, four could be used to make a positive identification. One spectral type, however, appeared in both natural and synthetic low-alkali emeralds, including natural emeralds from Nigeria and Colombia and hydrothermally grown synthetic emeralds from Lechleitner and Russia.

The authors discuss the advantages of KBr pellets, for which powder is scraped from emerald samples, to obtain infrared spectra. However, a minimum of 0.5 mg of powder is required, making this method less than ideal for gemological purposes. It should be used only when all other nondestructive methods fail and only with the permission of the owner. Spectral graphs accompany the text, as does a useful table of significant spectral features correlated with locality and compositional information for the samples studied. *CMS*

JEWELRY MANUFACTURING ARTS

'All that glitters': Part IV. E. Weber, *Jewelers' Circular-Keystone,* Vol. 162, No. 2, February 1991, pp. 142–145.

Each segment of this continuing series focuses on a specific aspect of antique jewelry, giving clues to identification by analyzing specific examples. The topic for this installment is commemorative and historic antique jewelry.

Images or emblems of royalty are frequently found in antique jewelry. The likenesses are usually carved cameos or painted miniatures, mounted in gold as brooches, pendants, bracelets, or rings. Often the borders are further embellished with engraving, enameling, or gems. Many of these were presented as royal gifts for special service or allegiance, or to commemorate an historic event. Mourning jewelry also can have historic significance if it relates to royalty or famous persons.

Dates and/or inscriptions are almost always present, and many times the jewel will be placed in a special presentation box. Both of these factors provide positive clues to pinpoint time of manufacture.

The examples discussed here were drawn from the 18th through the 20th centuries and include such widely different personalities as Louis XVI, Queen Victoria, and D. H. Lawrence. Including the cover insert, 11 color photos illustrate the text. Although figure 2 has been printed upside-down, it does not detract from this otherwise intriguing article. *EBM*

Chatelaines. R. Krieger, *Vintage Fashions,* Vol. 2, No. 2, 1991, pp. 14–19.

The author of this interesting article briefly describes the evolution of the chatelaine from nothing more than a bunch of keys up to its present-day manifestation as the purse. Originally, the chatelaine (a French word meaning "mistress of the castle") was a clasp from which useful household items such as keys, seals, scissors, and the like were suspended on short chains. Chatelaines first came into use in the Middle Ages, but they gained status as jewelry during the 18th and 19th centuries when they were worn by both men and women as ornamental pieces from which charms or watches might be hung. This article describes different styles of chatelaines and the various objects that might be attached to them. For example, elaborately engraved or enameled watches were frequently suspended from the center chain, which would be engraved or enameled to match. The text is illustrated with 12 photos, all but two of which are black and white. Unfortunately, most are out of focus, but, nevertheless, they pique one's interest. *EBM*

Copyrights: When someone's got designs on your designs. D. Bottorff, *American Jewelry Manufacturer,* Vol. 38, No. 11, November 1990, pp. 63–65.

In one of the better articles on design copyright, Bottorff provides important information. She notes three significant changes in the copyright law: (1) U.S. citizens can enforce the copyright of their design in foreign countries; (2) within the U.S., it is no longer required that designers stamp or affix the copyright symbol to their work; and (3) transfer of ownership of copyright from a designer to the manufacturer must be done in writing—a manufacturer does not automatically obtain the copyright by purchasing the design. Bottorff provides a succinct process for copyrighting a design via the U.S. Register of Copyrights, Washington, DC, 20599. She also briefly mentions the American Jewelry Design Council, an organization of designers who hold the concept that as soon as jewelry is seen as an art form, designers will be more motivated to protect their work. *RT*

Favourite snuff bottles: The George and Mary Bloch Collection. G. Bloch and M. Bloch, *Arts of Asia,* Vol. 20, No. 5, 1990, pp. 90–98.

Mary and George Bloch began collecting snuff bottles in 1983 after a chance meeting with Sotheby's snuff bottle expert provided the catalyst for this new venture. In this article, the Blochs discuss 43 of their pieces, all of which are illustrated with color photographs of the front and back views. Of particular interest are those snuff bottles made from organic materials: a series of intricate ivories from the 18th century; a luminous red amber bottle; and several made of bamboo, hornbill, gourd, and tangerine skin. In virtually all cases, these are carved with intricate, significant symbols.

The Bloch collection also contains many more traditional materials, such as chalcedonies, whose variable inclusions and coloring provide the source of the design, and jadeite and turquoise. By observing the dates assigned to various bottles, one can document the use of specific gem materials.

The Blochs have put together a collection in which each acquisition becomes an opportunity to learn more about the pieces one already possesses. It is fortunate that in a time when many collectors are very secretive about their collections, the Blochs are willing to share their expertise in such detail.

Lisa S. Routledge

Glass beads of China. P. Francis, Jr., *Arts of Asia,* Vol. 20, No. 5, 1990, pp. 118–127.

As any gemologist knows, glass has long been used to imitate natural stones: The earliest documented use of glass in China was to imitate green and white nephrite. But much like the early synthetic gems, glass was considered a rarity in China and was highly prized for its own unique qualities.

The use of glass soon moved beyond that of jade simulant, and its manufacture reached a peak with the spectacular "Eye" beads in the late Chou period (481–221 B.C.). China's importance as a beadmaker has only recently been noted, as researchers struggle to make sense of the evidence of 3,000 years of production and trade of glass beads. Francis, an expert on the history and development of beads, reviews the evidence for glass beads from China, drawing on collections outside China as well as on translations of Chinese literature. What results is a remarkable overview of the topic, which provides a framework for future work.

Lisa S. Routledge

Traditional body ornaments from the Naga Hills. A. Herle, *Arts of Asia,* Vol. 20, No. 2, 1990, pp. 154–166.

The remote hills of Northern India near Tibet and Burma (Myanmar) are home to the Naga tribes, once head hunters, an agricultural people who have remained separate from their Hindu neighbors. Body ornaments of ivory, brass, and many organic materials such as conch shell and hornbill ivory express personal status, clan membership, and prowess at war.

Festivals held to celebrate the planting and harvesting of crops, and the fertility-related taking of heads, were occasions for displaying a multitude of ornaments. Not just a gorgeous display of personal status, it was believed that this self-adornment would win the favor of the crop spirits and ensure a good harvest. The author concludes by noting that a significant collection of historic documents and pictures of artifacts from Nagaland exists at Cambridge University and is accessible by an interactive video-disc. Thirty-two photographs illustrate the article. *Lisa S. Routledge*

SYNTHETICS AND SIMULANTS

Detection of synthetic emeralds by thermal conductance. P. G. Read, *Journal of Gemmology,* Vol. 22, No. 4, 1990, pp. 233–234.

The author discusses the usefulness of thermal conductance testers in the separation of synthetic from natural emeralds. Tests were done with an Alpha-test meter, which provides a digital readout of conductance values. Five readings per sample were obtained and averaged for a variety of natural and synthetic emeralds. While not exhaustive, the report indicates that, in most instances, readings from synthetic emeralds are significantly lower than those from most (but not all) natural emeralds. *CMS*

Optical absorption spectra of synthetic tourmalines. M. N. Taran and A. S. Lebedev, Abstract, 15th General Meeting, International Mineralogical Association, June 28–July 3, 1990, Beijing, China, pp. 457–458.

Tourmalines synthesized in hydrothermal solutions were doped with various transition metal ions (Fe, Ti, Cr, Ni, Cu, Co, and Mn). Optical absorption spectra in the range 400–1000 nm are presented for these synthetic tourmalines. Absorption bands recorded are assigned here to various causes. It is interesting to note that the spectrum of the Cu-doped synthetic tourmaline exhibits the same absorption features as have been reported for the copper-containing blue tourmalines from Paraíba, Brazil. *JES*

Thermal diffusivity of isotopically enriched ^{12}C diamond. T. R. Anthony, W. F. Banholzer, J. F. Fleischer, Lanhua Wei, P. K. Kuo, R. L. Thomas, and R. W. Pryor, *Physical Review B*, Vol. 42, No. 2, 1990, pp. 1104–1111.

General Electric recently grew colorless gem-quality synthetic diamonds. These type IIa synthetic diamonds have a reduced concentration of ^{13}C in order to achieve a superior thermal conductivity. To produce such high-purity material, a synthetic diamond thin film was first grown by chemical vapor deposition from a gas enriched in ^{12}C. The resulting film was then powdered and used as a carbon source in a classic high-pressure diamond synthesis process to grow two crystals (0.92 and 0.95 ct), each containing 99.9% ^{12}C (as compared to 98.96% ^{12}C and 1.04% ^{13}C in natural diamond). According to the authors, these crystals would be an E color on the GIA diamond-grading scale. Their thermal conductivity is 50% higher than that of natural type IIa diamonds.

Although the purpose of this material is purely industrial (increase in thermal conductivity to facilitate miniaturization of integrated circuits), this new type of synthetic diamond could surface on the gem market. *EF*

TREATMENTS

A jeweler's guide to emerald oiling. T. Themelis and D. Federman, *Modern Jeweler*, Vol. 89, No. 5, May 1990, pp. 65–69.

Mr. Themelis of Gemlab Inc. (a firm that offers an emerald oiling service) and Mr. Federman discuss the many aspects of emerald oiling, including the many types of oils, epoxy resins, dyes, plasticizers, and hardeners used today, as well as inherent problems that occur with certain types of fillers. They cover the cleaning of a previously treated stone (which sometimes must be done repeatedly to ensure that all of the old filling is gone) and describe in detail Themelis's four-step treatment process. Several helpful care and handling tips are given, and a proper disclosure section is also added to assist jewelers who deal with emeralds and many other gems treated in this fashion. Unfortunately, the section on detection is too limited and the photographs are not as helpful as they could have been, but the information on the different filling materials and filling processes is very good. The article also contains several before-and-after photographs of treated emeralds. *CPS*

MISCELLANEOUS

The Hillman Hall of Minerals & Gems, The Carnegie Museum of Natural History. R. A. Souza, W. E. Wilson, R. J. Gangewere, J. S. White, and J. E. King, *Mineralogical Record*, Vol. 21, No. 5, 1990, pp. 1–32.

This is an excellent, detailed review of the founding and history of the Carnegie Museum in Pittsburgh and the genesis of the Hillman Hall of Minerals and Gems. This article and its 52 accompanying photographs (primarily by Harold and Erica Van Pelt) is so comprehensive that it has also been bound for sale as a separate volume.

Gangewere and Souza recount the early acquisitions of the mineral and gem collection, and describe the succession of curators who helped develop the Division of Mineralogy. A trustee of the museum, Henry L. Hillman, established the Hillman Foundation to support a new mineral exhibit designed to present "minerals in a manner of sculpture and shown for their beauty as well as physical properties and economic uses." The Hillman Hall opened to the public in 1980, culminating 11 years of specimen acquisition, planning, and construction.

After the detailed history, Souza describes the hall itself. Following the natural flow of the floorplan, the reader is led from one specialized display to another, concluding like a grand finale in the Masterpiece Gallery. The Van Pelt photographs illustrate the "Highlights of the Collection" and are accompanied by detailed descriptions of the specific specimens shown. *LBL*

The Pre-Columbian civilizations of Peru. M. Jaquet, *Aurum*, No. 36, Winter 1989, pp. 62–69.

This article highlights the major societies that existed in Peru before the Spanish conquest, the evolution of their gold-working technology over 3,000 years, and their contributions to what we think of as Pre-Columbian art.

The Chavin people (1200–200 B.C.) worked gold by hammering nuggets into sheets and then embossing the pure metal. The Nazca society (200 B.C. to 700 A.D.) is famous for their gigantic animal silhouettes visible from the air. Although they discovered gold casting, they continued to hammer out thin medallions and heads. The Mochicas (200 B.C. to 700 A.D.) existed at the same time as the Nazca, but lived in northern Peru while the Nazca spread through the southern desert. Their jewels were the most inventive of the era, with breast pendants and ear jewelry of hammered and welded gold.

The Chimú empire (1000–1450 A.D.) was an extension of the Mochicas. They excelled at gold craftsmanship and used techniques such as welding, plating, alloying, filigree, and lost wax to create incomparable works that have been recovered from tombs. The Incas (1200–1532 A.D.) considered gold "the Sweat of the Sun." The artisans, many from the conquered Chimú, used gold to cover temple walls and decorate gardens. Unfortunately, most works were melted down by the Spanish conquerors.

Sixteen beautiful photographs show intricate details of the workmanship and use of gemstones such as lapis lazuli, chrysolite, pearls, emeralds, and turquoise. The author concludes this fascinating article with a discussion of various treatments and techniques that the ancient Peruvians had mastered in their use of gold. *Peter Solomon*

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