Gems & Gemology

GEMS & GEMOLOGY is the quarterly official organ of the American Gem Society, and in it appear the Confidential Services of the Gemological Institute of America. In harmony with its position of maintaining an unbiased and uninfluenced position in the jewelry trade, no advertising is accepted. Any opinions expressed in signed articles are understood to be the views of the author and not of the publishers.

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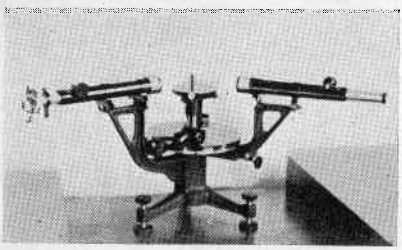
Research Spectrometer and Other Gifts to G.I.A. Laboratory

The facilities of the Gemological Institute of America have been very materially increased by recent important gifts.

The most valuable of these was a very fine research spectrometer presented to the Laboratory by Harold D. Feuer, Certified Gemologist, of Worcester, Mass. The instrument is one of the finer models manufactured by Gaertner of Chicago. The great value of this instrument can readily be seen from the fact that it can be used for measurement of the refractive index, birefringence and dispersion, and for accurately calibrating the angles of cut stones, as well as for regular spectroscopic work.



Spectrometer presented to G.I.A. Laboratory by Harold D. Feuer. (About 1/15 actual size.)

A second very important donation by Mr. Feuer was that of a number of cut stones, including zircon, spinel, chrysoberyl, ruby, sapphire, beryl, tourmaline, peridot, and quartz, in a wide variety of colors. The group includes more than 200 stones. The finest of these specimens are to be added to the Institute's collection, while others will be used as test stones for the identification examinations of the G.I.A.

Other gifts not previously acknowledged in *Gems & Gemology* include a number of emerald crystals presented by Richard Van Esselstyn of New York City. The crystals are of many varying types from Colombian mines and serve to illustrate very completely the types of material and matrix from the several sources in that country.

EXAMINATION RESULTS

Since the Spring, 1936, issue of *Gems & Gemology*, examinations for titles or for classifications have been completed by the following persons:

Certified Gemologist

Massachusetts
Harold D. Feuer, Worcester

Wisconsin
Edwin E. Olson, Milwaukee

Junior Gemologist

New Jersey
C. A. Allen, Cranbury

Ohio
R. C. Hoover, Hood & Hoover Co., Akron

REGISTERED JEWELER AMERICAN GEM SOCIETY

New Jersey
Jean R. Tack, Newark
Jerome B. Wiss, Newark

Connecticut
William B. Hawley, Davis & Hawley Co., Bridgeport

Graduate Member, A.G.S.

New Hampshire
Myer J. Kassner, Rennie & Kassner Co., Laconia

New Jersey
Louis A. Jackes, Jr., Newark
Warren R. Larter, Larter & Sons, Newark

Cultured Pearls*

by

ROBERT M. SHIPLEY

President, Gemological Institute of America, Los Angeles

The following advertisement by one of America's largest and most exclusive department stores appeared in a newspaper:

CULTIVATED PEARLS IN A SPECIAL ACCESSORY ROOM SHOWING

February 24th to February 29th —a glamorous tale of discovery and achievement—a tale of conquest and beauty—the cultivating of genuine pearls by (here appears the name of a producer) from a tiny pearl seed to its full-fledged beauty after seven years of scientific cultivation — a real pearl, identical with a natural pearl in formation, color, texture—the result of nature's process, yet not an accident of nature! . . . . . .

The manner in which this advertisement was worded leaves a wholly incorrect impression of the true nature of cultured pearls. As a result of extensive acquaintance with thousands of American retail jewelers, it is my observation that similar statements made by traveling salesmen and in advertising pamphlets and articles in national periodicals have left an incorrect impression of the true nature of cultured pearls, both in the minds of the public and in the minds of the proprietors of most retail jewelry stores.

There is a fundamental difference between genuine and cultured pearls. Genuine pearls almost always have nuclei so small that they rarely can be seen by the naked eye—while cultured pearls (spherical) are formed by the insertion, by man, of a bead of mother-of-pearl in the mantle of the mollusk; the bead is then coated over with deposits of pearly nacre in the process of shell growth. The mother-of-pearl sphere used in the cultured pearl is composed of parallel (or almost parallel) layers of nacreous material, while the inner layers of genuine pearls are concentric.

Research conducted by the laboratory staff of the Gemological Institute of America in the examination of numerous strands of cultured pearls retailing above $50.00 reveals that the layers of nacreous coating on cultured pearls average in the neighborhood of one millimeter. This is observed in drilled pearls by methods which require no sawing or other damage to the pearl. On the larger pearls in such strings this coating is of about the same thickness, and therefore makes up a still smaller portion of the entire cultured pearl. Obviously, although their chemical composition is identical, the structures of genuine and cultured pearls differ greatly, and any statement that their formation is identical tends to mislead the public as to the true nature of the cultured pearl.

No proof has ever been submitted to the Gemological Institute that any pearl contained in the pearl strands offered to the trade has been cul-

*A.G.S. Research Service.

tured or cultivated by the substitution of a seed pearl (or any genuine pearl) instead of a mother-of-pearl sphere. Many retail jewelers have been shown, by cultured pearl distributors, pearls which have been sawed into two portions; one larger and one smaller. The larger portion reveals the contour and orient of an inner (spherical) layer of nacreous material. This has the appearance of a nucleus which might have been a smaller pearl which had been inserted by man, but when a concentric nacreous layer of a natural pearl is thus exposed, it also will present a similar appearance. "Seed pearls" have uneven ("bumpy") surfaces which would present an entirely different appearance. It has also been questioned whether the depositing of nacreous layers upon the uneven surfaces of seed pearls would produce cultured pearls of sufficiently spherical form with smooth surfaces.

Natural pearls were found in Japanese waters before the production in these waters of cultured pearls, although they were inferior in value to pearls from the Persian Gulf and Ceylon. It seems entirely possible that one or more natural pearls might, at any time, be found in a mollusk in which a mother-of-pearl sphere has been inserted by man. If several pearls should be found in such a mollusk, it would be obvious that only one was cultured, since the producers state that only one mother-of-pearl bead is inserted in the culture process.

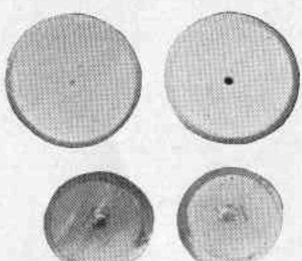
The sawed pearls shown to jewelers are probably pearls which have been formed naturally rather than as a result of the efforts of the producers of cultured pearls. Distributors' representatives say that some pearls found on Japanese pearl farms do not have mother-of-pearl centers, but that the proportion is probably less than 1%. They do not state definitely that such pearls are the result of the insertion of genuine pearls in the mollusk by the cultured pearl producer; but, unfortunately, the impression which is left with many retail jewelers is that some cultured pearls are thus produced, *i.e.* from the insertion of small genuine pearls in the mantle of the mollusk.

Seven years is ordinarily mentioned as the period of time usually necessary to bring a natural pearl to its greatest beauty. Many cultured pearls are produced in less than this period of time. The thickness of the coating does not seem always to depend upon the length of time that a pearl has been in the mollusk. However, many cultured pearls have a much thinner coating of nacreous material than that indicated by the above mentioned experiments in the Institute's laboratory.

Many biologists also consider the cultured pearl to be genuine from a purely biological standpoint; but, as was clearly pointed out in *Gems & Gemology* in the Editorial on page 34 and also in the footnote on page 44 of the March-April, 1934, issue and page 110 of the May-June, 1934, issue, the *cultured pearl is not gemologically genuine.* On the other hand, the cultured pearl is a more desirable article than an imitation pearl. As a result of their scientific education, Certified Gemologists recognize that a cultured pearl, in one respect at least, is, in structure, somewhat similar to a gold-plated article. However, the cultured pearl has distinct merits upon which it can be sold honestly, and it is unnecessary to leave an incorrect impression with his customer regarding its true nature in order to take advantage of the great sales opportunity it offers to many jewelers. Copies of the paintings of old masters are worth only a fraction of the value of the originals, no matter how beautiful or perfect the copies may be.

Of great importance is a dissemination of knowledge of the true nature of cultured pearls among all retail jewelers. If the retail jeweler obtains the wrong impression of this merchandise, he may be guilty of unintentional misrepresentation in the sale of that merchandise to his customer, which will not only destroy confidence in him, but will also undermine confidence in the entire trade. What is more important, the majority of those jewelers who rarely, if ever, sell genuine pearls seem to have obtained the false impression—and passed it on to their millions of customers—that there is almost no difference between genuine and cultivated pearls and that there is no method of distinguishing between them.

The difference in appearance between the majority of genuine pearls and the majority of cultured pearls is apparent to the experienced pearl dealer. The cultured pearl can be accurately and unmistakably distinguished from the genuine pearl by scientific methods. It is being thus scientifically distinguished in the national gemological laboratories of France, England, and the United States, an ever-increasing number of them being sent for determination to the laboratory of the Gemological Institute of America. If, when cultured pearls are sold, the impression is left with the customer that they are identical with genuine pearls in the manner implied in the advertisement quoted at the head of this article, it may later be revealed by scientific tests that the jeweler has deceived his customer.



SMALLER PEARL *Illustrates Average Thickness of Coating of Better Quality Cultured Pearl.* LARGER *Has Thinner Coating and Is Apparently Representative of the Cheap Cultured Pearls. These are Cross-Sections, 2½× Actual Size; the Larger Specimen Is 6.8 mm. in Diameter—the Smaller, 5.4 mm.*

New Member of G.I.A. Board of Governors

William Elder Marcus was elected a Governor of the Institute at the last semi-annual meeting of the Board of Governors. At the same meeting, the firm of Marcus and Co. of New York was chosen as a sustaining member of the Institute. This firm for years has been especially active in disseminating a knowledge of gems to the American public and has recently prepared and distributed extremely attractive and valuable booklets on asterias and pearls.

Marcus and Co. was the first retail firm in New York City to become affiliated with the Gemological movement, and its general manager, Kenneth Van Cott, as President of the New York chapter of the American Gemological Society, has done outstandingly constructive work for the movement. Marcus and Co. are preparing three certified gemologists.

Members of the Institute Board of Governors are elected from among Institute member firms, and as William Elder Marcus, President of this firm, has, during the past year, rendered signal service in criticism and development of the Institute's courses and other educational work, his election as a member of the Board of Governors of the Gemological Institute of America quickly followed. Well known as one of America's outstanding pearl experts, and the head of the retail firm which, since it introduced the black opal in this country, has been one of America's outstanding gem institutions, the selection of Mr. Marcus as Governor is a particularly fortunate one.

Confirms G.I.A. Synthetic Emerald Research

In an article prepared by Dr. W. Fr. Eppler which appeared in the May 23rd, 1936, issue of the German *Goldschmiede Zeitung*, the validity of the fluorescent test for the new synthetic emerald-beryl (igmerald) was confirmed. This test was discovered in the laboratory of the Gemological Institute of America and first reported in the July-August, 1935, issue of *Gems & Gemology*. The distinction is made possible by the fact that synthetic green beryl—under certain wavelengths of ultra-violet light—exhibits a bright red fluorescence, while the genuine emerald shows little or no fluorescence under the same rays.

Appointments to Advisory Board

To fill the vacancy left by the death of T. Edgar Willson, late editor of the *Jewelers' Circular—Keystone*, A. Merchant Clark has been appointed to the Student's Advisory Board of the Gemological Institute of America. Mr. Clark is well known in the jewelry trade, as he served on the *Jewelers' Circular* staff as associate editor for many years, and succeeded T. Edgar Willson as editor of the journal.

Other appointments to the Student's Advisory Board are: Richard L. Barrett of Case School of Applied Science, Cleveland; Samuel G. Gordon, Academy of Natural Sciences, Philadelphia; Alfred C. Hawkins, author of the *Book of Minerals*, Brunswick, New Jersey; and Edward Wigglesworth, Boston Society of Natural History, Boston.

The Ruby Mines of Burma*

Condensed from The American Consulate Report of Winfield H. Scott, Rangoon, Burma, completed May 22nd, 1935, loaned through the courtesy of the Metals and Non-Metals Division of the United States Bureau of Mines, Washington, D.C. A summary prepared by David H. Howell, Certified Gemologist of Pasadena, California.

After the overburden has been removed the "byone" is removed and placed on floors constructed of flat stones and clay. Water is then conducted to the "byone" and the lighter material is washed away into a tailing channel with small falls built in it with small pits at the bottom of each fall where the gems lodge and are later retrieved.

"Lus" consist of deep underground excavations or shafts into the hillsides, sometimes several hundred feet in depth. This term also includes large openings in the "byone" filled with decomposed material and all natural widenings which may be mined with profitable results. These workings are dangerous and require great experience on the part of the miners. Another method of river and stream damming is employed called "saye." Pools are formed and hand dredging by diving operations are used to recover gemstones.

Modern Methods

One of the modern methods is to dig large pits about 50 feet in depth and several hundred feet in length into the "byone" and then dig smaller water holes in the limestone bed rock which are then filled with water. The "byone" mined is conveyed to these water holes and then sucked up to the surface by mechanical means through eight-inch pipes. Here it is conducted through sluices and series of falls arranged at intervals and the gems extracted from the "byone" much as gold is recovered with "riffle boards" in placer mining.

At Mogok and Katha there were two washing plants operated by the B.R.M.Ltd. The gravels were transported from the mines to the washing plants and recovered by screening and washing in pans. The Company also built a large drainage tunnel through a small mountain range at a cost of £40,000 which enabled mining to a greater depth than heretofore. They also constructed a hydro-electric plant to furnish electricity for the district and this plant was the first to be built in Burma. It also supplied light for the town of Mogok. Recently, however, this tunnel has caved in in some parts and two large lakes have been formed which now cover the site of the Mogok of 1885.

Mining operations proceeded favorably in the district until 1908 and the advent of the synthetics and the silver panic of the United States of America caused a tremendous drop in the price of rubies. It is stated that the ruby declined 300% for the good grades and much more for those of inferior quality. Then came the World War which demoralized the situation still fur-

*G.I.A. Research Service.

ther. The B.R.M.Ltd. went into voluntary liquidation December, 1925, and offered their equipment for sale. Operations continued, however, on a small scale until the advent of the world depression and they were forced to surrender their leases to the government. This was on June 30, 1931.

Washing, Examination and Sorting

The traditional method of removing the gem-stones from the "byone" is to wash it in oval-shaped basins made of large boulders and finished smooth with clay. There is a small opening at one end for the removal of the silt and lighter materials which are removed during this process. The "byone" is dumped into this basin and a stream of water is conducted to it and directed to flow over the "byone" by means of bamboo pipes. Hoes are employed and the natives also use their hands to agitate and stir the material in the basin. The lighter material escapes through the small opening and when the water runs clear the remaining concentrate is flowed through a trap called a "zaloke." The gems are then removed by hand and the refuse washed down with the other tailings. Native women are allowed to search the tailings for any gem-stones not heretofore recovered.

Marketing and Grading

After the stones are recovered from the washings at the mines they are placed in bamboo or metal containers and sealed. They remain sealed until all parties interested in the mine are present and then are opened for sorting and evaluation.

Sorting is always done in the daytime. The stones are placed on brass trays around which are seated the sorters. They first remove the valueless and inferior gem-stones and these are later sold for watch jewels or crushed and sold to lapidists for abrasive use. Many of these inferior stones, however, are peddled in and around Mogok, Mandalay and Rangoon to tourists, visitors and local residents. The remaining stones are then roughly graded according to size. After this they are evaluated by the owners, assisted by one or more brokers. During the evaluation no words are spoken and all trading and bidding is carried on in a finger sign language. The hands are generally hidden under the large sleeves of the native dress or under handkerchiefs. The following are a few of the Burmese terms for gem-stone grades:

Lenbouk—1st water stones exceeding four carats.

Anygyi—2nd water stones.

Asah—3rd water stones.

Gair—Large opaque stones.

Anyun—1st quality two-carat stones.

Lathi—1¾-carat stones.

Athaibouk—¾-carat stones.

Sagathai—½-carat stones.

Kyauk-me—Dark stones.

Gaungsa—Pale, inferior stones of mixed sizes up to six carats.

Apya—Fine quality flat stones.

Pingoo-choo — Star rubies, 1st quality.

Pingoo — Silky ruby with or without star.

Gawdone, gaw-cho—Star sapphires.

Nilt—Large sapphires.

Nilasa — Mixed, inferior sapphires.

Every phase of the sorting and valuing is shrouded with the utmost secrecy. Nearly all mine owners and operators in Mogok maintain a considerable stock of all classes of gem-stones but all are carefully concealed and revealed only upon the most persistent inquiry and demand from a prospective buyer.

Cutting and Polishing

During the reign of the Burmese Kings all royal rubies were cut round, or en cabochon, by means of rough grinding stones. Indian carvers were brought into the country and brought the art of fashioning with them. However, today they have entirely disappeared and the cutting and polishing is done by Burmese and Burmo-Shans. During the time of the B.R.M.Ltd. nearly all stones were sold in the rough and sent to London from whence they were shipped to America, France and Germany. Those stones not sent to London were cut locally or in India but though the cutting has been considered efficient, most of these stones were recut upon reaching European centers.

In grinding the stones they are attached to one end of a rough piece of wood about one-half inch in diameter and six inches long, by means of an adhesive gum called "check."

Instead of using stone grinding wheels and metal laps in the roughing operations, the natives use wooden laps called "boards." As many as eight boards are employed during the grinding of the stone. Some of these boards are imported from India and they vary in roughness and hardness. The boards are charged with corundum, varying from coarse grains to the finest dust.

After the stone is ground, cutting is the next step. This is accomplished upon fast revolving metal discs using either corundum or diamond powder. Faceting and polishing are done on hand-propelled polishing stones charged with corundum powder. The powder is mixed with a little water and olive oil.

The charges for grinding and polishing are one rupee per carat for rubies and sapphires and eight annas per carat for spinels. Four annas are charged per carat for all other stones.*

Laws Regulating Mining Operations

Those eligible for mining licenses are people whose names appear on a list of hereditary miners. Later this list was amended to include those miners who had been employed by the B.R.M.Ltd. for a period of at least ten years. The fee for this license is 10 rupees per man. Customarily three miners are employed for the smallest claims. These fees allow the miners to employ only the native methods for their operations. Extraordinary licenses are issued upon application and payable three months in advance. The fees vary, depending upon the location of the claim and the methods employed. These licenses allow the miner to use machinery and other modern methods for their operations. However, since the closing down of the B.R.M.Ltd. most of the operations are being conducted upon native methods.

Illicit Mining

Since the disappearance of the old tribute system and a more strict

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*16 annas equals one rupee. One rupee is about 37 cents American money.

attitude of the courts, illicit operations are gradually lessening. Difficulty in the disposition of stolen stones has also reduced stealing. However, there is still some illegal and dishonest trading. Those women who work the tailing dumps often act as fences for stolen goods, claiming such stones, if found in their possession, were actually found in the tailings. Also, some unscrupulous miners secrete stolen goods in their own mine workings, later mining them and claiming legal possession. Also, non-privileged outsiders who cannot obtain licenses legally finance miners on the list and smuggle goods out of the district.

Exports

Total value of rubies, sapphires, and spinels produced by the B.R.M. Ltd. for the years 1889 to June 30, 1931, officially stated was approximately £2,038,600 to £3,644,800. This averaged about £55,000 per year of operation. There is no consideration for stolen goods in these figures.

Until recently shippers on consignment basis paid the prescribed local import duty upon the return of their stones from foreign importers and dealers. However, now the shippers of consignment goods register export certificates with the collector of customs at Rangoon and these stones are allowed to re-enter the country duty free if they return within three years of their export date and are the same size, weight, and quality recorded on the export certificate.

Future of the District

According to the export reports of the B.R.M.Ltd., approximately 85% of all the stones recovered in the Mogok Stone Tract were rubies. The rarity of large stones is evidenced by the statement that 182 stones mined aggregated 8903 carats and their sales prices averaged about £133 or more per carat. Fourteen of the 182 stones recovered realized £0.66 or more per carat. One of the fourteen weighed in the rough 24 carats and six weighed 20 carats each. The day peace was declared after the World War a ruby was discovered and called the "Peace Ruby." It weighed in the rough 42 carats and sold in Mogok for £27,500, the highest price ever realized for a ruby in the rough.

Since the termination of the B.R.M.Ltd. all rubies and sapphires and other stones mined, with the exception of the three mines, are mined by natives employing native methods. During the operations of the company some gem-bearing gravels were left untouched. Certain Buddhist pagodas stood in the way of the mining operations and would not sell to the company. Thus the ground under them represents valuable sources of gems. Also, the flooding of the country by the breaking of the water drainage tunnel has buried another possible source of gems. According to this Consulate report, however, even under the most optimistic conditions ruby mining offers small profits. The average run or yield of the gem gravels is about one rupee per ton removed. When one figures that this is about 37 cents United States of America money, it becomes evident that the margin is small. Then, too, taxes must be paid, labor must be hired and mining overhead is notoriously high, so ruby mining is not such a lucrative business as an uninformed person might be led to believe.

Cleaving the Jonker Diamond

Excerpts from the address delivered by Lazare Kaplan at a meeting before the New York Chapter of the American Gem Society.

At no time in my experience have I been confronted with so definite a challenge as when the Jonker Diamond was submitted to me. Everything about this astounding stone presents a new facet. It would seem that nature herself had entered into a conspiracy contrived to conceal this priceless treasure from the covetous eyes of men forever.

Calling to her assistance incalculable forces, heat that no thermometer could record, when the earth was in the making, she had so adroitly distorted its surface that even Europe's leading experts were misled. Their plans for cutting the Jonker Diamond would have destroyed the stone.

Fortunately, when I had made a thorough examination of the stone, I discovered their error. But even then, I was not sure how to proceed. So elusive was this beauty that it was a year before I was sure of its grain. And I may add that in its study, not only did I have to devise new tools, but I had to establish new rules for myself.

In the rough, the Jonker has all the characteristics of the typical river diamond: the red spots of iron oxide and sand, often forced into the open cracks of the stone by the action of the water; the gray coat; the form and true composition; and finally the softly pleasing blue color.

As I have already said, the finding of the correct planes of cleavage presented an extremely difficult problem. Much publicity had been given to the large, flat surface of the Jonker Diamond. Wild conjectures had been made that it might correspond with the flat surface of the Cullinan Diamond, and that, ages ago, the two might have been one huge stone. The European experts to whom the Jonker was submitted, at any rate, took it for granted that the large surface of the Jonker formed one of the planes of cleavage, and planned to split the diamond in accordance with that theory.

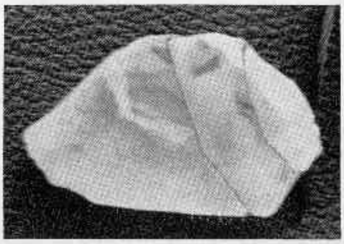
This plane, however, ran across the grain, and to attempt to cleave in any parallel plane would have been comparable to attempting to split a piece of wood across the grain. It would have ruined the stone. What the Europeans mistook for a split which had produced the flat surface was in reality a natural formation—a freak of nature. My study of the Jonker revealed to me this trick of nature's, and at the same time led me to discover the true line of cleavage.

There was one certain spot on the surface of the Jonker that indicated the correct planes for this cleaving. Then, somewhat as a naturalist reconstructs a dinosaur from a few scattered bones, I laboriously reconstructed the crystallization of the diamond and thus determined exactly all the planes along which to cleave.

Usually, in cleaving diamonds, the planes of cleavage are obvious at first sight, the real problem being to discover the exact position of any chance imperfection. In the Jonker, however, the problem was presented in reverse order, as I have already indicated, the location of the grain presenting the greater perplexity.

I found only one small space on the Jonker where I could make my groove. Then began a work of incalculable patience. One small slip would spoil the groove, and I should be compelled to abandon my whole plan for cleaving. You may well imagine that in this initial step my son, Leo, and I exercised the utmost care. We took every precaution to make sure that the groove not only followed the grain accurately, but that it was perfectly shaped. We knew that, whereas in many other difficult industrial processes satisfaction may be attained by performance that is merely good, in diamond cleaving the performance must be *perfect.*

It is at this final high point in the drama of diamond splitting that the feeling of romance and adventure is at its height. And I must admit that it is a glorious feeling of superiority that comes over me when I find that I can make the diamond, the hardest and most durable thing on earth, obey my every command . . . when, by the application of a little strain, I am enabled to do a thing that files and drills could never do.



The Three Pieces Produced by the First Two Cleavings of the Jonker Diamond, Reassembled to Show Their Relationship in the 726-Carat Original Stone. The Weights of the Pieces Are: From Left to Right, 505 Carats, 185 Carats, and 36 Carats. The Largest Finished Gem Will Weigh About 175 Carats.

GEMOLOGICAL GLOSSARY

(Continued from last issue)

Gorgulho (gore-gul'hoe). A diamond-bearing quartz and clay gravel of Brazil.

Goshenite goe'shen-ite). Colorless beryl.

Goutte d'Eau (goot doe). Colorless topaz.

Goutte de Sang (goot d'san). Blood-red spinel.

Grain. In gemology, one-quarter of a metric carat (.0500 grams), a unit of weight commonly used for pearls, also with other gems. In English system of weights, .0648 grams, or 1/7000 of a pound averdupois. Also refers to a cleavage direction in a gem mineral.

Grainers. Diamonds which in weight correspond to fourths of a carat. A diamond of one-quarter carat weight is a one-grainer; a diamond of one-half carat, two-grainer; a diamond of one carat weight is a four-grainer.

Grain Marks. Lines on facets resulting from imperfect polishing, especially refers to the marks appearing on a facet placed parallel to a cleavage direction.

Granite (gran'it). A granular igneous rock containing principally quartz and feldspar.

Granitic (gra-nit'ik). Granite-like or composed in part of granite.

Granular (gran'ue-lar). Composed of or resembling grains.

Graphite (graf'ite). An opaque black mineral whose composition—carbon—is the same as that of diamond. Hardness 1-2. Specific gravity 2.2. Sometimes occurs as inclusion in diamond.

Grating (grate'ing). A system of close equidistant and parallel lines or bars, especially lines ruled on a polished surface, used for producing spectra by diffraction. Gratings have been made with over 40,000 such lines to the inch, but those with a somewhat smaller number give the best definition. They are of great assistance in spectroscopic work.

Greasy Luster. Luster resembling that of oily glass. Produced by reflection from a non-plane surface. Seen on polished jade.

Green Chalcedony. Usually a cryptocrystalline variety of quartz stained green. Also may refer to chalcedony of a natural green color.

"Green-ears." Pearls taken from inland streams.

"Green Garnet." Incorrectly applied to green enstatite from South Africa.

"Green Onyx." Green-colored chalcedony; also incorrectly called "Chrysoprase."

Green Starstone. Chlorastrolite.

Greenstone. Nephrite.

Grinding. The preliminary shaping of a rough stone; followed by polishing. Grinding is done on carborundum wheels or on metal laps and diamond powder or carborundum is usually used, depending on hardness of stone.

Grossularite (gros'sue-lar-ite). From Grossular, meaning "Gooseberry." A species of garnet. Hardness 7½; refractive index 1.745. Translucent to semi-translucent. Light to dark yellowish-green, also white. Occasionally substituted for green or white jade. Called Gooseberry stone and incorrectly "African Jade," "South African Jade," "Transvaal Jade," "Garnet Jade," "White Jade." Hessonite is the transparent orange variety of grossularite. See Hessonite.

Grupiaras (grue"pi-ar'as). Shallow deposits of diamond-bearing gravel on hills near rivers in Brazil.

Guarnaccino (gwar-na'sene-oe). Yellowish-red or brownish-red garnet. Same as Vermeille.

Gum. Any of a number of amorphous, tasteless substances, exuded in most cases in plants, and hardening on exposure to air. A natural gum prepared for industrial or other uses. Used to imitate amber. See Copal Gum and Dammar Resin.

Gypsum (jip'sum). An ornamental and curio material. Monoclinic. Hardness 2, refractive index 1.52. Fibrous, pearly chatoyancy, red-brown to colorless. Satin Spar is a variety incorrectly called "Niagara Spar" and "Hyacinth of Compostela." Transparent, colorless variety is Selenite, incorrectly called "Russian Crystal." Opaque snow-white (Alabaster). See also Alabaster.

Habit. Crystal shape or shapes in which a mineral usually is found.

Hackly Fracture. Breaking with a rough surface having many sharp points, like most metals.

Half Moon. A style of cutting which produces a stone shaped as a half-circle.

Half Pearls. Pearls sawed into halves.

Hair Stone. Same as sagenite.

Haliotis (hal"i-oe'tis or hae'li-oe-tis). The genus consisting of the ear shells. Often yield blister pearls or irregular whole pearls, usually of pronounced colors. See also Abalone.

Hardness. In gemology, the resistance of a substance to being scratched. A property by which various gem-stones and imitations may be identified.

Hard Mass. Generally applied to an unusual glass, over 6 in hardness; also occasionally, but inaccurately, to synthetic spinel.

Harlequin Opal (har'lee-kwin or kin). Opal with close-set, angular (mosaic-like) patches of color. See also Cat's-Eye Opal.

Hatchet Stone. Nephrite.

Haüyne or Haüynite (ha'win or ha'win-ite). A constituent of lapis-lazuli; hardness 6; translucent to opaque; bright blue to green-blue. See also Lapis-Lazuli and Sodalite.

Hawaiite (ha-wye'ite'). A gem variety of olivine from the lavas of the Hawaiian Islands. It contains but little iron and is pale green in color.

Hawk-Eye. A variety of crystalline quartz, similar to tiger-eye, but contains fragments of crocidolite not entirely replaced by quartz. These crocidolite fibers retain their original grayish-blue color resulting in a bluish chatoyant stone.

Haystacks. Term applied by American river fishermen to high-domed button pearls.

Heated and Stained Stones. See Altered Stones.

Heating. The heating of minerals to drive off or to change their color.

Heliodor (hee'li-oe-dore). Yellow to brown variety of beryl.

Heliolite (hee'li-oe-lite). Sunstone (feldspar).

(To be continued)

The Selection of a Microscope For Gemological Work*

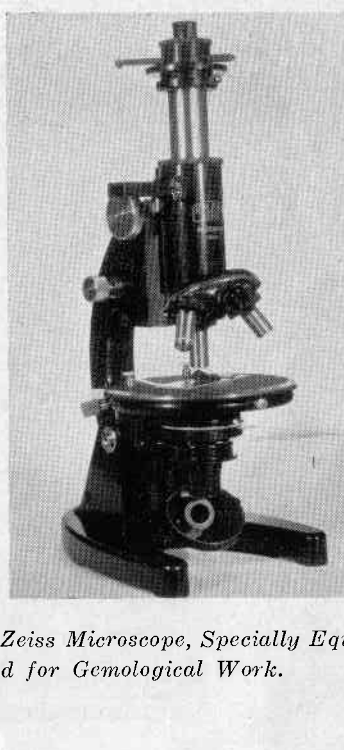
The value of a correctly equipped microscope for gem-testing work has been amply proved by the use of such an instrument in the G.I.A. laboratory, and also by gemological students throughout the United States. This instrument will perform more valuable services in gem identification than any other. It is the only apparatus which can be relied upon in every case to detect synthetic rubies and sapphires (corundum), and spinel. Moreover, by proper attachments for polarized light, the optic character of any transparent stone can be ascertained and the pleochroism, and even in many cases the refractive index of gems can be determined.

Grading vs. Testing

Several manufacturers of optical equipment are producing and attempting to sell to the members of the jewelry trade, apparatus which they claim to be "gem *testing* microscopes." Almost without exception, these are designed simply for study of imperfections under relatively low magnification and should be classed as gem or diamond *grading* instruments. In one case the instrument furnishes rather high magnification, probably sufficient for the identification of the majority of synthetic stones, but even this equipment cannot be provided with accessories for polarized light.

Of course, a grading instrument which makes the study of imperfections a very easy matter is the desirable piece of apparatus for a jeweler to own. It has added value in that he can use it to show imperfections, or the absence thereof, to his customers in a manner which is not possible with the ordinary eye loupe. In instruments for this purpose, the binocular feature has some advantage. However, in designing a microscope suitable for use in identification of an unknown gem, it has not yet been possible to combine the required attachments for polarized light with the binocular feature.

In microscopic equipment suitable only for perfection grading, the par-



Zeiss Microscope, Specially Equipped for Gemological Work.

*G.I.A. Confidential Service.

ticular advantage of a stationary instrument with fixed light source over the ordinary eye loupe is that the former gives much better illumination than is ordinarily possible with the eye loupe alone. Of course, if a suitable box furnishing illumination were available in conjunction with the eye loupe, it would serve this purpose just as well as the more ornate apparatus now being marketed which has both the magnifier and illumination as integral parts of the assembly. In fact, the illuminating unit alone would, in many cases, have very decided advantages, as it would be possible to equip it with a finer lens than is commonly employed with the complete unit. The ideal imperfection grader would probably be a binocular instrument with a built-in light source. As yet, this combination has not been featured on the market. Research is being carried on in the laboratory of the G.I.A. with a view toward making such apparatus available in the near future.

The jeweler who contemplates purchasing a microscope should, first of all, decide what use he wishes to make of it. If his desire is only to grade imperfections and to furnish an instrument with which he can show relative perfection of a stone to his customer, one of the grading instruments now on the market will probably serve his purpose better than a complete gem-testing outfit. However, he should be careful not to purchase complicated and worthless equipment, such as is being offered by at least one manufacturer.

If it is his desire to do both grading of imperfections and gem identification work with his microscope, a complete unit such as that illustrated here will undoubtedly prove the most valuable. It is equipped with several unique attachments designed solely for use with cut stones, whether mounted or unmounted. Attachments of this nature are not manufactured by large optical firms, who consider the field of gemology too limited to warrant the necessary expense of development. An instrument can be purchased complete for approximately $350.00. The essential parts used for detection of synthetic stones and for grading of imperfections can be bought for about $160.00 and additional gem-testing features added from time to time at the will of the owner.

Readers of *Gems & Gemology* are entitled to confidential information concerning any gemological apparatus as part of the service included with a subscription to this periodical, and prospective purchasers of microscopic equipment are urged to take advantage of this service.

A GEMOLOGICAL ENCYCLOPEDIA

(Continued from last issue)

HENRY E. BRIGGS, Ph.D.

ALTERING OF GEMS (Continued)

The bulk of black chalcedony coming from Germany is dyed. The color of "Swiss lapis" is also due to dyeing; the stone is nothing but agate dyed blue. Jasper dyed blue is sold as "German lapis." Chalcedony is dyed blue and sold as blue onyx. It is also dyed green and sold as chrysoprase.

By far the greater percentage of cheap stones coming from Germany are altered. Idar and Oberstein are the centers of this business, and great quantities of the material are turned out yearly.

The American lapidaries have done little or no altering of gems, especially in a commercial way. The bulk of gems cut in America are natural, unaltered minerals, if they are minerals at all. However, because of the low cost of these altered gems in Germany, many are imported into America and offered as "genuine." True, the stones are genuine, but they are also altered. In the case of dyeing, the microscope or spectroscope will usually reveal the fraud.

Foil and Enamel Backings

Occasionally we see a genuine stone which lacks in brilliancy, backed with foil to increase the "snap" of the stone. Also, mountings are often backed or lined with special foil to improve the color or brilliancy of the gem. Enamel is also employed for the same purpose.

SYNTHETIC GEMS

A synthetic gem is one which is man-made, but which is exactly the same as the natural in composition and optical and physical character. However, it is beyond the present ability of man to produce a gem crystal which is exactly in every respect the same as the natural, perhaps because the natural gems were formed very slowly and often under pressure which man is unable to produce artificially. These conditions caused certain peculiarities in the natural gems which can be taken advantage of to discriminate between the natural and the artificial.

About 1895 reconstructed rubies were introduced to the market. While reconstructed rubies had been made prior to this date, they were not of a very good quality and hence comparatively few were sold. These reconstructions were made by fusing together tiny fragments of the natural ruby. They were not as successful as were the truly synthetic stones which came onto the market a few years later. Today the synthetic has almost entirely replaced the reconstruction.

Synthetic ruby came onto the market about 1903, and made rather rapid progress. It afforded a cheap substitute for the natural gem where the purchaser was unable to afford the genuine article, and yet it was as hard as the natural and thus would give far better service than would any other type of artificial gem. Synthetic sapphires also were introduced shortly after and have found a ready market in cheap jewelry.

Synthetic corundum is produced by a process known as the "Verneuil process," so called after its inventor. This process, briefly, consists of the fusing of pure bauxite in a special furnace. The furnace consists of a gas torch so arranged that the powdered bauxite may be introduced into the current of gas and blown out into the flame at the aperture of the torch. The bauxite is instantly heated to a terrificly high point, fused, and changed into molten alumina Al_2O_3. A fireproof support is arranged directly under the aperture of the torch and the molten alumina collects upon this support and grows into a boule. In some of these boules one can clearly see the crystallographic outline of the gem, while in others it is not so clear. However, the nature of the crystal can be easily proven with the aid of the polarizing microscope. The red color is produced in this synthetic corundum by adding chromium oxide to the bauxite. By varying the amount of this oxide that is added, almost any shade of pink or red can be obtained. By introducing various other coloring agents, the synthetic corundum is colored many different colors and sold as imitations of various stones. Beside the synthetic ruby and sapphires (blue, green, pink, colorless, yellow, violet, brown, etc.), synthetic corundum is to be had in the following colors and made to imitate the gems as shown in the brackets: Green-red (alexanderite), Light-bluish to bluish-green (aquamarine), Pink (Morganite), Hyacinth (hyacinth Zircon), Yellow and pink (Topaz), Green and pink (tourmaline).

The properties of synthetic corundum are the same as the natural. However, due to a difference in the crystalline growth of the two, there are certain differences which will serve to distinguish the two. In the synthetic, we find that under a microscope concentric rings of color are clearly visible, and also certain structure lines, giving the stone the appearance of being composed of thin layers which are always parallel to the surface of the boule. In the natural stones, we will note that the color is often uneven, but the zones of color in the natural gems are straight, or nearly so, and parallel. Grain marks due to imperfect polishing, or striation due to repeated twinning, may be seen in the natural gems, but they are not like the structure lines found in the synthetic. In the synthetics we will often find air bubbles which are so large as to be easily seen with the naked eye, and in every synthetic will be found small air bubbles which are visible under the microscope. These can best be seen when the stone is immersed in a liquid of fairly high index of refraction. The bubbles are always round and appear the same as bubbles in glass. In the natural gems, we sometimes find cavities, but they are always of angular geometrical shapes and conform to the shape of the crystal. Also, in the synthetic, we often see a cloudy patch which is nothing more than a certain amount of unfused bauxite which is present in the stone. In the natural stones inclusions are found, but they are either liquid or of some such material as rutile, silica, etc.

(To be continued)

The Line-Cut Diamond*

A new form of cutting for diamonds has been developed; it promises soon to become popular in the trade.

by

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It has long been recognized in cutting of diamonds and other transparent gems that the brilliant cut produces the most satisfactory results from the standpoint of maximum brilliancy and fire. Caprice of fashion, however, in later years, has had much to say about how diamonds and other gems shall be cut, especially those used in a decorative background in a fine piece of jewelry in conjunction with or supporting a larger diamond or other colored jewelry.

A profusion of lines, angles, and fancy shapes are the current vogue. This has necessitated the substitution of squares, oblongs (baguettes), triangles and other fancy shapes, in the place of the small, round, brilliant cut or eight-facet diamonds (melee). Up to the time of the invention of the line-cut diamond, much of the desirable brilliancy and fire inherent in the diamond was not used to the fullest extent in these fancy shapes, due to the conventional step-cut style for fashioning the square, baguette, and other off-round shapes.

Perspective top view of a small, square, line-cut diamond. Stone appr. 2.2 mm. square, magnified 4×.

The problem of the inventor of the line-cut diamond was to follow the whim of fashion, which at present calls for small squares, baguettes, and fancy shapes, and at the same time devise a style for cutting these shapes so as to approach more closely the brilliancy and fire of the recognized best method, the brilliant cut, without increasing the weight per stone over the conventional step-cut style usually followed in fashioning square diamonds and other fancy shapes. This has been accomplished, as is proven by grants of patents not only in this country and Canada, but in England and France. The line-cut diamond approaches more closely the brilliancy and fire of the round brilliant-cut stone than any other known means thus far devised for fashioning gems in shapes other than round. Furthermore, the proportions for this style of cutting have been computed so that the refractive power of the diamond is utilized to a greater extent than is possible in the conventional step-cut form. It eliminates to a marked degree the lifeless appearance of the small diamond when cut in the conventional step style, especially when grease, dust or other foreign matter accumulates on the pavilion facets of a gem. The latter result is

*A.G.S. Research Service.

achieved by the large number of crown facets and by their arrangement.

During the years of the diamond's popularity, a number of styles of cutting have been developed with a view to releasing more of the gem's inherent beauty than was possible with more conventional shapes. Notable among these developments were the twentieth century cut, and the star-cut developed by M. Caire of France. Both of these were round, and intended to replace the standard brilliant. Though both were very effective, neither found enduring popularity; the reason probably was the added expense of cutting the complex systems of facets. In the case of the recently developed line-cut, this condition will not prevent a general acceptance by cutters as well as purchaser, since the facet arrangement of the line-cut is comparatively simple.

The line-cut fashion is more like the step-cut than any other form. However, it differs from the step-cut—the form generally given baguettes—in that its facets are not all four-sided. (See illustration.) According to the inventor, this revolutionary method of faceting gives the line-cut diamond more brilliancy and fire than is possible with the step-cut.

It is of interest to know that comparatively few mechanical patents have been issued for the fashioning of gems, especially the diamond, so to students of inventive minds, interested in gemology, the accomplishment of the inventor of the line-cut diamond should serve as an inspiration.

DIAMOND MARKET

Sales volume in the European diamond centers, Antwerp and Amsterdam, showed a slight falling-off in the past month or so, but no importance is attached to this decrease since it is regarded as purely seasonal. Prices of all types of finished stones continue to be firm and to show constant increase. Unfavorable labor conditions in the diamond-cutting centers, which had previously allowed the cost of finished stones to be retained at a very low level, are being improved and will probably result in raised prices on the finished articles. Strikes of diamond workers have occurred, and should they continue will tend to cause a rise in prices.

Fine quality larger stones continue to be in demand, and their increasing scarcity produces constantly rising prices. The demand for industrial stones, particularly of sizes from 4 to 12 carats, shows a constant increase, and has a helpful effect on the stability of diamond prices in general.

The DeBeers Corporation proposes shortly to begin washing of the blue ground on the floors of the Jagersfontein mine, which work will be followed by the washing of the blue above ground at Koffyfontein. Mining operations have been pursued at the Dutitspan since March, with one shift operating. The DeBeers Company expects to work two shifts in this mine before long.

BOOK REVIEWS

***The Key to Precious Stones,* by L. J. Spencer. Blackie & Son, London, 1936.**

Although apparently written as a popular treatise for the layman, much of interest to the gemologist is included in this recent book. Written by the former Keeper of Minerals in the British Museum (Natural History), by an author already well-known for his 1904 translation of Bauer's *Edelsteinkunde* (Science of Precious Stones), the text includes much new information, and some startling personal opinions.

The *Key* combines a scientific presentation with popular handling. There is a very good discussion of the diamond. Some valuable information on instruments and methods of gem testing appears. There is much description—unnecessary to the average gemologist—of crystal forms.

One notable characteristic of the book is its unique viewpoint on the subject of synthetic stones. Its author even goes so far as to make very clear that he considers carefully manufactured synthetics generally superior to genuine stones produced by the less controlled processes of nature.

Without doubt, *A Key to Precious Stones* is a valuable contribution to the subject of gemology.

***The Story of the Gems,* by Herbert P. Whitlock. Lee Furman, New York, 1936.**

Admirably fulfilling the promise of its title, this book—which is shortly to be released—deals with the subject of gems from the popular viewpoint. The technical side of gemology is only slightly developed, but sufficiently to serve as a foundation for discussion of more generally interesting subjects. The book in general is one which can easily be read and understood by a layman. It is recommended to those jewelers who desire to know something of the true nature of the gems, but do not wish to make a serious study of them. *The Story of the Gems* will serve as an excellent book to which the gemologist or the scientifically trained jeweler can refer those of his customers who are interested in "reading up" on this fascinating portion of the jewelry trade. It is a valuable contribution toward making the American public gem conscious by a man admirably fitted for that service. Herbert Whitlock has devoted a long and useful life to the education of the public, and this book has been long in preparation.

Especially to be recommended is Mr. Whitlock's discussion of the development of gem cutting. This chapter is thoroughly illustrated with line-drawings which, together with the text, trace the history of forms of cutting from the first crude cabochon style to the effective brilliant of the present day.

The chapter on jade also is noteworthy. In its preparation, the author has had free access to the famous Drummond collection in the American Museum of Natural History, where he is Curator of Minerals and Gems.

—*Robert M. Shipley.*

SELECTED BIBLIOGRAPHY

(Continued from last issue)

Cellini (Benevenuto)
Trattato del' Oreficeria.

Characteristics and Localities of the Principal Precious Stones. Supplement to The Jeweler's Circular: The Jeweler's Circular Publishing Co., New York.

China, Mineral Wealth. The most important books in Chinese on the mineral wealth of China (in Chinese) consist of 105 volumes. Volumes 59, 60, 61 give descriptions of metals and vols. 8, 9, 10 are about metals and minerals. The work includes material on Chinese technology and one volume (pub. in 1907) is the best volume on the mineral wealth of China, with an Atlas.

Chung Yu Wang
Bibliography of the mineral wealth of China. London, Griffin and Co., 1912.

Church (A. H.)
Colours of Precious Stones. [In Magazine of Art., i., p. 33.]
Discrimination, etc., of Precious Stones. [In Jour. Soc. Arts, xxix., p. 439.]
Physical Properties of Precious Stones. [In Proc. Geol. Assoc., v. No. 7.]
Precious and Curious Stones. [In Spectator, July 9, 1870.]
Precious Stones. London, 1882, 1913.
Precious Stones Considered in their Scientific and Artistic Relations with a Catalogue of the Townshend Collection. Wyman and Sons, Limited, London, 1908.
Townshend Collection. [In Quart. Jour. Science, Jan. 1871.]

Clapton (E.)
Precious Stones of the Bible. London, 1899.

Claremont (Leopold)
Precious Stones. Philadelphia and London. J. B. Lippincott Company, 1903.
The Gem-cutter's Craft. London. G. Bell and Sons, 1906.

Clarke (F. W.)
Plans for Collection of Gems and Precious Stones. U. S. National Mus. 1884.

Clauder (G.)
Schediasma de tinctura universali, vulgo lapis philosophorum dicta, etc. Norimbergae (Nuremberg), 1736. An alchemical treatise containing 13 folding tables having a list of minerals with their properties grouped under the following heads: Nomen, Substantia, Color, Pondus, Natura, Praeparatio, Tractatio, Contenta.

Clave (Estienne)
Paradoxes, ou Traittez Philosophiques des Pierres et Pierreries, contre l'opinion volgaire. Paris, 1635.

Cohen (E.)
Ueber Capdiamanten. [In Neues Jahrbuch, i., p. 184, 1881.]

Colonne (Francoise Maria Pompee)
Histoire Naturelle de l'Univers. [4 vols.] Paris, 1734.

Concerning Precious Stones and Jewels. New York, Theodore A. Kohn and Son, Jewelers.

Cooper (C. W.)
The Precious Stones of the Bible, with an Account of the Breast Plate of the High Priest, the Ephod, Urim and Thummim. London. H. R. Allenson, 1924.

(To be continued)

A Substitute for Star Sapphire?*

Man continues his attempts to reproduce the beauty of natural gems. However, with the recent appearance of a stone which admirably represents blue star sapphire, science need not develop a test for its detection. The great popularity of star sapphires stimulated its creation and will probably result in a demand for it which will be a source of additional profits for the jeweler —especially if it is sold on its own merits, rather than as an imitation of sapphire.

The stone is an *assemblage* of a simple cabochon of natural asteriated quartz (apparently rose quartz) and a thin, blue glass mirror cemented to the base — although it might be further sub-classified as a doublet, or possibly as an improved foil back—a type often used abroad in fine jewelry. It is being marketed under the name of *Star-o-Lite,* although it could probably be properly sold as backed or mirrored star quartz. The blue color of the glass is strong enough to entirely offset the very light-reddish (pinkish) hue of the rose quartz. In fact, the quartz portion of a star doublet which was tested in the Laboratory of the Gemological Institute of America was found to be almost colorless, giving rise to a question as to whether or not it may have been treated in order to lighten its color.

Although the resulting star is less pronounced than one in a fine star sapphire, the effect achieved is very good. Under casual observation from above, the stone appears to be a fairly good star sapphire. When the stone is viewed from the side, the attached mirror is immediately visible; therefore, detection is simple. Should one of these stones be so mounted as to conceal the attached mirror, it could easily be detected by a simple hardness test—an 8-point will scratch quartz (7) very easily, but will not scratch sapphire (9).

Tests show that ordinary exposure to hot or cold water, such as would be experienced when the wearer of a ring set with a star quartz doublet washed his hands, results in no appreciable damage to the stone. However, jewelers are warned against "boiling out" a piece of jewelry, in which one of the stones is set, after cleaning or repairing it. The heat of boiling water is sufficient to soften the cement joining the mirror to the quartz cabochon, and also to remove the silvered coat on the back of the mirror. Customers should also be warned not to clean rings in boiling water or with chemicals—like alcohol—which will dissolve the cement. Also, purchasers of shirt-studs or cuff-links should be especially careful to remove them before sending shirts to the laundry.

As yet, no instance of sale of a star quartz stone as a genuine star sapphire has been reported. However, it is very possible that such misrepresentation will be made, and jewelers are cautioned to be on the lookout when purchasing new stocks of star sapphires or jewelry articles in which they are set. It is also highly probable that similar stones, backed with red glass to imitate star ruby, may appear shortly.

*A.G.S. Research Service.