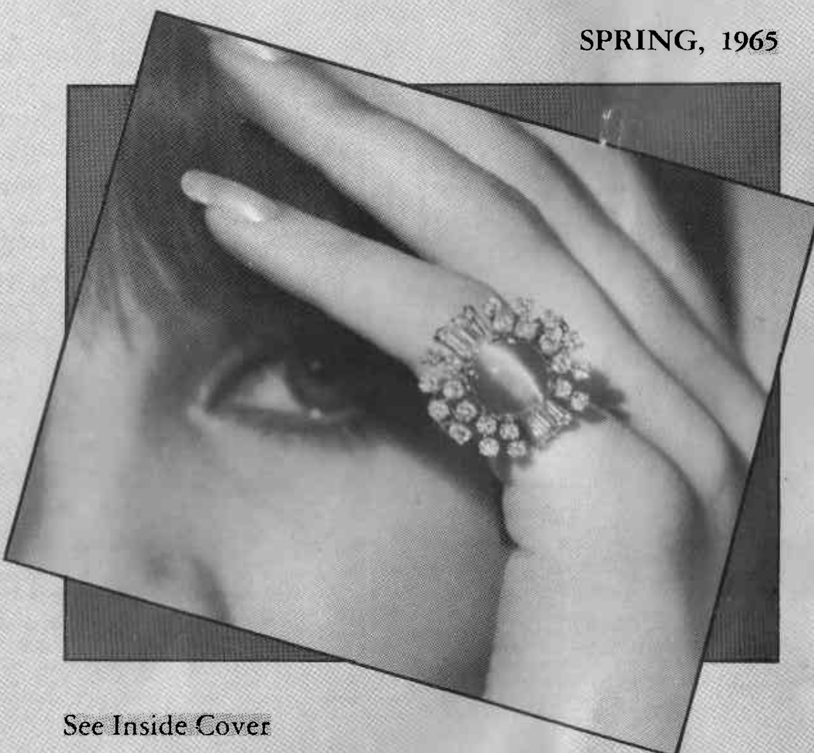
Gems and Gemology

SPRING, 1965



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Gems & Gemology

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On the Cover

Baguette and round diamonds encircle and accent a pale-green cat's-eye in a cocktail ring designed by Mermod, Jaccard, King of St. Louis. The ring is one of the 24 pieces in the 1965 Diamonds International Academy Collection.

Photo courtesy
N. W. Ayer & Son, Inc.
New York City

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New Hydrothermal Emerald

by

E. M. Flanigen, D. W. Breck, N. R. Mumbach and A. M. Taylor

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Several new commercial synthetic emeralds have become available in the last few years. Synthetic emeralds developed by Lechleitner, Gilson and Zerfass[1] have entered the market along with the well-established product of Chatham. In our opinion none of the stones marketed to date are equal in quality to first-grade natural emeralds, such as the highly prized ones from the Muzo and Chivor Mines in Colombia or from the Ural Mountains. Research investigation of hydrothermal crystal growth has been carried out over the past several years at the Research Laboratory of Union Carbide Corporation's Linde Division, Tonawanda, New York, by Dr. D. W. Breck, Miss E. M. Flanigen and Mr. N. R. Mumbach. The work has led to a process for producing all-synthetic hydrothermal emeralds of a quality believed to be comparable to the finest natural gemstones. Crystals as large as seventeen carats and faceted stones as large as three to four carats have been produced. Early commercialization of the process at the Linde Crystal Products Development Laboratory, Speedway, Indiana, by Dr. F. R. Charvat and Mr. E. M. Comperchio, is expected to result in the availability of the new emeralds later this year.

A description and characterization of the new Linde material is presented here, as well as a comparison with natural emeralds and other synthetic emeralds now on the market: Chatham, Lechleitner, Gilson and Zerfass. The

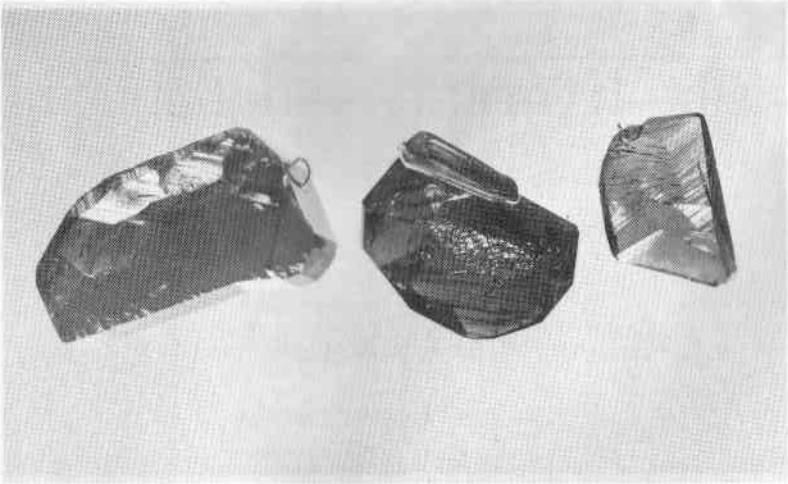


Figure 1. **Hydrothermal emerald crystals, 11.42, 6.77 and 2.52 carats**

crystal properties of the Linde stones were determined by Dr. A. M. Taylor of this Laboratory. Comparison with the synthetic products of Chatham, Lechleitner and Gilson, is based on Dr. Taylor's independent examination and property measurements, as well as on the data reported in the literature[1, 5].

Linde hydrothermal crystals usually are tabular and parallel to two opposing dipyramid faces and are bounded by first- and second-order prism faces. The basal pinacoid is always present but is very small, and a second-order dipyramid is occasionally developed. Several fully grown crystals are shown in *Figure 1;* they range in size from 2.5 to 11.4 carats. This growth habit differs significantly from flux-melt emeralds, which terminate either as hexagonal prisms (Chatham) or tabular crystals with hexagonal or dihexagonal prism edges (Gilson[1], Zerfass[2]). Natural emeralds also show a typical hexagonal prism habit. Initially, growth is carried out on a beryl seedplate. The emerald growth is cut from the seedplate and used as a seed for the subsequent all-synthetic hydrothermal emerald. The Linde product is normally faceted with the table parallel to the first-order pyramid. Distinct dichroism is seen through the table. The color more closely resembles the blue-green of Uralian or Chivor emeralds than the yellower green of Muzo emeralds. Several faceted gems are shown in *Figure 2.* The X-ray diffraction pattern and hardness of the new hydrothermal emerald are essentially identical with those of the natural material.

Synthetic and natural emeralds usually can be distinguished by their optical and fluorescent characteristics

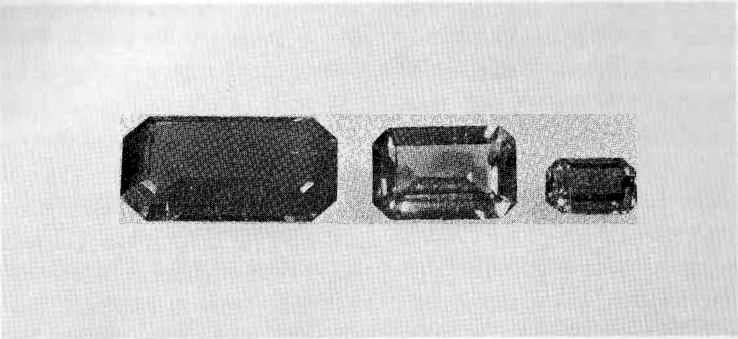


Figure 2. Faceted hydrothermal emeralds, 3.3, 1.5 and 0.38 carats

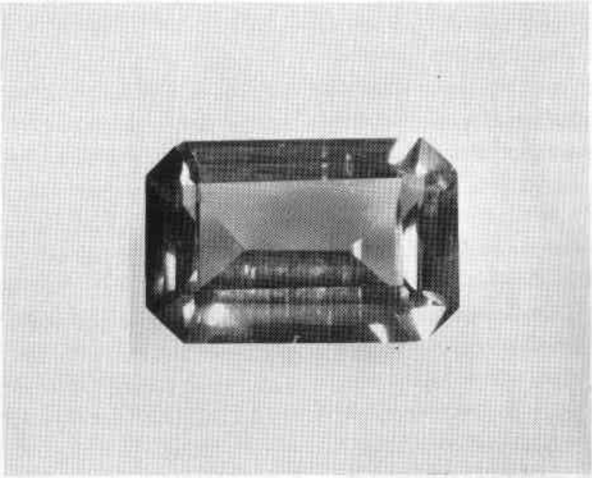


Figure 2*a*. Faceted hydrothermal emerald, 1.5 carats

and typical imperfection patterns. Natural emeralds have a refractive index of $\omega = 1.565\text{-}1.586$, $\varepsilon = 1.570\text{-}1.593$, a birefringence of .005-.007, and a specific gravity of 2.69-2.77[2]. Their fluorescence behavior under long- and short-wave ultraviolet light varies from none to a deep red, depending on the concentration of fluorescence "poisons"[3], such as iron and vanadium. Similarly, the dull-red residual color typically seen when viewed through the dichromatic Chelsea color filter[3] under tungsten light varies in intensity.

The properties of synthetic emeralds are a function of their method of growth. Flux-melt or diffusion-melt emeralds, such as Chatham, Gilson and Zerfass, show refractive indices of $\omega = 1.56$, $\varepsilon = 1.56$-1.57, a birefringence of .003 to .005, and a specific gravity of 2.65 to 2.67. Chatham and Zerfass emeralds show a bright-red residual color when viewed through the Chelsea filter, owing to their high chromium content and freedom from "poisoning" impurities[3]. This characteristic often is used to distinguish the synthetic from the natural. Exceptions have been observed; for example, in some Chivor emeralds a bright-red residual color is also seen. Also, flux emeralds grown in this Laboratory from V_2O_5 show no red fluorescence characteristics, presumably due to the quenching effect of vanadium ions incorporated in the crystal from the flux. Chatham and Zerfass emeralds, under long- and short-wave ultraviolet light, fluoresce from dull to strong red. The Gilson material is unique in its fluorescence characteristics; various authors [1, 4, 5] report from yellow to olive-green fluorescence under long wavelength, and yellow to orange to olive green under short wavelength. It shows a dull-red residual color under the Chelsea filter, more closely resembling the natural in this characteristic. Variation in color from yellow-green to blue-green in two Gilson stones examined in this Laboratory parallels the fluorescence differences. Its unique behavior is probably due to the presence of extraneous ions or inclusions from the flux, as suggested by Liddicoat[1]. Variation in both fluorescence and color are presumably caused by changes in flux composition.

The only known example of commercial emerald believed to be grown hydrothermally is Lechleitner's *Emerita.* This material consists of a seed of faceted natural beryl with a hydrothermal-emerald overgrowth. The refractive index of the overgrowth was found in this Laboratory to vary with the depth of green color, or chromium level, from the early *Emerita* to recent overlays, which are deeper green. The refractive-index range measured is $\omega = 1.577$-1.587, $\varepsilon = 1.582$-1.597, and a birefringence of .005-.010, the maximum values corresponding to maximum chromium. A specific gravity of 2.649-2.707 was reported by Holmes and Crowningshield[2]; as they point out, however, it is of little significance, since it is a bulk property and is essentially that of the natural-beryl preform, which is the main portion of the stone, rather than the emerald overgrowth. The fluorescence under short- and long-wave ultraviolet and the color through the Chelsea filter is bright red, the intensity varying with chromium level and thickness of the overlay. Examination in this Laboratory of the new beryl-emerald sandwich wafer, or beryl-emerald composite, produced by Lechleitner shows refractive indices of $\omega = 1.562$-1.567, $\varepsilon = 1.567$-1.573, a birefringence of .005-.006, and a specific gravity of 2.67-2.69. The composite consists of a central colorless hydrothermal-beryl seedplate, with hydrothermal-green-emerald layers on either side rapidly fading into colorless-beryl layers toward the table and base of the stone. The color loss may be due to exhaustion of the chromium in the nutrient solution toward the end of the growth period. A similarity in inclusions between the outermost colorless-beryl layer and the seedplate suggests a hydrothermal beryl of synthetic origin for the seedplate.

It should be noted in the above discussion that the classification of the Zerfass emerald as flux-grown differs from that postulated by Gubelin[4]. He concludes that the Zerfass emerald is hydrothermal, because of the presence of cuneate growth funnels. Experience in this Laboratory has shown that the presence of cuneiform-funnel inclusions are more a function of the seedplate orientation than the growth method *per se,* and have been observed in both flux and hydrothermal emeralds when the seedplate is inclined at an angle, especially obliquely, to the crystallographic axes. The refractive index and density are consistent with a flux-melt origin and are considered to be more characteristic invariant properties. We were unable to procure a Zerfass emerald for our own examination.

The refractive-index range for the Linde hydrothermal emerald is ω = 1.566-1.572, ε = 1.571-1.578, a birefringence of .005-.006, and a specific gravity of 2.67-2.69. These values span a chromium concentration of 0.3-1.2% and increase with increasing chromium level. Therefore, it can be distinguished from all previous fully synthetic emeralds by its higher refractive index, density and birefringence. In these properties it more closely resembles natural emerald, also presumably of hydrothermal origin. The Linde product shows a bright-red fluorescence when excited by short- or long-wave ultraviolet light, and a bright-red residual color through the Chelsea filter. The fluorescence is especially brilliant under short wave. The intensity through the filter is greater than that of any emerald tested, including Chatham.

The imperfection patterns in natural emerald are typically two- or three-phase inclusions and crystal inclusions. The latter are often crystals of halite or similar soluble salts, and probably are indicators of the composition of the crystallizing hydrothermal fluid. Flux-grown synthetic emeralds, such as those of Chatham, Gilson, Zerfass and Igmerald[2], contain characteristic wisplike or veillike feathers, usually along curved surfaces. They are distinctive "fingerprint" for flux growth. The feather inclusions normally are two phase, consisting of minute cavities containing solidified flux and a gas bubble. The Linde hydrothermal emerald appears transparent and flawless macroscopically, or under 10x magnification. The high degree of optical clarity gives the faceted stone a very pleasing brilliance. Under 400x magnification, two-phase inclusions are observed, consisting of aqueous fluid and a gas bubble *(Figure 3)*; these are similar in appearance of the two-phase inclusions in natural emeralds and are concentrated at the interface between the seed and

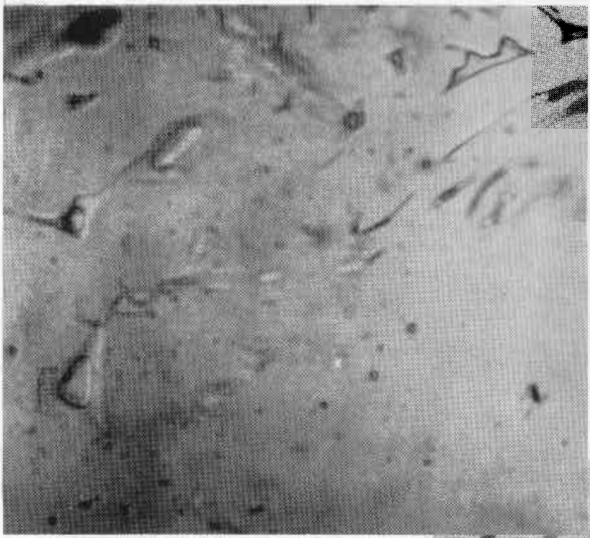


Figure 3. **Typical two-phase inclusions in hydrothermal emerald (400x)**

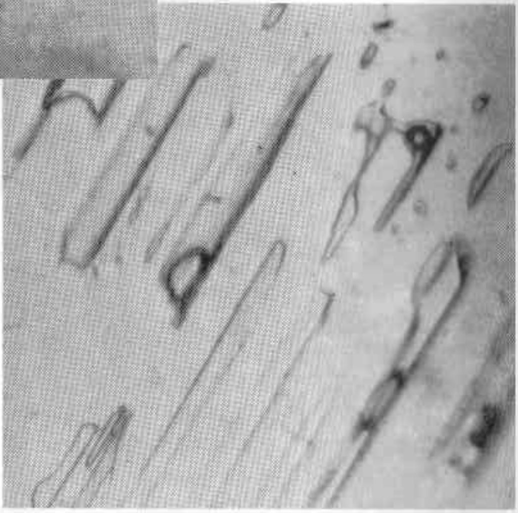


Figure 4. **Parallel tubelike cavities containing two-phase inclusions in hydrothermal emerald (400x)**

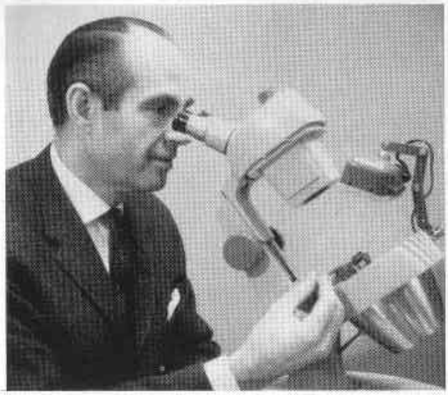
new growth. The refractive index of the fluid is lower than that of the enclosing emerald, close to that of water. In most cases, the cavities tend to be tubelike and the bubble elongated, as illustrated in *Figure 4*. Cuneiform growth funnels are often present. Phenacite inclusions have been observed but are not common. A careful examination of the stone in a liquid of similar refractive index shows a slight variation in color and chromium content at the two synthetic-emerald seedplate-growth interfaces, resulting in two thin bands of slightly more intense green.

Summary:

The new Linde hydrothermal emerald can be identified by its exceptionally high optical quality, color and bril-

Continued on page 286

Developments and Highlights



at the

GEM TRADE LAB

in New York

by
Robert Crowningshield

Trapiche Emeralds

Figure 1 illustrates the largest *trapiche* emerald crystal we have encountered. Although not of deep color, it displays the typical crystal growth beautifully. *Figure 2* is a photograph of one of the richest colored *trapiche* crystals we have seen. Thanks to student Italo DeVivo of Colombia, we had an opportunity to examine a large lot of cut stones from this material. He states that the term *trapiche* has become well known and that the stones cut from these crystals are characteristic. *Figure 3* illustrates the sizes and shapes available from the rough. The stones are rich in color but they lack brilliance, because of a texture that appears to be made up of parallel banding. Black inclusions of an flat brilliant-cut marquise diamond with an enormous culet is set above a smaller marquise. With the unaided eye, the deception might be successful; that is, unknown material also characterize many of the stones; these are shown in *Figures 4 and 5.* According to reports, trapiche-emerald rough has become scarce; therefore, cut stones may not be available for any length of time.

"Piggy-Back"-Mounted Diamond

The term "piggy back" has been used for some time, we are informed, to designate a style of mounting that employs two fancy-cut diamonds positioned to appear as one. *Figure 6* indicates the difficulty of photographing a ring of this type, in which a very

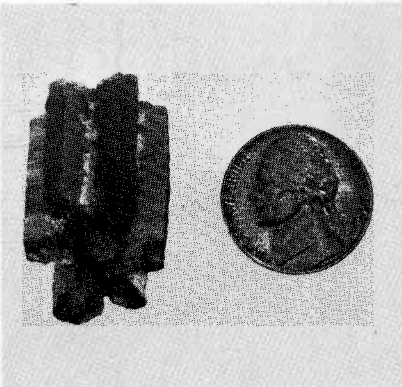


Figure 1

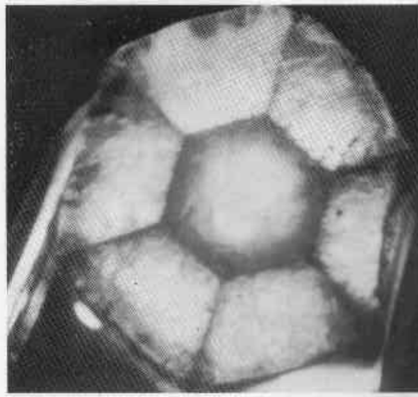


Figure 2

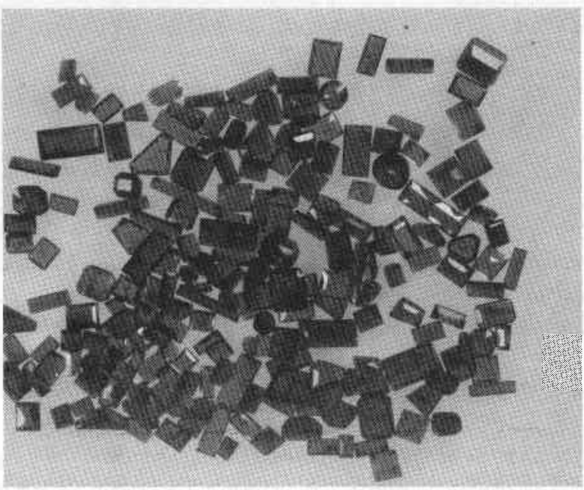


Figure 3

if dirt has not become wedged between the largest culet of the top stone and the table of the "piggy-back" stone. In *Figure 7*, the large culet of the top stone is indicated by the white arrow. The culet of the small lower stone may be seen in the center of the larger stone's culet. Conceivably, an appraiser taking measurements could overestimate the weight of the contrived stone by a wide margin.

Unusual Synthetic-Emerald Cuts

Figure 8 illustrates intaglio stones in a man's and a lady's ring and in *Figure 9* a cufflink-and-stud set, all of which are unusual cuts for synthetic emeralds. Represented as "very old," the client

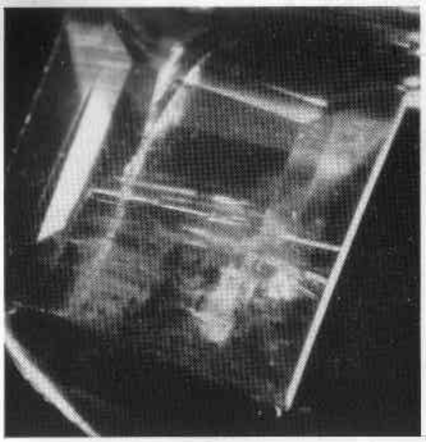


Figure 4

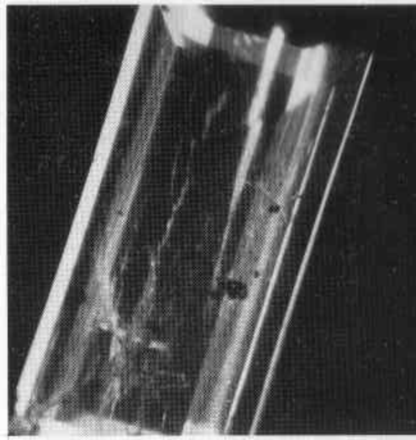


Figure 5

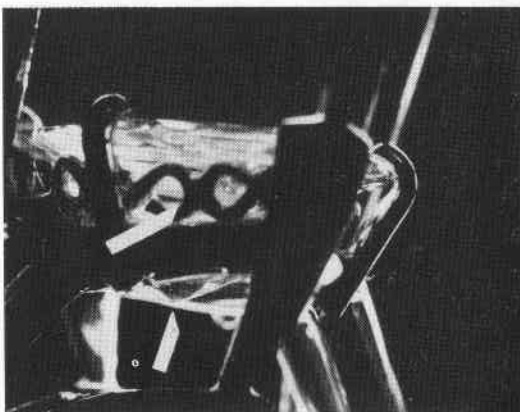


Figure 6

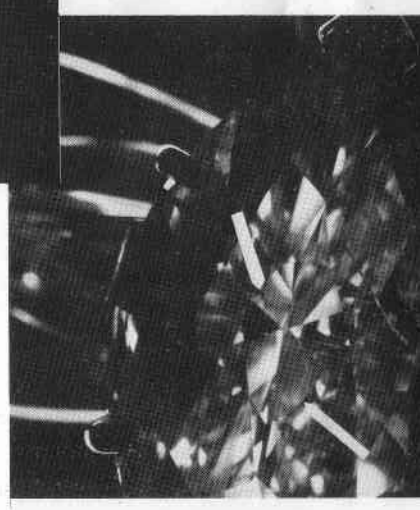


Figure 7

Figure 8

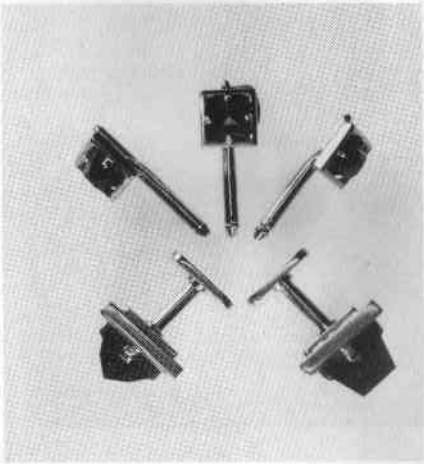


Figure 9

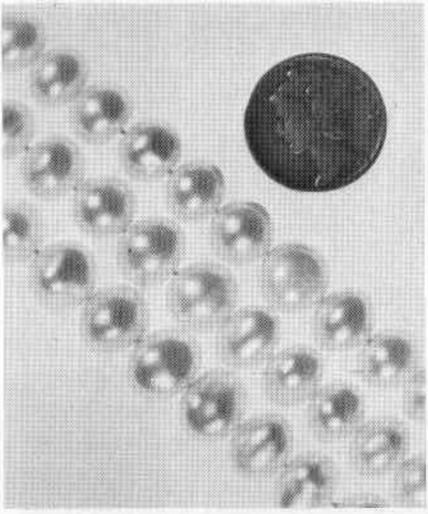


Figure 10

had purchased them overseas for a considerable sum of money.

Lake Biwa Cultured-Pearl Necklace

A long three-strand necklace of pearls, purchased abroad as natural, proved to be composed of the largest and the nearest-to-round Lake Biwa tissue-graft cultured pearls we have seen. *Figure 10* shows the center section of the necklace actual size. In addition to being large, they were lovely.

Coincidental Identifications

We have spoken before of the numerous occurrences of coincidental identifications. *Figures 11 and 12* are excellent examples. Within a week's time, two diamonds with tubular inclusions were examined. In both stones, the tubes came to the crown surface and appeared very much like those in the cut stones from the recent find of kunzite in Brazil.

Diamond Roundelles

Figure 13 illustrates two out of approximately 50 diamond roundelles used as separators in a long rope-chain necklace of natural pearls. This style of cutting for diamond is very rare.

Figure 11

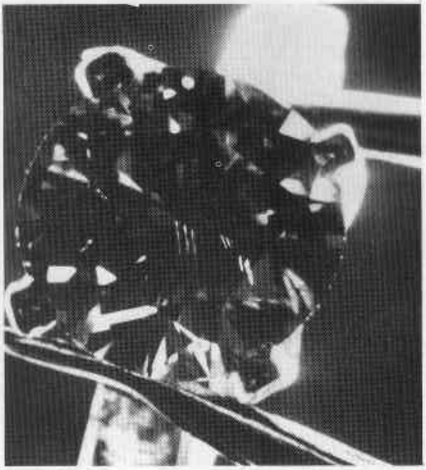


Figure 12

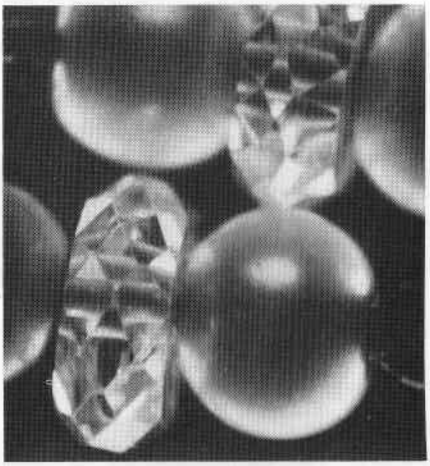


Figure 13

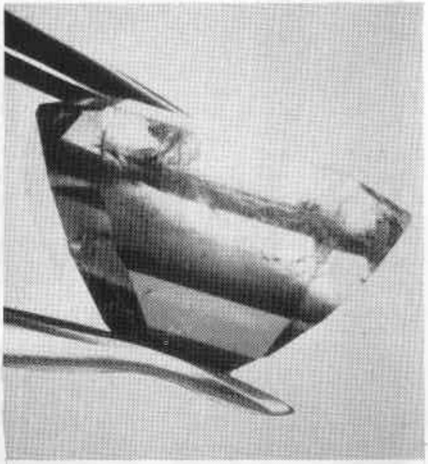


Figure 14

Colorless-Topped Natural Emerald

Figure 14 illustrates a large natural emerald in which the color was confined to the pavilion; the area near the table was colorless. It was interesting to note that on the colorless table the refractive index was 1.575-1.583 and on the pavilion it was 1.57-1.573. The photograph was taken with the stone immersed in diluted bromoform that has a refractive index of 1.56.

Clouds in Natural-Color Brown Diamonds

We have commented before on the

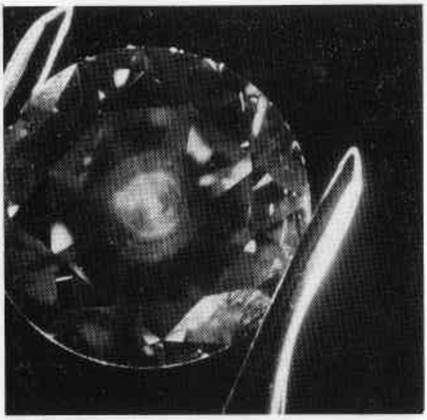


Figure 15

natural-colored brown diamonds that often have a central cloud of a very symmetrical shape. Recently, all but one of a lot of 17 natural-brown diamonds submitted to the Laboratory showed a central cloud of this type. *Figure 15* illustrates the effect very well.

Black-Treated Opals

A peculiar patchiness was observed recently in a black-treated opal, illustrated in *Figure 16.*

Conch Pearl

The flamelike structure of a conch pearl is particularly well illustrated in

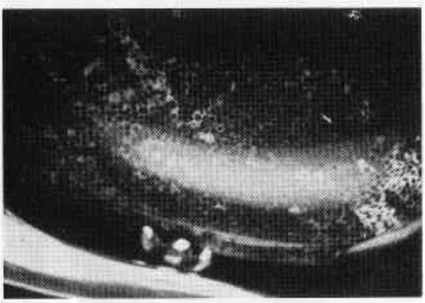


Figure 16a

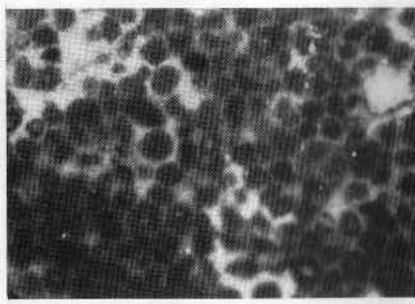


Figure 16b

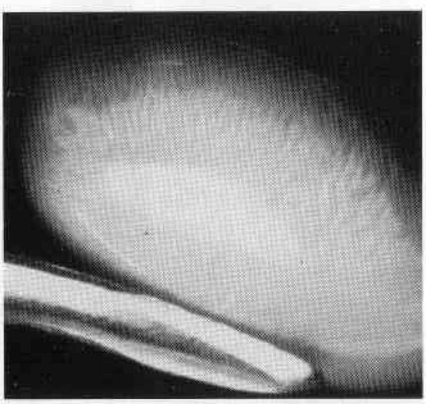


Figure 17

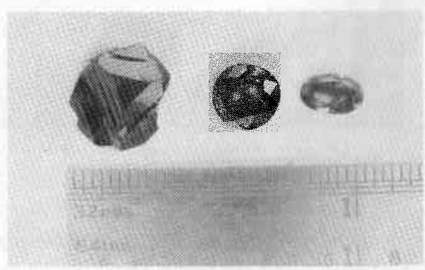


Figure 18

Figure 17, taken recently when we identified a very lovely pink one.

Flux-Fusion Synthetic Ruby

Recently, we examined two cut stones

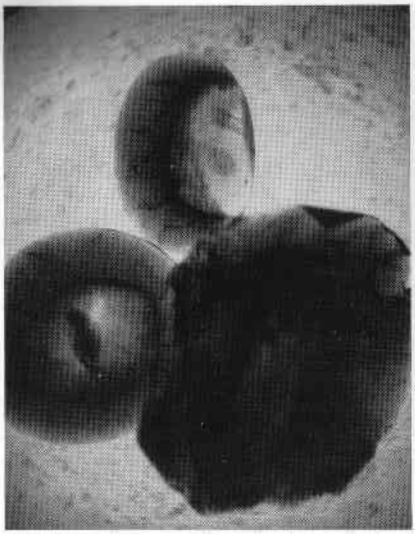


Figure 19

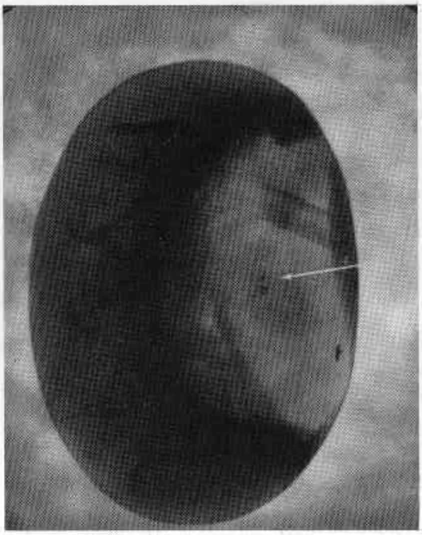


Figure 20

and a flat crystal of fine, slightly purplish-red corundum that proved to be synthetic ruby, probably grown by flux fusion *(Figure 18)*. They were part of a shipment of natural rubies from India. The crystal weighed 2.82 carats and the larger of the two cut stones, 1.02 carats. The refractive index, specific gravity and dichroism were normal for corundum; however, under short-wave ultraviolet light the fluorescence was weak, unlike Verneuil-furnace-grown synthetic rubies.

Evidence that the stones were grown from natural "seeds" is shown in *Figure 19*. Within the clearer areas bounded by the dark line we noted typical natural inclusions, consisting of angular crystals, fingerprint inclusions, Burma color distribution and patches of rutile needles. In the dark-red areas outside the seed we noted wispy inclusions, very similar to those in flux-grown synthetic emeralds.

Figure 20 shows the smaller cut stone immersed in bromoform. In the lighter area one can see two crystals, above which the rutile needles extend in a broad path to the girdle. In the darker area, dimly seen, are the wispy inclusions. *Figure 21* is a picture of the same stone not immersed. The white arrows in both pictures point out the two included crystals. In *Figure 21*, needles and a fingerprint near the crystals may be seen. *Figure 22* was taken of the crystal immersed in bromoform, to show more clearly the central seed area.

Crystals large enough so that the seed would not have to be used may be grown, in which case the more obvious and familiar inclusions of natural stones

Figure 21

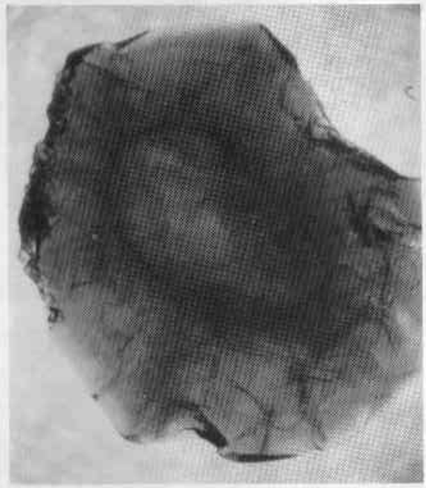


Figure 22

would be absent. If so, familiarity with the inclusions in the synthetic material is essential. In addition to the wisps, so typical of flux-grown synthetic emerald, we found numerous low-relief crystals of unknown nature.

Unusual Stones

Unusual stones encountered in the Laboratory in recent weeks included a transparent gray-blue kornerupine in a stickpin, a yellow apatite cat's-eye and several four-rayed black-diopside stars.

Acknowledgements

We are indebted to **Herbert Walters,** of Craftstones, Ramona, California, for a parcel of small tumbled garnets and zircons. The latter are of a deep-brown color that fades rapidly when exposed to sunlight; however, heating them returns the dark color.

From student **Dan Lennon** we received several valuable study stones, including a synthetic-spinel doublet that imitates an emerald.

From Gem Trade Laboratory member **Robert C. Nelson, Jr.,** we received a selection of rough green beryl in which we cannot detect chromium. It will be very useful for research purposes.

Mallorca and Imitation Pearls

by

Frederick H. Pough, Ph.D.
Santa Barbara Museum of Natural History

In recent years our wives, who religiously read and believe some of the women's magazines, seem, for some reason, to have reached a conclusion that the Island of Mallorca (or Majorca) has some connection with the finest of imitation pearls. Most husbands and all jewelers have been familiar with imitation pearls for all of their observant lives and most of us have felt that an imitation pearl was suitable for sale by the well-known chain that once sold everything for five or ten cents, and that to ask any higher price was just for the foolish.

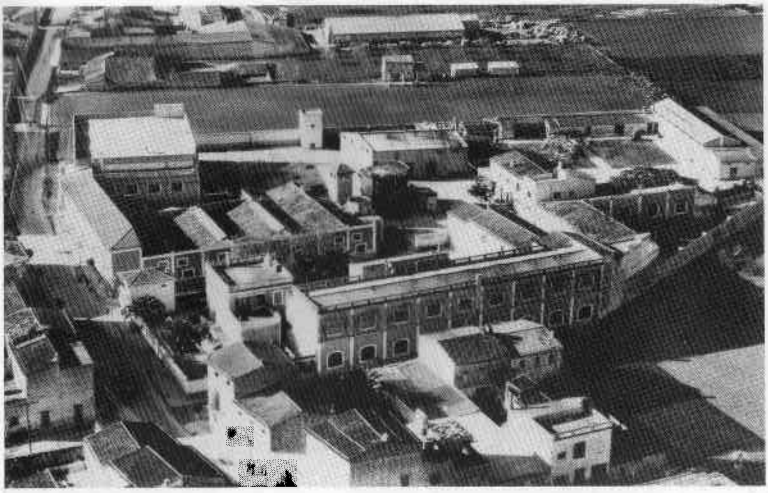
The writer once heard a story from a man still well known in the trade that well illustrates this point. It seems that, as a youth, my friend was calling on an important wholesaler and found him occupied with dipping his hand in a barrel, pulling out fistsfull of imitation pearls and then tossing them into three different cartons, one at a time, but without glancing at them. On being asked what he was doing, the wholesaler replied that he was "sorting pearls." "But you are not looking at them," my friend protested. The wholesaler answered, "America is a wonderful country; these are the $1 strands, those are the $2 strands, and over there are the $5 strands." Without stating it quite so succinctly, most of us in the trade have felt that the varying virtues of imitation-pearl necklaces were just about that significant. Hence, to learn suddenly, via the women's trade, that Mallorca is *the* place to buy imitation pearls inexpensively seems about as important as finding a real bargain in toothpicks.

On the other hand, when we check into the ladies' facts, we find that things are not as they once were, back in our ingenuous days. Imitation pearls can be expensive, very expensive. So, surely, even our not-always economy-minded spouses can't be this wrong; perhaps there is something to this Mallorca jazz after all. Investigation proves that everybody is right. Mallorca does have a maker of superior-quality imitations, for which there is something to be said, and it also has a great many makers of the chain-store quality as well. The problem is to know the difference. One thing is certain; if you go to Mallorca, you will be able to buy an inexpensive string of imitation pearls, just as the travel agents tell you. Of course, you could buy an identical strand for about half as much in the local Woolworth's, but the travel agents don't tell you that; perhaps they don't even know it! In Mallorca you can also buy the expensive strands and you will pay an expensive price, though it may be a little less than the extra handling and duty make the same strand cost in the U.S., France, Germany or Japan. The maker claims to sell to all buyers at the same price; the only differences are those introduced by duties and taxes.

There are factories all over the world making imitation pearls. Probably there is relatively little difference in their operation, and their product is fairly well standardized. One or more layers of pearl essence is flowed, by dipping, over a round, white-glass bead and, after drying, they are strung into necklaces, bracelets or whatever use is called for. It is a case of mass production, no inspection, and the cheapest possible product. The sheen is a silvery-pearly luster, and next to a strand of cultured or oriental pearls they look more like dully polished silver beads than pearls. Or, if the maker is fancy, they may be pink or blue or some other hue, still with a silvery luster. The woman who buys them pays little and is not greatly perturbed when, two years later, she has to throw them out because they have turned yellow.

Faced with this situation, and considerable competition, a Spanish firm with a factory in Mallorca, **Industrias Heusch, S.A.,** decided to see if something could be done to raise the image of imitation pearls in the eyes of its customers. Accordingly, they began a program of research into various modifications in procedures that might be instituted to improve the product. Eventually, around 1953, they succeeded in developing an imitation that did not look like a silver bead when placed next to a string of real pearls; one with some of the luster and orient that we look for in genuine pearls but did not expect to see in pearl-essence copies. They now market them under the name *Majorica Pearls,* and it is these pearls and only these that, as a result of international promotion, have given the Island of Mallorca its reputation among today's fashionable women. Their problem now is to put over the message that not all Mallorca pearls are of one quality, that there are cheap Mallorca imitations just as there are cheap U.S., Japanese or Italian imitations. The evident superiority of the Majorica grade has tended to confuse buyers into thinking of Mallorca as a grade, not a place.

The secret of Majorica's success lies in much more handling of the beads

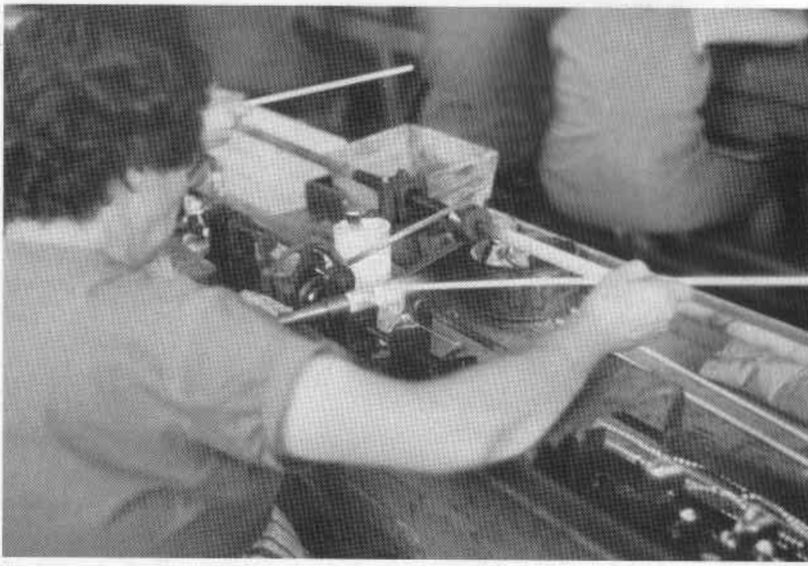


Industria Española de Perlas factory in Manacor

during the dipping process and the use of a different essence for the final layers, combined with repeated polishings and a careful grading of the product before placing it on the market. In contrast to mass production and no examination, which is the rule with most imitation-pearl makers, it is not surprising that the Majorica product has found an acceptance denied other imitations.

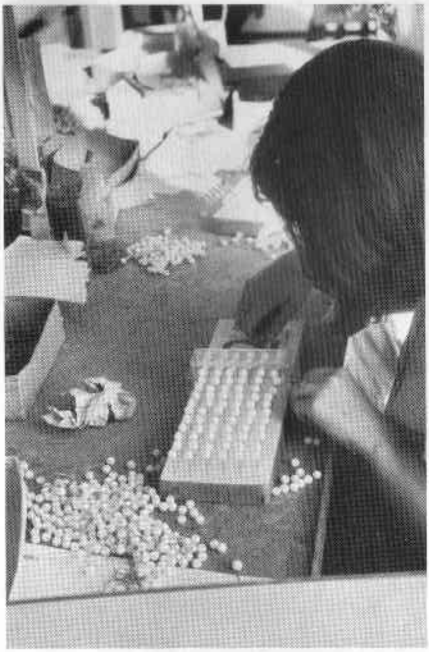
A visit to the factory of the Heusch Mallorca subsidiary, **Industrias Española del Perlas Imitación, S.A.,** in Manacor, about 30 miles east of Palma, is interesting; there, one can see the whole process, starting from the white-glass rod to the finished necklace. The same company has a tourist outlet and demonstration factory for the lower-grade product on the town square in Manacor, a place to which tour guides carefully shepherd their charges, just in case they have got so far on the Island without already having succumbed to the lure of a bargain and souvenir. Downstairs there is a salesroom, and above, redolent with a smell of lacquer so intense that one would almost be afraid to light a cigarette, are rooms populated with girls who are dipping bead-strung wire racks into flat pans of essence and setting them out to dry. The tourist-demonstrated process, however, is one of the lesser grades of **Industrias Española's** products; the top grade is done exclusively at a factory on the edge of town. Only there have they the freedom from traffic and the controls over conditions that will let them make something that is to be as critically graded as the Majorica quality.

Largely self-sufficient, the factory employs some 873 workers, a figure about half the total number of Mallorcans engaged in the making of imitation pearls. Their tasks are varied: Some are



Melting the glass to make the beads that become the basis for all simulated pearls

The larger beads are individually set in short lengths of wire to make up pincushion-like rectangles



Individually mounted beads on wires are set into blocks that are inverted into the lacquer-filled trays

Dipping the glass beads in the pan of lacquer, ensuring a quick and even layer of essence

kept busy chopping wood to keep the fires burning, while others work in glass-walled antiseptic rooms wearing white smocks and tending the still-secret machines that have been developed by **Industrias Española** for some of the processing.

Mallorcan wood is used as a source of the gas needed by 200 girls who work in the largest single room in the factory, turning out the white beads that are the basis of the imitations. The beads are made on a clay-slurry-coated wire from a white glass that comes in the form of long rods. The tips are melted to form one round bead after another along the wire. The size is judged by eye, and the girls become very skillful in time. Only about one applicant in ten can do this, for it is one of the most skilled jobs in the factory. After a trial of a month or so, the foreman can tell if a girl is going to prove satisfactory or not.

The beads cool quickly and then are slipped off the wires. An old step, of dissolving out the copper wire in acid, has been obviated by the slurry coating, which keeps the glass from adhering so tightly to the wire. They are then sieved for size, each millimeter of diameter being separated into four sizes and examined enough to remove any obviously faulty spheres.

Upstairs, depending on the size and quality of the necklaces for which they are intended, they are strung once again onto wires that run back and forth along a rack or that are mounted on stiff wire

Polishing and resetting the beads in preparation for further coating layers

Checking the finished pearls for any blemishes that would make them unacceptable for the finest strands

Nipping off the hanging drop of excess essence coating, the final preparation step

pins and stuck in rows in a rectangular block, like giant-headed pins in a mammoth pincushion. The latter are for the Majorica quality; they will receive special attention, which the wire-strung ones will not. The beads are then dipped into shallow pans filled with a cream-fluidity essence and placed on a great rotating rack to dry. As they come around again, they are lifted off and dipped again.

The pin-mounted pearls are handled a little differently. After a few dippings, they are removed from the blocks and each is polished in a chamois with a bit of polishing dust. They are then set up a second time and dipped in fresh essence, this time a natural one derived from fish scales. This is the old *essence d'orient,* which has been superseded almost everywhere by the synthetic compound that is the near-universal basis of today's beads. **Industrias Española de Perlas** has agents in several fishing ports who procure scales from the fishermen. They get them by providing the fishermen with special double-layered

Miss Monica Ragby, winner of the 1963 Miss United Nations contest, which took place in Palma

Crown worn by Miss United Nations at the 1964 ceremony

nets that retain the scales knocked off by the struggling school. The *guanadine*, the pearly material, is freed from the scales by dissolving the latter in a petroleum product and concentrating the pearl matter. This is shipped in large cans to Mallorca for further refining and incorporation into the lacquer.

Much of the fine iridescence that can be seen in the Majorica pearls, in contrast to the cheaper ones, is attributed to the continued use of this natural essence.

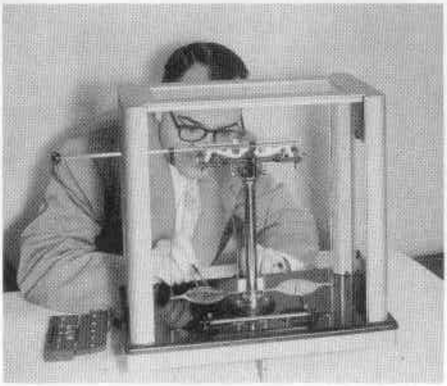
Following a second polishing operation, the pearls are coated with a protective layer and sent to other workers who remove the pins, puncture the holes, and examine them for perfection. Following approval, they are sorted into their respective sizes and strung on strings, just as are cultured pearls.

Industrias Heusch Reunidas, S.A., attribute the success of their product to the careful quality controls that they maintain at all times, plus their marketing policy. It was interesting to compare necklaces made several years ago; Heusch keeps each 10,000th necklace for this reason and numbers each strand. Those made some years ago had not darkened at all. An international advertising campaign has prepared a market with considerable success. A guarantee that accompanies each strand is claimed to be really valid and enforceable, for the buyer is not obliged even to return to the original seller to get satisfaction. Alberto Heusch estimated that they have to make good on the guarantee about once in 10,000 strands. In general, they know that they are perfect when delivered. Since the final coating is claimed to be reasonably resistant to most hazards, even including perfume, damage for which they can really be held responsible, or for which an owner might consider them responsible, is relatively infrequent.

Prices seem high by comparison with most other imitation and cultured pearls. In the smaller sizes, they may sell for half as much as a cultured strand; but as the diameters grow, cultured pearls appreciate in price much faster than the Majorica product. The greatest sales volume is in the nine- or ten-millimeter strands anyway, where there really is a great difference. Each strand is numbered and is accompanied by a little certificate giving the 5-year guarantee. In each country there is an exclusive distributor who handles them for that country. In the U.S. it is Trifari, Krussman and Fishel. U.S. sales represent about 15% of the total, Spain's 50, and Japan's, where a distributorship was established only a year ago, already 1½%. Total annual sales are between 300,000 and 400,000 necklaces at the present time, with the number rejected at final inspection well over this figure. Despite the great loss this represents, for nothing can be salvaged except the beads, Heusch adheres to this policy. He knows that the only way the company can maintain the standing is by consistently turning out a flawless product.

The writer wishes to thank those who were so helpful to him in visiting the factory in Mallorca: Mr. Louis F. Krussman, who made all the arrangements; Mr. Alberto Heusch of Barcelona, from whom the commercial details were ascertained; and Señor Pedro Riche Rousset of Palma and Manacor, manager of the factory.

Developments and Highlights



at the

GEM TRADE LAB

in Los Angeles

by
Richard T. Liddicoat, Jr.

Emerald Fluorescence

A natural emerald was sent in because the jeweler was curious about its strong yellow fluorescence. The cause was a plane of white arborescent inclusions in a large separation that extended most of the way through the stone *(Figure 1)*. It is possible that this separation was filled with material during the polishing operation.

Window at the Culet

Another rich-green-appearing stone was set in a gypsy mounting. There was no question about its natural origin, since it had natural inclusions, plus the refractive index and birefringence of emerald. However, if the stone contained any green, it was too weak to reveal even a faint absorption spectrum. Around the culet of the stone in *Figure 2* can be seen an area where a green filling behind the stone had drawn away, leaving an almost colorless opening. Another such opening is visible in the upper right-hand corner of the photo. There were several others.

Surface Condition on Conch Pearls

Five conch pearls were sent in to be identified recently. In *Figure 3,* the bright, roughly triangular area is a light reflection. The surface of most conch pearls has a fairly high luster, but each of those submitted showed areas with a dull, faintly etched appearance, in comparison to the remaining portions. Such

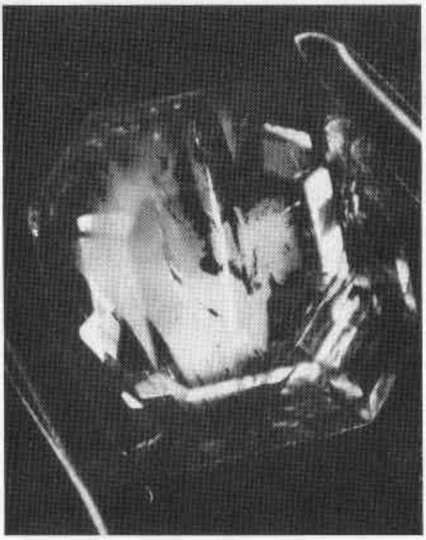


Figure 1

Figure 2

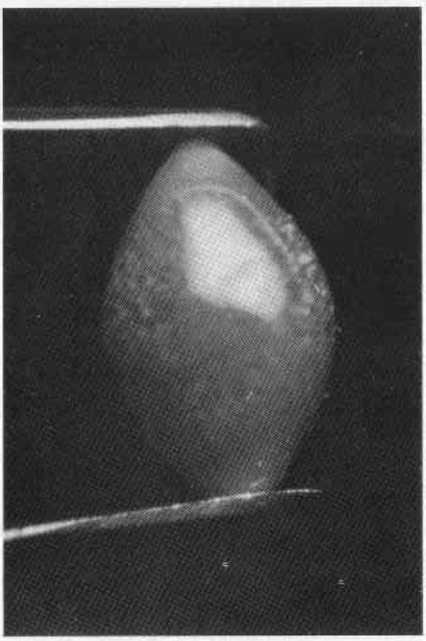


Figure 3

a dull area is shown faintly on the right side of the light reflection. This may be a common feature of conch pearls, but we had never noticed it in the past. The characteristic flamelike structure of conch pearls is visible out of focus around the bright reflection.

Prominent Curved Striae

Two oval mixed-cut stones of about the same size were submitted for examination and identification. Both were synthetic corundum, but the curved growth lines were so obvious that they could be identified by the unaided eye from a distance of several feet. The ruby is shown in *Figure 4,* using reflected light only for illumination. The while lines are masses of bubbles. The sapphire is shown in *Figure 5;* its prominent growth lines are caused, as might be expected, by uneven color distribution.

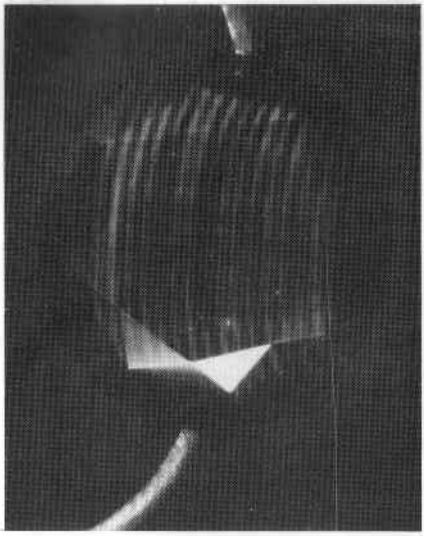


Figure 4

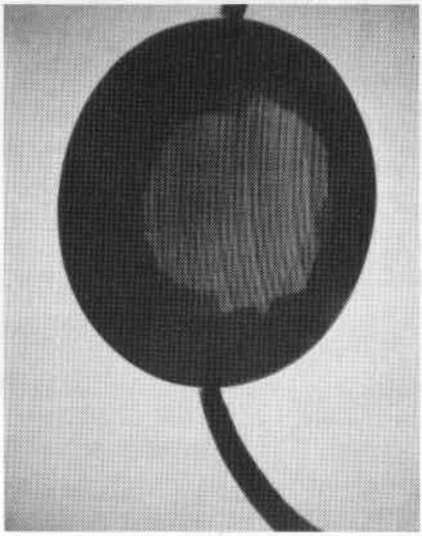


Figure 5

Figure 6

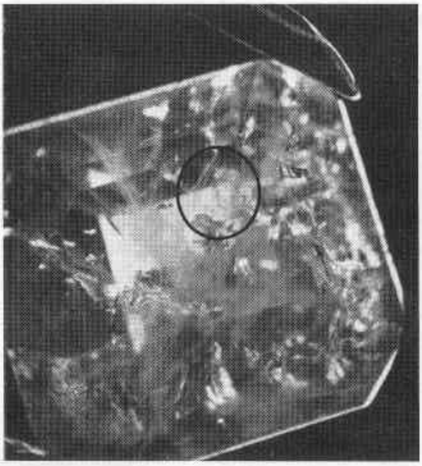


Figure 7

Semioriented Separations in Synthetic Emerald

Figures 6 and 7 show a characteristic of some synthetic emeralds; often, several appear in the same stone. This is a series of cracks, very roughly hexagonal and prismatic in outline. They are oriented parallel to the optic axis. Sometimes, they appear to be the rough outlines of individual crystals in parallel growth. *Figure 6* does not show this very clearly, but the shiny reflections from the breaks that penetrate the stone from the table are visible. The outline is still poorly shown, but some are more discernable in two areas encircled in *Figure 7*. Often, the cracks do not form a complete 360 degrees, but only three or four sides of the six may be visible.

Burned Diamond

Figures 8 and 9 portray a burned diamond. It was interesting to see that the affected area was so sharply defined and apparently related to the crystal structure of the stone. Although in the photographs it would appear that the outline is square, Arlo Herring, the San Jose, California, jeweler who took the photos, said that the corners were not right angles but slightly off.

Burned?

Another diamond was thought to have been burned during a repronging operation. When the stone was examined under high magnification, it was clear that no damage whatever had occurred to the surface. Apparently, the stone was so fluorescent that it became very cloudy in daylight, leading the owner to believe it had been damaged.

"Black Jade"

A black cabochon in a piece of jewelry composed of several colors of jade failed to show the usual properties of the black stones used in this kind of jewelry, which usually is nephrite. Three received in succession had indices in the high 1.50's and a lower specific gravity than nephrite. X-ray diffraction of one showed it to be serpentine.

Diamonds Stolen from Earrings

A beautiful pair of diamond earrings, each set with many carats of both emerald cuts and round brilliants, was brought in to be photographed. The jeweler who had made them several years before, was reappraising them when he realized that they were one link short on each drop, a fact that had not been noticed by the owner. Missing from each earring was a round brilliant of about five grains. *Figure 11* shows the crude filing job done to remove the evidence after the link had been cut off.

"Synthetic Aquamarine"

We received a stone for identification, accompanied by a note stating that it had been sold to a customer with the claim that it had been made by melting chips of aquamarine. It was described as the most recent advance in the field of gem synthesis. The stone was the usual blue synthetic spinel, which is sold in error so frequently as "synthetic aquamarine."

"Bargain Emeralds"

A jeweler brought in several rings set with stones that had been bought in Hong Kong as emeralds. They were taken to a jeweler in this country, who pronounced them as emeralds of great value, without testing. On the basis of his appraisal, the woman and a companion returned immediately to Hong Kong and spent all the money they could raise to purchase the "bargain emeralds." They were all poor examples of Gilson synthetic emeralds, with a low degree of transparency; in addition, they were cut very poorly. Even had

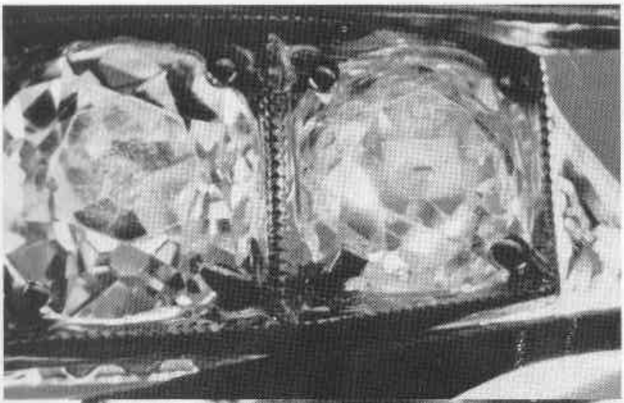


Figure 8

Figure 9

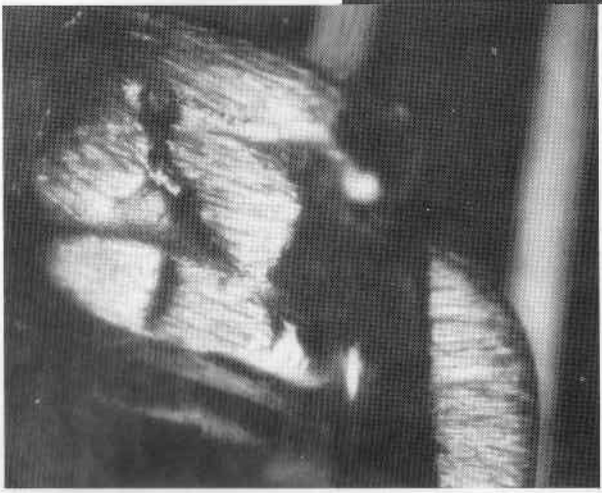


Figure 10

they been natural emeralds, their value would not have been great. Later, the woman herself visited the Laboratory with many more pieces of jewelry; each was set with synthetic emeralds.

An Impossible Situation

Another woman brought us an emerald-and-diamond ring that had two chips at the girdle and a cavity on the crown of the emerald. It had been remounted from an old ring that had been purchased in Poland just before World War II. Her concern about the minor damage evaporated when the stone proved to be synthetic emerald. It was larger than anything that Chatham was marketing at that time; in fact, it would seem to have had to be less than about fifteen years old.

Cultured Pearl or Mabe?

A jeweler brought us a cultured pearl that could best be described as either a high button shape or a slightly flattened sphere. A band of metal set with diamonds encircled it completely at its widest diameter. The jeweler was concerned that perhaps it was two mabes joined, with the joining plane hidden by the metal. Fortunately, there was one point where the metal was not tight against the pearl, so magnification made it possible to see that it was a single unit, instead of two mabes.

Continued from page 265

liance. The gemologist can distinguish it readily from other fully synthetic emeralds by its high refractive index, birefringence and density. These properties resemble those of natural emerald, but its bright-red fluorescence and color through the Chelsea filter should differentiate it from most natural stones. Differences in crystal inclusions should provide an additional distinction. Although the optical and density characteristics of the Lechleitner beryl-emerald composite are like the new Linde product, the sandwich, or wafer, makeup can be discerned easily when examined in a fluid of like refractive index. The Linde hydrothermal emerald represents a new source of excellent-quality synthetic emerald, comparable in beauty to the finest Chivor, Muzo and Uralian emeralds.

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Book Reviews

THE ROMANCE OF SEALS AND ENGRAVED GEMS ***by Beth Benton Sutherland. Published by The Macmillan Company, New York City. 174 pages, 141 black-and-white illustrations. Price: $6.95.***

Starting her art training at Skidmore College and reaching the apex of her career as one of America's most distinguished gem engravers, Beth Benton Sutherland now tells the fascinating story of the little-known glyptic art in her recent book entitled *The Romance of Seals and Engraved Gems.*

In a thoroughly readable and entertaining manner, the author discusses fluently and enthusiastically the years of painstaking effort required to master this exacting craft, acquaints the reader with the techniques and stones used, explains the kinds of designs that characterize each era, and demonstrates how more sophisticated cultures created new kinds of seals with a wider range of uses. These included marking the dynastic succession of kings, conferring power on ministers, identifying coins, and confirming a marriage contract (the origin of the wedding ring). The book concludes with a brief discussion of seals and gems in modern times, a list of tools and techniques of the trade, the materials used for engraving and their hardness, a synoptic calendar and a bibliography.

Mrs. Sutherland is well qualified to write a book on this subject. After a long and arduous apprenticeship under Ottavio Negri, one of the last of the great gem engravers of the world, she traveled extensively, visiting museums and perfecting her knowledge of this ancient craft. Her engravings have been exhibited widely and are included in many museums and private collections.

This book is a storehouse of exciting history, an informative and useful addition to any gem lover's library. It is illustrated with examples from all the important epochs in the history of the glyptic art. It is introduced by A. E. Alexander, gem expert and former Tiffany executive. Our only criticism is that perhaps more photographs and other illustrations would have been appropriate in a work of this kind.

JEWELS, by P. J. Fisher. Published by B. T. Batsford, Ltd., London. 112 pages, 81 black-and-white illustrations and four color plates. Price: Approximately $4.20.

In the publisher's words, P. J. Fisher, FGA, has prepared a text especially for young people and others who would welcome a book written in simple terms on the always-fascinating subject of gems and gemology.

Jewels asks and answers forthrightly such questions as what are jewels made of? where are they found? how do they acquire their color and brilliance? how are they tested? Chapter headings under which these and other subjects are discussed and explained in elementary terms include *Gems Through History, The Nature of Gems, Diamonds, Other Important Gemstones, Organic Gems, The Diamond Cutters,* and *Testing Gems.* The 112-page illustrated book concludes with a simplified property table of the more important gems.

This book should prove to be entirely adequate as a beginning text on the subject.