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On the Cover

Diamonds and cabochon emeralds combined in a necklace by William Ruser of Beverly Hills, and worn by screen star Joan Bennett. The emeralds are joined by rounded platinum links paved with diamonds. The ring, also designed by Ruser, is an emerald with interlocking bands of diamonds fanning out from the side.

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The Recognition of Surface Irradiated Diamonds

by
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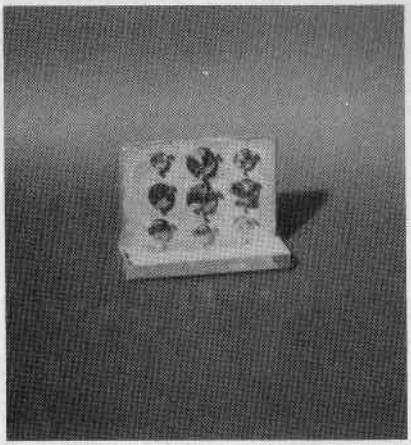
and
A. A. SCHULKE, *Washington University, St. Louis*

THE PAPER BY Martin L. Ehrmann in the summer 1950 issue of *Gems and Gemology* recounted some of the pioneer work by Mr. Ehrmann and Dr. Harry Berman of Harvard on the coloration of diamonds by the cyclotron. Mr. Ehrmann carried the work further at the Columbia cyclotron in cooperation with Dr. William Havens. In recent years, the senior writer has worked with Dr. Havens and others in an attempt to learn more of the effects and their cause, and to try to work out a means of predicting the results.

The earliest experiments on diamond coloration are reportedly those of Sir William Crookes, who, by immersing the stones in radium bromide, obtained a green coloration. This was reported, as told by Mr. Hardy in the same issue with Mr. Ehrmann's article, in 1914. Subsequently, greening of diamonds appears to have been done commercially, and radium-treated stones were placed upon the market. This treatment must have involved considerable risk, for experiments by the writer in which the diamond was exposed to a great quantity of radium, through the courtesy of Mr. Gilbert Labine of Toronto, produced negative results. At the time the diamonds were at Port Hope radium refinery they were placed in the radium safe with 2 1/2 grams of radium, but it was radium encased in glass and brass containers. Presumably, only the penetrating *gamma* rays bombarded the stones. With them was a pale yellow sapphire, a pale yellow scapolite and a light kunzite. The sapphire became amber color, the kunzite pale blue-green, and the scapolite amethyst in a period of nineteen days. The colored stones were selected on the basis of previous experiments with X-rays[1] which had shown them to be particularly susceptible to color changes. (Sapphire and kunzite accompanied the diamond at the Bikini test and none was affected in the least.) The explanation of the color changes has not yet been found; in the case of the radium treatment it is clear that the penetrating rays used in medical irradiations pass through the diamond without affecting it, for even a year's exposure had no effect. On the other hand, these same rays do affect the other stones mentioned. The effect penetrates the stone and is not only on the surface. It is also temporary, exposure to light has now removed the coloration induced by the radium.

As a result of these experiments, together with the reported success of the earlier workers, it is apparent that the coloration of diamonds reported up to now



American Museum Natural History photograph

Figure 1

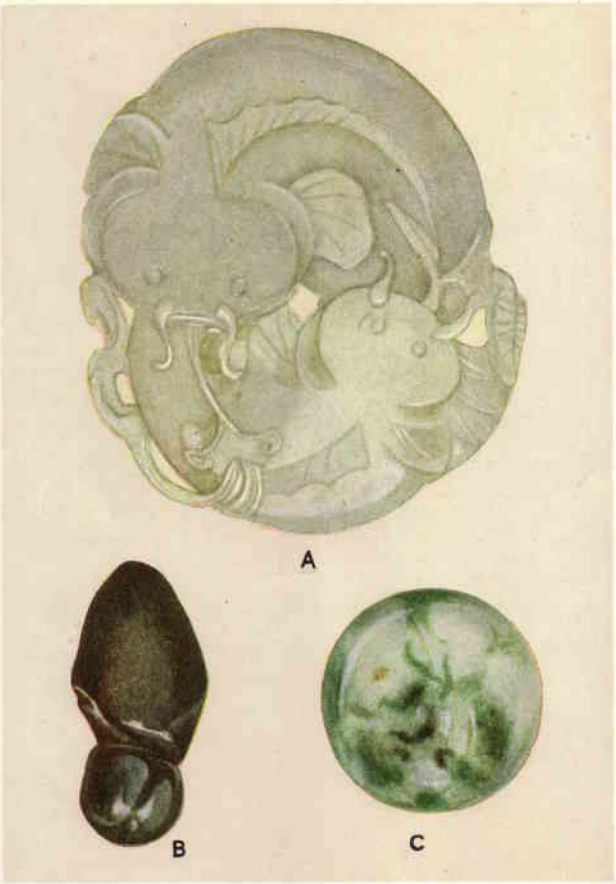
• Holder with diamonds for use on the end of copper water-cooled probe in Columbia University cyclotron.

has been affected by less penetrating radiation. Consequently, it is quite natural that the coloration would be extremely superficial, affecting only the outermost layers. The junior author has calculated that the penetration of 10 million volt deuterons amounts to 0.007 inches; not very deep. Consequently, recutting of the old radium-treated stones was, and is, a certain means of identification, without too great a loss of weight. On the other hand, the color is nice and the stone far more valuable in green than it would be in the brown or cape that will result from recutting (since obviously no one would treat a fine white stone), so this procedure is not desirable. Some stones are said to retain some radioactivity, and can be recognized by prolonged exposure to photographic film[2]. However, since some diamonds are weakly phosphorescent, caution should be observed in this test, the film should be shielded from all light, and the diamonds from direct contact with the film as well.

Temporarily, cyclotron bombardment with deuterons or protons has taken the place of the hazardous radium treatments. This irradiation is far easier, much more rapid and less expensive than the old system. Since it is now generally known that diamonds can be colored green, and sometimes brown, by irradiation, there is no longer any likelihood of deception about the nature of the color. Furthermore, it is very easy to recognize diamonds that have been bombarded by deuterons and protons; now that we have acquired enough familiarity with them. The writer has not seen any stones that were definitely known to be radium treated, but since the coloration is a skin coloration, and since skin colorations are identifiable by the means shown in the accompanying illustrations, he is reasonably confident that the radium-treated stones can be recognized in the same way.

The cyclotron bombardment of diamonds has interested physicists for some years. In the main, only small stones have been treated. The first reports by J. M. Cork[3], of the University of Michigan, appeared in 1942 in a scientific journal. Subsequently, there have been several news mentions[4] of the cyclotron treatments and a wholly speculative discussion of the possibility of neutron irradiation in atomic piles in a popular British publication[5]. Actual experiments have shown that the order of error in the calculations of the latter article is almost astronomical. Stones that have actually been placed in the atom pile have been reported to have blackened (through green) very rapidly[6].

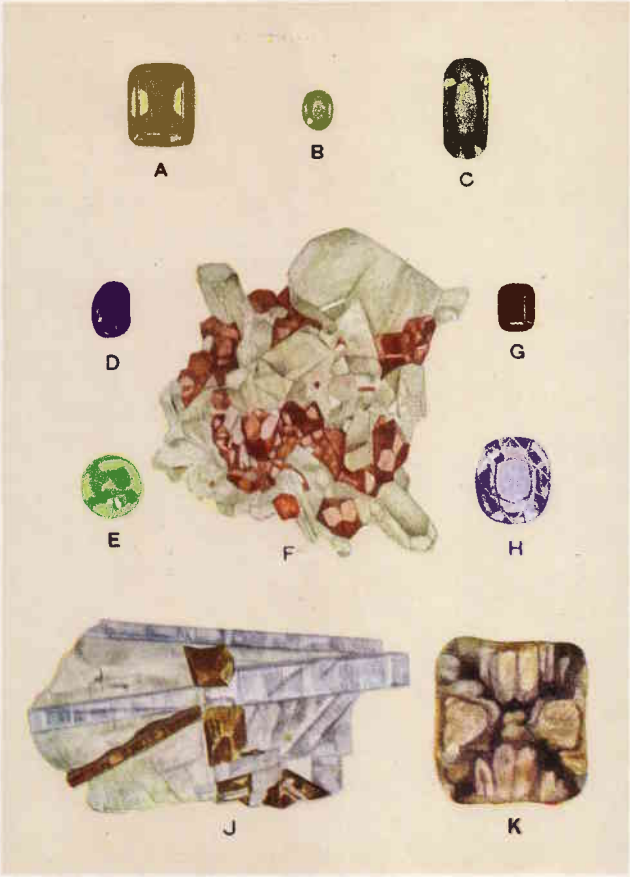
One cannot here go into the description of the cyclotron and its principles, good accounts will be found in any number of popular books. The reader will learn that there are two types of target locations possible for a cyclotron, and several types of beams and rays can be produced. The highest intensity bombardment is obtained in a cyclotron, like the old one at Columbia University, when the target is mounted on the end of a long copper tube known as a probe, and inserted into the cyclotron chamber itself. The bombardment takes



JADE

Both figures (A) and (B) are nephrite. The carved ornament at the top of the page comes from China while the darker green (B) is known as "Spinach Jade" and is most commonly found in New Zealand. The jadeite used to form the cabochon (C) came from Tawmaw, Burma. Jades may appear in black, white, violet, and reddish shades but the more closely it approaches a fine emerald in both color and transparency, the more highly it is valued. Specimens from the collection of British Museum (Natural History), London.

Printed in England.



ANDALUSITE, ENSTATITE, ETC.

The green andalusite (A) is from Brazil. This gem is strongly trichroic and when properly cut as in the illustration will display the red color. Figure (B) illustrates an enstatite, often incorrectly termed "green garnet," Kimberley. The slightly bluish green gem (C) is diopside, Zillerthal, Tyrol; (D) kyanite; (E) idocrase, often mistaken for jade. The illustration at (F) is diopside with garnet, Ala, Piedmont. (G) Idocrase; (H) fibrolite from the Burma ruby mines, Mogok. Kyanite with staurolite in mica schist from Pizzo Forno, Faido, Switzerland, is pictured at (J). Figure (K) shows chiastolite, a variety of andalusite, Fresno County, California. Specimens from the collection of British Museum (Natural History), London.

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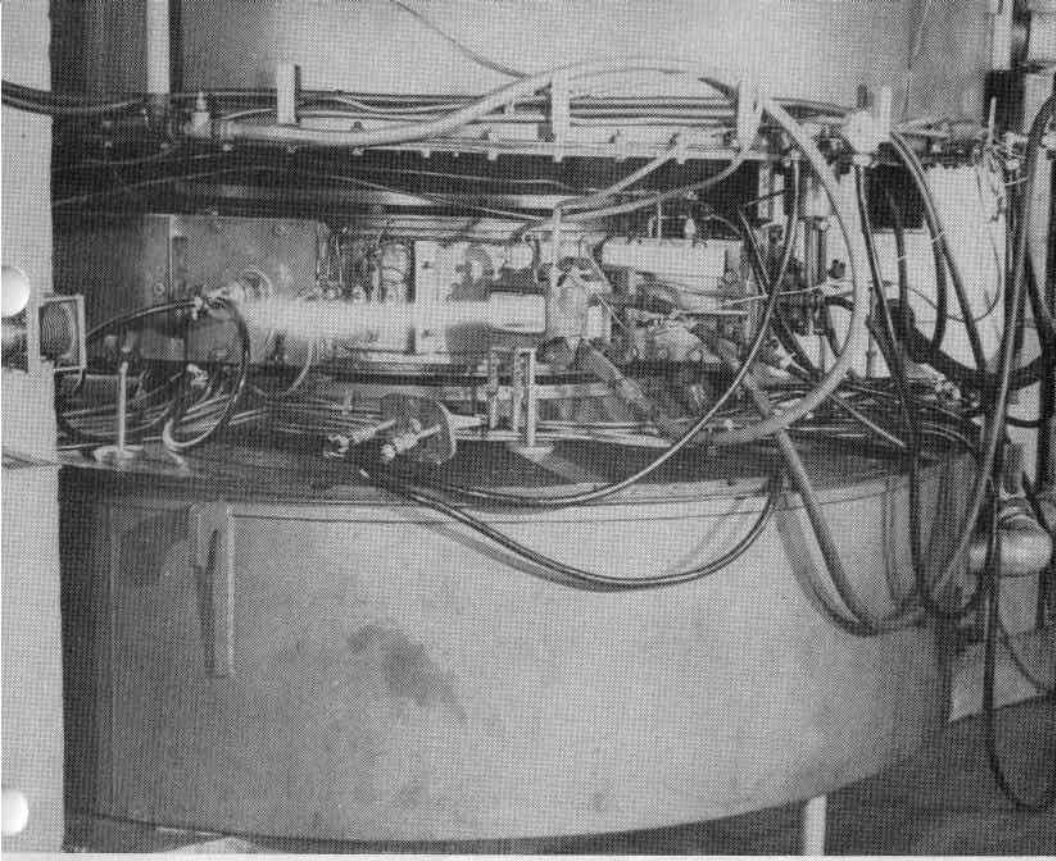


A. A. Schulke photograph

Figure 2

• The Washington University cyclotron in operation, showing the blue beam in the ionized air.

place in a vacuum, the narrow beam nearly parallels the side of the chamber and, hence, strikes the target at an oblique angle. Diamonds irradiated in this manner will be colored on the side. It is not a convenient type of bombardment to use because of the necessity of employing a secondary vacuum chamber, fitted with rather elaborate seals, in order that the probe may be inserted and removed from the main vacuum system. Since the deuteron stream strikes only one side of the stone, it is necessary either to make two treatments of each to obtain even fairly uniform coloration (exact matching of exposures is impossible) or provide some mechanism for oscillating the target during bombardment.

The stopping of the deuterons by the target produces great heat, and the whole target area becomes hot, both literally and in a radioactive sense. Hence, special mountings must be prepared, like that shown in (*Figure* 1), which will hold the stones firmly in place, yet be resistant to the heat, and not susceptible to a type of atomic transformation which will reproduce dangerously radioactive substances. The illustrated plate was made of nickel, at the base is a small tray to catch any stones that might fall out so that they would not fall into the interior of the cyclotron and involve a dismantling operation for their

recovery. The stones themselves were mounted with the shortest possible prongs on a plate which slipped into place on the mount and was locked there. The assembly was soldered to the end of the probe, the long copper tube, which is water cooled. The treatment was not entirely satisfactory from another standpoint; the beam is extremely narrow in this type of bombardment, hence, general coverage of the plate could only be obtained by moving the probe up and down to distribute the bombarding particles over the surface, and an accurate measure of the amount of bombardment that any specific stone received could not be obtained.

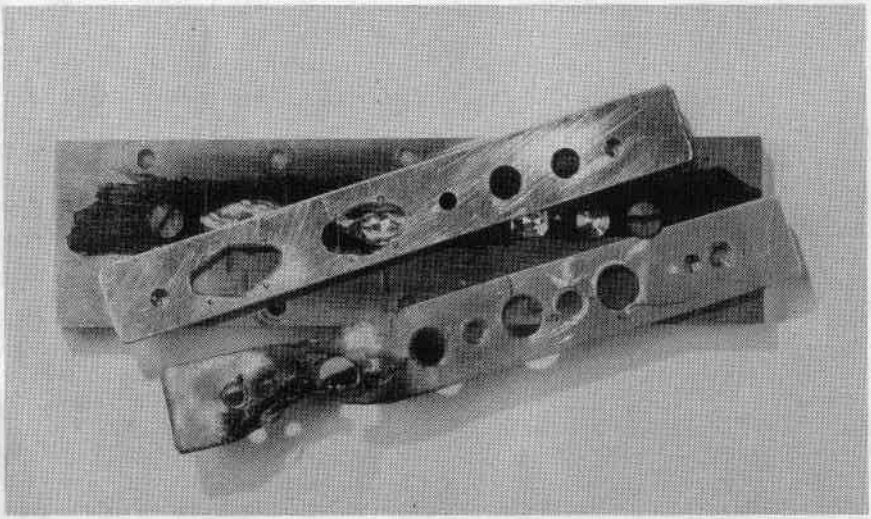
The plate illustrated had a series of diamonds ranging in color from white to cape and light brown. It was anticipated that there might be a regular intensification of coloring dependent upon the original purity. However, because of the uncertainty about the length of the exposure each had received, no conclusions about this were reached in this test. Subsequent experience has lead us to the belief that the coloration takes place in the diamond structure itself, and the impurities have no effect, the final color is the total of the discoloration added to the original color. The best green is obtained with the pale brown stones, white stones are bluer green, cape stones are noticeably yellow-green.

It is not difficult to see the triangle of color almost on the surface of the stones irradiated on the Columbia cyclotron. In some there was interference from the shadow of adjoining stones and the coloration formed inverted v's; where there was overexposure the color was actually black. However, even in these stones, there was a thin green margin which showed that to be the actual discoloration. Careful repolishing of one of these very dark stones reduced the intensity of the band and yielded a green stone; however, since the skin is so extremely thin this job is too ticklish to be practical. Heating these stones to about 800° C. changed this green to a lighter chestnut brown, but heat carried to the point of frosting of the stones (ac-

Figure 3

• Target plates from the Washington University cyclotron, showing the damage to plate resulting from heating during high-level operation.

American Museum Natural History photograph

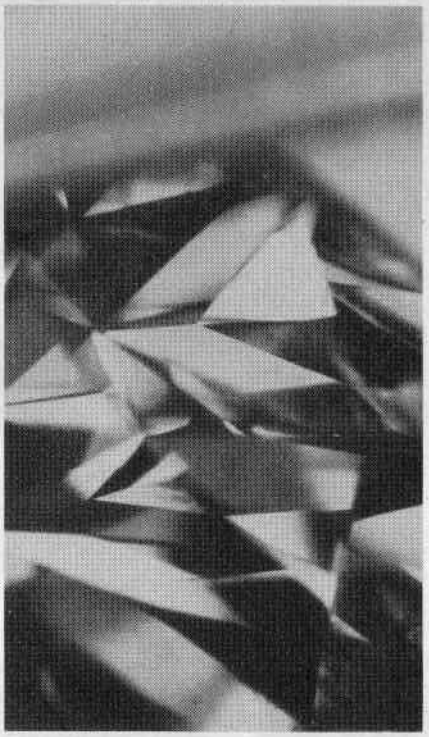


tually burning them slightly) did not completely remove it. Further experiments along these lines are in progress.

A later experiment at Columbia gave a startling result. It was expected that green stones would be produced consistently after the first series of experiments in which all went to green. However, two larger stones were then treated which were originally cape in color and the cyclotron operated at slightly higher intensity than before. To our surprise, the stones came out an attractive golden brown. The only explanation that seems acceptable at present is that the effect of irradiation at the higher temperature is to make the stones brown; producing, in other words, the same effect in the initial treatment that was obtained in the subsequent heating of the greened stones. Local heating at the time of these bombardments is undoubtedly intense, in one case at Columbia the nickel container was so badly burned that a portion of the target became unsoldered. It was quite probable that the stone was heated more than usual, with the result that the stone was actually quite hot during the exposure.

The inconvenience and unpredictability of the results at Columbia suggested that a transference of the experiments to the Washington University cyclotron in St. Louis would be more productive. Results of this work are given in the balance of the paper.

A whole series of experiments were instituted anew with the Washington University cyclotron, which can produce both internal and external beams. The external beam can be brought out some distance away from the cyclotron, by means of suitable piping, or allowed to diffuse itself in air. Under this latter condition it ionizes the air and is visible as a blue streak (*Figure* 2). Treatments are made by placing objects in this beam, either close to the instrument where the beam is narrow and intense, or somewhat further away, a yard or so, where the beam is larger and more diffused. It is obvious that this is a much more satisfactory arrangement than the probe method, and treatments are far easier.

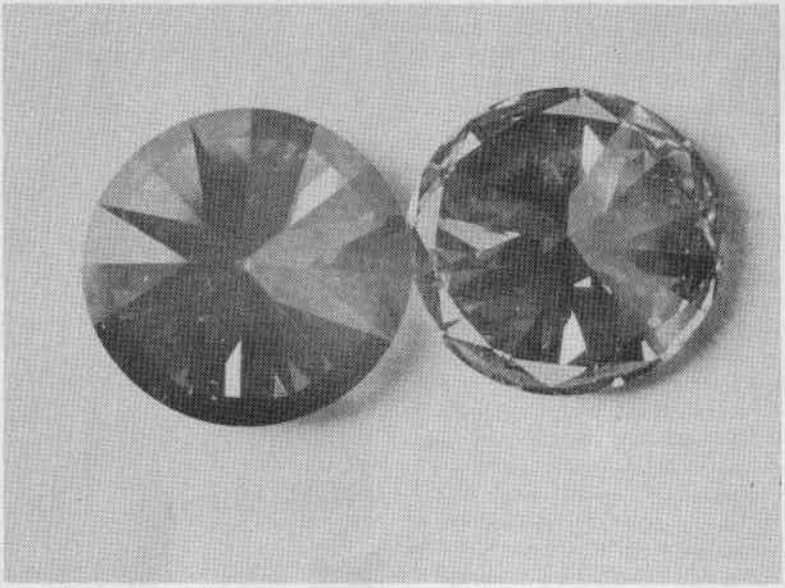


Tiffany photograph, A. E. Alexander

Figure 4

• View of cyclotron greened, top-treated stone through the table, showing triangles and lines of deep color in geometric patterns.

The Washington University cyclotron can be made to produce a beam of deuterons, protons or *alpha* particles, depending upon which gas is fed into the chamber. Most of the early work was done with deuterons, which were considered to be more effective. However, one treatment was made with protons and one with *alpha* particles, which showed that color changes could also be produced by these methods; the color of the treated stones appeared to be more green than brown for protons, and golden brown for *alpha* particles. Since further work with this form of irradiation has not



F. H. Pough photograph

Figure 5

• Pair of treated stones, viewed from the bottom, the left hand one showing a dark ring, resulting from a top treatment; the other is bottom treated and is light in color around the girdle.

been tried, it is not known whether the unusual color was caused by higher temperature and intensity, or if it is a constant characteristic of the type of particle used. It should be noted here, however, that for various technical reasons, the depth of penetration of the protons and *alpha* particles was only about half that of the deuterons.

The target area in the Washington University cyclotron is occupied by an aluminum plate (aluminum is used because it does not remain radioactive as long as other materials which might be equally workable). This plate is water cooled, but, nevertheless, becomes very hot in high intensity bombardments. The diamonds were fastened to this plate with a second sheet of aluminum in which holes had been cut to hold the stones by a few points at the girdle. Since it was felt that this type of mounting provided little actual cooling of the rather loosely held stones, most bombardments were made in an atmosphere of helium. The use of helium, which has six times the cooling effect of air, helped reduce the surface temperature of the stones below the point where they may have frosted. The impact of the beam on the target was at right angles and it was possible to set these stones so that a whole crown or pavilion would receive the treatment and be uniformly colored. Both top and bottoms of different stones were irradiated, though it was not necessary in any case to color both surfaces. The intensity of color was found to depend upon the length of the treatment. An attempt to make brown stones by a high intensity bombardment was unsuccessful, because the heat of the beam so warped the target that the stones fell out of the beam after a very short (and insufficient) bombardment (*Figure* 3).

The treatment in St. Louis was fairly predictable, but in one case it was found that in a single lot of stones one went green and two went brown. The explanation for this is a little uncertain; there has been, subsequently, reason for believing that one portion of the beam was more intense than other parts, and it is possible that the stones were heated more in one area than another. It was in an attempt to check this that the unsuccessful high intensity experiment described above was undertaken.

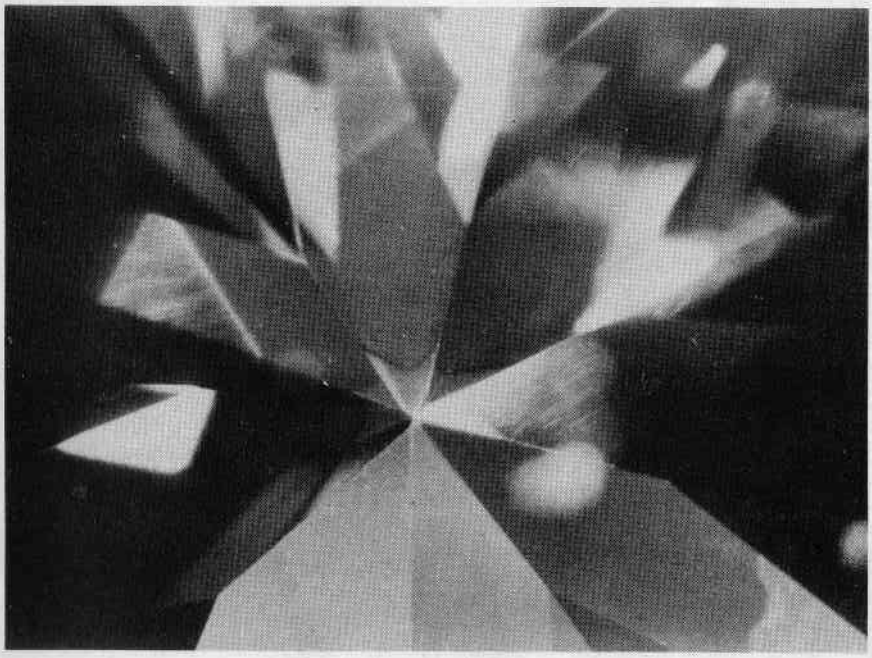
A crown-treated stone has the entire upper surface colored. When it is set, it has a uniform appearance except around the girdle border. A careful loupe examination reveals a series of reflections of triangular cubistic patterns that show varying intensities of green. This can be photographed and shows in *Figure* 4. Actually, it is far easier to see in the stone than the picture indicates. For comparison, one might look at any brilliant-cut colored stone and note that the facets reflected do not show this pattern of lines, trapezohedrons and triangles of lighter and darker hue. When such a stone is unset and examined in a paper with the culet up, there is a very dark ring to be noted around the stone, between the table and the girdle, *Figure* 5.

Pavilion-treated stones, placed bottom up on the paper, do not show this ring. Faced up they are identical in appearance with the crown-treated stones. However, the same colored streaks will be seen in the facets reflected through the star and bezel facets that were noted in the other stones. In addition, there is to be seen near the bottom, through the table, reflections in

Figure 6

• Bottom treated stone with no culet, showing dark eight-pointed star at bottom.

F. H. Pough photograph



all the pavilion facets of the adjoining facets and culet (if present) that appear to be nearly parallel to the surface of these facets, *Figures 6 and 7*. This produces a deep green framing line bordering the culet or the bottom of the stone, a short distance away from the tip. As will be noted in the illustrations, the figure would have an eight-sided angular outline if the culet were very large, and would be an eight-pointed star if the culet were missing.

Emerald-cut and marquise-cut stones show similar green bands bordering the bottom facet edges when they are bombarded in this way. In either case, the recognition of such stones poses no problem. Probably the surface-colored, radium-treated stones will show a similar concentration of color near the surface and consequently, these peculiar and characteristic deeply colored bands reflected in some facets.

A word of caution should be uttered however. It would be possible to shield a stone from the rays in such a way that only the table was colored and so produce an all-over coloration of the stone which would not be so apparent. The writers have not tried this, it would be supposed that the other crown facets would be obviously colorless at some angles and reveal the treatment. However, deuteron bombardment is only one of the treatments now possible, thanks to the physicists' recent developments. Penetrating radiation, such as from atomic piles, affect more than just the surface and, if suitably controlled, might lead to colorations quite comparable to those obtained in the cyclotron. Such coloration in depth would not be detectable by the methods pictured here.

The only natural green diamonds that the writers have seen are stones cut from crystals with minute green inclusions or with a colored skin, particularly the stones characteristic of Bahia in Brazil. The green of these stones is identical with the artificially induced colors. It is generally assumed that the colored skins were the result of natural irradiation in the ground from an intimate association with radioactive materials. Heating has had the same effect of browning that it has on treated stones. The characteristic tourmaline greens noted in diamonds, then, when they exist in nature at all, seem to be from irradiation and not, as in the case of other diamond colors, from submicroscopic pigmentation. Unless traces of the original skin with such green spots or tiny specks can be seen in the stone, the only safe assumption with regard to tourmaline green diamonds is that they are treated stones. Their value, then, should not be much higher than that of cape or light brown stones of comparable size and quantity.

It would be appropriate to say a word or two about the problems of cyclotron treatment of diamonds. The work is not without some hazard to both health and property. Since the exposures are very short and are best done at low levels of operation, it is not easy to gauge the exact strength of the bombardment, or can the effects be examined conveniently at frequent intervals. Over-treatment will, of course, make the stones too dark and must be avoided. Unfortunately, at the conclusion of the bombardment, the target area remains so dangerously radioactive that in order to examine the stones, even briefly, it is necessary to either disassemble the target behind lead shielding with long-handled tools or wait an hour or more until the radioactivity decreases to a less dangerous level. This consumes an appreciable amount of time, time that could be devoted to projects which are more important from a research standpoint than diamond coloration. Since most of the privately operated cyclotrons of the country are engaged full time in research, it is usually not at all convenient to free the instrument for diamond or other treatments that have no goal other than simple stone coloration. The expense of cyclotron operation is also very high.

Further than this, there is a great health hazard; for the target plate and the stones are intensely radioactive at the conclusion of a treatment. Some time must elapse before the stones can be safely handled, though, eventually, they do lose all radioactivity (and cannot, indeed, be detected in this way, as we have already mentioned). Nevertheless, haste, eagerness to see the result, and the cost of the idleness of the cyclotron itself, add up to an impelling and dangerous urge to take a chance and examine the stones before it is really safe. Hence, it is understandable that cyclotron operators, who have experimented and who now know more or less what will result from a definite type and duration of bombardment, are not particularly eager to undertake new experiments which will not lead to any new knowledge.

Preliminary work with other bombardment atom pile irradiations and neutrons, indicates that comparable results can be obtained, but the color is through the entire stone and is less easily recognizable, since it is not a surface skin. Furthermore, by present methods there is less health hazard and less inconvenience in some of these treatments than in the original work; if the effects prove to be equally permanent, it may be that cylotron-accelerated deuterons will be supplanted by other radiations.

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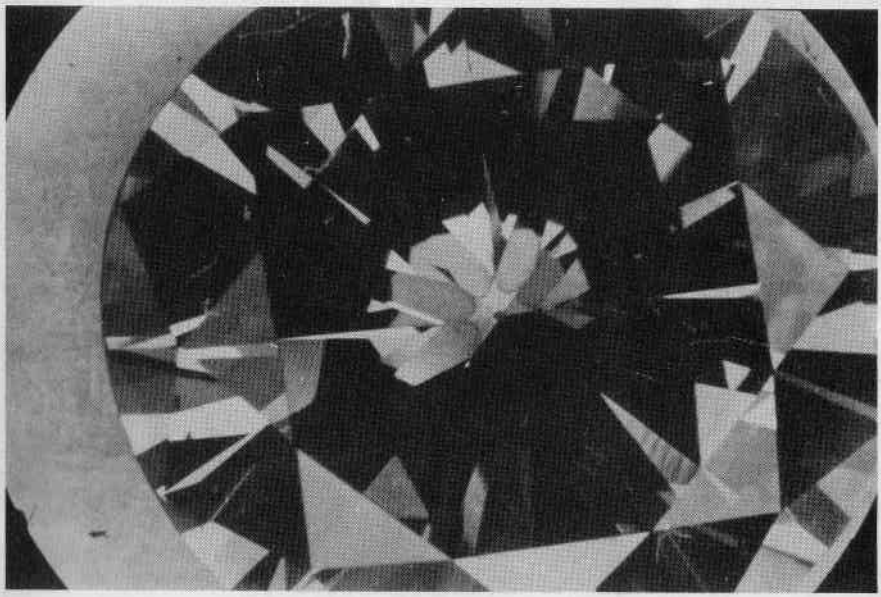
6. Letter from D. E. Blackwell, Cambridge Observatories.

Figure 7

• Bottom treated stone showing dark star pattern around culet, viewed through the table.

Tiffany photograph, A. E. Alexander



Diplomas Awarded 48 by Gemological Institute

Since last reported in the winter issue of *Gems and Gemology,* forty-eight students have been awarded diplomas by the Gemological Institute of America. Of this number, the following ten have completed both the correspondence and residence courses and have received their diplomas in the Theory and Practice of Gemology:

Robert L. Bechtel, W. Palm Beach, Florida.

Eugene C. Canfield, Jr., Charleston, S. C.

Anthony D. K. Ching, Honolulu, T. H.

John H. Frederickson, E. Weymouth, Mass.

Frank A. Grygier, Erie, Pennsylvania.

Eugene H. Hendrickson, Manden, North Dakota.

Guy R. McVay, Florence, Alabama.

Emil J. Palenik, Whiting, Indiana.

Jack E. Schunk, Bela Horizonte, Minas Gerais.

Eugene H. Young, Charleston, West Virginia.

Diplomas in the Theory of Gemology from the Gemological Institute of America, awarded upon completion of correspondence courses, were received by the following persons:

Albert B. Adkins, Vicksburg, Miss.

Lewis Bailey, Bethesda, Maryland.

John H. Ballas, Pueblo, Colorado.

John W. Belting, South Bend, Indiana.

Paul A. Bock, Williamatic, Conn.

Addis L. Bowles, W. Collingswood, N. J.

Otto H. Boysen, Great Neck, New York.

Raymond J. Cadoret, Woonsocket, R. I.

Spencer L. Carpenter, High Point, N. C.

C. Kenneth Charles, Donora, Penn.

Paul V. Coleman, Chicago, Illinois.

Richard B. Curtis, Arkansas City, Kansas.

Alexis Francis Doubet, Erie, Penn.

Robert M. Farrand, Los Gatos, Calif.

Samuel S. Finchley, East Rochester, N. Y.

John Garbosky, Scranton, Penn.

Louis Goldstein, Everett, Massachusetts

Donald F. Goodreau, Providence, Rhode Island.

Merle C. Hamilton, Lincoln, Neb.

A. J. Holmes, Jr., Lumberton, N. C.

Paul M. Hutcherson, Macon, Georgia.

Robert S. Ichikawa, Long Beach, Cal.

John E. Klohr, Barberton, Ohio.

William P. Knight, Ottawa, Kansas.

Milton M. Lifland, Levingston, N. J.

James F. Mechler, Eau Claire, Wis.

Irving Michaels, Jr., Bridgeport, Conn.

Joseph J. Miske, Ottawa, Illinois.

Alphonse S. Morris, Bridgeport, Conn.

Albert Neugebauer, Dishman, Wash.

Paul C. Nolin, Lewiston, Maine.

Jack C. Robb, Livingston, Montana.

Charles I. Schannep, Portland, Ore.

Hugh C. Schlief, Spooner, Wisconsin.

Philip F. Schnittspan, San Jose, Calif.

Harry Spiro, Detroit, Michigan.

Renato Tieger, Milan, Italy.

William Jackson Warren, Sr., Warrington, Fla.

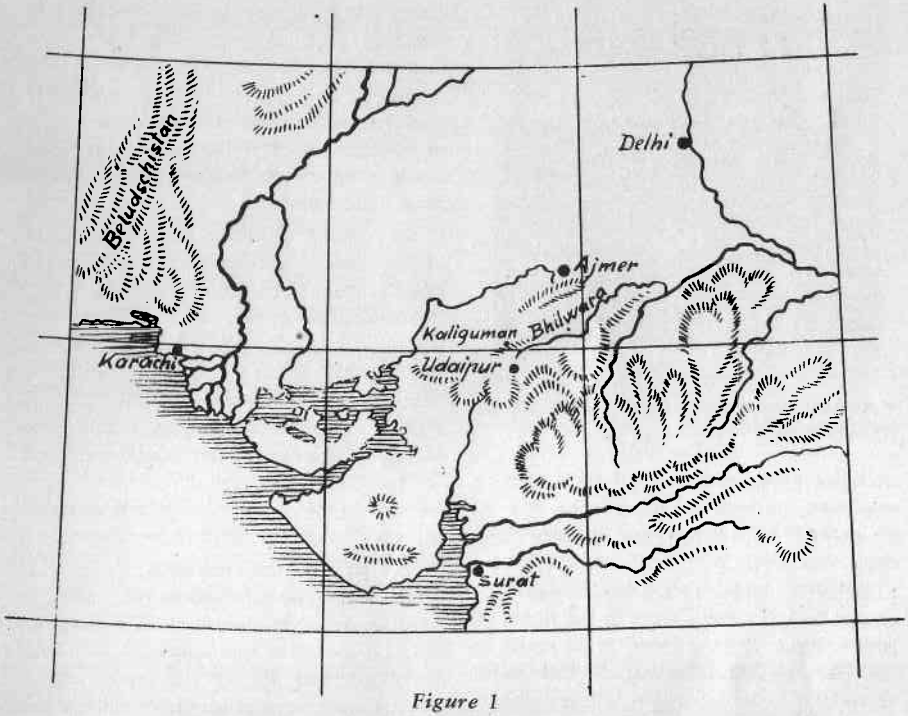


Figure 1

Some Additional Data on Indian Emeralds

by

DR. E. J. GUBELIN, C.G., F.G.A., *Lucerne*

INDIAN EMERALDS and their specific properties were the subject recently dealt with by R. Webster[1] and Dr. A. E. Alexander.[2] Both papers were still lying on the shelves of my laboratory for more intensive study when a parcel was submitted to me containing four Indian emeralds of sufficient size and quality to repay thorough investigation of their peculiarities. Far from wishing to question the statements of the other authors by publishing the results of my examination, this collection of facts not only confirms their findings, but also contributes toward present-day knowledge of Indian emeralds.

I happened to test my first Indian emerald in 1943, when I noticed the distinct difference of its inclusions in comparison with

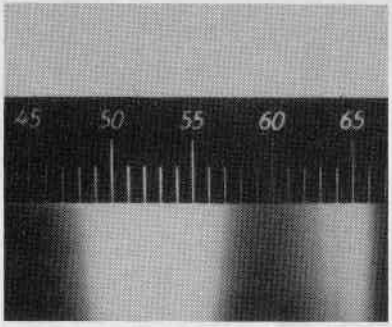


Figure 2
• Absorption spectrum of dark green Indian emerald.

anything hitherto known to me, but as it was a single specimen I was not able to draw any definite conclusions. My suspicions were, however, sufficiently aroused by its abnormality, and I took some photomicrographs, keeping them apart in the hopes of later insight. Then I tested some again in the years 1945 to 1948, at the same time as the first details of the Ajmer-Udaipur Mines became known.[3 4 5]

The mines so far under operation are located in the Arawali Mountains range, which stretches from Ajmer southwards beyond Udaipur, in the States of Rajputana and Merwara. The exact sites have been indicated as lying near Kaliguman, a hamlet halfway between Amet, and the famous old fortifications of Kaliguman, approximately thirteen miles from the station,[6] and near Bhilwara. *(Figure 1)* These new emerald sources were discovered at the beginning of the war in the course of extensive prospecting for beryl and mica in that area. As far as these latter raw materials, important to the war industry, were concerned the undertaking met with no success, but the prospectors discovered some crystals of a rich green color, which were later identified by the Geological Survey of India, as emeralds of low to good quality. Upon this exciting discovery, mining was systematically organized and was soon showing results. Emerald crystals ranging from one and one-half to five inches in length and up to one and one fourth inches in diameter were found in situ. Those described hereafter may be regarded as reliable examples of the properties of Indian emeralds, which are now appearing on the market at more frequent intervals.

This Indian deposit would appear to be of the same character as the well-known emerald seam in the Ural mountains, where the emeralds occur in a contact zone between granite and crystalline schists. Besides this Siberian occurrence those in South Africa and in the Habach Valley in Austria are of the same type. Similarity is especially striking between the Habach and the Indian deposits, and all following observations on the mother rocks and accessory minerals holds true for both localities.

The rocks in the vicinity of the emerald mine at Kaliguman consist of layers of hornblende schist upheaved at a steep incline. It measures approximately 100 yards in length and 60 feet in depth, and is southwards flanked by impure talcose and chloritic schists which alter, towards their periphery, into normal hornblende schists. The northern area has not yet been explored, but further strata of biotite schist may be expected.

The occurrence of emerald is inherent in the biotite schists towards whose depths the emerald content seem to diminish. Those interested in the study of deposits may like to know that some kind of a quartz-feldspar rock, which is likely to have resulted from a pegmatitic intrusion, was observed in the mine. With regard to the internal paragenesis the fact that pockets of actinolite and hornblende asbestos are enclosed in the biotite schists may be of some importance, since actinolite crystals also belong to the endogenesis of Russian emeralds. Occasionally a few veins of limestone traverse the housing rocks.

The workings were primarily operated as open pits, but the disintegrated nature

of the rocks and the frequent shortage of water caused the miners to sink shafts from which galleries were run into the emerald-bearing biotite schists at various levels.

It has been reported that several fine emeralds comparable in quality to the highly esteemed Colombian gems have been recovered, and those described hereafter might well be from this lot.

1). **External Appearance**

All Indian emeralds which had so far passed through my hands were cut specimens, so that unfortunately I was unable to check their crystal habit and observe external peculiarities particular to Indian emeralds. However, basing examination upon the numerous included negative crystals, it was possible to conclude that Indian emeralds develop short to long hexagonal prisms ending with truncated heads, i.e., with strongly reduced rhombohedra and a large basal plane, and consequently do not noticeably differ from other emeralds.

First specimen: A trap-cut square emerald weighing .70 carats. Color comparable to the finest gems from El Chivor. Luster somewhat harder but really vivid.

Second specimen: An emerald-cut stone of .78 carats with a rich green color similar to finest El Chivor emeralds. Vivid yet harder luster. Both stones appeared comparatively clean to the naked eye.

Third specimen: A triangular trap-cut emerald weighing .95 carats of very beautiful, pronounced emerald green color resembling a Muzo emerald with soft, velvety luster.

Fourth specimen: Comparable to specimen three, of emerald-cut, weighing 2.42 carats. Its soft, emerald green color was nothing short of finest Muzo quality and its luster had a warm yet vivid glow. The interior of the latter two stones was thinly veiled by a delicate "jardin."

Figure 3

• Phenological inclusion picture of Indian emeralds. 40X.

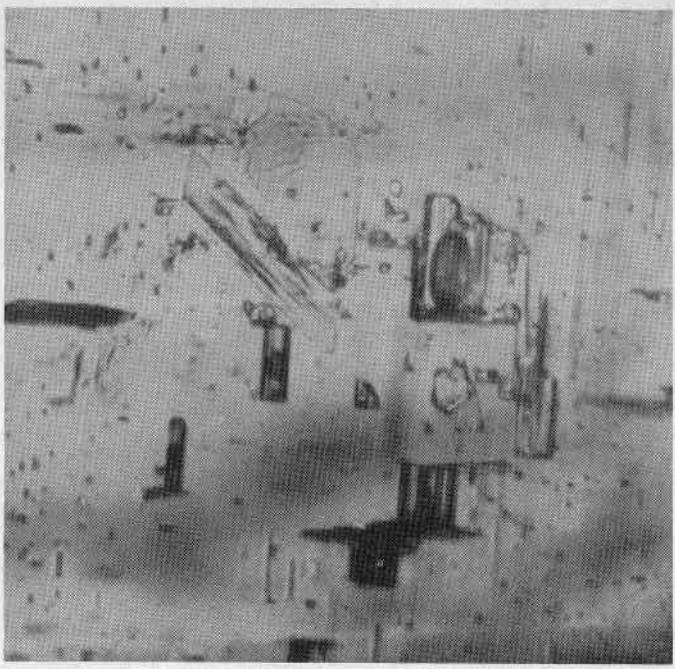


Figure 3a
• **Two-phase inclusions in Indian emerald. 75X.**

2.) Diagnostic Properties

a) *Optical Values:* Examination of the optical constants did not produce any surprise, although it was noticed that the values for refractive indices and double refraction were comparatively high—similar to emeralds from the kindred sources in Siberia and Transvaal. In order to make this survey as complete as possible, I venture to compare other authors' findings with my own.

	ω	ϵ	Bi.
C. J. Payne.[1]	1.5927	1.5853	-0.00745
A. E. Alexander[2]	1.591	1.581	-0.01
E. J. Gubelin:			
.70ct.	1.5875	1.580	-0.0075
.78ct.	1.5875	1.580	-0.0075
.95ct.	1.591	1.582	-0.009
2.42ct.	1.598	1.589	-0.009

My readings, as given above, were obtained by means of an Abbe Refractometer and checked on an Erb and Gray Refractometer. It is significant that the heavier samples gave higher data, an observation that concurs with other properties.

b) *Dichroism:* Specimens 1 and 2 showed distinct dichroism, namely: ϵ blue-green; ω light yellow-green. The darker samples 3 and 4 possessed strong dichroism, namely: ϵ blue-green; ω yellow-green.

c) *Spectroscopic Examinations:* The two lighter stones produced a normal emerald spectrum, casting absorption lines and bands onto the scale at:

ω 6830, 6828, 6758, 6640, 6460 Å
ϵ 6758, 6388, 6370, and 6300-5800 Å and 4775 Å

The darker stones again behaved differently in that they showed maximum transmission in the green region at 5050 Å, while the red area was completely absorbed. Only the very persistent doublet at 6370 and 6388 and the band from 6300-5800 Å was visible. *(Figure 2).* This un-

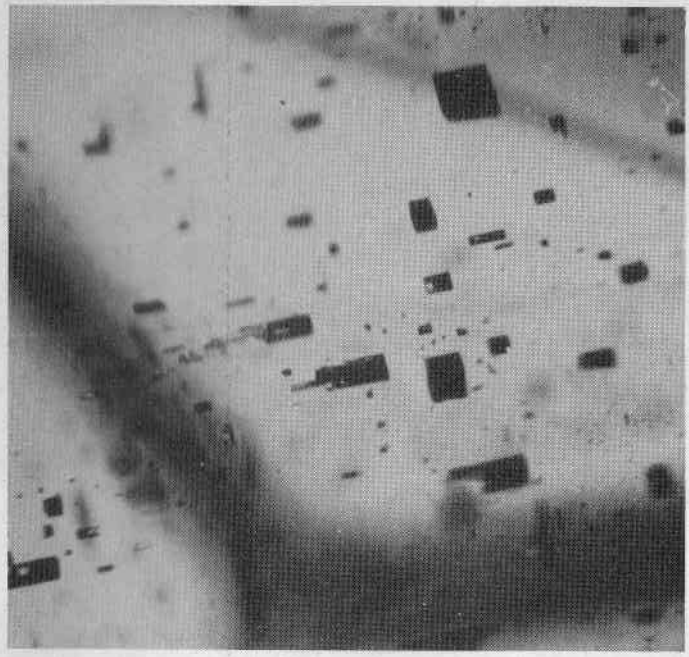
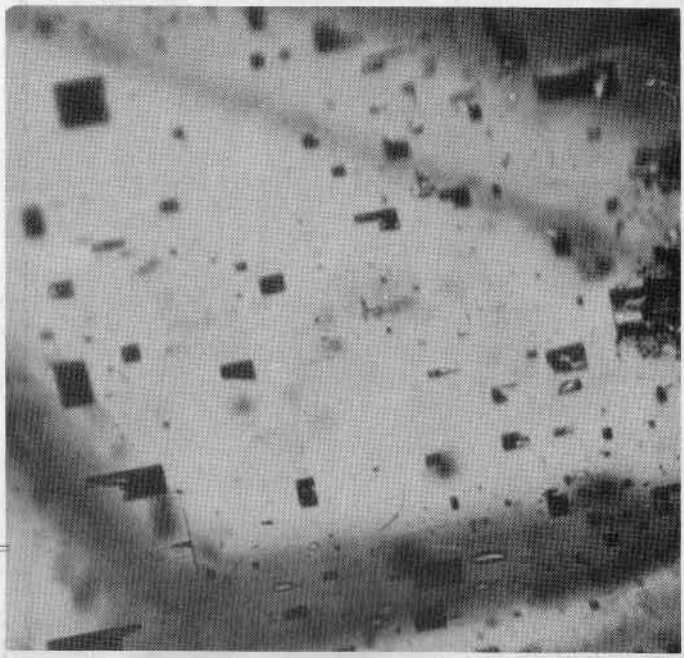


Figure 4

• Rectangular, square-shaped and comma-like inclusions in Indian emerald. 75X.

Figure 5

• Typical two-phase inclusions in Indian emerald. 75X.



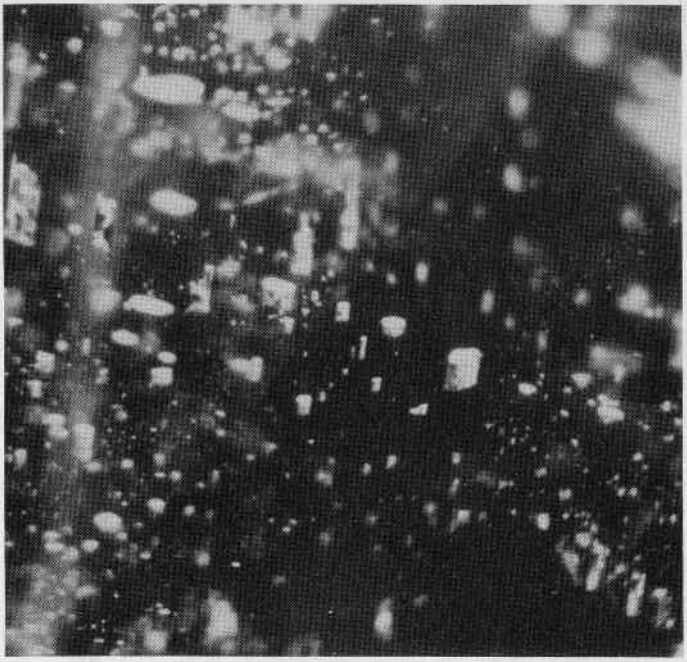


Figure 6
• **Diagnostic inclusion picture of Indian emerald revealed by dark ground illumination. 40X.**

usual reaction corresponds to the curious irregularity, which provides absolutely fresh evidence for identification, that Indian emeralds do *not turn red* through any of the color filters at present known to gemologists. Whether or not they revealed the normal absorption spectrum, all of them remained decidedly green and hence did not differ in this respect from emerald green paste – an odd distinction from emeralds of other localities and the synthetic species.

d) *Luminescence:* Under ultra-violet rays ranging from 2500 to 3650 Å all[3] four specimens remained inert, while under X-ray irradiation the two lighter colored stones glowed with a faint, dull red luminescence.

3.) Physical Properties

a) *Specific Gravity:* In conformity with the other somewhat higher optical constants the specific gravity also yielded higher values similar to the emeralds from Siberia and the Transvaal, yet unlike those from Colombia and Brazil. The density values so far published will again be compared with my measurements:

B. W. Anderson[1]:		s = 2.73 -2.74
A. E. Alexander[2]:		s = 2.75 -2.76
E. J. Gubelin:	.70ct.	s = 2.746
	.78ct.	s = 2.739
	.95ct.	s = 2.781
	2.42ct.	s = 2.740

With the exception of my sample No. 3, which deviated entirely from average constants and here disclosed a remarkably high specific gravity, all the other density values remain within the normal limits of variation.

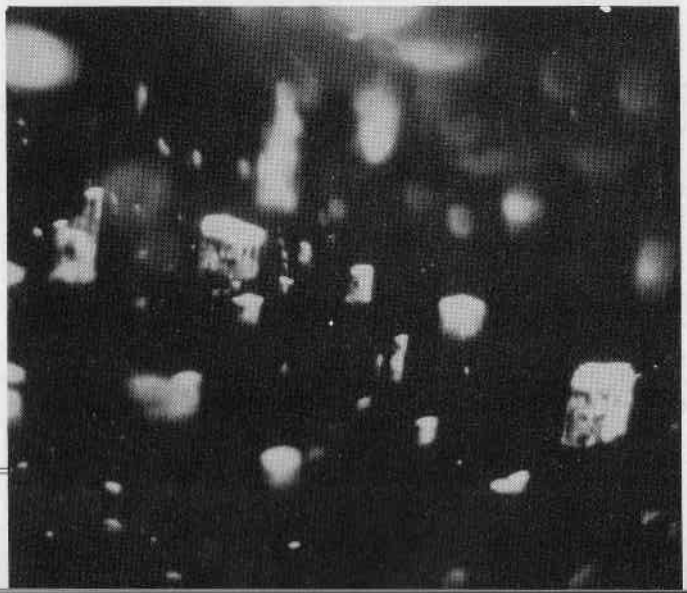
b) *Hardness:* The scratching hardness which is generally referred to in gemology as a diagnostic property appeared to vary

Figure 7

• Strong magnification discloses the two-phase inclusions to be negative crystals. 75X.

Figure 8

• Two-phase inclusions in Indian emeralds are negative crystals with emerald habit. 100X.



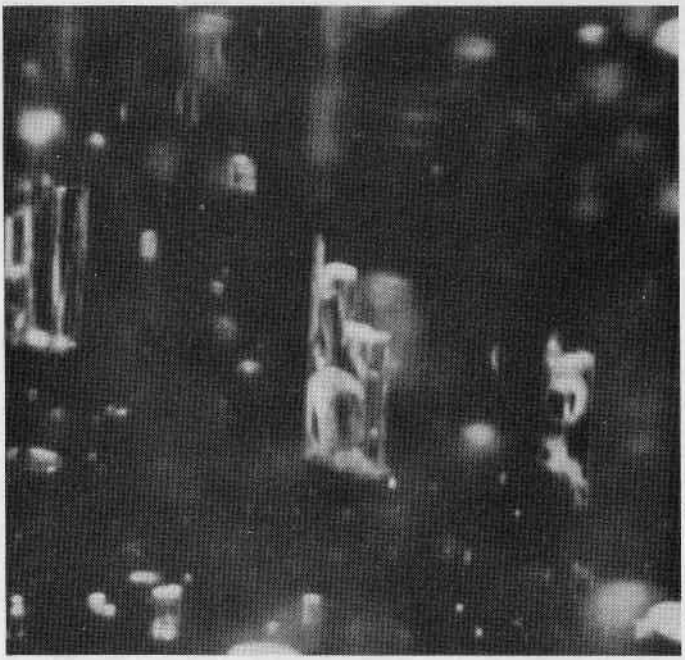


Figure 9

• Frequently two-phase inclusions in Indian emeralds form groups of negative crystals, one being remarkably longer than the others. Thus the comma-shape is formed. 200X.

from seven and one half to seven and three fourths, after Mohs' scale. Lapidaries, however, consider Indian emeralds to be somewhat softer than others.

In spite of the slight divergence from average values and the previously-mentioned marked difference from emeralds from other sources, neither the optical nor the physical properties were sufficiently distinctive to serve as conclusive symptoms. Here again, as in so many other gem instances, one is forced to fall back on inclusions — those infallible marks of specific formation — in order to glean information about the provenence of Indian emeralds. It is, therefore, better to concentrate on the endogenesis:

4.) Microscopic Examination

From the particular type of the deposit described above it may easily be deducted that the emeralds will contain rich internal parangeneses of accessory minerals from their surroundings and that, in consequence, the quality of the majority of the gems cannot be outstanding, i.e. fine stones will be rare.

The phenological picture of the internal structure may reveal dense masses or delicate veils of inclusions which closely resemble the "jardins" in emeralds from Colombia. But through the microscope surprisingly new endogenetic pictures — unknown in emeralds from other deposits— present themselves to the observer, offering characteristic growth-marks for inspection. *(Figure 3, figure 3a)*

Under low magnifying power the "jar din" dissolves into a mass of singular inclusions which prove to be of two differ ent natures, lying at right angles to each other. Rectangular or square-shaped cavi-

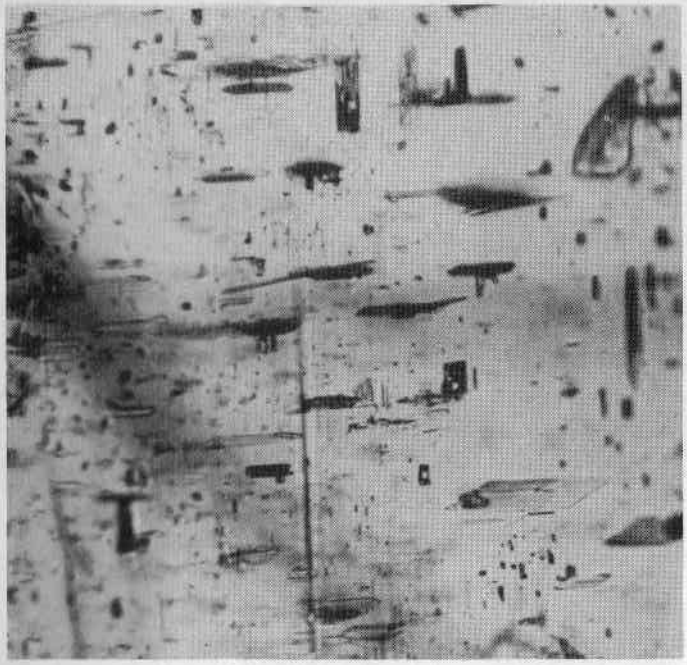
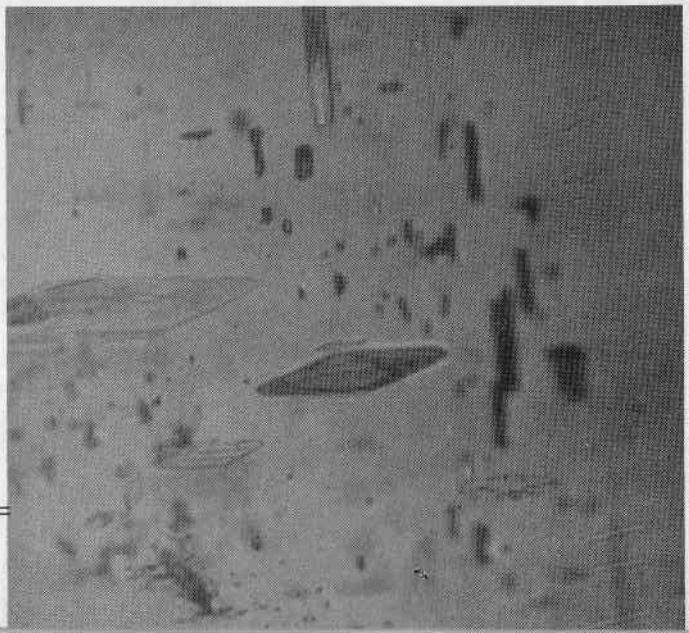


Figure 10

• Biotite tablets are oriented parallel to the basal plane. 40X.

Figure 11

• Idiomorphous biotite flakes belong to the inclusion symbiose of Indian emeralds. 125X.



ties, filled with liquid and a movable bubble (so-called libella), are the most characteristic and significant. They run parallel to the optical axis of the host gem. R. Webster's[1] accurate observation that these cavities are further characterized by a projection along one side, thus giving the inclusion the appearance of a "comma," cannot be bettered, and these should be regarded as one of the typical features of the endogenesis of Indian emeralds. *(Figures 3 and 4)*

Examination under stronger magnification from 75 to 150 times, and also in a special dark ground illumination, yields a fascinating and considerably more instructive view of the true nature of these telltale inclusions. The apparently rectangular, square and comma-like cavities now prove to be negative crystals of well-developed emerald habit, a revelation which explains the rigorous orientation parallel to the optic or c-axis of the emeralds. *(Figures 6 and 7)* The comma-like growth is accounted for by joint formation of such negative crystals, among which one of a considerably longer and more slender shape grew out of its cluster of shorter companions. *(Figures 7 and 8)* In comparison with the typical three-phase inclusions in Colombian emeralds, these negative crystals filled with liquid and a gas bubble may rightly be termed two-phase inclusions.

The other type of inclusion, which resembles delicate fissures embedded in the emerald at right angles to the crystal axis *(Figure 10)*, consists of idio or xenomorphous biotite tablets and flakes *(Figure 11)*, upon which the two-phase, negative crystals are frequently placed perpendicularly. *(Figures 3 and 9)* The occurrence of biotite within these Indian emeralds is at once suggestive of the internal paragenesis of emeralds from Siberia and the Habach Valley. Finally, in addition to the aforementioned enclosure, minute rods of actinolite and crystals of iceland spar may be present.

Far more instructive and illuminating than long verbal descriptions are the photomicrographs accompanying this and previous articles. Therefore, if the reader impresses them on his memory, the recognition of Indian emeralds from those of other mines will no longer present any real difficulty.

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AUSTRALIAN ASSOCIATION ADDS 32 NEW MEMBERS

The third annual report of the Gemmological Association of Australia shows a grand total of 609 active members, and indicates a steady growth of the gemological movement in that country.

Although 1950 membership total shows an increase of only 32 over membership for the previous year, one new branch has been added during 1950 and interest in the courses is generally keen.

Due to great distances between the various states of Australia, the Association is divided into five state organizations. Membership shows 264 in New South Wales, of which 82 hold fellowships; 144 (32 fellows) in Victoria; 98 (38 fellows) in Queensland; 89 (41 fellows) in South Australia; and 39 (36 fellows) in the West Australian Branch, bring the total to 609.

Preliminary classes were held in all states during 1950. Diploma examinations were conducted in all except Western Australia which did not join the Association until early in 1950.

Dr. D. P. Mellor, Sydney University, is president and A. A. Wirth, S. Harp, R. Tiley, and Jack S. Taylor comprise the Management Committee.

Gemological Digests

NEW GEM MINERAL DISCOVERED BY BRITISH GEMOLOGISTS

In the first half of the 20th century three previously unknown gem minerals have been introduced to modern man—the latest still nameless and its source of origin unknown. The other two—brazilianite and benitoite—are familiar to most gemologists.

Although two brilliant-cut specimens of the still unnamed new gem mineral have been intercepted by British authorities and thoroughly examined by gemologists Anderson, Payne, and Webster of the London Gemological Laboratory—as well as by Dr. G. F. Claringbull and associates of the British Museum of Natural History—there is no definite knowledge of their habitat.

The first specimen of the pale lilac, transparent gemstone was discovered in November, 1945, by its owner Count Taaffe, F.G.A., a collector and hobbyist of Dublin. Count Taaffe's curiousity was aroused when, while examining a parcel of spinels through a binocular microscope, he noticed a slight doubling of the back facets of a 1.419 carat stone. Lacking adequate gemological equipment, he forwarded the stone to the London Laboratory for positive identification.

There, Count Taaffe's observation of double refraction (about .002-3) was verified; the mineral was shown to be uniaxial with a density of 3.62; and it was found to have an R.I. of 1.72, and a hardness of 8 according to Mohs' scale.

Still unable to classify the stone as any known species or variety, permission was obtained from the owner to cut the stone in order to make chemical and X-ray examinations. The stone, reduced to 0.55 carats, was returned to its owner and extensive crystallographic and chemical tests were made by the Mineral Department of the British Museum of Natural History. On March 17, 1951 announcement of the discovery of a new mineral was made for the first time in *Nature* by Dr. Claringbull of the British Museum and B. W. Anderson and C. J. Payne of the London Laboratory. The second specimen, also cut, was found by Payne in October, 1949, while examining an assortment of cut spinels.

Scientific examinations reveal the new mineral to be of the hexagonal system, Class 62, of the rare hexagonal trapexohedral class of crystal symmetry. Until 1942 no mineral had been known to belong to this class. At that time Dr. Bannister of the British Museum described a mineral from Kenya, called Dalsilite, which belongs to the same space group.

Chemical components of the newly-discovered mineral were found to be magnesium, beryllium, and aluminum. This, added to its close resemblance to spinel in physical properties, suggests—according to Anderson in the *Gemmologist*—that it may be a magnesium beryllium aluminate intermediate in composition between chrysoberyl and spinel. "This, of course," says Anderson, "is simply intelligent speculation and can only be confirmed by skilled micro-analysis."

In October, 1949, C. J. Payne, while making a routine test of a mixed parcel of colored stones, discovered a smaller cut specimen of the new mineral weighing .87 carats. When almost all of the stones in the case—containing principally green sapphires and pale spinels—had been examined, he noticed that one pale lilac spinel had a refractive index slightly higher than the others. Where usually these pale spinels

have an index of 1.715, this stone showed 1.720 and 1.721. In no other way was it different in color or appearance. Greatly excited now, Payne made further tests which showed a uniaxial figure which proved to be negative. Density, taken in Clerici's Solution by the refractive index method, proved to be 3.61. When submitted to Dr. W. Stern for hardness tests, he found it to be slightly softer than synthetic spinel. The British Museum again confirmed that this was the same mineral as Count Taaffe's stone. This second stone is now owned by B. W. Anderson.

Under spectrographic examination Count Taaffe's stone showed a vague band in the blue very near, and exactly like, the band shown by blue spinel—a band due to ferrous iron at 4580 Å. The stone discovered by Payne was too pale to show any real absorption spectrum. It was likewise of slightly lower indices no doubt due to the lesser degree of iron in its composition, which also reduced the intensity of the lilac color.

There was no apparent dichroism in either of the stones so far discovered. The second stone was tested for flourescence and found to flouresce green in X-rays, but showed nothing at all under ultra violet light.

Although it is said the new mineral is of small interest as a gemstone, it is nevertheless remarkable that an unknown mineral should first appear in faceted form. To date, source of origin has not been established although the characteristic type of cutting is indigenous to Ceylon and it is believed the stone was cut there. It is assumed that the second stone may have been cut in Idar-Oberstein since the parcel came from Europe, but all of this is entirely conjectural. It is strongly suspected that the gem originates in the gem gravels of Ceylon.

Since two cut specimens have been discovered, accessible collections—both in the British Museum and the London Laboratory's regular flow of stones—have been watched for other specimens of the new mineral. Although in such negligible supply, the stone can have little importance commercially, there is little doubt that other stones exist and the alert gemologist, scientifically trained and having gemological instruments available, may be the next to report one or more of the new gemstones in his own collection.

Joseph A. Phillips,
Gemological Institute of America

REPORT TWO LARGE DIAMONDS RECOVERED IN SOUTH AFRICA

Although the recently opened Premier Mine at Kimberley is best known for its industrial diamonds, occasional large stones found there are usually of fine quality. Such was the 195 1/2 carat diamond recovered recently which is described by C. H. Beck, Secretary of DeBeers, as "of perfect color and half the size of a match box." Value of the diamond was not disclosed but it was stated that it was sold for a "considerable price."

The second diamond, weighing 182 1/2 carats and of a yellow color, was found on the DeBeers Private Alluvial Diggings on the farm Nooitgedacht, on the banks of the Vaal River. The diamond, which was found by a digger named Cornelissen, was sold to a firm of diamond cutters in Johannesburg for 5,657 pounds, 10 shillings.

Kay Swindler

Gemological Digests

REPEATED TWINNING LINES SEEN IN SYNTHETIC CORUNDUM

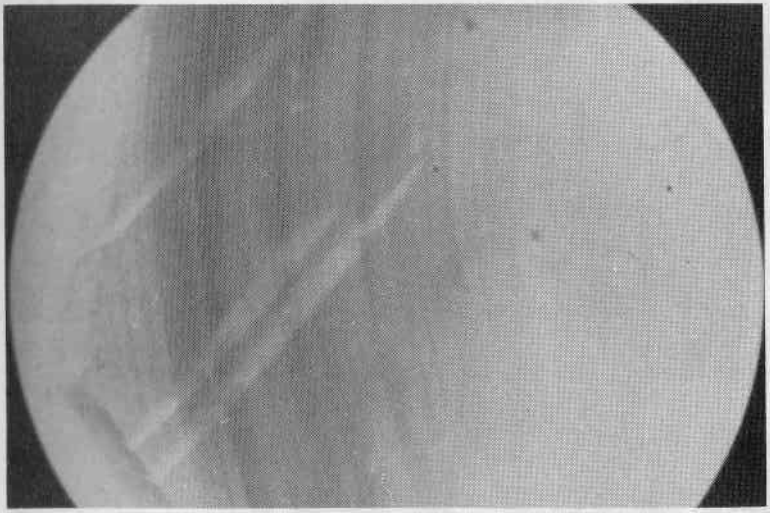
In identifying some transparent blue stones recently in the Gem Trade Laboratory of the Gemological Institute of America, a synthetic sapphire was discovered which exhibited both curved striae and repeated twinning lines. Previously curved striae had been considered proof of synthetic stones, while twinning lines had, heretofore, been considered properties of natural stones only. Both are clearly shown in the accompanying photograph of the synthetic sapphire.

Prior to this discovery, a yellow synthetic sapphire with a single repeated twinning line had been noted in the Laboratory. Both this stone and and blue one were now tested in a polariscope. Both exhibited the irregular extinction characteristics of natural repeatedly twinned stones.

As if by predestined coincidence, a few days later a dealer submitted a 5.6 carat cabochon ruby which displayed repeated twinning lines prominently. It was on the basis of these characteristics that he had purchased the stone as genuine. Unfortunately, this synthetic ruby was too dark in color to permit an adequate photograph for reproduction.

The significance of these observations is that if repeated twinning lines were observed, the stone might readily be identified as genuine if no further examinations were made for synthetic features. It indicated also that the crystallization of synthetic corundum does not follow the curved pattern of the striae as some beginning gemology students have thought.

• Curved striae and repeated twinning lines in synthetic blue sapphire.



Gemological Digests

DESCRIPTION GIVEN OF THIRD LARGEST DIAMOND DISCOVERED IN BRAZIL

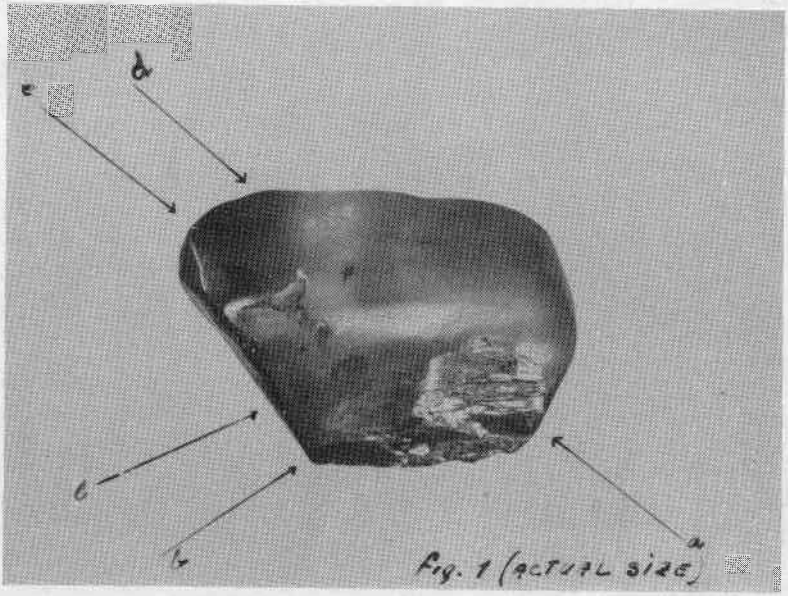
The Diamond "Presidente Eurico Gaspar Dutra" was discovered on July 25, 1949 by a prospector (*Garimpiero*) in the Douradinho River, district of Coromandel, state of Minas Gerais, Brazil.

The dimensions of the rough diamond were as follow: length 54.5 mm; width, 38.5 mm; height, 23.0 mm. The stone weighed 407.68 carats, placing it third among the largest Brazilian diamonds and 26th among the largest reported diamonds of the world. Specific gravity was found to be 3.534.

The rough diamond was partially rounded by alluvial action, but through careful study was determined to be of octahedral habit. Four of the octahedral planes were well developed as a result of which crystallographic orientation was made possible. Other more complex combinations of cubic forms whose faces were substituted for the octahedral edges were found to be present in the rough material.

Figure 1 shows the approximate actual size of the rough diamond. (A) indicates an area of peculiar step-like cleavage on one of the faces; (B) is a large conchoidal fracture which presumably resulted from a violent shock when a large piece was broken off during alluvial action. At (C) a follicular (hair-like) inclusion was seen. Another inclusion which appeared to be a shapeless mass of graphite was seen at (D). (E) is a cavity whose origin might be attributed to another crystal which previ-

• Presidente Eurico Gaspar Dutra diamond slightly smaller than actual size.



ously had been encrusted there.

In the area of (B) were several superficial separation planes which were colored by a reddish (possibly iron oxide) material. This reddish color had an influence on the color of the diamond which was brown with a tinge of rose. When cut, the fashioned stones were of the same color.

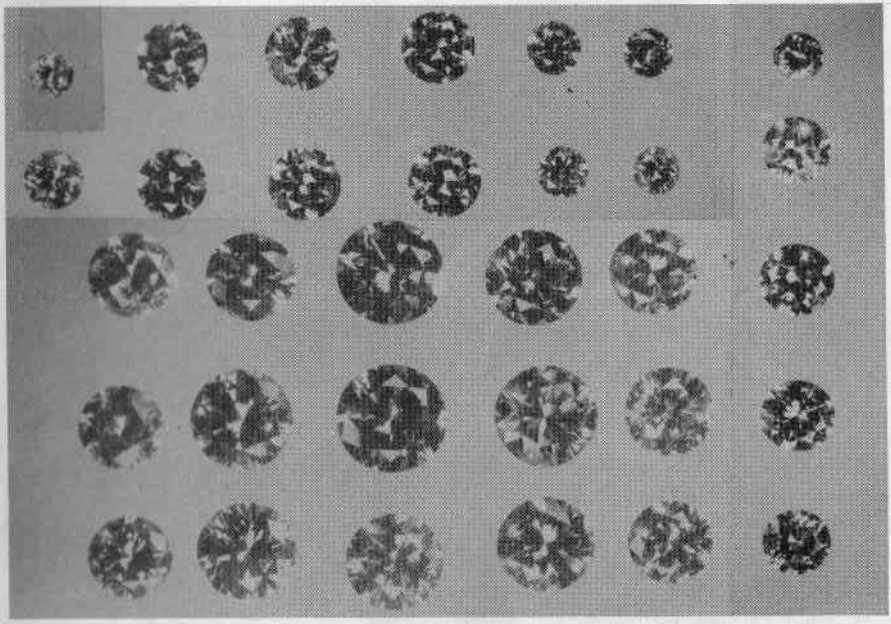
The rough diamond was purchased by the associated diamond buyers, Genach Shadrycki and Luiz Pires Galante. Later, upon reimbursing his partner, Shadrycki became the sole owner of the "Presidente Dutra." He entrusted the cutting of the stone to Fredrich Karl Odenbreit, a young German Brazilian cutter, in Rio de Janeiro, who obtained from it 36 stones, all but four of which are shown in the photograph (*Figure* 2).

Cut in brilliant style, and totaling 136.00 carats, the largest stone was 9.60 carats and the smallest 0.55 carats. The total weight realized on cutting was one third of the total weight of the rough stone.

The Classifying and Appraising of Precious Stones Bureau of the Ministry of the Treasury appointed Senor Esmeraldino Reis for the study, classification, and appraising of the "Presidente Eurico Gaspar dutra."

Esmeraldino Reis
Rio de Janeiro, Brazil

• 32 of the 36 stones cut from the 407.68 carat rough diamond. Actual size.



Gemological Digests

TWO NEW GOVERNORS ELECTED TO G.I.A. BOARD

At the March 17 meeting of the G.I.A. Board in the Statler Hotel, Washington, D.C., two new governors were elected to serve on the board of the Gemological Institute of America for the coming year. These were William S. Schwanke, president of Schwanke-Kasten Company, Milwaukee, and Paul S. Hardy, President of Hardy & Hayes, Pittsburgh. Both have been active in the affairs of the Gemological Institute since its inception.

Retiring from the Board at the spring meeting were Charles Peacock III, Treasurer of C. D. Peacock, Inc., Chicago; and Geo. Carter Jessop, Treasurer of J. Jessop and Sons, San Diego.

No change was made in the officers who direct the affairs of the Gemological Institute of America. Dean Edward H. Kraus, University of Michigan, was elected for the sixth time as President of the G.I.A.; Fred J. Cannon, Slaudt-Cannon Agency Company, Los Angeles was elected Secretary-Treasurer for the third term; and Robert M. Shipley continues as Director. Dorothy M. Jasper was retained as Secretary to the Board.

For the fourth year H. Paul Juergens, Juergens & Andersen, Chicago, will serve as Chairman of the Board, and J. Lovell Baker of Henry Birks, & Sons, Ltd., Montreal, begins his second year as Vice-Chairman.

Others serving on the G.I.A. Board of Governors for 1951 are: Carleton E. Broer, The Broer-Freeman Company, Toledo; Charles H. Church, Church and Company, Newark; Glynn Cremer, Glenn Cremer, La Crosse; Myron Everts, A. A. Everts Company, Dallas; Edward F. Herschede, Sr., Cincinnati; Earl E. Jones, Jones Bros., Jewelers, Moline; Lazare Kaplan, Lazare Kaplan and Sons, New York City; William P. Kendrick, William Kendrick Jewelers, Louisville; John S. Kennard, Kennard and Company, Boston; E. A. Kiger, C. A. Kiger Company, Kansas City; P. K. Loud, Wright, Kay and Company, Detroit; Ernest J. Meyer, Meyer's, Grand Island; and Jerome B. Wiss, Wiss Sons, Inc., Newark.

No change was made in the Executive Committee to which the Board has delegated most of its powers to be used during the interim between the less frequent regular meetings of the Board. Charles H. Church of Newark, N. J., continues as Chairman. Other members are Fred J. Cannon, and Frank Davidson, both of Los Angeles.

DE BEERS MINE TO REOPEN IF SAMPLING INDICATES PROFITABLE OPERATION

Reopening of the old De Beers Mine is planned by De Beers Consolidated Mines, Ltd., if sampling of blueground indicates operations may be profitable.

Early in 1950 three pumps were installed and draining of the 1,000 foot shaft was started. Experts have computed that 139,000,000 gallons of water have been removed from the twenty-one miles of underground workings.

Discovered in 1871, the De Beers operated until 1908. Pumping water continued until 1941 when that, too, was suspended.

When mining was in progress fifty years ago a large block of diamondiferous ore at the western section of the pipe was left untouched because of the yield of diamond from the top portion of this section was insufficient to make mining operations profitable. It is this section that is now being tested for possible profitable working since more advanced mining techniques are now

in use. Access to this area will be gained through an old crosscut from the shaft at 1,000 feet, and prospecting will be carried out by a series of small drives from there.

If samples indicate that working the mine may prove profitable, the company may once again bring this famous old mine into full operation.

RECONSTRUCTED RUBIES SOLD AS SYNTHETIC TOLD BY GEM TRADE LABORATORY

In the first sixteen months of operation under the Gemological Institute, the Gem Trade Laboratory reports identification of seven reconstructed rubies.

The two latest stones identified were in fine platinum mountings. One was used as the central stone in a bracelet of natural rubies and diamonds which sold for $65,000 wholesale. The other was used as the center stone in a fine platinum and diamond ring.

The Gem Trade Laboratory warns that many of these reconstructed rubies may be around since many were sold in this country from 1890 to 1900. It further cautions that because of incomplete identification they are probably being incorrectly classified as synthetic rubies.

GOVERNMENT REPRINTING OF DR. A.R.CAHN'S REPORT ON CULTURED PEARLS CONSIDERED:

Whether or not reprints of Dr. A. R. Cahn's report on the Cultured Pearl Industry in Japan will be made are to be predicated upon demand for this material. Readers who would like copies of this comprehensive and authoritative article are urged to notify the Gemological Institute which will in turn advise the government agencies of the existing demand among its readers and students.

This report was originally prepared and printed in very limited editions for the General Headquarters, Supreme Command for the Allied Powers in Tokio. Although microfilm or photostatic copies could be obtained, the cost of these was prohibitive for general circulation or use.

SOUTH AFRICAN JEWELERS CONSIDER PROHIBITION OF TERM 'BLUE WHITE"

According to the *Diamond News* prohibition of the term "blue white," as applied to diamonds, was proposed by the Johannesburg Manufacturing Section at a March meeting of the South Africa Jewelers' Association, Limited. The proposal was referred to the National Executive for consideration.

Members of the Association gathered at the March meeting also felt the National Executive should consider the prohibition of the term "pure" in describing diamonds. It was suggested that the most accurate way of describing such diamonds would be by the use of the term "flawless."

Both of these proposals, if adopted, would concur with present rulings of the American Gem Society.

NEW GEM SUBSTITUTE RESEMBLES EMERALD

One of the recent gem substitutes to appear on the market, according to the Gem Trade Laboratory, is a synthetic spinel triplet sold under the name of "soldered emerald." The crown and the pavilion of synthetic spinel are joined by green cement. This and the fractures produced by heating the pavilion before assembly produce a stone having the appearance of a slightly flawed natural emerald. Identification can be readily made by taking a refractive index reading.

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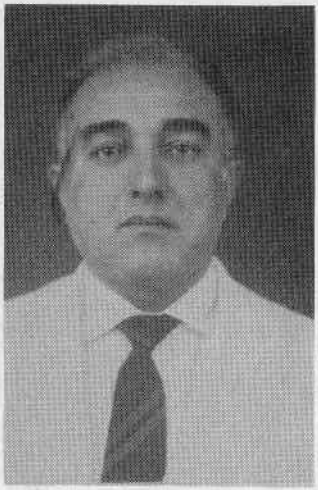
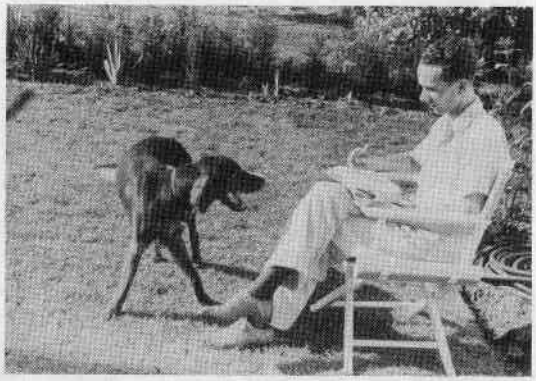


ESMERALDINO REIS, of Rio de Janeiro, was born shortly after the turn of the century. It is through his courtesy that authoritative information on Brazil's third largest diamond was furnished the Gemological Institute. Sr. Reis is a functionary of the department of precious stones of *Mininterio da Fazenda,* Rio de Janeiro, where he works as gemologist and classifier of precious stones. His diploma in mineralogy and petrography was issued to him by the National Faculty of Philosophy of Rio de Janeiro. In addition to acting as examiner for the Department of Assistance of the Public Services, he is also professor of gemology in the improvement classes of the Economic Case of Rio de Janeiro. At present Sr. Reis is preparing a book, *Os Grandes Diamantes Brasileiros,* which describes the large diamonds of Brazil.

DR. EDWARD J. GUBELIN, first Research Member of the Gemological Institute, and member of the Editorial Board of *Gems & Gemology,* was born in Lucerne, Switzerland, in 1912. Reared in a family of jewelers, in 1925 young Gubelin became fascinated with the science of gemstones after his father returned from hearing a series of lectures by the first European Gemologist, Prof. Dr. H. Michel of Vienna. His father subsequently established a laboratory for the young gem enthusiast. In order to acquire a sound background for gemology, Edward Gubelin first studied mineralogy at the University of Zurich. Later, he studied with Prof. Michel in Vienna, and under Prof. Dr. K. Schlossmacher in Konigsberg. Near the close of 1938 he received his doctorate. His title of Certified Gemologist was awarded in 1939, and in 1946 he received his fellowship from the Gemological Association of Great Britain. He is founder of the Gemological Association of Switzerland and lectures annually on gemology in both Britain and Sweden.



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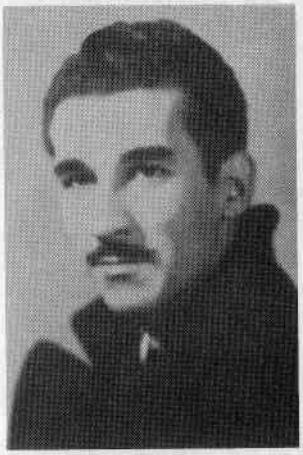
DR. FREDERICK H. POUGH was born in 1906 and educated at Washington University, Harvard University, and at the Victor Goldschmidt Institute in Heidelberg. He first came to the American Museum of Natural History in 1935, and since 1945 has been Curator of Physical Geology and Mineralogy. As custodian of one of the largest and most complete mineral and gem collections, Dr. Pough is recognized as an authority on rare minerals. He is one of the pioneer workers on the irradiation of gemstones, with modern sources (cyclotrons, atomic piles); still a scientific research problem of importance. He has made numerous trips to the new volcano in Mexico, Paricutin, and in the course of his studies, has compiled a motion picture record of the new volcano. This film was shown in London, at the 1948 International Geological Congress, and has also been seen in various other parts of the world, including Australia and New Zealand. He has a long list of scientific publications to his credit, and has recently become more widely known through his lectures and popular writings on minerals, gems, and vulcanology.



A. A. SCHULKE, Chief Engineer in charge of the Cyclotron Laboratory, Washington University, St. Louis, received his formal education at that institution. There also he assisted in the design and construction of the cyclotron where the first beam was obtained in November 1941. It proved an invaluable aid in solving some of the early problems connected with the production of material for the atomic bomb. Actually, Schulke is somewhat of an anomaly — being an engineer by training and profession yet working in the field of nuclear physics. During the past several years his time has been completely absorbed in directing the activities of the laboratory and giving lectures or talks on the subject of cyclotrons. He is a member of the American Institute of Electrical Engineers and of the American Physical Society.