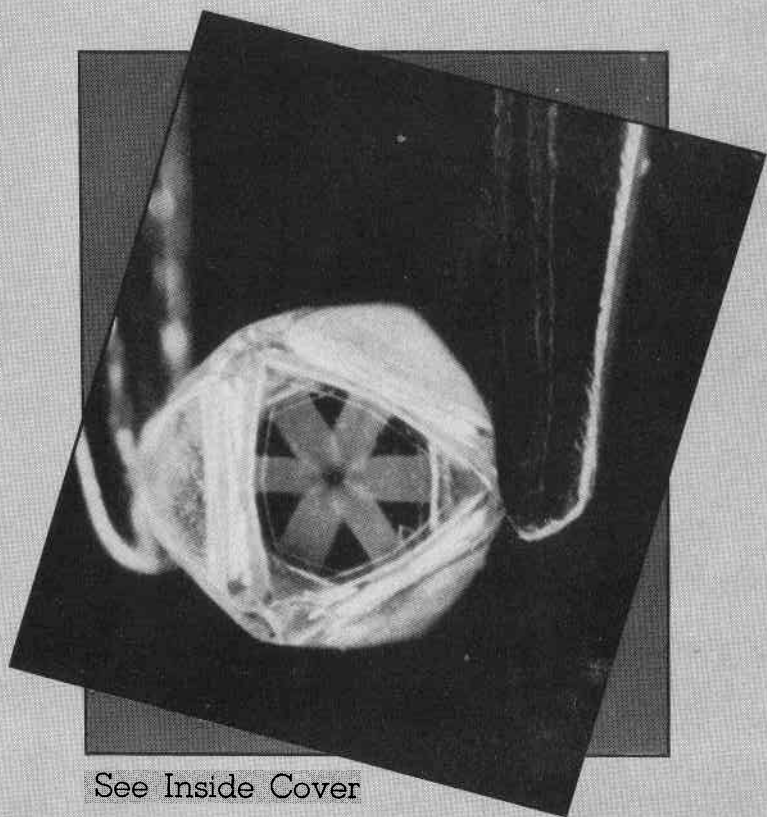


# *Gems and Gemology*

SPRING 1952



See Inside Cover

# GEMS & GEMOLOGY

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### *On the Cover*

*A diamond crystal with an unusual cloudy inclusion extending from corner to corner of the octahedron like crystallographic axes. Crystal loaned the G.I.A. Laboratory for photography by Martin Ebrman, Los Angeles.*

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# Many "Reconstructed Rubies" Found To Be Synthetic Corundum

by

LESTER B. BENSON, C.G., F.G.A.

*Director G.I.A. Laboratory, Los Angeles*

Recently a number of stones have appeared on the market that were thought to be reconstructed ruby. Although the exact process used for the commercial production of synthetic corundum has been known for many years, the degree to which synthetic material may overlap in appearance the reconstructed stone is given little attention in present text books. In fact, little information has been published concerning the exact method used to produce reconstructed ruby.

This also applies to the characteristics of synthetic stones that were produced during the period of transition which led to the commercial production of synthetic ruby by the Verneuil process. Failure to record characteristics of these early stones is due largely to the fact that suitable equipment for photomicrographs (that could reveal and record the characteristics of cut gemstones to full advantage) was not available at that time. Although it has been implied that large quantities of reconstructed stones were produced, securing such material for study has always proved extremely difficult.

By standard U. S. definition, reconstructed stones were made of fragments of genuine stones sintered together under intense heat with or without pressure. By the method of manufacture necessary to fit such a definition, the ruby fragments would have to form a mosaic joined by fused sections that may or may not have assumed a crystal structure upon cooling. Natural characteristics would be expected in the unmelted portions of the ruby fragments.

Only a few such rubies have been reported in gemological literature which combine in any way the characteristics of natural material and material that had been melted. One of these was the one reported by Anderson<sup>1</sup>. This had the characteristics of a synthetic ruby but obviously had been grown from a natural seed crystal. A re-examination of the characteristics of so-called reconstructed rubies reported in recent years— together with stones offered recently to the G.I.A. as reconstructed— suggests a need of a reevaluation of the whole reconstructed problem.

<sup>1</sup> I. B. W. Anderson: *Reconstructed Rubies*, *Gems & Gemology*, Summer 1949, Page 187.

Although experiments on the reconstruction or synthesis of rubies began in the early 1800's, apparently it was not until approximately 1882 that a few stones appeared on the market labeled "reconstructed." According to an unconfirmed report these were thought to have been made by a priest in a small town in Switzerland, and the report stated that the stones were produced by binding together small particles, or chips, of genuine ruby by fusing small particles of quartz. Obviously, a strict definition would not permit such stones to be considered reconstructed but, instead, merely silica bonded rubies. At any rate, these stones supposedly duplicated the appearance of fair quality rubies and were sold at relatively high prices.

The essential identifying characteristics of such stones would be variable hardness due to the amorphous and soft nature of the bonding agent, in contrast to the corundum fragments and a lack of extinction characteristic of a doubly refractive crystal when rotated in the polariscope. This would result from the random crystallographic orientation of the silica bonded fragments. However, if such stones *were* ever made on a commercial basis they could not have gained much importance since none have been encountered, or at least reported.

In 1877 the first synthetic corundum was produced, but it was not of gem quality. Gem quality material, according to one report, did not appear on the market until about 1886. If this is correct, they were undoubtedly confused by some jewelers with the first so-called "reconstructed" stones, and sold as such.

Between 1880 and 1890 a Swiss engineer was supposed to have produced true reconstructed rubies from ruby sand on a commercial basis. These were referred to as "Geneva" rubies and the boules were stated to have been about the size and shape of a shoe button. (A similar description is applied to the first synthetic boules produced by Verneuil.)

Whether all of these "Geneva" rubies were made by fusing together ruby powder only, or whether they were just bonded fragments, is unknown. The definition referred to earlier would cover bonded fragments only. However, we are led to believe that these stones were made from powdered natural rubies with the addition of chromic oxide in the later stones to improve their color.

Actually, since the possibility of producing synthetics had been made known in 1886, there seems little likelihood that any great amount of time was devoted to the production of reconstructed ruby when gem quality natural ruby, even in small sizes, is relatively scarce and costly. This indicates the possibility that much of the so-called "reconstructed" ruby produced prior to 1900 was, in reality, synthetic.

For some reason, the characteristics which have been associated with synthetic corundum in the majority of gemological publications are those common only to boules formed by the Verneuil process as we know it today. The implication is that rubies produced prior to the Verneuil announcement were reconstructed. However, investigations to date have not verified this. On the contrary, there is strong evidence indicating that rubies were made by accretion of molten material, grown into a single crystal long before the Verneuil process was announced.

From study of material that fits the description given to "reconstructed" stones at that time, it seems evident that such accretion can form a single crystal even though the deposition is interrupted or uneven over the surface. The existence of a structure which is divided into several areas (*Figure 1*) each containing symmetrical and closely spaced curved striae, but with the general orientation of the striae in each area differing from that of the adjoining area, is not necessarily indicative of reconstructed stones.

On the contrary, such stones could have

been produced by fusing alumina powder, but with haphazard and changing orientation of the boule in relation to the direction from which the powder was deposited. In this latter instance, the uneven surface growth will result in low angle to even high angle intersection of the growth lines at the points where each of these areas are grown together. This is not encountered in a boule grown with the assistance of a mechanical apparatus that provides constant orientation of the boule and even distribution of  $Al_2O_3$  powder on the growing surface. This is accomplished in the modern Verneuil oven.

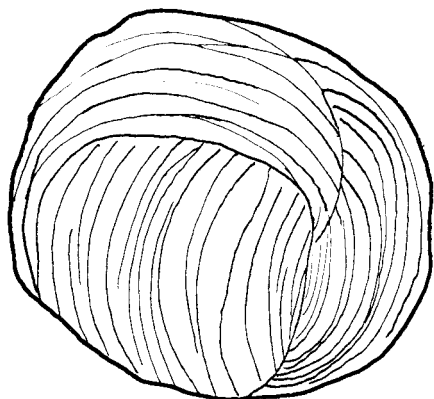


Figure 1

Stones produced by sintering natural fragments would possess very irregular striation, particularly for the adjoining areas of the fragments. Obviously, there would be little advantage in powdering grains of natural ruby to obtain the powder necessary to produce a well-formed boule when the resultant stone, in appearance, could be duplicated with commercially prepared powder at a much lower cost. It should be noted that intersecting striae do not indicate a structure composed of several individual portions, each with a different crystallographic orientation. Instead, intersecting striae generally indicate the direction of

growth only for each of the given portions.

The latest group of "reconstructed" rubies submitted for examination were on the average of one half to three fourths carats in weight and possessed numerous erratic gaseous inclusions and pronounced intersecting curved striae (i.e., all the characteristics often associated with so-called reconstructed stones). Many of the gaseous inclusions are developed into elongated and angular forms similar to the gaseous inclusions seen often in natural stones.

Further investigation revealed, however, that these were nothing more than stones that were cut from the bottom tip of synthetic boules. It is generally assumed that this portion of a synthetic boule is discarded as waste. However, in an attempt to secure a quantity of these tips for examination, it was learned that many cutters in this country have channeled these boule tips to foreign cutters—particularly in the Orient—and have obtained prices for this material in excess of that usually received for flawless synthetic corundum. Apparently a large quantity of this material has been cut and returned to the trade, presumably as natural ruby. Since they are highly flawed to the unaided eye, they could easily pass undetected in a parcel of natural stones.

The presence of intersecting curved striae is easily accounted for when considering the nature of the seed material used to start the boule. The majority of the stones that have been examined at the G.I.A. laboratory were taken from boules that had been started from oriented colorless rods—obviously, then, of fairly recent manufacture. A typical side view of the relationship of the growth lines in the rod to the surrounding material, and the corresponding area from which these stones were cut, is illustrated in *Figure 2*.

Depending on the exact nature of the seed, and the orientation of the cut stone in relation to the original boule, the striation in these stones may appear through the

table as intersecting striae, oval-shaped striae, or completely circular and tightly curved striae. Furthermore, depending on the color, or lack of color, of the "seed," these stones sometimes display rather patchy color distribution.

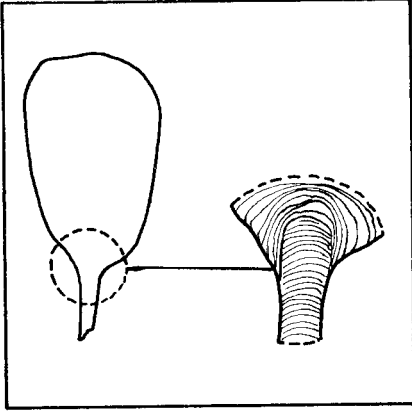


Figure 2

Figure 3 pictures a cross section of a boule tip showing the concentration of bubbles and curved striae present in the rod, and a similar concentration of bubbles and striae to the right, showing the general pattern of growth of the boule from the rod.

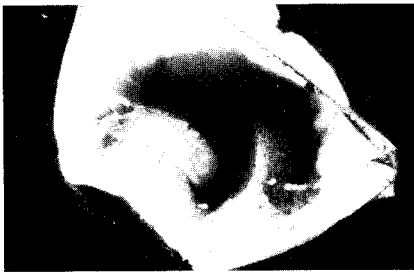


Figure 3

Figure 4 shows a different boule tip in which the top of the rod seed is well outlined. The surrounding boule is lacking in both bubbles and noticeable striae.



Figure 4

Figure 5 shows half of another boule tip, with the direction of observation being made parallel to the rod seed. In this particular case the rod is visible as a colorless, flawless center surrounded by the highly flawed and striated red synthetic corundum.

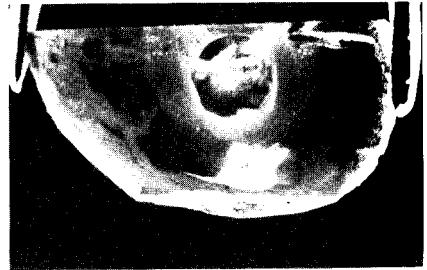


Figure 5

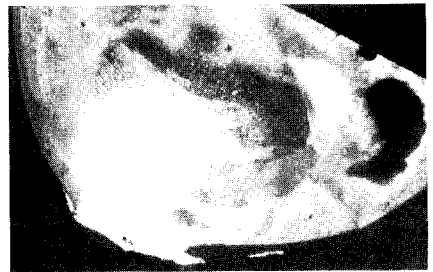


Figure 6

Figure 6 reveals another characteristic — highly concentrated and elongated bubbles spreading out in a fan-shape from the center of the rod. It should be noted that in

nearly all cases where elongated bubbles are found in synthetics they are laying perpendicular to the growth lines. This is also shown in *Figures 3, 4 and 5*. This characteristic would not be expected in a stone composed of sintered fragments, or one grown by melting fragments together.

*Figures 7 and 8* show two different views of a stone cut from this material to show intersecting striae as well as the typical bubbles. Since a synthetic boule could just



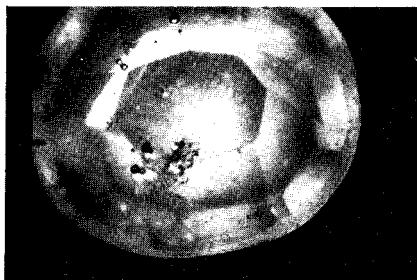
*Figure 7*

as easily be started from a natural seed or a fragment of another synthetic boule, the characteristics shown here do not necessarily cover all that could be expected from stones made in this manner.

A second type of material presented to this laboratory as reconstructed ruby consisted of small "shoe button-shaped" boules of about three eighths inch in diameter. One of these boules is shown beside a typical modern synthetic boule in *Figure 9*. They had been taken from a larger group of similar boules that had been in a jeweler's stock for many years, and were referred to on the invoice as "reconstructed rubies." The surface of these boules exhibit small, slightly raised circular areas which indicate that the boule was built up by a succession of deposits at different parts of the surface

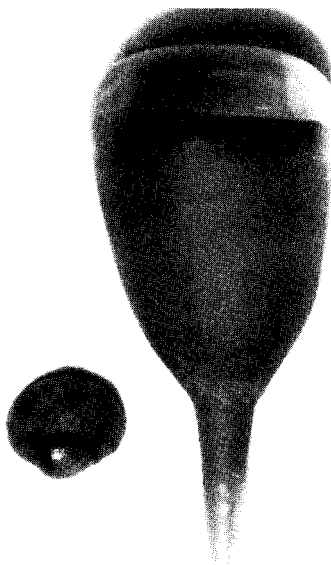
However, a cross section indicates a fairly even placement of striae beginning from the nucleus and accumulating to the outer

edge. A small button on the bottom of the boule had been fused over and, as such, did not indicate that it had been attached to



*Figure 8*

anything during the growing process. Considering the nature of the striations which are indicated in *Figure 11*, the boule could



*Figure 9*

have been attached during the initial growing formation but if so the bottom portion was fused over and rounded upon completion of the boule. The seed or nucleus from which these were started was obvious-

ly a piece of corundum formed previously by the same method.

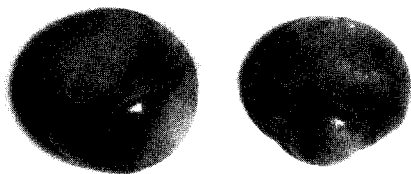


Figure 10

Although these boules correspond exactly to the description of some of the first reconstructed boules, they display absolutely no inclusions which in any way resemble or indicate that natural ruby was used. Also, since they were obviously grown from powder using a piece of similar material as a seed and possess striae, bubbles, and slightly uneven color banding resembling closely the characteristics to be found in the boule tips, it is concluded that these are nothing more than synthetic boules grown prior to the commercial application of the modern Verneuil process.

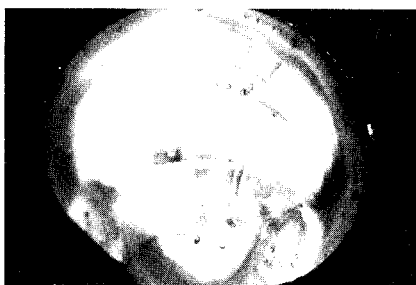


Figure 11

Figure 12 shows a different focus on the same cross section revealing the numerous bubbles also present in the seed area.

In conclusion, it may be said that the presence of any great quantity of truly reconstructed rubies in the trade is still rather doubtful, and that the majority of stones which have been so identified are probably synthetics of early manufacture. Obviously,



Figure 12

ruby fragments which are bonded with quartz fragments that in turn would become amorphous upon solidification, would show characteristics quite unlike anything described above, and could be identified by hardness tests and lack of continuity in crystallographic orientation of the fragments. Also, any stone composed of sintered natural fragments will not display curved growth lines for the individual fragments as such lines can only result from artificial growth in which the material is completely melted and grown by accumulation.

Of course, as pointed out in previous publications<sup>1</sup>, a molten mass of natural ruby, while in a viscous state, could develop swirl lines which could be irregular and even intersecting, but there would be nothing in this type of growth to cause the development of elongated gas bubbles that would be perpendicular to the swirl lines. This is a characteristic of many stones which have been identified as reconstructed. Of course, this is not meant to imply that no reconstructed boules have been found. On the contrary, a few such boules have  
(Continued on page 166)

1. *Gems & Gemology*, Summer 1949, pages 184-190.



# G.I.A. Founder Retires After Twenty-one Years

**EDITOR'S NOTES:** *Readers are referred to the Summer 1951 issue of GEMS & GEMOLOGY where on pages 35 through 48 appears a complete history of the Gemological Institute of America from the time of its inception, coupled with an outline of Robert M. Shipley's contribution to the industry through the establishment of the Institute.*

After more than a score of years devoted to the advancement of gemological training on the North American continent, Robert M. Shipley retired on March 31, 1952, from his directorship of the Gemological Institute of America, founded by him in 1931.

Operated as a partnership by Robert and Beatrice Shipley for twelve years, the Gemological Institute of America was presented to the trade by them in 1942, and incorporated as a non-profit educational institution the following year. Since that time the

founder has continued to serve as Executive Director.

"Without the many jewelers and numerous educators who helped in the development of the gemological profession, there could not have been a successful industry-controlled school for the jeweler," Robert Shipley commented on the eve of his retirement.

He expressed appreciation to many individuals, and especially commented on the indebtedness of all in the trade to the Retail Jewelers Research Group which was one of the first organizations to back the training program for jewelers. A number of the Group's members served on the Institute's first Board of Governors and many of these men, with others, have been active through the years in the direction of G.I.A.'s operation and the formation of its policies. Some of these same men still serve on the



school's governing body.

In recognition of the great service which they have rendered to the entire industry, Robert and Beatrice Shipley were honor guests at the annual banquet of the Retail Jewelers Research Group held May 14 at the Lakeshore Club, Chicago.

O. C. Homann, C. B. Brown Company, Omaha, presiding as toastmaster, introduced Percy K. Loud, Wright, Kay & Company, Detroit, who presented the Shipleys with a bound book of letters expressing appreciation to them from industry leaders in all parts of the world. He also presented them with three beautiful sterling silver trays from members of the Group.

"The greatest reward that can be earned by a man who has lived his three score years," said Loud, in making the presentations, "is the respect and admiration of his associates. The man who has left the world a little better than he found it, has won the very highest honor that the world can bestow in the recognition by persons in his own industry."

C. I. Josephson, Jr., C. I. Josephson, Jewelers, Moline, Illinois, Chairman of the Group, spoke of the closeness of association of members of his group with the Gemological Institute of America. "I view with pride," he said, "the fact that the Jewelers Research Group was one of the first in the trade to recognize the value of an educational program for jewelers. Through the years many of us have served on its governing board and have watched it grow into one of the most influential instruments in the industry for advancement of the jeweler."

Others to honor the Shipleys for their accomplishments in raising the standards of the industry until the trained jeweler of today has attained a professional status, was the American Gem Society which was founded by Robert M. Shipley and early graduates of the G.I.A. in 1934.

As a concrete expression of the regard and gratitude of members of the A.G.S., H.

Paul Juergens, Juergens & Andersen, Chicago, presented, on their behalf, an exquisite jadeite carving mounted on a base of lapis lazuli. The significance of the pine tree of jade and the stork on the base is interpreted in the Orient as symbolizing longevity, and a withdrawal from worldly cares.

On April 14, employees and staff members of the Gemological Institute honored Robert and Beatrice Shipley at a dinner in Beverly Hills.

Richard T. Liddicoat, Jr., who succeeded Robert M. Shipley as G.I.A. Director, read messages from earlier associates of the Institute who could not be present due to distance. He voiced the sentiments of the entire staff when he said, "Our purpose in gathering here this evening is to collectively and individually express our appreciation for the privilege of having been associated with you. The results of your intensive efforts during the past two decades are evident in all divisions of the industry today. The inestimable value of the trade institution which you have created will live on to influence the industry through generations to come."

In passing on the responsibilities of the G.I.A. management and acknowledging the gift from the staff, Shipley responded, "Your gift means much to me. It is the happiest thing that has happened to me for years past. Your signatures on it will keep you in my life for years to come. There is, however, an even greater gift that you can give me, and that is to continue to teach G.I.A. students not only ethics but culture, and a bit of philosophy. During the last few years your developments in the presentation of the science of gemology have been outstanding and gratifying. But give our students more than the means by which to make more money and gain prestige through the scientific ability to test gemstones and grade diamonds. Give them something to make their lives happier—and their surroundings more beautiful. Give them something to live by."



• This pendant head from Tlaxiaco, Oaxaca, is French-green jadeite streaked and mottled with gray. It is one fourth inch thick and one and five sixteenths inches high.

# Jade in Mexico

*by*

**DR. RAYMOND J. BARBER**

*Curator of Mineralogy and Petrology, Los Angeles County Museum*

It will take countrymen to rediscover the rock deposits of Mexican jade. But before they will bother to search, they must be assured that they can sell the right kind of stone as soon as it is found.

The urge for discovery of minerals is economic. When the people who roam the hills realize that there is a ready market for

a special type of rock they will become alert to the possibility of gain. That is what inspires prospectors to pick and shovel, and causes the goatherd to keep his eyes open for bright green stones when he is crossing a stream.

In every town of southern Mexico today there is someone known to be interested in

buying ancient carved images. So, when a farmer turns one up while plowing his field, he knows he can sell it to the *patron* in town. The townsmen in turn keep these idols and bright stone carvings for the periodic visit of a dealer, who will buy them at a profit. Thus, the antiquities find their way to the city curio shops, where the tourists will pay big prices for them.



• Actually of marble, this oyster-gray "chalchihuitl" (Aztec word for green stone), idol was found at Yanhuitlan, Oaxaca. It is one and three eighths inches high and five eighths inch thick.

There are not enough of these genuine artifacts, though; so, naturally, the lapidaries supply imitations. Furthermore, the stores have found that the average tourist is not especially interested in archeology.

Cleverly carved pieces for feminine adornment, or utilities for the home, are popular; and these are now made abundantly of green glass. When a casual visitor from north of the Border asks the salesman, "Is this desk set really jade?", the answer will be, "Yes, Mexican jade." And that is a pity because, instead of pushing a rank imitation, he could be offering true jade if only some natural deposit were found from which the lapidaries could obtain a regular supply.

It will be remembered that two minerals are rightly entitled to be called "jade": *nephrite*, a lime-magnesia amphibole; and *jadeite*, a soda-alumina pyroxene. Both occur in colors from white to deep green, depending upon the amount of iron present. Both are suitable for intricate carvings. Some nephrite artifacts are found in Mexico, but the ancient lapidaries used mostly jadeite. Either stone would now be acceptable for renewal of the art. Jadeite, however, is the more valuable of the two minerals, and therefore more sought after. It is harder, heavier, and more brilliant than nephrite, besides being much more rare in the world. At present the only known deposits of natural jadeite suitable for gem cutting are in northern Burma, and it is from there that Chinese obtain all of their raw rock. Some small discoveries of mineral recognized as jadeite have been made in California, but the stones are not of gem quality.

Great numbers of jadeite carvings have been found in southern Mexico ever since the Spanish Conquest, but there have been no discoveries of any local deposits from which the stones might have been quarried. This fact, together with the similarity of some pieces to the oriental jades, has led many archeologists to believe that the rough mineral was imported from Asia. Some even have thought that the carving itself had been done in China.

Indeed, elaborate theories were put forward some years ago in attempts to ration-

alize the idea of a complete culture having been transplanted from China into Mexico. By careful comparison of chemical and optical analyses, however, it has been shown that the typical Mexican jadeite differs appreciably from that mined in Burma. The Burmese stones are almost pure *soda-jadeite*, while nearly all of those from Middle

Authentic jade carvings, representative of all the well-recognized ancient Mexican cultures, have been reported as far north as Sonora, and southerly into Panama. Most of them have been unearthed in the excavation of temples and tombs, but many have been washed out of loose earth by the rain.

The greatest number have been found in the States of Guerrero, Oaxaca, Chiapas, Vera Cruz, and Tabasco. This wide distribution does not mean, however, that the original rock occurred in so many places, but only that jade was held in the highest esteem by all the early peoples of Mexico — the Maya, Mixtec, Zapotec, Olmec, Toltec, and Aztec. The great quantities of jade artifacts that have been discovered in Maya



• Highly polished, deep dull yellow-green No. 2 jadeite was used for this pendant foot found at Cholula, Puebla. Five eighths inch high and one eighth inch thick.

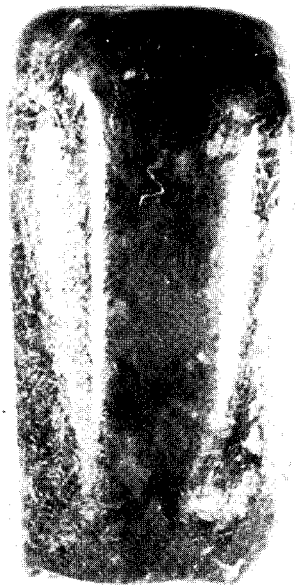
America show replacement of parts of the soda and silica by lime and magnesia, enough to be defined as *diopside-jadette*. The Mexican mineral, therefore, is truly jadeite, but of such distinct character that it could not have originated in the Orient. Many of the Mexican pieces were carved from stone somewhat below the best quality, yet there are enough of the very finest to have justified their use in the highest art.



• The amulet head of highly polished Artemesia-green jadeite was found at Tanhuitlan, Oaxaca and is five eighths inch high by three eighths inch thick.

ruins, for example, dating back as far as 96 B. C., probably were brought there from the mountains of Oaxaca on the west, or of Guatemala on the south, to be carved

for use in religious ceremonies. This seems to be certain, because in Yucatan there are for the most part only limestone and alluvial rocks, which would not be favorable for occurrence of jade. So the Maya must have obtained the rough stones either from their southern neighbors or from the Zapotec and Mixtec miners.



• Found at Taxco, Guerrero, this Empire-green jadeite bead is highly polished. Three fourths inch long and three eighths inch thick.

All over Middle America there was implicit belief in the beneficial effects of jade amulets. Magic and divine influences were ascribed to them for protection against disease and for relief of pain. Upon the death of a rich man, a piece of jade was placed in his mouth to function as a heart, and jade images were buried with him to assist on his journey to the Beyond.

The Toltecs carried their veneration of jade so far as to believe that their most

powerful ruler, Topiltzin, incarnation of the god Quetzalcoatl, was begotten by a jewel of fine green jade that his mother had cherished in her bosom.

The Aztecs, after their conquest of all the older nations of central Mexico, required the subject tribes to contribute jade regularly as the price of survival. Accounts of it were kept in the Tribute Rolls that still exist, showing the type of stone carvings and the names of towns that supplied them.

In those ancient times, therefore, there was great demand for jade in all parts of central and southern Mexico, and unquestionably the Indians knew where to find the rough stones. They may not have located the ledge rocks, but did find broken-off pieces as boulders and smaller pebbles that had been washed down by the mountain streams, and even into the beds of the rivers. Many of the carved pieces, in fact, show plainly that their form was influenced by the size and shape of the original stone. Two boulders of rough jade—one weighing 200 pounds—have been discovered in excavated ruins of Mayan temples, where they had been taken in preparation for carving. Also it is reported that recently a pebble of jade was found by an archeologist in the bed of a river that flows out of the high mountains of eastern Oaxaca.

A natural question often asked is, "Why, if jadeite is native, have no quarries of the original mineral been found in Mexico?" As suggested at the beginning, the reason is economic. The gathering of jade boulders had been profitable for the miners during the flourishing days of the Golden Age in the Valley of Mexico. But the prosperity and peace that had come to the country by fusion of the northern Toltec strength with the Olmec and Mixtec cultures, was ended suddenly by the Aztec invasion. The people who formerly had been allowed to profit from their labor were forced to give up all their precious stones as tribute to the fierce

*(Continued on page 166)*

# The Synthesis of Quartz\*

by

DR. ROBERT M. GARRELS

*Department of Geology, Northwestern University*

After more than five years of intensive work by a number of investigators sponsored by the Signal Corps Engineering Laboratories, large crystals of quartz have been successfully synthesized. This event is not in itself of tremendous significance to gemologists, but its implications are. The method employed approximately duplicates natural conditions of quartz growth; the result is that synthetic material is very hard to distinguish from the natural. The parallel to the situation in terms of natural versus synthetic emeralds is obvious; knowledge of the conditions of quartz growth undoubtedly gives us much insight into those of emeralds. Even more important, perhaps, is the implication that the knowledge gained during the quartz work can be applied to the synthesis of a variety of gem materials.

Quartz is grown in high temperature—high pressure water solutions, as opposed to the dry fusion used for corundum and spinel. The chief barrier to formation of quartz from a fusion is the crystallographic changes that occur during heating or cooling. If quartz is heated, it undergoes a number of changes in crystal structure with increasing temperature. Conversely, if it is

cooled from the liquid, it goes back through the same changes. Such solid state structural changes tend to disrupt any single crystals grown at the higher temperatures. There are still other difficulties in growing quartz from fusions, but fundamentally the difficulty is that the presence of different crystal structures at high temperatures makes production of clear crystalline material stable at room temperature impossible. Consequently, quartz must be grown within the range of stability of the low temperature form—at temperatures less than 575°C.

This restriction meant finding a solvent in which silica was at least slightly soluble at temperatures less than 575° C., so that source material could be dissolved and re-grown into large single crystals. The solvent used by nature seemed to be water with various amounts of dissolved salts, so it was the most obvious choice. Other solvents have been tried, but none has been suitable.

Experiments soon showed that although silica could be dissolved in considerable quantities near room temperature, in several types of concentrated water solutions, it

\* The material in this article has come from the Signal Corps Engineering Laboratories projects on quartz synthesis.

could not be reprecipitated to form large crystals. Instead it reappeared as a gelatinous essentially amorphous mass. Suitable growth conditions could only be realized at temperatures far above the ordinary boiling point of water. Equipment capable of withstanding very high pressures was necessary.

Gradually two distinct approaches to the growth problem evolved. One can be called the constant temperature method, the other the temperature gradient method.

### CONSTANT TEMPERATURE METHOD

In the constant temperature method some form of silica more soluble than quartz is heated to a water solution. The solution becomes saturated with the material used. Because quartz is less soluble than the form of silica used (such as silica glass), the solution is *supersaturated* with respect to quartz. A quartz plate or fragment in contact with such a solution will grow until the excess dissolved silica is removed.

The experimental difficulties involved were appalling. It was found that temperatures of the order of 400° C. were necessary. At that temperature the vapor pressure of water is approximately two and one half tons per square inch. Special steel bombs were constructed to withstand such pressures. Under these conditions water has an incredible ability to sneak around gaskets and fittings. Much time was consumed in developing gasket materials that would not leak or be attacked by the solutions, in learning the best way to make steam-tight connections.

Further difficulties arose from the chemical factors. When quartz plate was sealed into the bomb, along with more soluble nutrient material, both seed plate and nutrient dissolved if the solution used were too effective a solvent. One very effective device to minimize this effect was to suspend the quartz seed well above the level of the water when the bomb was filled at room temperature. Then, as the bomb was

heated, the seed plate remained uncorroded in the steam above the liquid, while the nutrient material dissolved and saturated the solution. Then, at about 375° C., the critical temperature of water was reached, and the solution all turned to steam. This steam, however, had a density near that of the solution, and was an effective medium for growth. Before this "flashing over" of the bulk of the solution into steam, the seed plate was in steam of low density, and neither corroded nor grew. Afterwards growth ensued. By protecting the seed plate in this manner, it was found possible to get growth on the seed plate, and some small crystals were formed. Another difficulty emerged, however; the nutrient material converted to quartz in place, without dissolving, moving, and reprecipitating on the seed plate. As soon as it became quartz, its solubility became the same as that of the seed, and growth stopped, for the whole principle of growth depended on a continuous supply of silica from a source more soluble than quartz.

### TEMPERATURE GRADIENT METHOD

In the temperature gradient method use is made of the increase in quartz solubility in water solutions as temperature is increased. In principle, growth of large crystals should be easy; in practice, the mechanical difficulties to be surmounted were greater than in the constant temperature method. Quartz is dissolved at a higher temperature, then the saturated solution is cooled and placed in contact with a quartz seed plate. The solution is supersaturated at the lower temperature, so that the seed grows until the solution is just saturated at the lower temperature. This is the method that had already been used to grow very large single crystals of several compounds, such as dihydrogen phosphate. For them, however, solutions below the boiling point could be used in essentially open containers. For quartz growth the temperatures for this method,



as for the constant temperature method, were 350-400° C.

There was one major limitation in this method that had to be observed. If the solution saturated at the higher temperature were cooled too much, spontaneous nucleation took place; that is, quartz crystals appeared throughout the solution, and little growth took place on the seed. Under proper conditions no new crystals appeared spontaneously, all silica in the supersaturated solution reappeared as quartz on the seed plate. Consequently, the problem became one of saturating solution with quartz at a higher temperature and then moving it to a new location at a carefully controlled lower temperature with operating conditions of two and one half to five tons per square inch pressure and a temperature of 350-450° C.

The Brush Development Company designed a satisfactory device by using two large pipes, connected to each other by two cross pipes, one near each end. One larger pipe was loaded with pure but irregular fragments of quartz. In the other was mounted one or more quartz seed plates. Then enough sodium carbonate water solution was added so that the system would be filled with liquid at the high temperatures of the run, after the liquid had expanded. Each pipe was jacketed with insulation, and heated electrically in such a way that the side containing the quartz fragments was hotter than the side containing the seed plates. The sodium carbonate solution became saturated with quartz throughout the system, but because of the higher temperature on the "feed" side reached a higher concentration there. By rocking the whole system mechanically the hotter saturated solution can be moved through the cross pipes to the seeds, where it cools and precipitates quartz on the seed plate; the cooler solution moves through the other pipes at the same time to the hotter chamber where it becomes saturated with feed material. This solves the problem of trans-

portation of hot saturated solution to an environment containing seeds at a lower temperature.

The problem has also been solved by the Bell Telephone Laboratories<sup>1</sup> by using a single chambered container. There circulation of solution is controlled by temperature gradient in an elongated bomb.

### PROPERTIES OF SYNTHETIC QUARTZ

It was found early in the work that the crystallographic orientation of the seed plate was of great importance in getting good growth of quartz. In general, the faces of a crystal represent directions of slowest growth, whereas edges or corners grow faster. In quartz the greatest rate of growth takes place parallel to the *C* axis. Eventually a way was found to cut seed plates so that a maximum rate of good growth could be obtained.

The synthetic material is, in general, un-twinned, unstrained, and free from all but very minute inclusions. These inclusions are two-phase—gas and liquid. This reflects, of course, the fact that liquid has contracted more than the solid quartz, leaving a bubble of water vapor with liquid. Solid inclusions are rare. There is no appreciable difference in density between natural and synthetic materials. It appears possible to grow colored material quite readily.

### CONCLUSION

The successful growth of synthetic quartz has resulted from the development of crystal techniques in high temperature—high pressure water solutions. Such an environment is similar to that in which quartz grows in nature. Consequently, there are no easily discernible differences between synthetic and natural material. The methods that have led to success in quartz growth undoubtedly are applicable to a variety of other gem materials.

1. Dr. Albert C. Walker: *Laboratory Synthesis of True Quartz Crystals*. Gems & Gemology, Winter 1950-51, Page 359.

# Occurrence— Mining and Recovery of Diamonds

by

A. ROYDEN HARRISON

*Consulting Engineer, Anglo-American Corporation of South Africa, Ltd.*

*This paper deals with occurrence, mining and recovery of diamonds but, like everything connected with diamonds, even these aspects are not without color or romance.*

## HISTORICAL DATA

Until diamonds were discovered in Borneo about 600 A. D. the diamond mines from India were the only source. Fields in Brazil were discovered early in the 18th century and Brazil soon became a major producer. The Indian fields were nearing exhaustion, and production from Borneo and Brazil had already waned considerably, when rich river diggings — followed by rich 'pipes' — were discovered in South Africa — from 1869 onwards. Other smaller deposits in the 19th century were discovered in Australia and British Guiana.

The 20th century started auspiciously with the discovery of the Premier Mine, near Pretoria — largest of all diamond pipes — in 1902. In 1906 a series of extensive alluvial deposits were found in the Belgian Congo, which were found to extend into Angola. In 1908 the first marine alluvial deposits were discovered near Luderitz on the South-West African coast. Following the

discovery of alluvial deposits on the Gold Coast in 1919, similar deposits were found in Sierra Leone and later in French West Africa and French Equatorial Africa. In 1926 further rich alluvial fields were found in the interior of South Africa. In 1927 extensive marine deposits were found on the Namaqualand coast and were proved to persist northwards beyond the Orange River into South-West Africa. The first small diamond deposits found in Tanganyika, in 1928, were followed by the much publicized discovery of the rich Shinyanga deposit in 1940.

The diamond deposits in the United States of America and Russia are of little more than academic interest.

Roughly 98 per cent of the present world output of about 15 million carats per year is produced in Africa. South Africa is not only the largest producer of gem diamonds, but produces industrial stones of finest quality. The Belgian Congo leads in industrial diamonds. The demarcation between industrial and gem diamonds varies, depending on demand and market conditions. In 1950, industrial diamond production reached 12 million carats equivalent to 79 per cent of all diamonds recovered.

## OCCURRENCES OF DIAMOND

Diamonds occur either in alluvial deposits, or in 'pipes' and fissures filled with basic volcanic material, now largely altered to serpentine and known as blue ground or kimberlite. Alluvial deposits originally derived their diamonds from pipes and fissures, the upper portions of which were denuded through erosion in the passage of time, and the eroded material redeposited in river beds and flood planes. In some cases diamondiferous material was transported to the sea by ancient river systems, and the diamonds were redeposited by wave action on beaches, which were subsequently elevated and covered with wind-blown sand.

Numerous pipes and fissures of kimberlite have been discovered in South Africa and elsewhere in Africa, but relatively few contain diamonds, and even fewer contain economic quantities.



• Kimberlite fissure crossing El-ands R Valley in South Africa.

Of the rich alluvial deposits in Central, West, and East Africa, the source of the diamonds has been discovered in only two

cases. In many cases, the source may never be discovered.

## INDIAN FIELDS

Probably the oldest known diamond field still operating is in Central India, at Panna, in the State of Vindhya Pradesh. Some small mines use most primitive methods to recover diamonds from narrow conglomerate beds overlain by up to 70 feet of overburden.

To reach the conglomerate, a circular excavation, 150 feet in diameter at the surface and sloping inwards, is made by hand, the debris being carried to the surface in baskets, on the heads of women and children, via a peripheral spiral stairway cut into the side of the excavation. On top of the conglomerate, radiating tunnels, four by three feet, are driven for a distance of 15 to 20 feet from the sides of the open-cast, and interconnected for ventilation. The conglomerate is broken up by moil, and by wood or dung fires. Mined-out areas are supported with sandstone blocks carried from the surface. Lighting is by a cotton wick in an open saucer of oil, and water is baled to the surface in small lifts by baskets or raised by a series of wooden Persian wheels fitted with calabashes. On the surface, the conglomerate is broken fine with hammers, washed by hand to remove the slime, and then dried and hand-sorted for diamonds, without any reduction by concentration whatsoever. The average yield is approximately 10 carats per 100 loads.<sup>1</sup>

Each little mine is leased by one or two families, every member of which, from six years upwards, spends mornings in wheat fields and afternoons in the mine. Only men and older boys may work in the tunnels, while women, girls, and younger boys carry the broken rock to the surface. The mouths of tunnels are draped with Hindu prayer symbols and, lest the yield be decreased, shoes are not worn in the workings, which are regarded as a temple. The red and green shales in the sides of the ex-

cavation and the bright red saris of the women, complete the colorful scene.

Until the Central Government took office, royalty from the mines was paid to the reigning Maharajah of Panna, who was also entitled to retain the larger diamonds. The Maharajah's predecessors assembled a necklace of 52 perfect, uncut, octahedral stones, varying in size, up to 25 carats of a total of 325 carats beautifully set in gold.

#### MOST MODERN MINE TODAY

The *Premier Mine* is the largest and the most modern diamond mine. Four million tons are treated per year, for a production of more than one million carats of diamonds, of which 80 per cent are industrial. The mine is an elliptical kimberlite pipe, 3000 feet long by 1500 feet wide, surrounded by felsite (a red micro-granite). It had been worked about 610 feet deep by open-cast methods. It was closed in 1932, as a result of the depression.

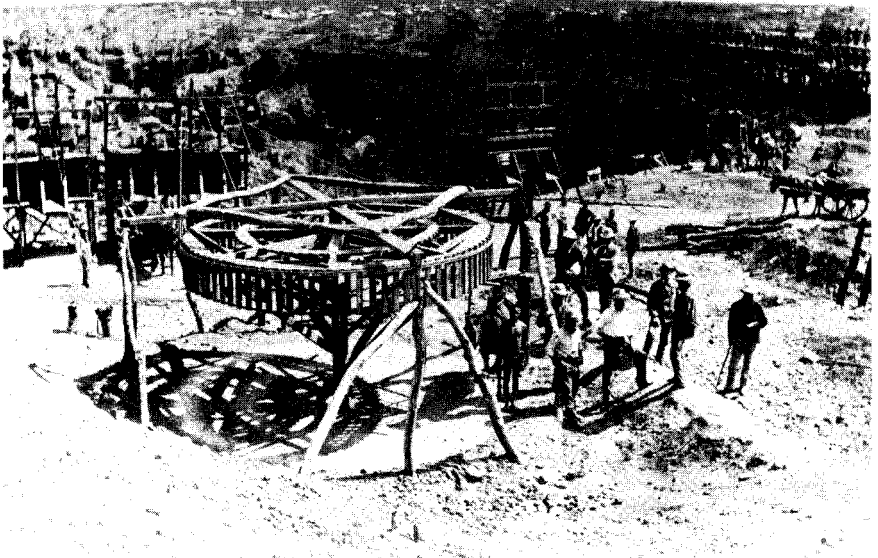
An underground mining system was introduced when the mine reopened in 1950. A cut, 200 feet deep, was taken across the full length of the pipe, originally 24 feet wide. Benching in steps from sublevels, at vertical and horizontal intervals of 50 feet, is now performed. Long-up holes, arranged fanwise, are drilled with rotary machines, from the sublevels, and this will continue in steps to the periphery of the pipe.

Broken ground is drawn off through cones at the bottom of the slot, and passes through finger raises, grizzlies and an ore-pass system, to the 890 foot collecting level, where the ground is transferred by eight ton self-tipping cars, into another orepass system feeding the main haulage on the 1060 foot level.

On the 1060 foot haulage level, the ground is loaded through compressed air-operated loading boxes into trains of 180 cubic feet trucks drawn to the main shaft,

- **Blasting operation in the enormous crater of the Premier Diamond Mine in 1927. Here the 3106 carat Cullinan Diamond was found.**





• Early picture of the Kimberley Mine showing first whim in 1874.

some 1200 feet from the periphery of the pipe. The cars are automatically tipped at a ramp at the main orepass grizzly, from which plus eight inch oversize material is fed to an underground jaw crusher. The minus six inch product joins the grizzly undersize at the shaft loading box system.

Hoisting two 12-ton skips from a depth of 1350 feet, a single 2500 h.p. Ward-Leonard hoist, operating 20 hours per day, raises 12,800 tons per day for treatment on the surface; lifting time 52 seconds.

The treatment plant uses most recent technical developments such as heavy media separation and vibrating grease tables.

From the surface ground storage bin, belt conveyors feed the crushing section, where the ground is reduced in closed circuit to minus one and one fourth inch. This product is then washed and screened to extract 10 mesh (1 mm.) material to be treated separately in jigs.

The oversize material is fed into 16 foot diameter cones, with a mixture of water and ferro-silicon as separating media. This media has a specific gravity of 2.95 and the diamonds (s. g. 3.5), together with heavy minerals, sink to the bottom of the cones, while lighter material is floated off. The float product is screened and the plus three eighths inch fraction extracted and re-crushed to minus three eighths inch. The minus 10 mesh material from this operation is removed and fed to Denver jigs, while the plus 10 mesh rejoins the main feed to the cones.

Both the sink and the float products are washed to remove ferro-silicon, which is recovered by magnetic separators. After washing, the concentrates (i.e. the sink product) from the cones, are conveyed to the recovery section, where they are joined by those from the jig section. The concentrates are screened into three sizes and

passed over vibrating grease tables, to which only the unwettable diamonds adhere. The capacity of the table is 40x that of usual side-shaking tables. Electrostatic separation extracts small diamonds.

In the previous working, diamond extraction was by rotary pans which were subsequently replaced by jigs. The yield was 17 carats per 100 loads. The yield with the present plan is much higher. The new methods have reduced native labor by 57 per cent and European labor by 11 per cent for the same tonnage.

#### PIPES IN KIMBERLEY AREA

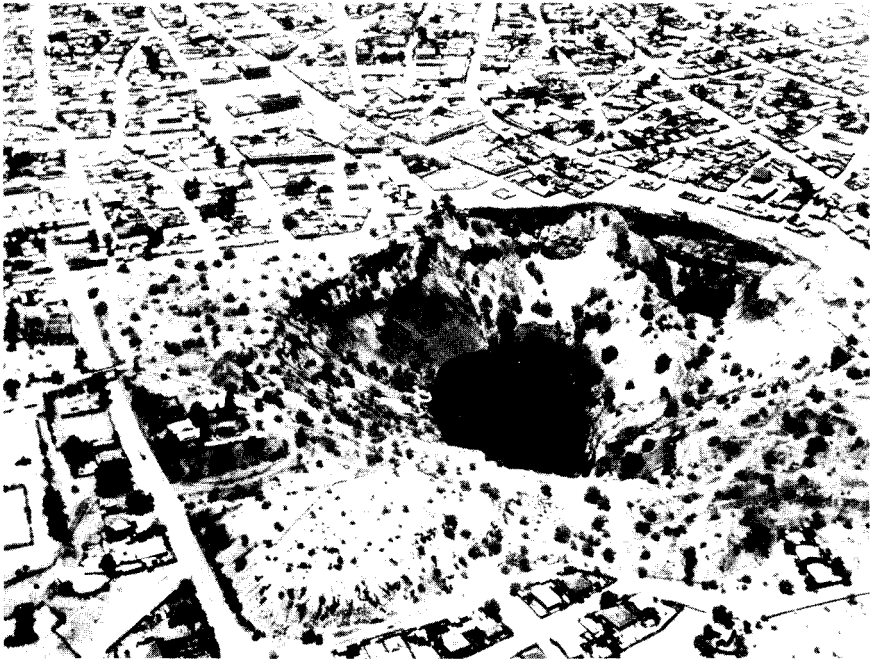
In the Northern Cape and the Western Free State, there are many kimberlite pipes and fissures. Substantial quantities of diamonds have, at times, been recovered from fissure workings, but their output was

small compared with that from the pipes. The pipes in this area have yielded the bulk of the £350,000,000 worth of diamonds produced in the Union to date.

The more important pipes are: The *Kimberley Mine* (The Big Hole), *De Beers Mine*, *Bultfontein*, *Dutoitspan*, *Wesselton*, *Koffiefontein* and *Jagersfontein Mines*. Of these, only *Jagersfontein*, *Dutoitspan*, *Bultfontein* and *Wesselton* are working now. On all mines, the practical limit to open-cast working has been reached, and present operations are underground. The mining system is, in general, the same.

Sublevels are from 25 to 50 feet apart and on each level a slot, or chamber, 10 to 14 feet in width, and extending vertically to the level above, is cut from one side of the pipe to the other. When such a slot, or

- View of the Kimberley Diamond Mine, the "Big Hole," when it was partially filled with water prior to being reopened in 1950 when open-cast methods were discarded for underground mining.





• The rushing waters of the Kasai River in the Belgian Congo.

chamber line, has been completed, another is cut parallel to it, leaving a pillar six to 10 feet wide between the two. This crushes fairly quickly due to the weight of broken ground above.

Unlike the kimberlite at Premier Mine, Kimberley blue ground crumbles with prolonged exposure to air and disintegrates more rapidly in contact with water. All drilling of blue ground in the Kimberley Mines, including long diamond drill holes, is done 'dry' with dust extraction.

Loading of the broken ground is done by hand from tunnels at 22 feet 6 inch centers, running at right angles to the chamber line, into trucks, which are hand-trammed to ore-passes, usually in country rock. The broken ground from a number of levels is brought to a collecting level below where endless rope haulages, or conveyor belts, bring the rock to the main shaft bin. The main hoisting shaft is set well back from the pipe in the country rock. Hoisting is at the rate of 6,000 loads (4,800 tons) per eight hour shift. On the surface, the blue ground passes over a grizzly, from which the over-

size proceeds via sorting belts to crushers set at three inches. The crushed product joins the grizzly undersize and is taken to the central washing plant. The blue ground is crushed to minus one inch and fed directly into primary rotary pans, with revolving radial rakes. Mud puddle separates diamonds and heavy minerals from lighter kimberlite gangue.

Tailings from the pans go to rolls set at three eighths inch and then to secondary or fine pans, through a three eighths inch screen, the oversize being returned to the coarse pans. Tailings from the fine pans are brought to the dump by belt conveyor with flingers. This replaces the used endless rope haulages and has saved much labor.

Concentrates from both the fine and coarse pans are taken in trucks to the pulsator, where further concentration is in pulsating jigs. The final concentrate is passed over sideshaking grease tables. In the future, pan concentrates will be dealt with in a small heavy media separation plant, and concentrates will go to vibrating grease tables.



• The Bushimaie Valley where the bulk of Belgian Congo diamonds are recovered.

Periodically, the grease (petroleum jelly), and the diamonds adhering to it, are scraped off the tables. The grease is boiled off and the larger concentrates are hand sorted, while finer diamonds are recovered by electrostatic separation.

### BELGIAN CONGO

In the Belgian Congo some 10 million carats are annually recovered from alluvial sources.

Here, diamonds were first discovered in gravels and in the valleys and sides of the lower reaches of tributaries of the Kasai River. About 600,000 carats are produced annually by numerous small mines operating. Some 50 per cent of the diamonds recovered are of 'sand' size and gems represent about half of the production. The Kasai field is an extension of the Angola deposits; geology and methods of mining and treatment are similar.

The bulk of the production comes from the later-discovered Bakwanga deposits between the Kanshi and Bushimaie rivers, some 700 miles northeast of Elisabethville. Diamond occurs in extensive deposits of gravels overlying dolomite and sandstone. Prospecting has recently revealed kimberlite masses.

In large scale operations several million cubic meters of overburden are annually removed, or mined and treated for obtain-

ing nearly 10 million carats of diamonds, about 98 per cent being industrial.

At present, operations are carried out by mining and treating in a number of separate sections, but complete mechanization and centralization is intended. Gravels are loaded onto conveyors and transported to a log washing plant. The washed gravels will then be treated in a heavy media separation plant and the concentrates processed in a recovery section for diamond extraction. A large hydroelectric power scheme, now under construction, will provide the necessary power.

### ANGOLA DEPOSITS

The Angola deposits are in the northeast corner of the territory, and extend into the Congo as far as the south bank of the Kasai River. The diamondiferous gravels occur in the valleys and on the sides of present-day streams and are largely derived from gravels deposited by an ancient drainage system that no longer exists. Remnants of the ancient gravels still occur beneath thick deposits of Kalahari sands on some of the present-day hilltops and are worked for diamonds. Three types of deposits are exploited, i.e. valley, hillside, and terrace gravels.

Overburden varies considerably, depending on the type of deposit which, in the case of terrace, is up to 120 feet thick.



There is an abundance of water throughout the area and, wherever practicable, overburden is removed by sluicing.

Gravels, one to four feet thick are mined by hand or excavator, and then transported to individual washing plants by endless rope haulage, or dump truck. Some 30 mines are usually operated at a time, each complete with a washing plant, in which two stages of concentration by rotary pans are followed by further concentration in jigs. Concentrates from these plants are brought to a central recovery section where the diamonds are extracted by grease tables. The average size of the diamonds is 5.36 stones per carat and the grade of the gravels, which varies considerably, averages 0.71 ct./cub.m. or 17 carats per 100 loads.

In both Angola and Congo, Africans are trained in the skilled trades and operate all heavy machinery. Vast sums have been spent on welfare and education of the African over a considerable number of years with excellent results.

#### TANGANYIKA TERRITORY

In Tanganyika, at Shinyanga, about 100 miles due south of Lake Victoria, diamondiferous gravels, three to six feet thick, exist over a large area, underlain by granite. Below the gravels, in one area, either one large or several small, kimberlite pipes have been found, but their payability has not yet been established.

At present gravels which are covered with two to three feet of overburden are mined. The overburden is removed by Carryall scraper and the gravels are loaded

by excavators into 15-ton Diesel trucks and brought to the treatment plants.

There are two plants — a heavy media separation plant and a rotary pan plant, the concentrates from which are added to the feed of the heavy media plant. The concentrates from the heavy media plant are washed and screened and then hand sorted. The gravel is, said to yield 20 carats per 100 loads.

#### SIERRA LEONE DEPOSITS

In Sierra Leone, diamondiferous gravels occur in minor tributaries of rivers in an area some 300 miles inland from Freetown. The gravels are lateritic and overlie granite. They vary from two to five feet thick and are covered by two to 20 feet of overburden.

Several deposits are usually worked at a time, each being complete with a separate washing plant. Overburden is generally removed by excavator and deposited into mined-out areas. The gravels are then loaded by the same machine into small cars and transported to the washing plant, which is similar to those used in Angola.

Concentrates from all plants are sent to a central recovery plant where the diamonds are extracted on shaking grease tables. Some 66 per cent of the diamonds from these fields are of gem quality. The diamonds are small, running three to five stones per carat. The gravels yield 2.0 to 2.5 carats per cubic yard, or 62.5 to 79 carats per 100 loads. An occasional large gem diamond is found on these fields.

*(To be continued next issue)*

• The native African shown here operates a grease table at the Tshikapa central plant in the Belgian Congo.



# Richard T. Liddicoat, Jr. Appointed Director of G.I.A.

Appointment of Richard T. Liddicoat, Jr., as Director of the Gemological Institute of America, to succeed Robert M. Shipley, founder, has been announced by G.I.A.'s Chairman of the Board, John S. Kennard.

The new director joined the Institute staff in 1940 as Assistant Director of Education. After serving in the U. S. Navy for three years, he returned to the G.I.A. as Director of Education early in 1946. In 1948, when Robert M. Shipley announced his intentions to retire, he appointed Richard Liddicoat Assistant Director of the G.I.A. and delegated to him general administrative duties. At the same time he was made actively responsible for the development, advancement, and successful operation of the educational and research departments of the Institute.

In January 1949 Liddicoat's responsibilities were further extended when the G.I.A. Operating Committee asked him to direct the expansion of the Institute's branch and laboratory in New York. When the Gem Trade Laboratory was turned over to the G.I.A. in September of the same year, it became Liddicoat's responsibility to integrate the facilities of the two laboratories. He returned to Los Angeles in February 1950 to continue his administrative duties and to direct the acceleration of the continuous program of modernization and expansion of the courses of the Institute.

In his future direction and operation of the G.I.A., Director Liddicoat is fortunate to have the assistance of capable department heads, all of whom have worked closely with him during the last few years of the Institute's expansion and progress.



**Richard T. Liddicoat, Jr.**

Richard T. Liddicoat, Jr. received his bachelor's degree in geology and his master's in mineralogy from the University of Michigan where he was also Assistant in Mineralogy for three years before coming to the G.I.A. The new director of the Gemological Institute is well known to readers of *GEMS & GEMOLOGY* through his technical articles which have appeared in this publication, as well as through his annual presentation of the educational sessions of conclaves of the American Gem Society. His sincere interest and understanding of the problems of students and other jewelers, coupled with his many years working with the retiring director, have well equipped him to direct the future activities of the Gemological Institute.

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# Gemological Digests

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## DR. EDWARD H. KRAUS REELECTED TO PRESIDENCY OF GEMOLOGICAL INSTITUTE

At the March 28 meeting of the G.I.A. Board in Chicago, Dr. Edward H. Kraus, University of Michigan, Dean Emeritus of the College of Literature, Science and the Arts, was elected president of the Gemological Institute of America for the seventh consecutive year.

Long recognized internationally as an authority in the field of crystallography and precious stones, Dr. Kraus was one of the first scientists to give wholehearted support to the Gemological Institute in its early years. He came to the University of Michigan in 1904 and in 1916 introduced a course in gemstones, continuing to present the course until 1933 when the class was

taken over by his associate, Dr. C. B. Slawson.

At the Chicago meeting, Charles Peacock III, C. D. Peacock, Inc., Chicago, was elected Vice President — an office which has been vacant for several years. Fred J. Cannon, Slaudt-Cannon Agency Company, Los Angeles, continues as Secretary-Treasurer, and Dorothy M. Smith as Executive Secretary. As reported elsewhere, Richard T. Liddicoat, Jr. was appointed Director of the G.I.A. to succeed Robert M. Shipley who retired March 31.

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DANA'S MANUAL OF MINERALOGY. 16th edition. Revised by Cornelius S. Hurlbut, Jr., John Wiley & Sons, Inc. \$6.00.

*Dana's Manual of Mineralogy* must be one of the oldest texts in use in any scientific field today, since the first edition was published in 1848. This is a revision of the 15th edition which was published in 1941.

The growing number of hobbyist mineral collectors and the host of amateur lapidaries who are interested in learning more of the science of mineralogy should find *Dana's Manual of Mineralogy* a text which covers the field of mineral identification in as basic a manner as is available to them.

While crystallography may remain somewhat hazy to the reader because of the difficulty of translating words into a three-dimensional picture, the lucid style of this text makes much of the remainder of the subject matter clear to the reader. The chapter on chemical mineralogy which has been rewritten largely from the last edition is particularly well done, especially the section on crystal chemistry. The entire book has been reset in a cleaner, more legible type face. *Richard T. Liddicoat, Jr.*



Dean Edward H. Kraus

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# Gemological Digests

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## JOHN S. KENNARD SUCCEEDS H. PAUL JUERGENS AS CHAIRMAN OF G.I.A. BOARD

John S. Kennard, Boston, was elected chairman of the Board of Governors of the Gemological Institute of America to succeed H. Paul Juergens, Chicago, at the 1952 spring meeting of the Board. Juergens, who is retiring as Chairman after serving four years in that position, will continue as a regular member of the Board.

Active in affairs of the Gemological Institute for many years, John S. Kennard received his Certified Gemologist title in 1937, and has served on the G.I.A. Board since 1943. President of Kennard & Company, Inc., he has been associated with the firm, established by his father in 1906, for the past 26 years.

Always interested in any group whose activities would benefit the industry, he has been associated with many industry organizations. For three years he was a Director of the Massachusetts and Rhode Island American National Retail Jewelers Association. He is currently a director of the Boston Jewelers Club and has been since 1938, serving as President during 1945-46.

One of the earliest students of the G.I.A., H. Paul Juergens enrolled when he had already been in the jewelry business for 37 years. He received the third Certified Gemologist title ever awarded. He has been one of the most enthusiastic boosters of gemological training in the industry and has not only encouraged young men in the trade to study the G.I.A. courses but has assisted them in finding positions or establishing businesses of their own.

In 1935, at the organizational meeting of the Metropolitan Guild in Chicago, Juergens was elected president of the group and has served in that capacity ever since.



John S. Kennard

As President, he headed the Central Division of the American Gem Society Conclaves until the regional meetings were combined into one annual assembly. At one time Secretary of the G.I.A. Examinations Board, he was also the first Vice President of the Gemological Institute after its incorporation in 1943.

There is perhaps no more beloved individual in the jewelry industry than Paul Juergens. He has that rare gift of making and holding friendships wherever he goes. Not only has the G.I.A. benefited from his untiring efforts on behalf of its progress and expansion, but the entire industry from his interest and the high standards of ethics which he preaches and lives.

Carleton G. Broer, President of The

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# Gemological Digests

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Broer-Freeman Company, Toledo, will serve as Vice-Chairman of the G.I.A. Board, succeeding J. Lovell Baker, Montreal, Vice President and Director of H. Birks & Sons, Ltd.

Newly elected members of the Board of the G.I.A. include Leo J. Vogt, Hess & Culbertson, St. Louis; Fred Herz, R. Herz & Bro. Inc., Reno; Robert Bromberg, Bromberg & Company, Inc., Birmingham; and Charles Peacock III, C. D. Peacock, Inc., Chicago.

Retiring board members are Glynn Cremer, La Cross, Wisconsin; Earl E. Jones, Jones Bros. Jewelers, Pekin, Illinois; and Ernest J. Meyer, Meyer's, Grand Island, Nebraska. The late Edward F. Herschede was also a member of the G.I.A. Board at the time of his death last September.

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## DR. R. P. G. GRAHAM RETIRES FROM G.I.A. ADVISORY BOARD

Dr. Richard P. D. Graham, Professor Emeritus of Mineralogy at McGill University, Montreal, has resigned as a member of the Educational Advisory Board of the Gemological Institute of America.

During the years he has been a member of this advisory body, Dr. Graham has been most helpful as a consultant to the G.I.A. He is well known as the author of numerous papers on mineralogical, crystallographic, and geological subjects, and is associated with many important organizations in those fields.

A Fellow of the Royal Society of Canada, Dr. Graham is also a Past President of its Section IV which covers Geological Sciences. He is a member of the Mineralogical Society (London); Member of the Mineralogical Society of America; Member, Canadian Institute of Mining and Metallurgy; Fellow, Society of Xi; and Honorary Member, Royal

Geological Society of Cornwall, England.

Dr. Graham, who was born in County Kildare, Ireland, studied at Oxford University, England, and received his bachelor's degree in 1904. He joined the staff at McGill the following year and received both his Master and Doctor of Sciences degrees from that University.

Since his retirement from the professorship at McGill, Dr. Graham is still active in the writing field, retaining the position of Technical Editor of *Canadian Mining and Metallurgical Bulletin*, a monthly publication of the Canadian Institute of Mining and Metallurgy. He is also editor of English Geological Reports released by the Department of Mines of the Province of Quebec.

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## THIRTY-TWO FELLOWSHIPS ANNOUNCED FOR 1951 BY AUSTRALIAN ASSOCIATION

Announcement of results of the 1951 Australian examination for Fellowship in the Gemmological Association of Australia has been received from Jack S. Taylor, F.G.A.A., Federal Secretary, of Sydney.

Thirty-two members qualified for Fellowship in the five states represented with the Australian prize going to P. Grove-Jones of South Australia. The first three positions were filled by Alan F. Wilson, West Australian Branch; P. Grove-Jones, South Australian Branch; and P. E. Playford, West Australian Branch.

Best students in each state represented were: Miss M. E. Cameron, New South Wales; T. Koller, Victoria; Alan F. Wilson, West Australia; Mrs. R. Herdsman, Queensland; and P. Grove-Jones, South Australia.

The Gemmological Association celebrated its sixth anniversary on October 25, 1951, and now shows a total of 261 of its members who have qualified for fellowship.

# Jade in Mexico

(Continued from page 150)

and bloody victors. Those miners who were able to cover up their diggings did so, and ceased all further development of the mineral deposits.

Then came the Spanish invaders under Hernan Cortez, who easily persuaded the oppressed tribes to help them attack the hated Aztecs. But once the power of Montezuma's empire was overthrown, the perfidious adventurers turned on the Indians, and persecuted them more cruelly than ever the Aztecs had done. Before his betrayal and fall from power, Montezuma had offered jewels of jade to Cortez, and was astonished to find that such gifts would be appreciated only for the gold mountings. He said that to his people one piece of fine jade was worth as much as two whole loads of gold. The Spaniards wanted only the precious metals, and drove all miners to work as slaves for production of gold and silver. Jade, therefore, ceased to have any value; there were no longer any buyers; and the stoneworkers had to go into metal mining or farming.

There was one Spanish priest, Fr. Bernardino de Sahagun, who befriended the Indians, and spent much of his time in writing an account of all he saw and trying to learn everything about this new country. So he asked the Indians how and where to find jade. But his interest was only scientific, and did not indicate any chance for renewal of the once profitable trade. He was given, therefore, only an imaginative story of "green magic." He was told that if one were to stand at a convenient place just before dawn, and look toward the rising sun, the appearance of a vapor like a delicate little smoke would show where to dig for precious stones. Also, wherever the herbage kept continually green there would be found a boulder containing jade, because that always emits a cool and damp exhal-

ation. Perhaps the family secrets of actual places and methods were purposely hidden in fantastic tradition, or the reality of jade sources actually had been forgotten.

The sturdy Zapotec and Mixtec Indians of Oaxaca were never conquered either by the Aztecs or the Spaniards, and actually have not been subjugated to this day. They mistrust representatives of government, and keep their affairs to themselves. It is reported that there is a cave in the back hills of the Mixteca where many jade idols are hidden, and closely guarded day and night against intrusion by strangers. That general region, also, is known to be geologically favorable for the occurrence of natural jade deposits. If those Indians could be persuaded to believe in some honest agent, who could protect them from government domination, and assure them of fair treatment in the lapidary trade, they might start prospecting. Then, in case they were to find old or new quarries of prime jade, there might thus be started a revival of that ancient American art.

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## Reconstructed Rubies

(Continued from page 144)

been reported in which some of the natural ruby from which they were grown is still intact.

However, none of the stones submitted to this laboratory as reconstructed have displayed characteristics that would indicate natural origin. Since it is now known that the characteristics of the reconstructed stone as outlined in present gemological text, are to be found in synthetic stones, it seems only reasonable that — to avoid further confusion regarding stones cut from boule tips and similar appearing synthetics — the use of the term "reconstructed" should be confined only to stones which consist of sintered natural fragments and which, in turn, display inclusions characteristic of natural rubies.

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# Contributors in this Issue

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DR. RAYMOND JENNESS BARBER, Curator of Mineralogy and Petrology at the Los Angeles County Museum, after thirty years of mining engineering and fifteen of university teaching, now devotes most of his time to mineral science. Graduated from Massachusetts Institute of Technology in 1906, he has traveled to many different countries in his mining practice and geological explorations. He was a special lecturer at Stanford University; Dean of the School of Mines at the University of Alaska; and lately on the staff of the School of Engineering at the University of Southern California. During various sojourns to Old Mexico, he became interested in the "jade question." Opposed to those who thought the stones must have come from Central Asia — because that was the only known source of jadeite — he advocated the existence of local quarries as yet not rediscovered. Last summer he spent a month — mostly in Oaxaca — investigating just this question for the Los Angeles County Museum. More than ever now he believes that deposits of gem quality jadeite exist in Southern Mexico. His article appears on page 147.

ROBERT M. GARRELS, Ph. D., has been instructor for the American Gem Society's Metropolitan Guild and the G.I.A. Study Group in Chicago for the past eleven years. Graduating from the University of Michigan in 1937, he received his doctorate four years later from Northwestern University, Evanston, where he is now Associate Professor of Geology. His chief research interest has been geochemistry, especially crystal growth, and his work in this field gives importance to the article which appears on page 151 of this issue. His article on "The Synthesis of Quartz" came from the Signal Corps Engineering Laboratory projects on quartz synthesis and was delivered by him as an address before the 1952 Conclave of the American Gem Society in Chicago. He is also known for his authorship of "Textbook of Geology."

LESTER B. BENSON, C.G., F.G.A., is well known to readers of GEMS & GEMOLOGY for the important articles he has contributed in the last few years. Director of Resident Training and Supervisor of the Godfrey Eacret Memorial Laboratory in Los Angeles, he is also in charge of the staff of ten G.I.A. instructors. Not only has he been responsible in the last few years for important developments in, and successful presentation of, resident class work but he has contributed much to recent research and revision of G.I.A. courses. His important contributions to identification problems, as well as effective colored stone appraisal systems, has made his name familiar to most members of the trade. Interested in gemstones and jewelry since his youth, he conducted a small jewelry manufacturing business in his home town of Denver before joining the Institute staff early in 1947.





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