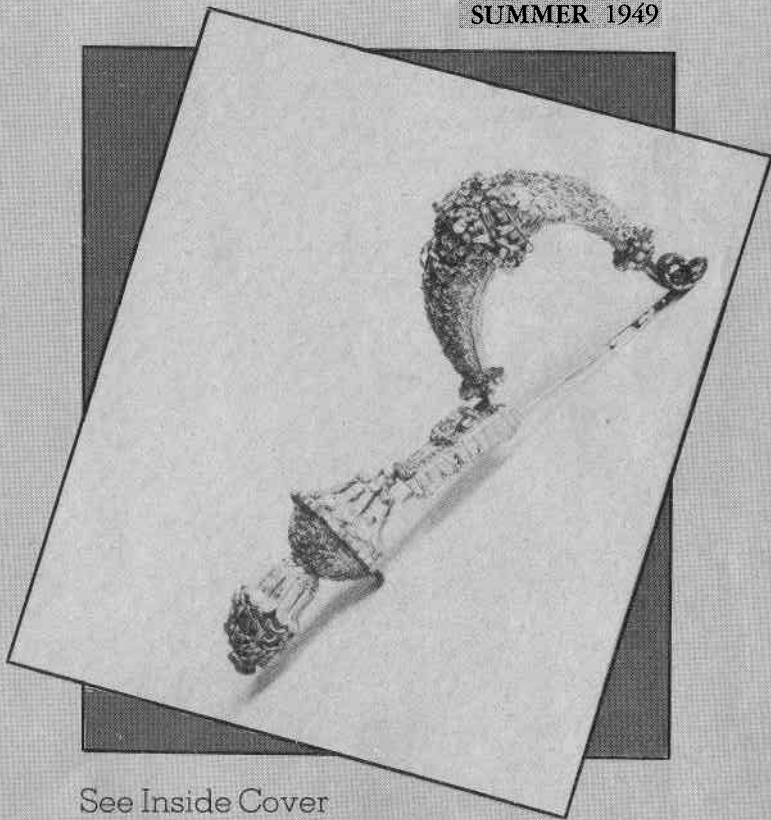


Gems and Gemology

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Report on A Radioactive Diamond

by

JOHN A. HARDY

*Consulting Engineer, New York City
Library Member, G.I.A.*

IN THE SPRING of 1938 the writer was shown two diamonds, both a deep lively green, one, a brilliant, weighed 0.71 cts. and the other, stepcut, weighed approximately 8 cts. The stones had been brought to this country from Belgium to be sold after first being exhibited at the New York World's Fair. The smaller of the two was purchased but the ultimate disposition of the other remains a complete mystery. It was certainly never exhibited at the Fair and all subsequent attempts to trace it or the importer ended in failure.

The brilliant was mounted in a "gypsy" setting shortly after purchase. It survived the setter's "boiling" as well as occasional cleaning with C.P. ammonia over a period of two years without any visible diminution of color. It was full cut in perfect proportion with no surface imperfections. There were, however, a number of "carbon" spots visible under a 10X loupe.

In early November, 1940, the ring was handed to the maker (a man of considerable experience) to have the setting shaved because it was too heavy for comfort. When returned, the stone had changed to a golden yellow. It had not been removed from its setting. There is no question of substitution involved. Aside from the known integrity of the maker, identification by means of the inclusions was easy and much later, when the stone was removed, the weight

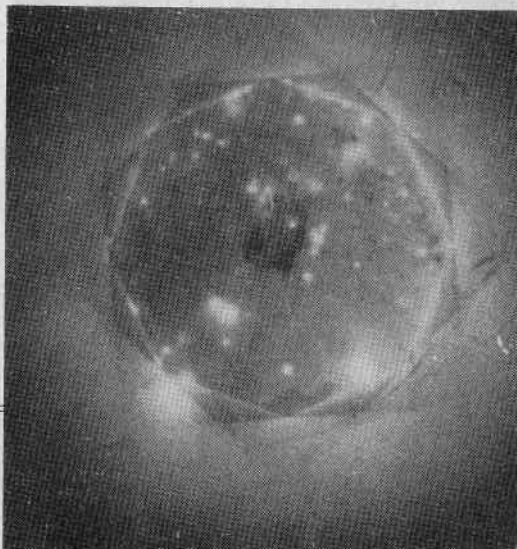
checked exactly. It may be assumed that the cleaning pan boiled dry: there seems to be no other reasonable explanation. Certainly it was not subjected to dry heat long enough or at too high a temperature to "burn" the stone.

In the days which immediately followed, it appeared to darken up a bit and gain a few greenish glints. This may perhaps have been imaginary and the result of wishful thinking.

The stone, incidentally, is not visibly phosphorescent, nor does it fluoresce.

Inspired by the statements of several authorities, which attributed a green color to radioactivity, the stone was suspended in a metal box approximately one millimeter above a piece of Eastman film (Panatomic X) for three hours, which, when developed

Plate I. Panatomic X



and enlarged produced the auto-photograph shown in Plate I, indicating definite radioactivity. A similar photograph was taken at the University of Michigan; see Figure 244, Page 146, *Gems & Gem Materials*, Fifth Edition (Kraus & Slawson, 1947).

The questions which naturally came to mind as a result of this experience were:

(1) If the stone had been deliberately exposed to some powerfully radioactive source prior to 1938, would activity still be present, would it account for the color, and was the color only a "surface phenomenon?"

(2) If the radioactivity was an inherent quality of the stone, was it the cause of the color and since the activity still existed, would the stone recover its original color without exposure to some radioactive source? What was the nature of the radioactive substance within the stone?

Various amateurish attempts were made to find answers to these questions. The stone was kept wrapped in heavy lead foil for long periods with no visible change in color. Auto-photographs were made under varying conditions and exposures and with films which ranged from dental "bite wings" to Wratten "M" plates, and so forth. It was not until the interest of our G.I.A. President, Dr. Edward H. Kraus, then Dean of the College of Literature, Science, and the Arts at the University of Michigan, was enlisted that any real progress was made.

In December, 1940 the stone, still in its setting, was forwarded to Dr. Kraus to determine the strength of radioactivity and whether it was constant or slowly decreasing in value. He wrote that "Professor J. M. Cork (of the Department of Physics) says that the radioactivity is rather strong and that he believes that it is inherent and undoubtedly caused by a content of uranium. He feels that it is inadvisable to wear the ring."

Needless to say the stone was immediately removed from its setting. As an interesting sidelight, dental film applied overnight to

the wearer's finger indicated the calcium in the bone had already been attacked by the stone's emissions.

While the ring was at the University of Michigan and later, the writer tested, by photographic film, as many colored diamonds as it was possible to obtain but with uniformly negative results. The colors included pink, brown, canary yellow, golden yellow, and blue.

In the spring of 1941 the stone was returned to Dr. Kraus for further observation. The report submitted by Professor Cork shortly thereafter is quoted in its entirety because of its concise appraisal of this unusual stone.

"Observations have been made of the radioactivity of this particular diamond, by absorption measurements with an electrometer and with a Wilson Cloud Chamber. It would reasonably be supposed that any natural radioactivity would be due to occluded thorium or uranium in the diamond. It was at once apparent, however, that this could not possibly be the case as the radioactivity of the diamond was four times greater than would have been observed from a comparable mass of pure uranium or thorium. It must, therefore, come from some of the daughter products in one of the radioactive series which although present in small quantities could exhibit strong radioactivity.

"From the energy of the Beta radiation and the maximum range of the alpha particles emitted, it now appears quite certain that the radioactivity is due to Radium D and its subsequent products. This activity has a half life of 16.5 years and decays by beta and alpha emission through RaE (5 Da), RaF (136 da) to lead. The strong beta rays observed agree exactly in characteristics with those from RaE and the alpha particles are similar in properties to those from RaF.

"The radioactivity was not lessened by immersing the diamond in boiling acids or lapping the surface. This indicates that it

comes from atoms actually within the diamond lattice. Such a phenomenon could easily be explained. If the diamond were packed close to Radon or Radium then on alpha disintegration, heavy recoiling radioactive nuclei would be driven into the surface. Such recoil particles possess an energy of more than 50,000 electron volts, enough to carry them into the lattice so that they might not be attacked by the dissolving acids.

"In any event this diamond is so radioactive that it could not be worn in its present mounting any appreciable length of time with safety. If the present guess is correct this radioactivity will die out to half its present value in 16.5 years. It would seem to me highly desirable to learn if this diamond has been treated in this way. If it were a natural phenomenon it would merit further investigation."

About this time the late Professor Harry Berman of the Harvard Mineralogical Museum was experimenting with the coloring of diamonds by means of the cyclotron. There followed an exchange of letters with Professor Berman and a visit to Cambridge that fall, when one of the treated stones was examined. The treatment incidentally attained only what might have been termed a "light beryl green" hue instead of the deep green originally possessed by the stone under consideration.

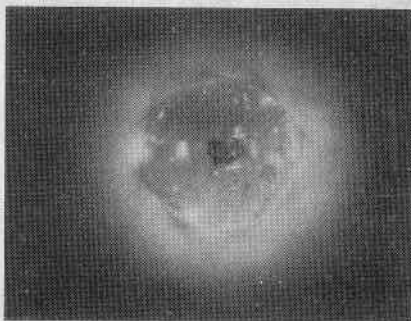
The more interesting parts of the correspondence with Professor Berman were as follows:

"We have found that practically all diamonds will color green if the exposure to cyclotron bombardment is short and not too intense. On the other hand, if the exposure is too long or too intense, the color will be a deep brown. I suspect that in the latter case the stone is heated too high and the brown is more a thermal effect than a deuterium effect.

"After bombardment, our diamonds are highly radioactive, but in the course of an hour or so this radioactivity drops almost

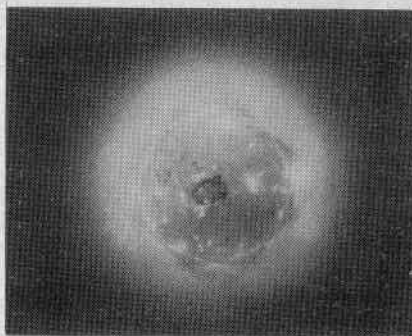
to zero. I am not sure whether there is any residual radioactivity after a matter of days. A rather rough quantitative test before a Geiger counter indicated that there is no residual radioactivity. I have not noticed any change in the color of our diamonds with standing. It seems to me that the color is more or less a surface effect and that if the stone were polished after bombardment I believe the color would either disappear or change to a brown due to the heat of polishing. I am not sure, however, on this point.

"We have not examined any natural green stones, so I cannot hazard a guess as to the naturalness of the coloring in your diamond.



Radiation exposure one hour

Wratten "M" Plate. Exposure time one hour, thirty minutes



"As to the cause of color in a green stone after bombardment with radium or with deuterons from the cyclotron, I can only make a guess. It is quite possible that bombardment and consequent introduction of energy into the lattice of the diamond may produce small disseminated particles of graphite, which is the stable modification of carbon. These, if they are of the right size and distribution, may give rise to a scattering effect of light which could very well produce a green color. The fact that this color is not lessened by heating (in the case of the cyclotron bombardment) and that it eventually turns to brown with too much bombardment is some support for the view expressed here. I can see no other way of obtaining the color. If we are correct, then it is possible, I suppose, that the stone will gradually change to some other color or deeper hue because the graphitization of the carbon once started may continue for some time after the bombardment has ceased. The radioactivity that we note immediately after bombardment is, of course, due to the formation of a radioactive isotope of carbon, which has a half-life period, I believe, of about a half hour."

Again in the spring of 1942 the stone was returned to Ann Arbor for observation and the radioactivity reported to be "about the same." So this time, however, it was decided to expose it in the cyclotron with the hope that results might lead to a more satisfactory explanation. Professor Cork thereupon exposed the diamond in the cyclotron, that is, to deuteron radiation at 10,000,000 volts for one micro-ampere hour. (approximately 15 minutes), with the result that it regained and has since retained its original deep green color. He was inclined to believe that the diamond was not originally green, but had been packed with some radium salt which produced the green color and induced the radioactivity, which persists. The heating of the stone then dispelled the color.

To add to the general confusion, G. F. H. Smith in his "*Gemstones*" (Ninth Edition) tells us that the green tint acquired by exposure to radium is unaffected even by heating to redness, but is destroyed by repolishing or by heating for some hours at 450° C.

Although there is nothing conclusive in the foregoing, the following general conclusion may not be considered amiss.

It would appear that radioactivity as a test for "treated" stones is a hazardous assumption since it rules out, in a rather arbitrary fashion, the possibility of radioactive inclusions occurring as natural phenomena. It is suspected that a careful review of early technical literature will reveal the reporting of such phenomena at a time when it is to be doubted that "treating" by radium salts or exposure to cyclotron radiation was feasible.

There is much yet to be learned of inclusions in gemstones. Original investigation by graduates and members of the Gemological Institute is recommended whenever possible in place of study inspired by accidents of the trade, as in this case.

Production Rises in Tanganyika in First Quarter 1949

According to a correspondent from Dar es Salaam, as reported in the *Financial Times*, production at the Williamson Mwa-dui Diamond Mine in the Shinyanga district of Tanganyika, has been rising rapidly during the current year. Exports for the months of January and February 1949 totaled 42,049 carats in comparison to the 9,770 carats exported during the same period in 1948. It was further reported that production for the first quarter of 1949 represents more than half the total value of diamonds exported from Tanganyika during the entire year of 1948.

Causes of Color in Gemstones*

by

C. S. HURLBUT, JR., Ph.D.

Harvard University

THERE ARE several properties that make minerals valued as gemstones. We can list as most important high hardness, high luster, high dispersion, and pleasing color. Many gems have a combination of two of these properties, a few have three, and some diamonds have them all. It is a combination of all four of these attributes that sets a fancy diamond quite apart from all other gems. When we think over the list of gem minerals and consider which of them has but one of the desirable properties listed, we find that color is the only one that can make a mineral a gem without being combined with others.

For example, *azurite*, *malachite*, *variscite*, *turquoise*, *lazurite*, *fluorite*, and *sodalite*, to mention a few, have little to recommend them as gems if we were to bleach them of their color. Other minerals such as beryl, topaz, and corundum owe much of their value to their color, although they have other desirable properties in addition. A colorless beryl is just as hard and has the same luster as the blue-green aquamarine, the pink morganite, or the deep green emerald. The mere addition of the color changes them from ordinary stones into superlative gems. It is, therefore, little wonder* that the gemologist should be keenly interested in color and the causes of color in gems.

One of the first things that the student of gemology learns is that gemstones can be

divided into two groups on the basis of color, *idiochromatic* and *allochromatic*. In idiochromatic minerals the color is an inherent property of the chemical compound and has been called chemico-compositional color. Thus malachite is always green and azurite always blue and color can be used as a distinguishing criterion in identification. Allochromatic minerals, on the other hand, are colorless or white when pure and the pigmenting material is foreign to the chemical compound.

In some allochromatic gems the coloring is due to the mechanical inclusions of microscopic particles of idiochromatic minerals. Thus inclusions of hematite may make a mineral red; inclusions of chlorite, green. However, more important in the coloring of allochromatic gems than mechanically held inclusions are slight chemical impurities. It is the role that these foreign elements play as pigmenting agents that is the most subtle and least understood.

In the chemical analysis of a colored stone, the chemist may report a small percentage of foreign elements such as titanium, vanadium, and chromium but frequently only traces are to be found. When the amount of impurity shows a direct correlation with the depth of color it is reasonable

*As delivered by Dr. Hurlbut before the members of the American Gem Society at its 1949 Conclave in Boston in April.

to conclude that it is the coloring agent. However, in some gems there is a poor correlation and in others it is impossible to find any chemical difference between color varieties. In many cases the depth of color seems disproportionate to the amount of impurity.

From careful spectroscopic analyses it has been shown that certain colored stones always show the presence of the same foreign elements. Pure corundum is colorless with a composition of Al_2O_3 but analyses of ruby report small amounts of chromium replacing some of the aluminum. The amount of chromium is extremely small and may escape ordinary chemical analysis. The sapphire in similar analyses shows small amounts of titanium or iron.

Although beryl, a beryllium aluminum silicate, is colorless when pure, the colored varieties have traces of such elements as lithium, sodium and caesium replacing the beryllium. The beautiful green of the emerald is apparently due to small amounts of chromium but the color of some stones is attributed to vanadium.

It is interesting to note that the causes of color are so poorly known that most textbooks reporting the color of gems say it is "reported to be" or "probably due to" one element or another. Certain elements tend to give all minerals in which they are found a similar color, as coloring due to copper is usually green or blue. Other elements, as chromium mentioned above, apparently are inconsistent in the colors they impart.

Let us take quartz as an example. Because quartz is such a common mineral the causes of the various colors in which it is found probably have been studied more than any other. The four well-known color varieties are citrine, amethyst, rose quartz, and smoky quartz. Although the literature regarding them is voluminous, there is little unanimity of opinion regarding the color.

In 1925 Holden* reviewed the earlier publications on the color of quartz and did

much experimental work of his own. He concluded that the violet color of amethyst is due to small amounts of iron and that the pink of rose quartz is due to manganese. Smoky quartz was a more difficult problem: No impurities could be found even in traces that could account for the "smoke" in smoky quartz. Holden concluded that it was probably due to atomic silicon which through radiation by radioactive materials had been separated from the oxygen in the SiO_2 structure.

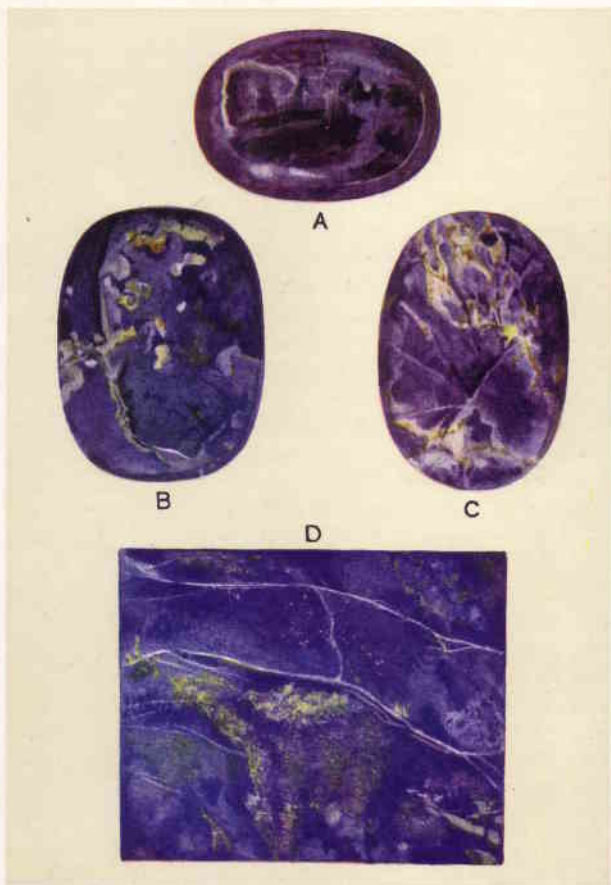
If smoky quartz is heated to $300^\circ C.$ it becomes quite colorless but when again subjected to radioactive irradiation the color is restored. This supports the theory that there is no foreign substance in smoky quartz, a conclusion that has stood the test of time.

However, conclusions reached by workers in recent months at Pennsylvania State College** contradict the earlier work as to the origin of the color in amethyst. This rather complicated but fundamental approach to the problem concluded that amethyst is colored by traces of titanium. The titanium atoms take the place in the quartz structure of some of the silicon atoms but they are not the same size and do not fit exactly. Since they are larger, they distort the lattice for a considerable distance away. It is somewhat analogous to placing an oversized brick in a wall. The other bricks placed around it would be thrown out of line for a distance equal to the thickness of many bricks. Thus a relatively few equally spaced atoms may distort the structure throughout. Such a distortion may produce a scattering of light and give rise to a color effect greatly out of proportion to the amount of impurity present.

In a similar way, small amounts of chromium may be responsible for the red in ruby and titanium for the blue in sapphire. It has

*Holden, E. F., *Amer. Mineral.*, vol. 10, pp. 203-252, 1925.

**O.N.R. Tech. Report No. 1, Pennsylvania State College: *Color of Minerals*, 1948.



LAPIS-LAZULI, SODALITE, VIOLANE

Figure (A) shows violane, a massive pyroxene named after its color. San Marcel, Piedmont. The Jasper (B) has been colored to imitate lapis-lazuli. Nunkirchen, Rhenish Prussia. Figure (C) is sodalite, a mineral closely resembling lapis-lazuli, but which lacks the familiar metallic inclusions common to the latter. Dungannon Co., Ontario. (D) is a fine specimen of lapis-lazuli. Specimens from the collection of British Museum (Natural History), London.



BERYL

Figure (A) shows a fine quality morganite from Madagascar. This name applies to beryls of a light red purple to light purplish red. (D) shows a natural crystal of aquamarine in granite, while a fine fashioned aquamarine is seen at (B) and another at (C) typical of the color of South American aquamarines prior to heat treating. At the bottom of the page (E) is shown a fashioned stone of golden beryl. Specimens from the collection of British Museum (Natural History), London.

long been known that these elements are present in colored corundum. Thus, in coloring synthetic rubies and sapphires, it is natural to expect that the same elements would produce the same colors. However, in the synthetics much greater quantities of the impurities are necessary to effect the same colors. Thus the temperature of formation, much greater in the artificial material, is a factor of considerable importance.

Not only is the temperature of formation important, but the thermal history of the mineral since its formation, has a profound effect on its final color. It is a well-known fact that a high percentage of the gemstones are a different color when they reach the jeweler than they were when they were mined or taken from the stream gravels of Indo-China, Ceylon, Brazil, or elsewhere. Very little of the processing, usually heat treatment, is done with modern scientific controls and virtually none of it with a knowledge of what is taking place within the stone.

Take zircon as an example. It is almost impossible to buy in this country any uncut gem material in its natural color to make a study of the color changes under controlled conditions. The reddish brown stones from Indo-China are heat-treated and cut in Siam. From the brief accounts available the processing is done in a primitive fashion under conditions determined by trial and error. Moreover, it is difficult to predict what will happen when a zircon of a given color is heated. If heated in a reducing environment, a brownish stone may become colorless, blue, or an off-color blue. If heated in an oxidizing environment, it may become yellow or colorless.

Other stones that are frequently heat-treated are corundum, beryl, topaz, and tourmaline.

What happens when a stone is heated? If heated in air, that is, in an oxidizing environment, the result may be different than when heated without air in a reducing environment as in the case of zircon. The

simple explanation is that the pigmenting element has been oxidized in one case and reduced in the other. Since the color of the various oxides of an element may be different, this undoubtedly explains the color changes brought about on the heating of some gems. For example, one oxide of iron, FeO, is black, but, if the iron is combined with more oxygen to form Fe₂O₃, it is red.

A most striking example of this in a gemstone is the new synthetic rutile, TiO₂. The best stones are clear and transparent with a slight yellow color. If the surface is touched with a spark of burning iron, such as is produced by the familiar Fourth of July sparkler, it is immediately reduced to a black titanium oxide, Ti₂O₃.

Accompanying a change in the state of oxidation, there is also a change in the size of the atom. Thus the well-known change to yellow citrine when violet amethyst is heated may be caused by a change in the size of the atom of the impurity, rather than by the color difference of the oxides of the pigmenting element. The lattice, distorted because of the presence of the foreign element, will become more distorted and thus scatter the light differently.

Another type of coloring in gems, not directly related to the chemical composition or chemical impurities, has been called *structural coloring*.^{*} Here colors are produced when the direction of certain wave lengths of the incident white light are selectively changed. This is due to physical causes such as twinning lamellae, alternating layers of different composition, thin films and minute particles. Since this is a directional effect the colors will change as the position of the observer changes. Such effects are well-known in opal and labradorite feldspar.

The phenomenon of interference gives the best-known type of structural coloring. This takes place when light is partially reflected from the upper and lower side of

^{*}Kennard, T. G., and Howell, D. H., Amer. Mineral., vol. 26, pp. 405-421, 1941.

(Continued to page 178)

A Method of Measuring By Application of Calibrated Microscope Eyepiece

THE measurement of a stone by means of the Leveridge Gauge has been used for a number of years and considered necessary equipment in the jewelry business. The stone can be accurately and quickly measured. The stone is placed in a pair of forceps attached to an arm above the top of the gauge and connected with the gauge, so when the stone is placed in the forceps the size of the stone is registered in millimeters on the gauge. By making several measurements and simple calculations and referring to a set of Weight Estimator Tables the weight of a stone can be quite accurately determined.

Another more satisfactory means of measuring stones and possessing the same degree of accuracy as the Leveridge Gauge, is a method involving the use of the A.G.S. Diamondscope or a similar microscope. This method allows one to measure the size of the stone by its diameter, further makes possible measuring the width of the table; the depth of the stone from table to girdle; and the depth from girdle to culet, which can not be done with the Leveridge Gauge. Also, it is not necessary to remove the stone from the forceps during this measuring operation.

In the case of the Diamondscope, a 10X eyepiece fitted with a millimetric scale enables stone measurements to be made visually by direct reading. This is accomplished by replacing one of the eyepieces in

the case of a binocular microscope or the single eyepiece in a monocular with the special calibrated eyepiece. (This eyepiece is obtainable in English or metric units from Bausch and Lomb). The scale used with the 0.7X Diamondscope objective. Stones' dimensions may be read off directly from the eyepiece scale. Obviously, this method is quick, inexpensive, and most satisfactory especially when making measurements of table diameters, which are difficult with other instruments.

A few simple remarks are in order so as to acquaint the user with the principles involved in the use of this device.

The special 10X eyepiece mentioned above is usable with the Diamondscope. It consists of a Huyghenian eyepiece in which is mounted a glass disc with the measuring scale engraved on it. The eyepiece is available with a scale 10 mm long having divisions every 1/10 mm. In other words, there are 100 scale divisions, each division being equal to 0.1 mm. Estimations to one-half scale division may be made, making the scale readable to 0.05 mm. Jewelers accustomed to making measurements in millimeters will find this scale most convenient.

The eyepiece is adjustable, that is, the length of the tube may be adjusted so that the scale may be brought sharply into focus and peered through. When this prefocussing when the eyepiece is held up to the light

Gemstones

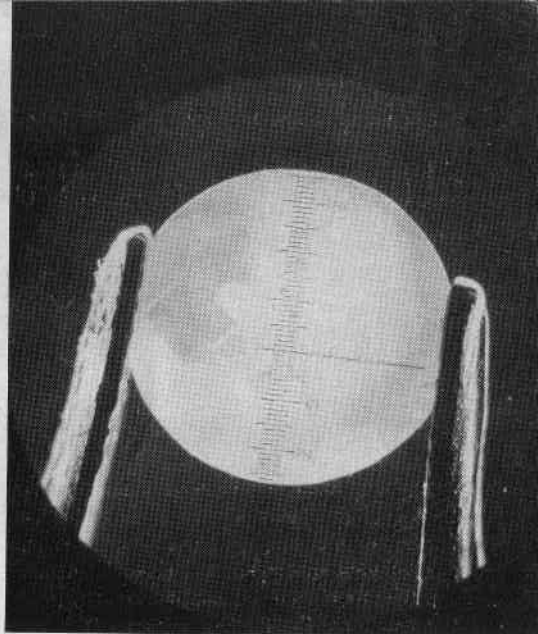
by

EUNICE ROBINSON HASTINGS, C.G.

is done, the eyepiece is then slipped into place in one of the eyepiece tubes of the Diamondscope. It is now most important to be assured that objects, which appear through the Diamondscope to be, for example, 3 mm wide are actually 3 mm wide. The best way to do this is to obtain a stage micrometer. A stage micrometer is nothing more than a glass microscope slide upon which is engraved a scale of precise length. Since we are dealing in metric units (mm) we shall require a precise length in millimeters. This, too, is available in a length of 10 mm. Now, by slipping this slide on the stage and viewing it through the optical system of the Diamondscope (using only the one eyepiece in the case of a binocular microscope — not looking through both eyepieces) the stage micrometer scale is visible. It will be necessary to orient the stage micrometer until the eyepiece scale divisions align as nearly as possible with the micrometer scale divisions.

Final adjustment comes with raising or lowering the adjustable eyepiece drawtube until each mm scale division of the scale coincides with each *actual* mm division on the stage micrometer. We are now assured that any object brought into proper focus may be measured directly by merely reading off the dimensions on the eyepiece scale.

One more word of caution. It will be noticed that, when focussing the Diamondscope, the stone appears to be in focus over



Photomicrograph of stone illustrating use of Calibrated Eyepiece in measuring diameter at girdle.

a fairly wide range adjustment. This is more pronounced when using the 10X eyepiece and the .7X objective. For ordinary scrutiny this is quite a satisfactory condition. But for measurements with the calibrated eyepiece one should make certain that the stone's image focusses upon the plane of the scale.

This can be accomplished simply, by moving the head almost imperceptibly from one side of the eyepiece to the other, keeping the stone in view. The stone's image will move with respect to the eyepiece scale. By refocussing the Diamondscope the stone's image may be made to remain stationary on the scale. Then it is proper to make a reading of the measurement. For example, in order to measure the diameter of a brilliant cut diamond at the girdle, place the diamond in the stone forceps, place in the Diamondscope and focus for a sharp image. If the image appears oval

(Continued to page 178)

Additional Notes on Refractive Indices of Cabochon Cut Stones

by

G. ROBERT CROWNINGSHIELD, B.S., C.G., F.G.A.

G.I.A. Director of Education, Eastern Headquarters

SINCE publication of the article, "Refractive Indices of Cabochon Cut Stones," by Lester Benson in *Gems & Gemology*, Summer, 1948,* the method described has been used to great advantage with the Erb & Gray instruments and the newer Gem Refractometer.** At that time no method for securing readings on cabochons or small stones on the Rayner refractometer was given. Further investigation has proved the latter instrument equally valuable for this type of determination.

With the Erb & Gray instrument, the eyepiece is removed from the optical system, and, because of the simplified optical system, the contact surface of the stone with the hemisphere may be seen in the reflecting prism and at the same time the scale will be in focus. With the Gem refractometer, the eyepiece may be left in the system and the spot appears behind the scale which remains in focus.

The technique involved in securing refractive indices of cabochons and small stones with the Rayner does not require the removal of the eyepiece, but it does require a somewhat different technique.

If a small drop of contact liquid is placed on the glass prism of the Rayner, it will appear in the eyepiece as a dark circle when viewed from a distance of approximately 12 to 15 inches. A portion of the lines on the scale will also be visible and the numbers

seen when the eye is moved slightly to the left. Although the contact spot and the scale will not be exactly in focus it is close enough so that a satisfactory correlation between the two may be made. Now, by following the spot up the scale numerically it will be seen to disappear at roughly 1.80—the index of the liquid.

Because of the presence of the correcting lenses in the Rayner, the reflection of the contact between hemisphere and stone may be difficult to find at first. However, these same lenses have the effect of magnifying the spot and scale, a considerable advantage, as the numbers on the scale will appear to be approximately $\frac{1}{4}$ inch in height, thus making this method practical for anyone who desires to use it.

If a small flat surface of a stone is placed in the liquid in contact with the hemisphere the circle will appear dark if the line of vision is below the R.I. of the material being tested, but as the line of vision is again raised numerically, there will be a point at which either the whole circle will quickly light up or, if white light is being used, there will be a blue-green line which will appear to draw over the spot like a curtain. When the bluish line has bisected the spot (the line will curve slightly) the eyes' focus must be shifted slightly and to the right where the numerals of the scale will come into view. Because the spot and scale are not exactly in focus, to secure the reading it is necessary to carry the spot mentally for an instant while the position on the scale at which the spot is bisected is

*See page 35, Summer 1948, *Gems & Gemology*.

**See back cover, Spring 1949, *Gems & Gemology*.

noted. Should the spot remain dark all the way to 1.80 and it is ascertained that the small facet has a good polish, it is almost certain that the stone has an R.I. above that of the contact liquid. It is assumed that in the above procedure that the facet being used is too small to cast enough reflection to be read on the scale in the normal manner.

Now we turn our attention to the application of the same procedure to securing indices of stones with curved surfaces. In placing the stone on the hemisphere, the amount of liquid must be limited so that the complete spot is in view, but it does not seem to be necessary to limit the amount of liquid as carefully as it does with the other instruments. If an oval spot is seen, it is best to turn the stone until the long direction of the oval corresponds with the long direction of the scale. Again, running the line of vision up the scale numerically, the spot will turn light at the point corresponding with the reading of the material. This may have the effect of the bluish curtain aforementioned, or in certain cases, the lower (numerically) end of the spot will be dark and the upper end light with the division bisecting the spot when the reading is to be taken, but no spectral color will be seen. In general, white light is the best source of illumination for this procedure.

For best results, it will be found advantageous to practice with several simple cabochons, the backs of which will give

good readings in the ordinary manner. Then the exact position of the dividing line of the spot may be noted. For instance, if the spot is bisected by a spectrum, the shadow will be a little short of bisecting the spot because the position of the yellow part of the spectrum should be the deciding factor and in a small spot this will have to be estimated. A good check can then be made with a reading on the back.

The spot method is valuable in testing stones with slightly curved surfaces—surfaces so slightly curved that at first it appears as if they are flat. If the reading is taken in the ordinary manner, the spectrum will appear to move up and down the scale depending upon the line of vision, and the reading will be unsatisfactory. If the amount of liquid is limited to a small spot, a satisfactory reading may be taken according to the spot method outlined above.

It will be seen from the above, that the Rayner refractometer will serve to secure indices of very small flat surfaces and well polished cabochons, as well as slightly curved surfaces. In addition, if great care is used, a small rough grain that presents either a smooth fracture or cleavage will often give a readable spot just as if it were a contact surface of a cabochon.

Further information and illustrations concerning the interpretation of cabochon readings are shown on pages 35, 36, and 37 of the 1948 Summer Issue of *Gems & Gemology*.

**Latest model of the Rayner
Refractometer is shown below**



Causes of Color

(From page 173)

a thin film or layer. The film is comparable in thickness to the wave length of light and the colors result from the destructive interference of certain wave lengths. The color changes rapidly as the point of observation is changed, since the color is dependent upon the total distance which the light travels through the film. The colors in precious opal are usually attributed to interference produced by thin lamellae.

To the colors of gems already mentioned should be added those colors induced by artificial means such as staining. The gem most commonly treated in this way is agate, and few stones reach the market that have not been artificially colored. Depending on the color desired, the agate is soaked in a solution of various salts or organic dyes. In most agates the various layers are differentially susceptible to the dyeing agent and the final result is to produce a much more pronounced banding than was present in the initial material.

Measuring Gemstones

(From page 175)

shaped, orient the stone in the forceps until it appears circular as it should be. Rotation of the eyepiece scale will constitute a quick check for proper placement. By moving the head from side to side and keeping the image always in view, focus until the *girdle* and the eyepiece scale are stationary relative to each other. Read the diameter in mm.

This foregoing may sound complicated but it takes only a short time to acquire the technique.

The equipment and procedure just described constitute a simple, inexpensive, and very satisfactory method of making heretofore difficult measurements of gemstones. While the above deal with the eyepiece

for the A.G.S. Diamondscope, the same method is applicable to any microscope and your dealer will be able to recommend the proper device to use with your particular instrument.

Having established the measurements of the stone, reference can be made to suitable tables for estimating weight, as can be done with the Leveridge Gauge.

Book Review

Gem Cutting. By J. Daniel Willems, Manual Arts Press, Peoria, Illinois. \$3.50.

The present intense light of publicity on all phases of gemology has made the American people cognizant of gemstones and gem materials as never before. It is also no doubt partially responsible for the rapidly growing hordes of so-called "rock hounds."

It is said that gem collecting today is the "fourth largest hobby" and that more than a million amateur gem cutters in America own some form of lapidary equipment. While there is now much good commercial equipment available, a great deal of it is still built or assembled by the amateur himself.

Dr. J. Daniel Willems, a Chicago surgeon, in his *Gem Cutting* tells details of assembling and arranging such a lapidary shop. He presents a well planned book that clearly reflects his surgical training — each step as organized as a herniotomy.

The book adequately and cleverly presents in an easily understandable, well illustrated, orderly fashion every phase of gem cutting from sawing the rough gem mineral specimen until the finished cabochon or faceted stone is ready for mounting. It also discusses all manner of equipment and how to build a lapidary shop. *Gem Cutting* was never intended for the professional lapidary but as an adequate guide to the beginner, it is beyond serious criticism and it should endure as an authoritative work and guide.

VEGETABLE IVORY—

What is it?

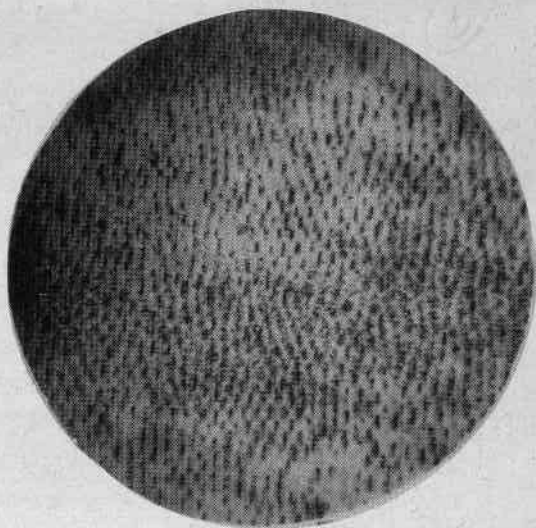
by

ROBERT WEBSTER, F.G.A.

IT MAY seem strange that such a wholly animal product as ivory should have a counterpart in the vegetable kingdom, but such is the case and 'vegetable ivory' has been known for a century or more. Known by name—yes, but its actual formation, constitution and properties are far less generally understood, and even the gemologist has not, until recent years, formulated a scheme of testing which will clearly identify an "ivory" specimen as vegetable ivory.

Where does this material originate? The true vegetable ivory is a nut furnished by one of the most beautiful of the palm trees—the 'ivory-nut palm' which grows in South America; particularly on the Andean plains of Peru; on the banks of the Magdalena River and along the Gulf of Darien in Colombia. The palm, known in Peru as *homero* or *pullipunta*; on the Gulf of Darien as *anta* and in Colombia as *tagna*, is scientifically known as *Phytelephas macrocarpa* and is a member of the *Arecae* tribe of palms.

The tree is characterized by a short and procumbent stem from the crown of which springs, like a tuft of ostrich feathers, light green pinnated leaves of extraordinary size and beauty which reach some 30 to 40 feet in height. The flowers, which are on a

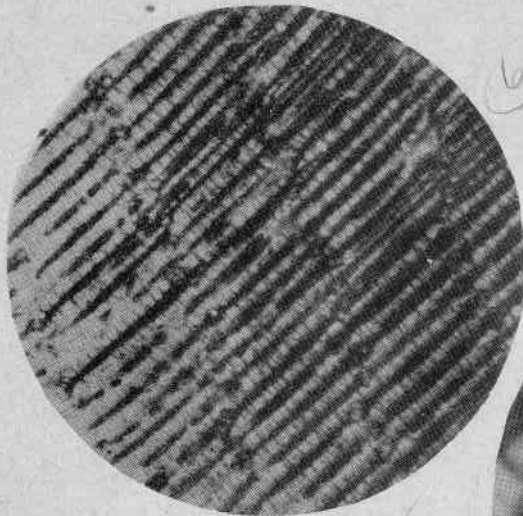


Vegetable ivory (corozo nut). South America. End view of cells. 25X

crowded spadix and have neither calyx nor corolla, form into the fruit which consists of an aggregate of six or seven four-celled leathery drupes, each of which contains six to nine triangularly-shaped nuts about the size of a hen's egg. These are commercially called *corozo nuts*.

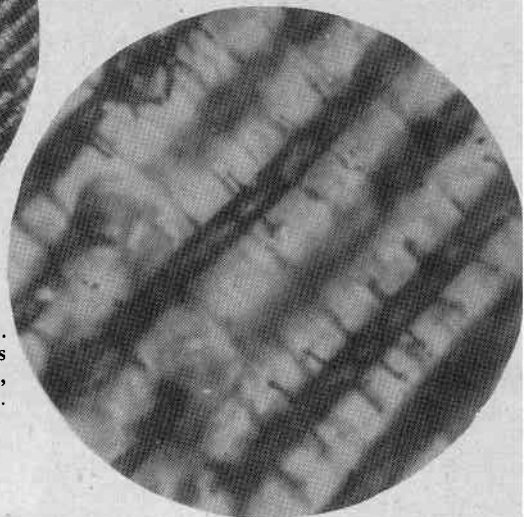
These nuts are not, during the whole of the period of their growth, solid, hard and white with a resemblance to ivory—this is the final stage, for, in the young state the nuts contain a clear insipid fluid which has been used by travelers to allay thirst. As the nuts age the fluid becomes milky and of a sweet taste and this, when the nut ripens, changes into the hard white material known as 'vegetable ivory,' which is used for small carvings, turnery, and for the utilitarian manufacture of "bone" buttons.

The ivory-nut palm is not the only source of a 'vegetable ivory' for another member of the palm family—the doum palm of Central Africa and Upper Egypt also supplies a similar material to that of the



62

Vegetable ivory (corozo nut). South America. Upper, cells viewed in length. 25X. Lower, enlarged view of long cells. 100X



South American nut. This palm, botanically known as *Hyphaene thebaica*, is characterized by its fan-shaped leaves and the repeated forking of the stem, in fact the sole instance of branching in the palm family. The fruit of this palm is in appearance something like a quince; has a reddish-brown skin which may be compared to that of a pomegranate. Beneath the skin there is a considerable thickness of a spongy dry substance, which in appearance and taste resembles gingerbread, and indeed it is used as an article of food and an infusion of it as a beverage; hence the palm has often been called the 'gingerbread palm.'

In the center of the fruit is the one 'fig-shaped' nut or seed which supplies the "ivory." Unlike the 'corozo nuts' which are solid throughout, except for perhaps a crack-like mark in the center, the doum palm nut contains a large hollow central cavity which follows in outline the outside of the nut. Thus no great thickness of material can be expected from these nuts which have been mainly used for the production of buttons; even in the case of the 'corozo nuts' only small pieces can be carved and larger models can only be constructed by jointing, such being the case of the beau-

tiful model of an Indian temple exhibited in one of the museums of the Royal Botanical Gardens at Kew near London, England.

According to A. Maskell, the 'betel nut' from the *areca palm* of the East Indies has been used for a 'vegetable ivory' and it has been suggested that the *coco-de-mer*—the double coconut (*Lodoicæ seychellarum*) from the Seychelles might be used as a further source. The writer has not examined specimens of these nuts.

Consisting of nearly pure cellulose, the 'vegetable ivory' nuts take a good polish but do not show the exquisite luster exhibited by polished ivory. Owing to the cellular nature of the nut substance some 'graining' may be observed which effect is increased in the case of 'dyed' material—all vegetable ivories taking stain well. The hardness of these materials is about 2 to 2½ on Mohs's scale, the corozo nuts tending to have a greater hardness than the nuts from the doum palm; both, however, are more sectile than either ivory or bone.

The density has been found to have the fairly restricted range of between 1.38 and 1.43, with the corozo nut tending to give values greater than 1.40 and the doum palm nuts below that value. It will be clearly evident, therefore, that a test for density will indicate whether a suspected specimen could be ivory or vegetable ivory but would not clearly differentiate between these two natural substances and the synthetic materials known as "plastics." The refractive index of vegetable ivory is approximately 1.54.

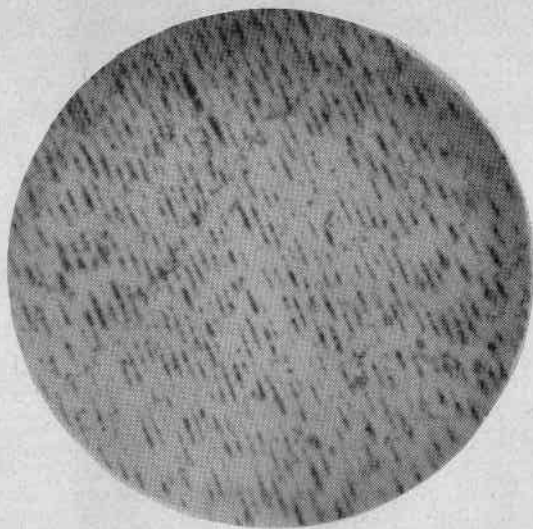
As with ivory and bone, it is the microscopical examination of the structure which gives the clearest and easiest means of identification, for the vegetable ivories give a picture at once distinctive and quite dissimilar to either true dentine ivory or to bone. The technique is similar to that suggested in an earlier article for the examination of ivory and bone—a peeling taken with a sharp knife and pressed flat on a 3 x 1 glass slip and a drop of oil applied. The

picture seen in the field of the microscope is typically 'vegetable,' the structure consisting of long 'torpedo-shaped' cells running roughly parallel; to which is due the 'graining' seen on the surface of specimens.

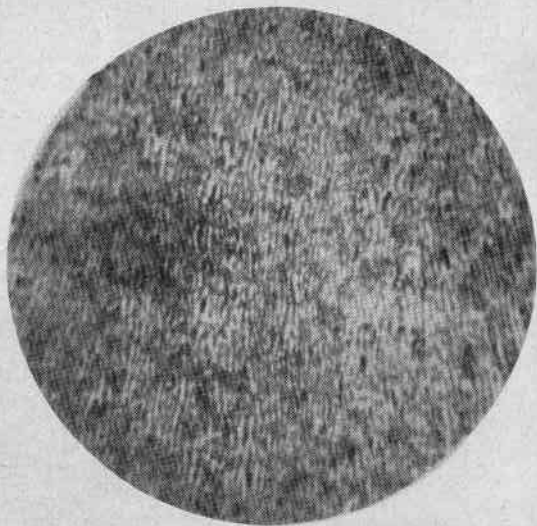
The cellular structure appears to be to some extent radial from the center of the nut, hence the cells may show directional character, and any pattern from an end-on view, producing a dot-like, circular or polygonal pattern; to the long strings of 'torpedoes' seen when the section is cut parallel to the cell length. It is more usual to encounter intermediate sections giving a picture of longish oval cells in parallel arrangement, and such may be referred to as a 'typical picture.' It may be observed that the cells seem to have 'canals' branching out from their sides and appearing to join up with the adjacent cells; these under higher magnification are seen to be just appendages with club-shaped ends, giving the cells a grotesque insect-like appearance. Under ultra-violet light (3650 Å°) the usual bluish fluorescence color so common to organic substances is observed; thus giving little assistance in identification.

In conclusion it could be mentioned that not only does the examination of the structure clearly distinguish ivory, bone and vegetable ivory one from another, but also from the 'plastics' which, in general, show a completely different picture having a fine granular appearance like ground glass. Further, although the article implies that this vegetable substance is used solely as an imitation of ivory, this is by no means always the case, for the writer has come across a necklet of 'coral' beads which turned out to be vegetable ivory stained a suitable tint.

As reported on page 127 of Winter 1948-49 *Gems & Gemology* Robert Webster is associated with B. W. Anderson in the London Gemmological Laboratory. His research on ivory was responsible for his being one of two to earn the Research Diploma of the Gemmological Association of Great Britain.

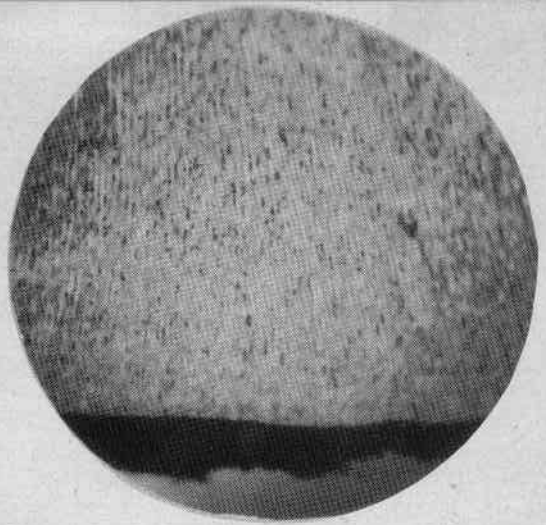


Vegetable ivory (corozo nut).
South America. 'Typical pattern'.
Cells viewed in intermediate position.
25X

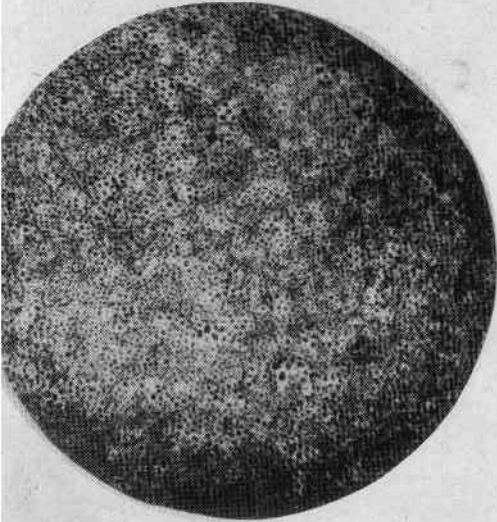


Vegetable ivory. (doug palm
nut). Nigeria. 25X

Vegetable ivory. (doum palm nut). Somaliland. 'Typical' picture with portion of the skin of nut. 25X



Vegetable ivory. (doum palm nut). Sudan. End on view of polygonal cells. 25X



Same specimen as above of enlarged polygonal cells. 100X

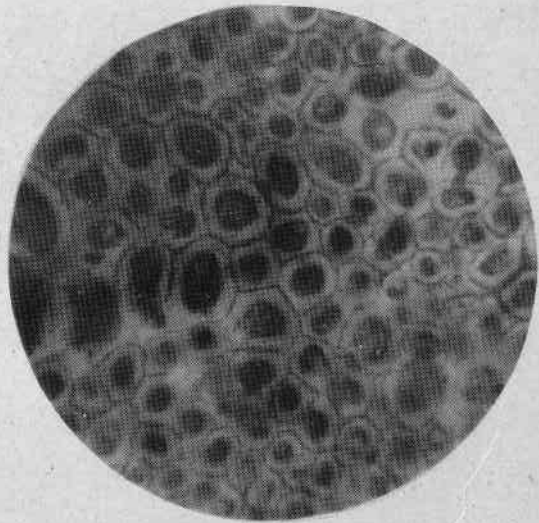




Figure 8

Reconstructed Rubies in Rod and Facetted Form

by

A. E. ALEXANDER, Ph.D.

Gem Trade Laboratory, Inc.,

New York, N. Y.

DURING the last three years, the writer has examined and tested thousands of rubies, genuine as well as synthetic. A sharp watch was kept in the hope that from an examination of such quantities of corundum — a reconstructed ruby would be found.

Many customers brought in rubies purporting to be "reconstructed," but always subsequent tests disclosed the corundum to be synthetic. It began to appear as if reconstructed rubies were a myth or at least the figment of some individual's fertile imagination.

One way to settle a problem of this kind is to make your own reconstructed rubies or find someone who has the facilities to do the job for you. Step one was to obtain material. Through the kindness of several wholesale colored stone dealers, it was possible to collect 14 carats of genuine ruby chips. These pieces were selected for good color and averaged $2\frac{1}{2}$ millimeters, each, in size. Care was taken to insure that the rubies contained rutile needles, as well as such other inclusions that characterize this variety of corundum, as genuine. The material was then submitted to Mr. A. K. Seemann, Manager of the Crystal Division

Figure 8. Drawing of a sectioned reconstructed ruby rod — showing gas vesicles, some with comet-like tails, and the ever present curved growth lines.

of the Linde Air Products Company, who was pleased to see what he could do to get the chips fused.

It was hoped to have the chips fused into one mass "as is" from which a faceted stone could later be fashioned. However, through some misunderstanding, or for technical reasons, the 14 carats of rubies were ground to 200 mesh and subsequently made into a rod.

The rod as eventually received averaged $1\frac{1}{2}$ to 2 millimeters in diameter and was 41 millimeters long. A section 10 millimeters long was first longitudinally sectioned in half and examined under a binocular microscope. Later, the same piece was thin-sectioned and studied petrographically.

It was observed that a slight loss in ruby color had occurred as a result of fusion. The rod was found to be full of gas vesicles, some spherical, some irregular in outline. In addition to these inclusions, there exists a number of comet-like gas vesicles, all with well defined tails. (Fig. 8) These particular inclusions proved to be very interesting in that they were arranged in a more or less fan shaped pattern. Well defined curved growth lines, which had formed normal to the length of the rod, but at irregular intervals were also noted.

The "c" axis was found to be roughly 60 degrees from the normal, a not unusual deviation in the case of synthetic corundum.

Under crossed nicols, in the position of maximum distinction, it was seen that here and there a grain, or several grains were oriented at variance with the rest of the mass. All the inclusions, mineral or otherwise, existent in the rubies prior to fusion could not be identified in the rod corundum. In this instance, a careful petrographic search for evidence of genuineness was made first at a magnification of 450x and later at a magnification of 900x.

While this investigation was in progress there came into the writer's office a stone dealer interested in having a 1.28 carat ruby tested.

At first glance, this particular stone appeared to be synthetic — not perhaps a "run of the mine" synthetic, but a Verneuil product nevertheless. The ruby was of a type generally associated with the early attempts made by Verneuil to synthesize alumina. The stone was next placed in a glass cell containing alpha-mono-bromonaphthalene and given further scrutiny.

The evidence revealed to the eye under these new conditions, clearly indicated that this ruby had been reconstructed.

The dealer was asked to donate the ruby to the Gem Trade Laboratory, Inc., "in the interest of science." After a period of time, the unusual stone was given to the writer.

Since a European meeting with Mr. Basil W. Anderson and Dr. E. J. Gubelin was in the offing, it was decided to take this ruby to Switzerland so that these two distinguished gemologists could have the opportunity of examining the gem. The meeting materialized in July, 1948, being held in the Luzerne laboratory of Dr. E. J. Gubelin. There the stone was carefully and critically studied. After weighing all the evidence, both Dr. Gubelin and Mr. Anderson concluded that this ruby was indeed a "reconstructed."

Dr. Gubelin kindly photographed the remarkable inclusions found in the ruby and his marvelous photomicrographs reveal the evidence which conclusively prove this

stone to be of reconstructed origin.

As for the inclusions themselves: note the peculiar swirl marks and how in some instances these marks are sharply terminated. (Fig. 1) The ruby contains four well defined undulate veils of varying size and beauty. This stone must be seen, however, in its entirety to best observe these particular inclusions. A material fused from several small pieces should possess gas-vesicles. This ruby is no exception. Still other inclusions, strongly resembling the kind seen in genuine ruby and sapphire are also indicated by Dr. Gubelin's photomicrographs (Fig. 2 to 7 inclusive).

The statistics on this reconstructed ruby are as follows: Weight: 1.28 carats; Color: An excellent ruby-red; Indices of refraction, as obtained from the table of the stone using Sodium light, gave: 1.760-1.767; Specific gravity, as determined on a Kerr balance: 4.00; Ultraviolet fluorescence (3600 A.U. filter) — bright red; X-ray fluorescence, using tungsten target, 90 kv, 10 ma — bright red; Absorption spectra, using Beck hand spectroscope #2458 reveals all characteristic lines for ruby.

The writer is indebted to Mr. Abraham Ball, New York importer of stones, who kindly donated the ruby to the Laboratory. To Dr. E. J. Gubelin for taking the time and the trouble to study and photograph this ruby. He also wishes to thank Basil Anderson for the interesting observations he made during the course of this investigation.

Lastly, as a matter of record, it should be stated that this stone is probably the first of its kind to be scientifically tested on two continents following a two way air borne trip across the Atlantic!

Background of Dr. Alexander, Director of the Gem Trade Laboratory, Inc., N. Y., will be found on page 63 of the Summer 1948 *Gems & Gemology*, with his article, "Pearl Fishing in the Persian Gulf" in that issue.

Observations on Reconstructed Rubies

by

E. J. GUBELIN, Ph.D., C.G., F.G.A.

*Gemological Laboratory,
Gemological Institute of Switzerland*

Knowing the process of reconstructing rubies — which is entirely different from both the natural formation of genuine rubies and the man-influenced growth of synthetic rubies — it seemed consequent to search for the most valuable diagnostic features of reconstructed rubies within their interior, which always bears the conclusive birth marks.

As reconstructed rubies were obtained by fusing together fragments of genuine rubies, could natural inclusions such as silk, rutile crystals, liquid feathers, etc., be expected to occur in reconstructed rubies? Hardly — yet if so, only exceptionally in cases when fragments are simply soldered together instead of being melted in a crucible. On the other hand curved striae, that decisive internal feature of synthetic rubies, need not be looked for since reconstructed rubies were not formed by the periodical deposit of molten drops. And yet again a feature of very similar appearance may have formed as the molten ruby mass was certainly in the state of a viscous, slowly moving flow, which while cooling off and recrystallizing, may have formed swirls. As long as the molten mass was heated impurities were burnt and air had access forming bubbles which were trapped when the mass hardened, hence gas vesicles may be expected.

Indeed gas bubbles and more or less

curved swirls are without exception found in reconstructed rubies. At first sight these internal features are very confusing, and a superficial observer might really regard the stone containing them as a synthetic ruby of early production or even as red paste if he has not previously determined refractive indices, density, and incidentally, absorption spectrum. Closer examination, however, reveals that the swirl marks are arranged in a most peculiar way, in that they are strongly curved with remarkably short radii which are arranged into groups and meet at sharp angles. While in synthetic rubies the regularly curved striae are rigorously parallel, the marked irregularity of the swirls forms a decisive criterion. (Fig. 1, 2, and 3) The majority of the gas bubbles, which occur in huge quantities, are spherical, (Fig. 3, 4) yet, numerous others have developed into bizarre, elongated, angular forms sometimes closely resembling the well known liquid-filled hoses, capillaries, tubes, and channels in genuine stones. (Fig. 4, 5, and 6)

All of the tests made on the reconstructed rubies described in these three articles were conducted in the laboratory of Dr. Gubelin of Lucerne, Switzerland. Biographical sketch of Dr. Gubelin will be found in Summer Issue 1947 of *Gems & Gemology*. Photomicrographs on pages 189-190 by Dr. Gubelin.

Occasionally these gaseous inclusions combine into veil- and feather-like, undulating systems which again are dangerously confusing for an inexperienced examiner. (Fig. 7) To the comfort of the latter, it may be emphasized that such deceiving gaseous formations never occur without being accompanied by single bubbles, and, besides, they always appear black from all directions while the liquid inclusions in genuine stones are transparent when viewed at an open

angle.

Another most characteristic means of identification is offered by the dense, net-like system of tiny air-filled fissures immediately below the dome-shaped surface of cabochon cut reconstructed rubies. They were formed when, during the cutting process, the internal strain caused by quick cooling was released. Such curious formations have never been observed either in natural or synthetic rubies.

Reconstructed Rubies

by

BASIL W. ANDERSON, B.Sc., F.G.A.

London Gemmological Laboratory

VERNEUIL, to his everlasting credit as a scientist, published full details of his revolutionary process for manufacturing ruby, and in his original paper (*Compt. Rend.*, 1902) even pointed out the internal features whereby his stones could be distinguished from natural rubies. The origin of the so-called "reconstructed" rubies was far more obscure: they were made in secret and sold for profit. The first types reached the market about 1882; they are said to have been made by an enterprising priest in a small village near Geneva, and were known as "Geneva rubies." In the eighteen nineties the chemist Michaud developed his own technique, fusing or sintering small pieces of valueless Siamese ruby in a platinum crucible under an oxy-hydrogen blow-pipe. As the general nature of the process became known, other people also began making the reconstructed stones, and the price soon dropped from 100 francs to less than 1 franc per carat.

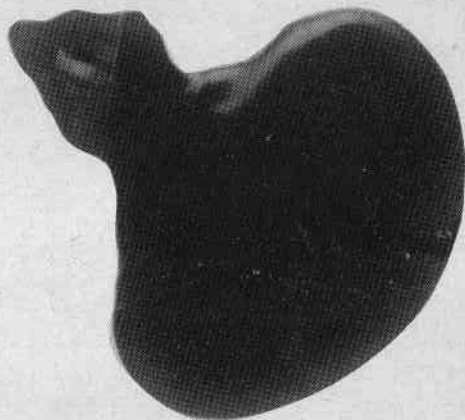


Figure 9. Reconstructed boule about 6X.

Several small pieces of the reconstructed "boules" are in the writer's possession, and are interesting in giving some clues as to the method of growth. The dimensions of each are much the same, about 9 mm x 7 mm, the weight of the complete boule being about 5 carats. The shape is oblate spheroidal, as shown in Fig. 9 with a little "neck" at the top where, in some cases, a small piece of unfused ruby is still attached, forming a complete proof, if any were needed, that these stones are not early examples of Verneuil's art. The unfused portion consists definitely of Siam ruby, and differs markedly in color from the main fused mass. It seems likely that the operator held this larger fragment in platinum

tweezers, and with it controlled and imparted a stirring motion to the mass.

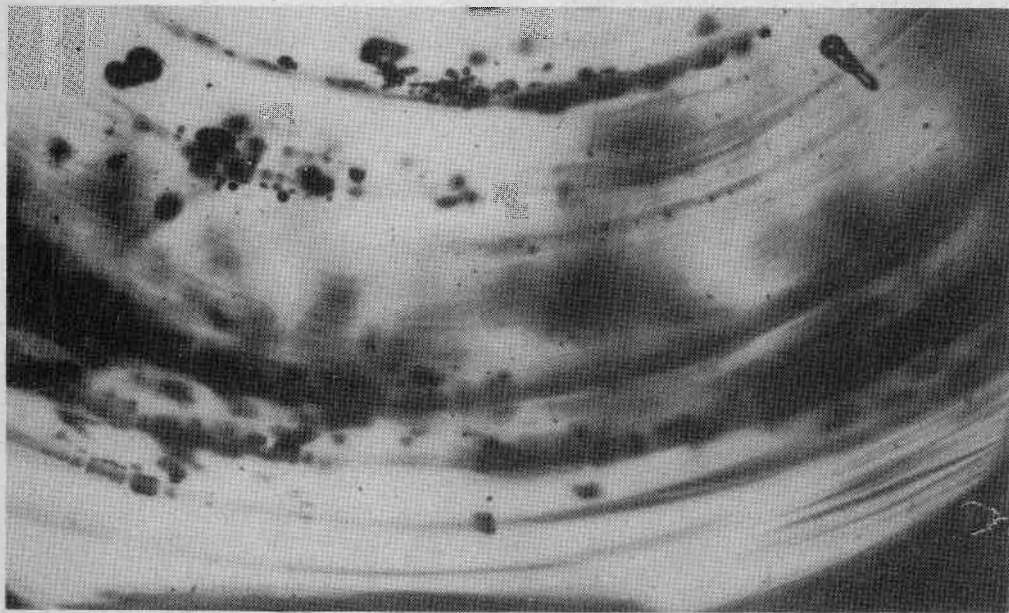
The well known tendency of the Verneuil boules to fracture symmetrically into two pieces is noticeable also in the reconstructed masses. The curved surfaces are glossy except for slight traces of rhombohedral crystalline formation along the longest perimeter. The boules are cracked and imperfectly transparent, but the several pieces of which they originally consisted have achieved at least approximately the same crystal orientation; this is shown not only by the fact that the dichroic colors are identical all over the stone when viewed from any one direction, and the extinction between crossed nicols is fairly complete over the whole field, but also by a tolerably clear cut uniaxial interference figure. The optic axis in each of the three cases examined was in the direction of the widest dimension—that is, at right angles to the direction in which the unfused ruby was attached.

It is believed that potassium dichromate was added to the crucible during the process of "reconstruction" in order to restore the color lost in the intense heat of the blowpipe. This may well account for the unassimilated material found in most reconstructed stones, some of which can be seen in the photomicrograph reproduced in Fig. 10. The color of the stones is more akin to that of Burma rubies than is the case with many modern synthetics and the absorption spectrum is not particularly intense.

As a matter of interest, the ultra-violet transmission of one reconstructed "boule" was measured by means of a quartz spectrograph, and was found to extend to 2700 Å, which indicates that, in common with the true synthetic rubies, reconstructed stones have a distinctly longer range of transparency in the ultra-violet than have natural rubies.¹

1. Anderson & Payne, *The Gemmologist*, October 1948, p. 246.

Figure 10. Internal structures of faceted reconstructed ruby. 30X. Photographs 9 and 10 by B. W. Anderson.



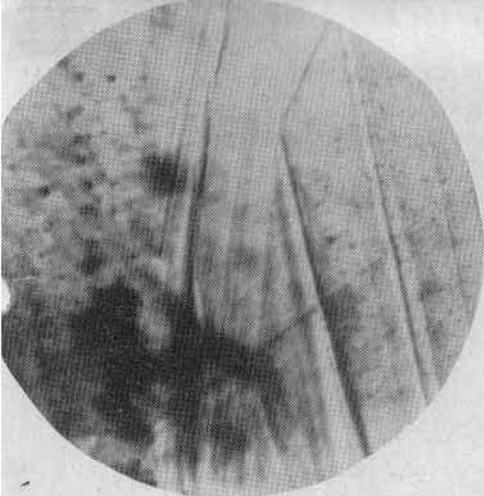


Figure 1

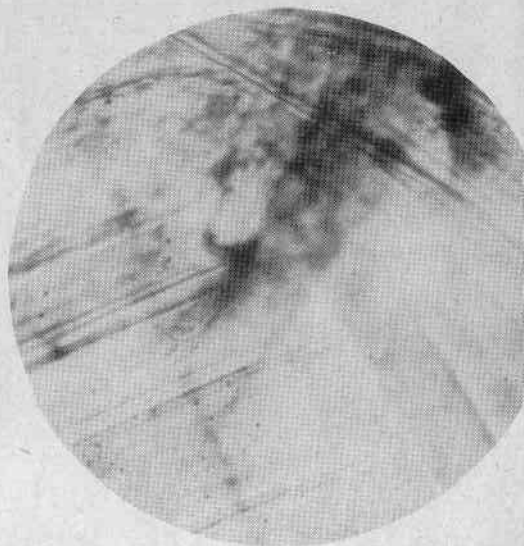


Figure 2

Figure 3



Figure 4

Figure 4. Group of bubbles, some of interesting configuration.

Figures 1, 2 and 3 show swirls. Note curvature and sharp cut off of fused particles.

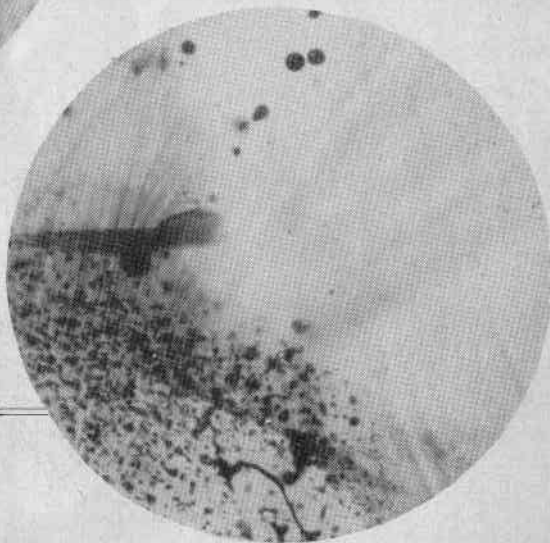


Figure 6

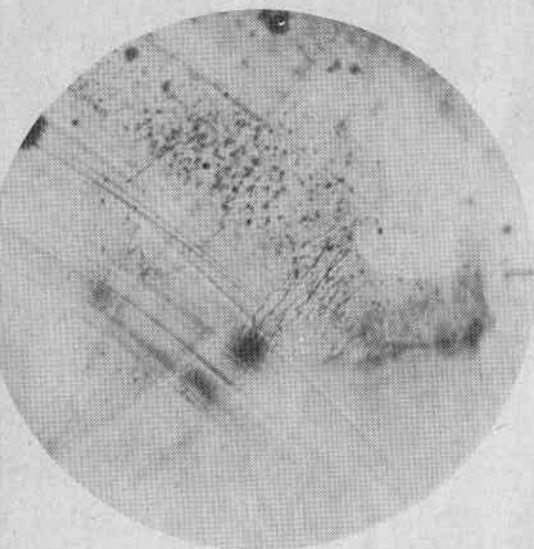
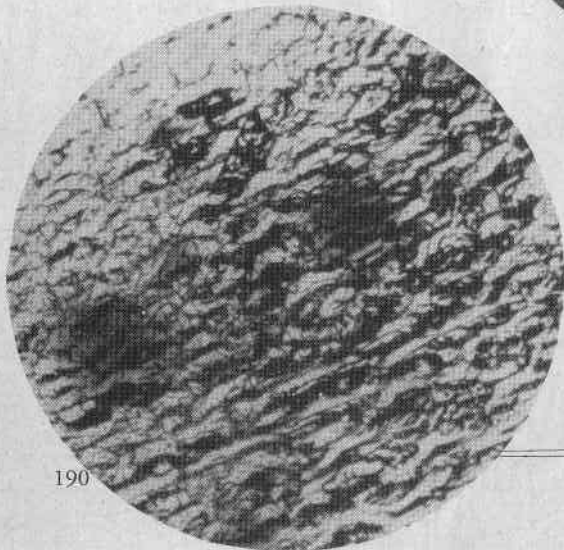


Figure 5

Figures 5 and 6 show inclusions suggestive of genuine stones.



Figure 7. Dark field, showing two shadowy veils and cloud of gas bubbles.



Surface inclusions
of reconstructed ruby

In IDAR-OBERSTEIN

Gemology Rises Again

by

KAY SWINDLER

G.I.A. Public Relations Director

READERS of *Gems & Gemology* will be interested to learn that with the passing of the first difficult postwar years in Germany, gemology begins to arise anew at Idar-Oberstein. In the spring of 1948 Professor Dr. Karl Schlossmacher, for many years professor of mineralogy at the University of Koenigsberg and a well known gemological specialist, advised the Gemological Institute that he had been appointed to establish a gemological institute at the centuries-old gem center.

During the past year the Gemological Institute has had considerable correspondence with Dr. Schlossmacher and we know our readers will want to hear his story of the present activity at Idar-Oberstein. First, however, let us review briefly the history of this unique city located in the Idar Valley of the River Nahe in Germany's Lower Saar Basin.

To the men, women, and children of Idar-Oberstein there is just one product which means their daily bread—their life. That product is precious stones. So it has been for almost two thousand years.

Legend and history have it that the industry had its inception in Roman times—when Caesar was pressing northward after his conquest of Gaul. It is claimed that in those days a troop of Roman legionnaires—passing through the valley of the Moselle—



Although more and more water power is being replaced by electricity, this scene is familiar in Idar.

crossed a mountain range and stumbled upon a small and unpretentious group of dwellings perched upon precipitous walls of rock between which ran a rapidly flowing mountain stream. The native peasants and hunters all had collections of beautifully marked stones which they had broken from the rocks surrounding their village. Among these collections the Roman soldiers recognized the same materials from which the artisans and goldsmiths of the Imperial City cut and polished the precious stones so prevalently worn at that time.

So began a period of lively activity in the little settlement then known as Hidera. The water power of the Idar brook was harnessed, great grindstones were installed. By the year 31 A.D. Idar was an important gem cutting center.

Although with the fall of the Roman Empire the demand diminished, the inhabitants never ceased their activity in the handicraft which had been introduced to them. However, real intense activity was not re-



The rotating beech-tree trunk smeared with tripoli powder for polishing stones is now but occasionally employed.

sumed until the 12th century. It was during this period that the Counts of Oberstein, among other German lords who owned the lands and the quarries, controlled the important business of supplying gems used to adorn the armor and swords of the medieval knights, or the attire of the castle maidens.

With this heavy demand for the native minerals, the deposits gradually began to be exhausted and the lords lost interest in the industry. It was then that the Idar-Obersteiners started to work as independent handicraftsmen. They united to form Guilds,

embracing three specific working groups — the stone pickers, the grinders, and the drillers. Soon the fame of Idar-Oberstein and its superior craftsmen began to spread and many foreign buyers came to the Idar Valley. As the supply of raw material became almost non-existent, natives traveled to other gem mining countries and soon it became the custom to send the stones to Idar-Oberstein for cutting. At no time during the passing of the centuries has the industry ceased to flourish. It is said that work such as this is accomplished by a delicacy of touch, inherited as the art has passed from generation to generation.

A world war must of necessity have a devastating effect upon an industry based to a very large degree upon export business and one which is dependent upon other nations to supply it with the raw materials necessary to continue. This was the problem which faced Idar-Oberstein at the close of World War II.

Fortunate in being saved from wartime destruction, the gem cutting industry of Idar-Oberstein is now striving to return to its former place in the trade. Many inhabitants have returned from their refuge in other lands and there are today gem cutters, agate cutters, diamond cutters, and engravers occupied in more than a thousand workshops. Although the industry is as efficient as in former times, activity has been retarded through restrictions on importing raw stones according to Dr. Schlossmacher.

In his new position as Director of the Gemological Institute of Idar-Oberstein, Dr. Schlossmacher is faced with many problems. There are no instruments, no books, and little money. During the past ten years while England, America, and Switzerland made rapid advancement in the perfection of gemtesting instruments, Germany's gemologists were unaware of these developments. Dr. Schlossmacher expresses his appreciation to the Gemological Institute of America, the Gemmological Association of Great Britain, and the American Gem Society for



Cutters of the Idar Valley vie with excellence of execution employed by cutters of antique gems.

providing literature and information regarding advancements made by them.

After the new Institute has advanced to the point where it is possible, Dr. Schlossmacher plans to present an educational course of both lectures and courses. This he had done in most of the important cities of Germany prior to the war. However, it is first necessary that the gem trade, the jewelers, and the goldsmiths organize and that the industry become economically sound before such educational plans can be realized. The fate of the newly-founded Institute is connected closely with the industry of Idar-Oberstein. The next few years will decide the fate of both.

Dr. Schlossmacher writes: "The fate of the industry of Idar-Oberstein depends largely on its connection with the markets of foreign countries from which it buys raw stones and sells its cut stones and jewelry. Since 1933 these connections with foreign countries have been disrupted due to the political development. With the beginning of the war in 1939, a complete interruption set in. Today, a limited quantity could be

sold in Germany. However, inability to buy raw materials made it necessary to use stocks which could not be replaced and so for 15 years the industry has been forced to work under conditions which are opposed to its entire development and structure.

"The money that existed in 1948," Dr. Schlossmacher continues, "was decimated by the reform of currency and a new law for taxes on property will touch the real values. The importer of raw stones thus will have lost his money and his stock. Besides, in the future he will need to compete in a foreign country's market, where the prices have risen enormously in comparison with former times."

Dr. Schlossmacher states that the years since 1945 have been especially difficult. In explanation of this he writes, "During that time the stocks were blocked and there existed a system of contingencies within the German zones of occupation. Fortunately these restrictions have diminished and have been partly repealed. The opening of the market at this time is, however, fraught with other difficulties. People have no money to buy luxury articles but are in need of household furniture and clothing.

He concludes, "So the future of the industry depends largely on the world market. One hopes at Idar-Oberstein that obstacles will be removed in a not too distant time. Now that restrictions on export are relaxing, the problem of procuring raw stones has become the most important concern of the gem industry. If that problem too is solved, the industry will again gain its place through the well known high quality of its products. The industry has reason to expect that soon raw stones can be imported again and that then the large demand of foreign countries for the special products from this center can be realized."

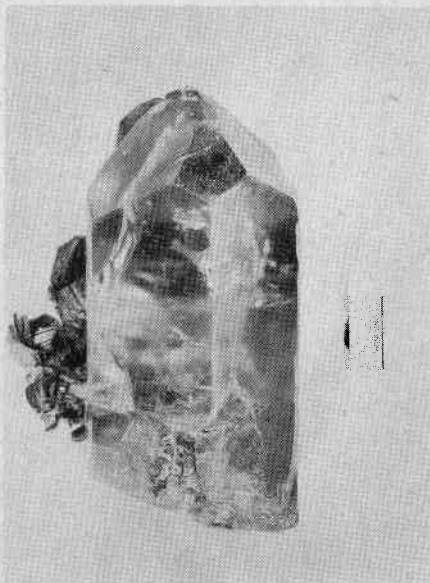
IN THE NEXT issue of *Gems & Gemology* will appear *The Precise Determination of the Color of Gems* by Prof. Dr. Schlossmacher with a biography of the well known gemologist.

Gemological Digests

BERYL POCKET CONTAINS 40 POUNDS GEM MATERIAL IN VARYING COLORS

Discovered in 1947, in a pegmatite dike in Minas Geraes, was a pocket containing approximately 60 beryl crystals in various colors, of which roughly 80% were gem quality. Most important among the larger crystals were four blue measuring 11" x 2", 11" x 1½", 7" x 1", and 6½" x 1", weighing respectively 1218 grams, 798 grams, 256 grams, and 160 grams. There was also a yellow-green crystal, 8½" x 4" (2244 grams) and a golden beryl, 2" x 4" (320 grams).

In addition, the pocket, which was the size of an ordinary washtub, contained 50 smaller crystals varying from ½" to 6" in size, all of varying colors. Roughly the pocket produced 40 pounds of gem quality beryl.



This was certainly one of the most fantastic finds of gem materials yet discovered and the editors of *Gems & Gemology* regret that it is impossible to reproduce a color photograph of the crystals. The photograph shown on this page illustrates a golden beryl crystal with crystallized mica which was taken from the same pocket. This crystal which is now in the Smithsonian Institution measures 3" x 6" and weighs 1820 grams. *Photographs and information through the courtesy of Allan Caplan, Importer, New York City.*

DE BEERS REPORTS PROGRESS ON RE- OPENING OF PREMIER

According to an official report released by the De Beers Consolidated Mines, Ltd., Kimberley, the re-opening of the Premier Mine will be completed by the close of 1949 and large scale production will be resumed early in 1950.

When all equipment is installed and the mine operating at full capacity again, production of 1,000,000 carats per year is expected. At the close of 1948, the report states that 120,379 carats had been removed in comparison to 14,018 carats recovered during 1947.

Because of the favorable results which were obtained with Heavy Media Sink and Float method of concentration at the Premier experimental station, the De Beers company has decided to install a plant of similar design and 10 tons per hour capacity at Kimberley. This will be used to test blue ground from Bultfontein, Dutoitspan, and Wesselton Mines.

Total production from all of the De Beers Mines during 1948 was given as 1,048,377¾ carats which is an increase of 25,953½ carats over production of the previous year.

Contributors in this Issue



B. W. ANDERSON, of the Editorial Board of *Gems & Gemology*, and a member of the Educational Advisory Board of the Gemological Institute, has headed the Precious Stone Laboratory of the London Chamber of Commerce since its inception in 1925. In addition to his extra duties as Senior Lecturer in Gemology at Chelsea Polytechnic, London, he is also author of *Gem Testing*, now in its fourth edition, and numerous articles in technical journals. Born in 1901, Basil Anderson was educated at Sedbergh School and King's College, London University. Although he graduated in Chemistry, he has always been thankful that his life's work has been in a laboratory in which the prevailing odor was that of methylene iodide rather than hydrogen sulphide.

JOHN A. HARDY, Mill Architect and Consulting Engineer of New York City, has been interested in gems and gem minerals in a general way for a great many years. More recently his interest has developed into a definite hobby. He is particularly concerned with the scientific aspects of the subject and expresses regret for lack of time to apply his efforts to some definite line of investigation, which he claims have been rather scattered to date. He has long been an enthusiastic supporter of the aims and ideals of the Gemological Institute of America and the American Gem Society. Educated at Dartmouth College and Columbia University, John A. Hardy, over the past twenty-five years, has directed the engineering of numerous paper and pulp mill projects and hydro-electric developments in the United States, Canada, Newfoundland, and Mexico. We know, with a keener consciousness of radioactivity than ever before, our readers will appreciate his Report of a Radioactive Diamond.

EUNICE ROBINSON HASTINGS, C.G., credits her interest in mineralogy to her grandmother who introduced the subject to her in her childhood. She received her formal education at Lasell Jr. College and special courses at Massachusetts Institute of Technology and, during 1936-39, her great desire to work in the Natural History Museum of Boston was fulfilled when she worked as Assistant to the late Dr. Edward Wigglesworth during the early years of his G.I.A. presidency. While there she became interested in the gemological movement and enrolled for courses of the Gemological Institute. In recent years her husband has worked with her to develop slides of photomicrographs of inclusions of gemstones, which she uses to illustrate lectures and articles.



CORNELIUS S. HURLBUT, JR., Associate Professor of Mineralogy, Harvard University, is a member of the G.I.A. Educational Advisory Board. Short biographical sketch of Dr. Hurlbut will be found in Spring 1948 *Gems & Gemology*. Others contributing in this issue, whose biographies do not appear on this page, are A. E. Alexander, E. J. Gubelin, and Robert Webster. Dr. Alexander was a contributor in Summer 1948 when his *Pearl Fishing in the Persian Gulf* appeared. *Gems & Gemology* readers are familiar with the many fine articles written by E. J. Gubelin and the excellent photomicrographs he has prepared. A member of the Institute's Educational Advisory Board, the Editorial Board of this publication, and G.I.A.'s only Research Member, Dr. Gubelin's background appeared briefly in Summer 1947. Robert Webster, an authority on ivory, was sketched in the Winter 1948 issue of *Gems & Gemology*.