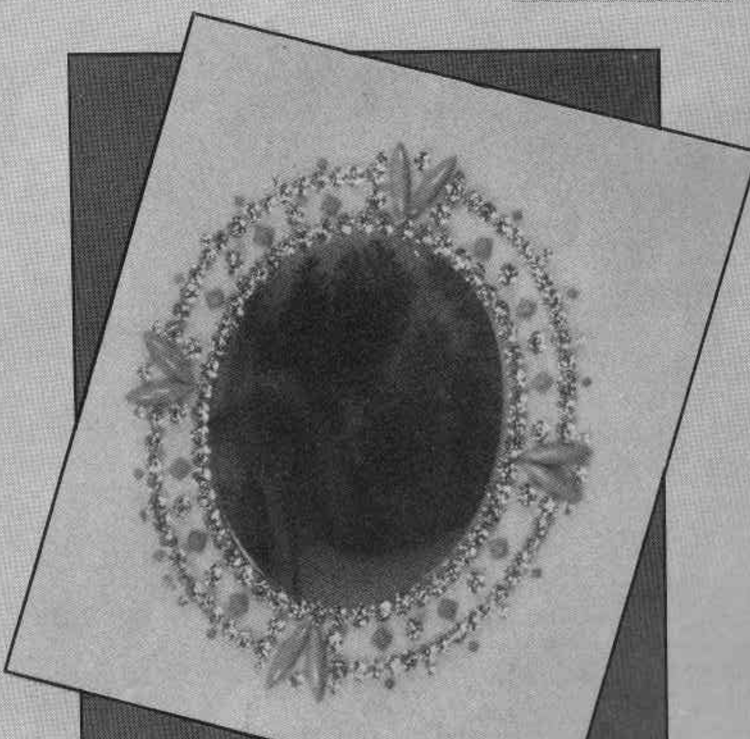
Gems and Gemology

WINTER 1951-52



See Inside Cover

GEMS & GEMOLOGY

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IN THIS ISSUE

On the Cover

M. D. Hohenstine, C. G., uses artistic designs of loose stones as effective window displays in his Columbus, Ohio store. Here is the 1039th design so used, consisting of 144 diamonds, 32 turquoise, and one landscape agate.

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Gem Trade Laboratory Installs New Pearl Testing Equipment

by

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The following article is presented as a summary of the requirements for the microradiography and X-ray luminescence of pearls and includes an outline of the techniques employed in the laboratories of the Gemological Institute of America, as well as a brief description of the new X-ray unit installed recently at the Gem Trade Laboratory in New York.

The acquisition of the Gem Trade Laboratory in 1949 by the Gemological Institute of America gave the Institute its first X-ray unit adapted exclusively for the radiography of pearls. This unit and the operating techniques[1] developed by the former director of the Gem Trade Laboratory, Dr. A. E. Alexander, were used until recently in the testing of thousands of pearls for the trade. The radiographs and general characteristics of these pearls were carefully recorded in the laboratory files and in June 1951 a research program was instituted for the purpose of developing, if possible, refinements in both X-ray equipment and operating techniques. The result of this work was gratifying and authorization was obtained from the G. I. A. Board of Governors to design new equipment that would utilize to best advantage all of the techniques developed to date for microradiography and X-ray luminescent testing of natural and cultured pearls.

Although this is not the only method of testing pearls, it is the only system by which an entire strand of pearls can be effectively tested at one time. It is also effective on most pearl-set jewelry, and therefore provides the most desirable type of equipment for a commercial laboratory.

For those readers who are unfamiliar with the principles involved in radiography, it is simply a method of studying the structural characteristics of a specimen without having to section, or otherwise destroy, the specimen. Basically, the procedure is to direct a beam of the X-rays at the specimen which has X-ray sensitive film placed immediately behind it. Any differences in the structural density of the specimen will cause uneven absorption of the X-ray beam and the resultant image recorded on the film (i.e., shadowgraph) will show these characteristics.

However, with some materials, such as pearls, the amount of resistance offered to X-ray transmission is very slight, and the type of X-rays developed at high kilovoltage normally used to radiograph, for example, the human body is much too penetrating for these specimens. When the kilovoltage is too high the resultant X-rays tend to penetrate the entire pearl without

1. A. E. Alexander, *Gems & Gemology,* Winter 1941.

sufficient differential absorption by the various layers.

The key to obtaining maximum film detail for pearls lies in selecting a type of radiation that will just penetrate the less dense areas but will be absorbed by the denser areas of the specimen. To. accomplish this, for pearl testing, requires the use of very soft X-rays (i.e., those rays of longer wave length generated by low X-ray tube voltage which have low penetrating power). Actually the term "X-rays" refers to a wide range of wave lengths of radiant energy which occur below the Grenz ray range of the electromagnetic spectrum. "Grenz" is the name sometimes applied to the intermediate wave lengths between the ultraviolet rays and X-rays. This radiation had been utilized recently in special Grenz ray equipment for the microradiography of thin sections of tissues, fabrics, etc., in conjunction with special X-ray film that will withstand magnification up to 200x. Grenz radiation is developed at approximately eight to twelve kilovolts. Although the X-ray absorption of pearls is too high for adequate penetration of Grenz rays, the radiation occuring just below this range does fulfill the penetration requirements for the microradiography of such materials.

Most of the less expensive X-ray units which have been tried from time to time for pearl testing are not designed to produce this softer radiation and to convert them requires the addition of an adjustable transformer that will make it possible to adjust critically the X-ray tube voltage to any point between 25 KV and the instruments usual maximum limit of 65 to 100 KV. More expensive X-ray units have this adjustment as standard equipment.

One of the main difficulties in using very soft radiation to obtain fine detail is that it requires much longer periods to obtain good film exposure. It also requires a very sensitive and fine-grained film that will withstand specified magnifications. Most small X-ray units do not have the necessary cooling arrangements to permit continuous operation for periods exceeding five to ten seconds, regardless of the type of radiation used and, therefore, to take the equivalent of a long exposure with such a unit requires several short exposures with alternate rest periods.

The most suitable fine-grained film necessary to record the slight differences in X-ray penetration through pearls is of a type made exclusively for microradiography and is capable of withstanding ten to fifteen magnifications. It is known as Kodak Industrial X-ray Film, type M. Another type of film that may be used to advantage is the Eastman Spectrographic Plate, Type V-O, rated at 35 magnifications. However, this film requires more than twice the exposure time or M.A.S. factor of the Type M. film, and actually has little advantage over the latter considering that the fine detail necessary for the identification of natural and cultured pearls is adequately revealed under twelve or less magnifications.

The problems of instrument design and techniques which must be considered in the microradiography and X-ray luminescent testing of pearls are as follows:

(1) The equipment must be capable of critical X-ray tube voltage adjustment at at any point between 30 KV and 90 KV with milliampere control ranging from 4 to 10 MA.

(2) It must be so designed that an entire strand of pearls can be exposed to the X-rays at one time, obtaining similar detail for both large and small pearls as well as for all areas of a single pearl.

(3) The film box must be so designed to permit the film to be placed as close as possible to the pearls so the desired structural characteristics may be recorded fully. Also, there should be nothing between the pearls and the film that is even partially opaque to soft X-rays such as metal or highly dense paper.

(4) When X-rays strike an object, a secondary radiation of longer wave length

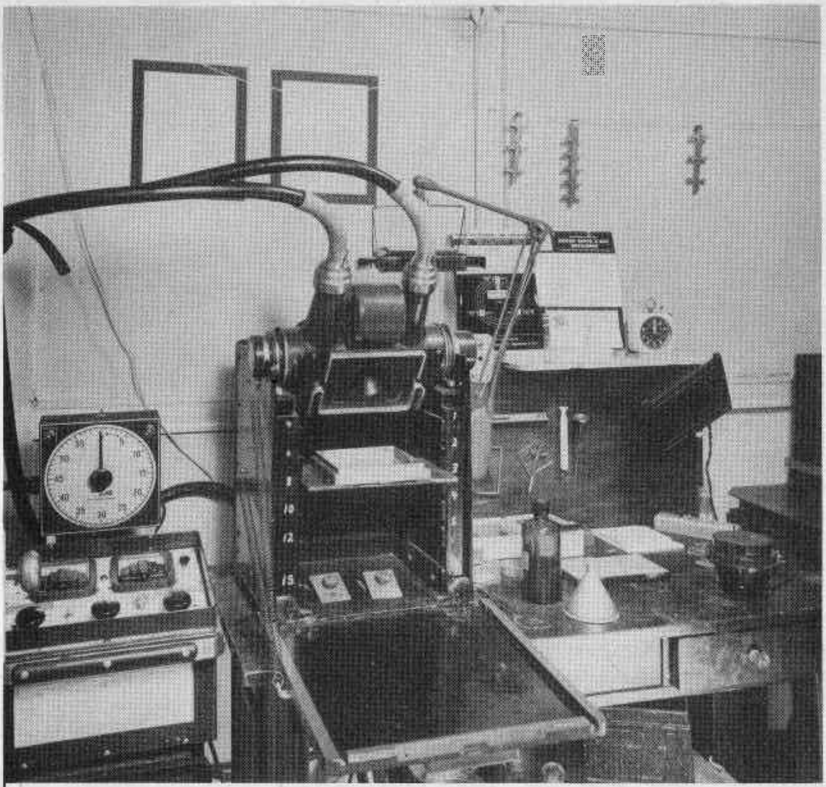


Figure 1. **New X-ray unit with X-ray head in a vertical position to show the modified pearl tray used to hold the pearls when testing for X-ray luminescence. Transformers, control box, and timer are shown at the left. Immersion cell to hold pearls for microradiography is shown on the film tray just below the X-ray head.**

is generated which scatters in all directions. This is relatively penetrating and with higher kilovoltages may be four to ten times as intense as the primary beam. This unfocused radiation will expose X-ray film and thus overcast and obscure image detail. Obviously a means must be employed to eliminate this.

(5) Although of less importance, X-rays are subject to a certain amount of reflection and refraction from the surface of any dense object. If not eliminated the results of such reflections will be particularly noticeable around the edges of the pearl image on the film, resulting from the variously reflected X-rays that impinged on the edges of the pearls at a large angle of incidence. Radiographs of pearls taken without correcting this will show indefinite or fuzzy edges which may even obscure the outer edge of the nucleus of a cultured pearl in cases where the total of the surrounding nacreous layers is very thin.

(6) A simple means of obtaining microradiographs of numerous loose pearls at

one time, without danger of their becoming mixed before they are correlated with the developed microradiograph and thus properly separated, is invaluable when large quantities of loose pearls are to be tested.

(7) To test the X-ray luminescence of pearls it is necessary that provision be made for reversing the X-ray head from the radiographic position to the upright position required for this test as well as constructing a suitable tray arrangement for holding the pearls within at least one inch of the tube. Shorter X-rays developed at 85 KV and 90 KV are necessary for this testing. Although the fluorescence of the average cultured pearl cannot be accepted as a conclusive test due to similar fluorescence obtained with most natural fresh-water pearls, it does provide a quick and excellent indication as to the identity of a pearl and of course will easily detect a mixed strand.

(8) Most important in the design of any X-ray unit are the protective devices necessary to shield the operator from both primary and secondary radiation. The average gemologist interested in the X-ray techniques employed in pearl testing, is not trained in the use of X-ray equipment. The lack of such training, of course, can result in serious X-ray burns even with the smallest available unit. A handbook of X-ray protection (HB20) may be secured from the bureau of standards, which outlines the necessary precautions for general X-ray work. One of the main difficulties with exposure to X-rays is that the effect may not show up until months or years later. Also, even though exposure may be for very short periods any one of which is not important the effect of exposure to X-rays is cumulative.

All of these basic requirements just outlined have been incorporated in the new X-ray equipment at the Gem Trade Laboratory. The Picker X-ray tube utilizing a tungsten target is cooled with a combination blower and circulating oil system which permits indefinite exposures when used for microradiography. Exposure periods are timed by the automatic timer sensitive to one half second and with a maximum range of sixty minutes. The type of radiation may be adjusted from 25 KV to 100 KV and from one to 30 MA providing an almost unlimited range and quantity of normal and soft X-rays. The X-ray head is reversible and has a combination tray and protective shield completely surrounding the tube window to eliminate any possibility of stray secondary radiation reaching the operator *(Figure 1)*.

The tray, mounted on the head, is equipped with a guide ring into which a spring balanced lead viewing cover, suspended at the right of the instrument, may be lowered when testing pearls for X-ray luminescence. Because of the intense radiation used for this test, the viewing cap consists of a three sixteenths inch lead frame and a three eigths inch lead glass window. The cap has "L" shaped apertures on each side to permit the drawing of a strand of pearls through the cap, and over the tube window, without danger of exposing the operator. This is shown in place in (*Figure* 2.)

To take a microradiograph, the viewing cover is swung out of the way and the head is rotated 180° so that the tube window is facing down *(Figure 3)*. This places it below the top edge of the special film box upon which the head is mounted. The film box is lead lined with a three sixteenths inch plate on the bottom and front, and a one sixteenths inch plate covering the remaining sides. Slots are built into the side of the case to permit adjusting the combination film and immersion cell tray to any point within the allowed six inch to eighteen inch film to X-ray tube distance. The pearls themselves are placed in an immersion cell with a transparent cellulose acetate bottom which rests directly on the film slot. To eliminate any fogging of the film due to secondary radia-

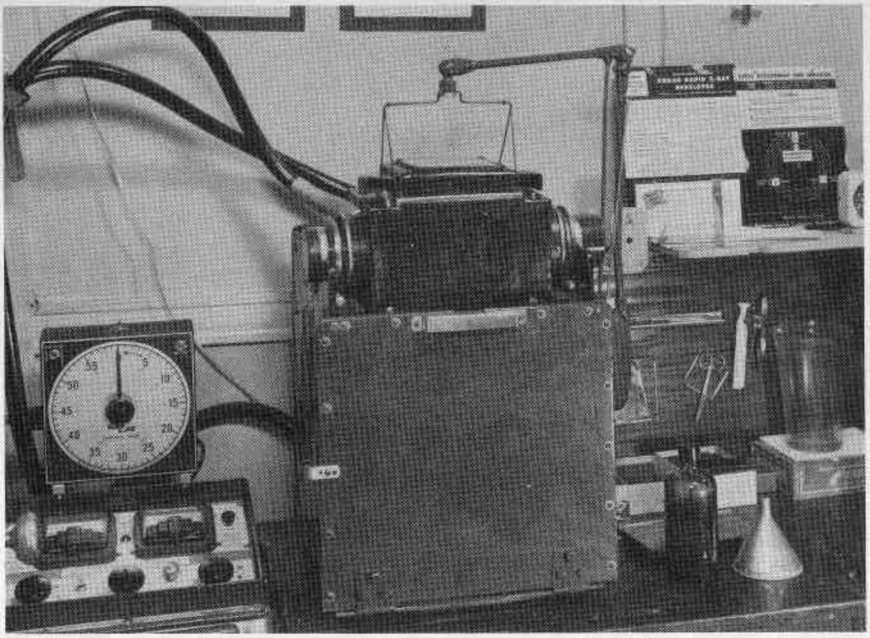


Figure 2. **The unit as it is set up, with protective cover in place, to test pearls for X-ray luminescence.**

tion and to compensate for variation in pearl size, the pearls are immersed completely rather than half, as was the former practice, in carbon tetrachloride. Carbon tetrachloride is opaque to the secondary radiation generated at the 20 to 40 kilovolt range. In addition, although it is transparent to primary X-rays of shorter wave length, it has approximately the same X-ray absorption for the softer rays now being used as do the less absorbing areas of the natural and cultured pearl. Therefore, when using soft X-rays, carbon tetrachloride may be used to fulfill several requirements.

It acts as a masking agent to absorb secondary radiation; an immersion liquid to minimize traces of surface reflection and refraction; and provides a means of compensating for differences in pearl size. Because of this exposure charts are no longer based on the size of any one pearl in the strand but instead on the depth of carbon tetrachloride, which is added in sufficient quantity to cover the largest pearl. By such a method similar detail can be obtained, for example, on a ten millimeter and three millimeter pearl, when radiographed side by side, as could be obtained on either pearl individually.

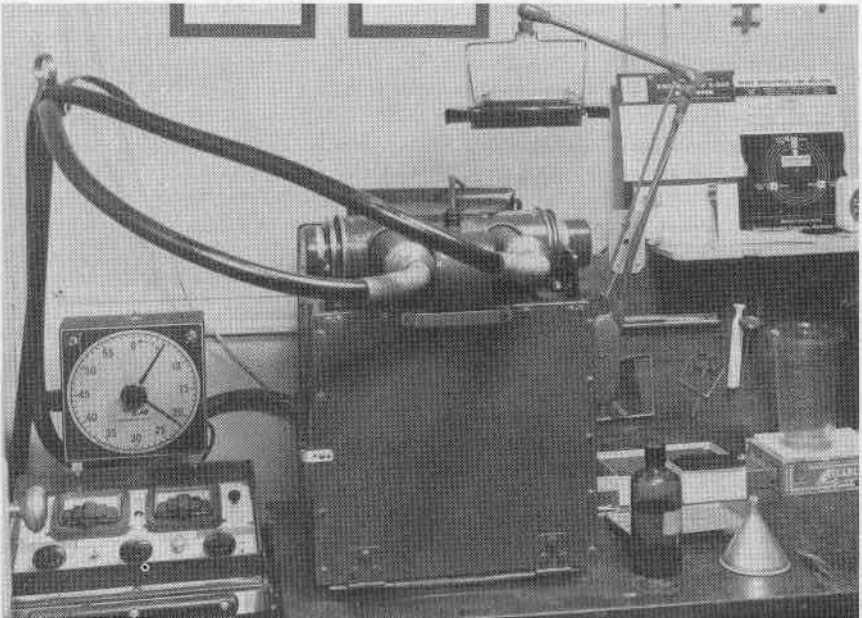
Such excellent results are being obtained with this equipment that it is common not only to obtain exceptionally clear detail of the concentric nacreous layers surrounding the nucleus of a cultured pearl, but in cases where the nucleus itself is so oriented that the radiation passes parallel to the layers of which it is composed, these show up on the microradiograph as pronounced straight lines within the surrounding concentric layers. Microradiographs showing parallel banding of the cultured pearl nuclei have been obtained easily on cultured pearls of twelve to fourteen millimeters in diameter which contain only small nuclei of five to six millimeters in diameter. To do this, of course, often requires taking several exposures of the pearl—each at a different orientation. Provisions have been made to do this quickly on one film by using four lead plates that fit in the immersion cell. By removing and then replacing a plate, after exposure, microradiographs may be taken from four different orientations with the only time involved being just that required for the total of the four exposures. These four positions invariably provide at least one picture revealing the parallel structure of the mother-of-pearl core. When testing loose pearls a special separator, which fits into bottom of the immersion cell, is used. This consists of crossed nylon thread similar in appearance to a tennis racket. In addition, the tray is so designed that the film may be extracted for developing without moving the immersion cell. The combination of these two factors readily prevents mixing of loose pearls before they can be correlated with the microradiograph.

The normal target to film distance used with X-ray radiation developed at 35 KV ranges from eight to ten inches. Theoretically, the greater the distance the more parallel will be the X-rays striking the object, a desirable factor in securing fine detail. However, because of the relatively high absorption by air of the very soft X-radiation used in microradiography, the X-ray intensity will decrease with distance more rapidly than calculations, based on the reverse square law, would indicate. It has been found, for example, that if the film to target distance is increased to eighteen inches the soft radiation (35 KV) becomes so weak that it will hardly penetrate ten millimeters of carbon tetrachloride.

Of course, good parallel radiation can also be obtained for very short target-to-film distances by use of a lead glass cone over the tube window. This permits the use of even softer X-rays than are now being used, but such a system must of necessity be confined to single pearls. Actually the need for increased detail above what is now being obtained has not yet been apparent.

The design of the present equipment, however, is such that the extreme range of usable radiation, the range of target distances, the permissible long operating periods as well as instrument accessories provide complete coverage for any type or size of pearl that could likely be encountered in the future.

***Figure 3.* X-ray unit with X-ray head reversed for microradiography. Miscellaneous accessories are kept on the backboard at the right of the instrument.**



Present Status of the Turquoise Industry[1]

by

DR. GEORGE SWITZER

U. S. National Museum, Washington, D. C.

Turquoise occurs in relatively few places in the world, and only in Iran (Persia) and the southwestern United States are deposits known which are now of commercial importance.

The world's oldest turquoise mines, on the Sinai Peninsula, were extensively worked by the ancient Egyptians, but have not been an important source of this gem for the past 3000 years. They are of special interest because they are the earliest mining operations recorded by history. Some other localities from which turquoise has been reported, include Ethiopia, Egyptian Sudan, Siberia, Turkestan, Afghanistan, Arabia, China, Germany, France, Peru, Chile, and Australia.

IRAN

The turquoise deposits in Iran are situated near the village of Maden, 36 miles northwest of Nishapur, in the province of Khurasan. There are a large number of mines, some actually worked, some abandoned. It is not known just when the Nishapur deposits first became known, but certainly as early as the 10th century, and possibly long before that. They still continue to be one of the world's principal sources of fine quality turquoise.

Production of turquoise in Iran during the years 1947-1951 is shown in the following table.

Iranian turquoise production, 1947-1951:

Year	Approx. wgt. (lbs) uncut turquoise mined	Approx. value uncut (U.S.)
1947	14,700	45,000
1948	17,300	72,900
1949	13,100	38,100
1950	9,600	19,300
1951	13,200	75,000

*Iranian year, ending March 21 of years shown.

United States imports of turquoise during 1950 were as follows:

Country	Rough and uncut	Cut but unset
Iran	$1,532	$
Belgian Congo	549	
Germany		552
India		305
China		1,915

On April 8, 1943 Iran and the United States signed a Reciprocal Trade Agreement by which the import duty on cut turquoise into the United States from Iran was reduced from ten to five per cent; uncut turquoise had been duty free for some time. However, since the discovery of good quality turquoise in the United States in the period between the 1870's and the early 1900's, very little Iranian turquoise has been imported into the United States.

UNITED STATES

The most important localities for turquoise in the United States are Arizona, Colorado, Nevada and New Mexico. Mining

1. Published by permission of the Secretary, Smithsonian Institution, Washington, D. C.

activity in these areas has varied greatly from time to time. Some of them are no longer productive, and production of turquoise in the United States appears to be diminishing. Most of the mining is done on a small scale, and accurate and detailed production figures are difficult to obtain.

ARIZONA: In Arizona the most important turquoise deposits lie to the southwest of Mineral Park, in Mineral County. Turquoise has also been reported from near Tombstone, Cohise County, and several other areas of minor importance.

During the years of 1940-50 there was very little activity in the Arizona turquoise mines. In 1947 a production of 100 pounds was reported from the Mineral Park area. In 1949 the Southwest Gem and Jewelry Company mined 75 to 100 pounds at its Cerebrat Ranch locality. In other years, during this period, production was reported as none, or very little, from Arizona.

Beginning about 1944 some turquoise was uncovered from time to time in the open pit of the Castle Dome Copper Company, Inc., at Miami, Arizona. In 1947 a production of several hundred pounds was reported, but the amount of turquoise seems to be diminishing with depth. 1950 production of turquoise from this locality was reported as a small amount of good quality.

NEW MEXICO: New Mexico has produced a greater quantity of turquoise than any other state. Up to 1915 its total production is estimated to have exceeded $5,000,000 in value.

The most important deposits in New Mexico are in the Cerrillos mining district, Santa Fe County, in the north-central portion of the state. Among the famous mines in the district are the Tiffany and Castilian. Other deposits, formerly of importance but now largely exhausted, are in the Burro Mountains and the Hachita district, Grant County and the Jarilla district, Otero County.

The New Mexico turquoise mines have been worked very little in recent years, and in the past ten years production has been almost nonexistent. In 1950 the New Mexico Bureau of Mines and Mineral Resources reported that an insignificant amount of turquoise was produced from the Tiffany mine in the Cerrillos district, and sold in Albuquerque to jewelry manufacturers.

COLORADO: Principal deposits of turquoise in Colorado are near Lajara, Conejos County, at Villagrove, Saguache County, and in the Holy Cross mining district, 30 miles from Leadville. For many years Colorado has ranked second to Nevada in value of turquoise produced in the United States.

In 1940 some production was reported from the Hall mine, near Villagrove. In 1941 the King mine, near Lajara, had an unusually successful year, as one "pocket" alone produced almost 700 pounds of good material. In 1942 the Hall mine was the principal producer. In 1943 production was low, but in 1944 the King mine yielded an estimated $7,000 of turquoise. In 1945 the King mine was operated but no production figures were reported, and there were reports of a new turquoise deposit near Cripple Creek. In 1946 the King mine was reported to have produced 2,000 pounds of turquoise valued at $30,000, and a similar production was reported from the King mine in 1947. From 1948 to the present there has apparently been very little turquoise mined in Colorado.

NEVADA: Nevada has been the leading state in turquoise production for a number of years. Principal production comes from Lander, Eureka, Nye and Mineral counties.

In 1940 Nevada produced an estimated $20,000 in turquoise. Of this the Fox Turquoise mine, near Cortez, Lander County, produced 7,928 pounds of rough, the best of which sold for $11,405. Some production for this year was also reported from near Tonopah, Nye County, and Austin, Lander County.

Nevada production of turquoise in 1941 totaled approximately $28,000, most of which came from the Smith Mine, near Cortez. Additional production for this year was reported from other mines near Battle

Mountain and Austin, Lander County, the Royston district, Nye County, and near Mina, Mineral County.

In 1942 the Smith Mine was again the principal producer, with an output of 13,-033 pounds valued at $32,000, while other areas yielded an additional $4,000.

In 1943 and 1944 there was apparently very little activity in the Nevada turquoise mining industry. In 1945 some turquoise was mined in the Tonopah and Battle Mountain district. The Pedro claim of the Copper Canyon Mining Company, near Battle Mountain is said to have produced 3601 pounds of rough. Complete figures are not available for this year.

In 1946 the Nevada Turquoise Company, at Mina, Mineral County, is reported to have produced turquoise valued at $20,000, and the Pedro claim near Battle Mountain nearly as much. From 1947 through 1950 turquoise production in Nevada appears to have dropped sharply. The available information indicates that only small amounts were produced during these years at the localities in the vicinity of Battle Mountain.

TURQUOISE SUBSTITUTES

A variety of turquoise substitutes have been and are being used, as well as various methods for treating inferior material to improve its color.

According to the State of Arizona Department of Mineral resources, a substitute for turquoise is being manufactured on a large scale by Phoenix Gems, Inc., of Phoenix, Arizona. In 1950 it is estimated that more than 9,000,000 carats of this substitute for turquoise was set by manufacturers of inexpensive jewelry. It is reported that the substitute has largely replaced the poorer grades of natural turquoise formerly used for this purpose, and that 75 per cent of the "turquoise" now set in western style simulated Indian jewelry is this material. The exact nature of this product is not known to the writer, although it is referred to in the report as synthetic turquoise.

REFERENCES

The data presented herein was obtained in part from unpublished reports on file at the United States Bureau of Mines, Washington, D.C., and in part from the following sources:

Pogue, Joseph E., *The Turquoise,* National Academy of Sciences, Vol. XII, Third Memoir, 1915.

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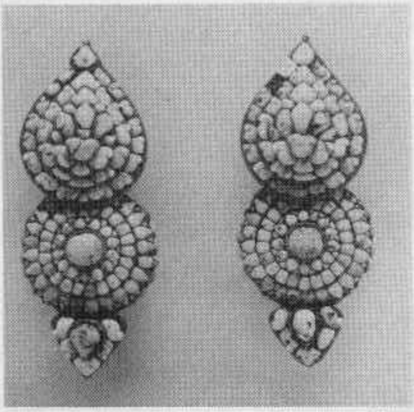
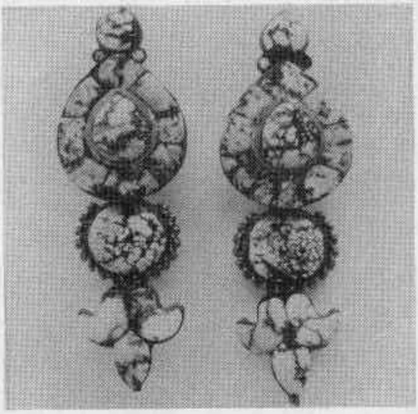
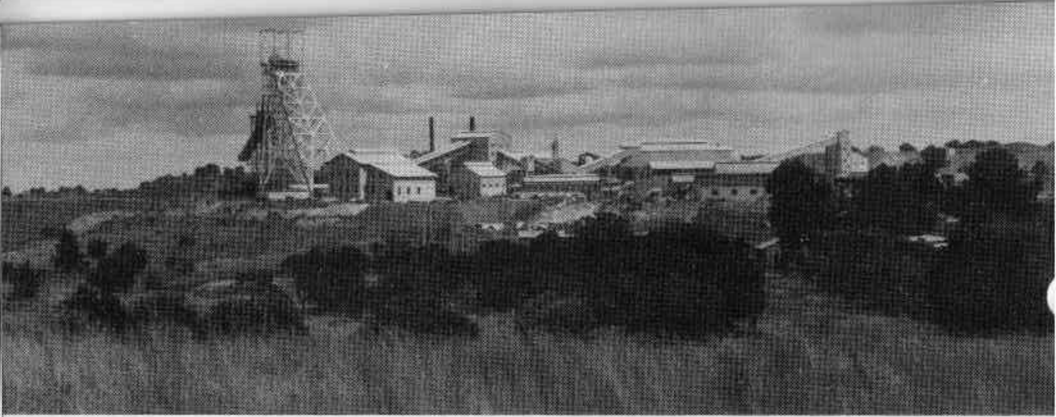
• Gold and turquoise earrings of the 17th and 18th centuries now in Metropolitan Museum of Art.







• **Panoramic view of the surface plant of the Premier Mine.**

Heavy-Media Separation Proved Effective

By

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The use of heavy media to replace jigs in diamond recovery from blue ground was first reported in *Gems and Gemology* in 1949. Investigation of this means of separation was started in 1945 with a laboratory unit. At that time the results were so favorable that a 100 ton per hour pilot plant was constructed. Its use proved so effective that old blue ground tailings were reworked and, according to information supplied by the American Cyanamid Company whose process is employed at the Premier Mine in South-West Africa, the recovery amounted to an average of 12.33 carats per 100 loads (80 tons).

Prior to the reopening of the Premier, a full scale plant with a capacity of 13,000 tons of blue ground per day was built and placed in operation in February 1950.

The heavy medium used is a suspension of ferrosilicon which is kept at an effective specific gravity of 2.87 at the top, while the bottom specific gravity is set at 2.97 to 3.05. The ferrosilicon has a specific gravity of about 7.0. When ground to the proper grain size, and mixed with water in the correct proportions, the heavy material suspension acts in a manner similar to a heavy liquid. Such suspensions are used widely in the metal mining industry.

Four cones which have a diameter of sixteen feet at the top are employed. About five per cent of the material fed into the cone is taken off as sink concentrates. The blue ground, which has a specific gravity of about 2.7, is floated off while diamond, zircon, garnet, and other heavy minerals sink through the heavy medium.

Material treated runs from less than one inch in diameter to plus ten mesh and constitutes approximately 80 per cent of the feed from the crushers. Recovery is claimed about 96 per cent as compared to 80 per cent for the old jig method. Recovery at

Premier Mine amounts to an average of 24.37 carats per 100 loads.

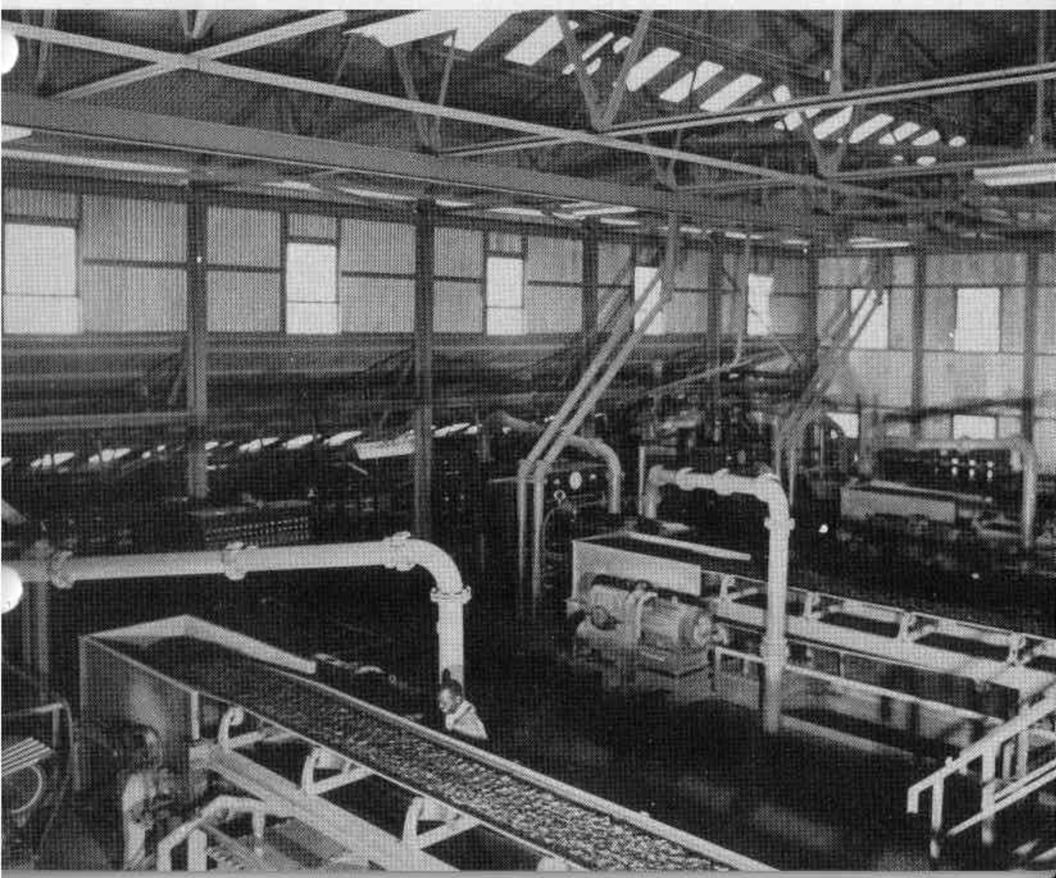
The material which floats off is screened on three eighths inch screens and materials of larger size are crushed to less than three eighths inch and returned to the original feed. The loss of media is reported to be from .25 to .75 pounds per load of new feed. Material that is less than ten mesh is still handled by the jig method.

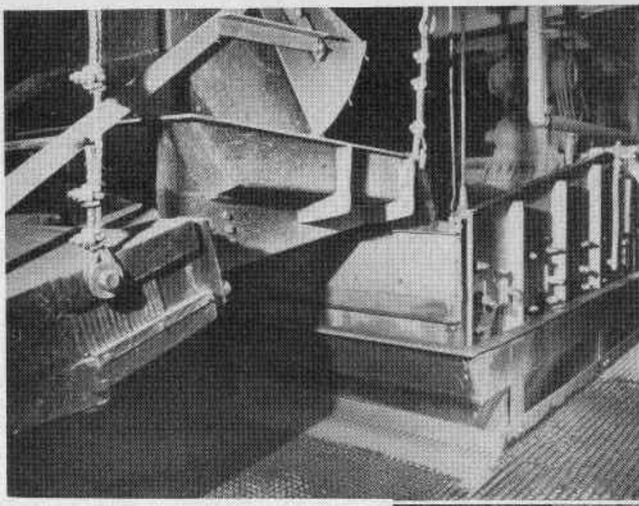
Perhaps the effectiveness of the Heavy-Media Sink method is attested to by the fact that it has been introduced recently by Williamson in his Tanganyika mines, as well as a unit installed by the Anglo-American Corporation of South Africa, Ltd. A small unit is also being operated by Consulting Engineers to De Beers Consolidated Mines, Ltd. The pilot plant originally used at the Premier has been moved to its alluvial mine at Orange Mouth in South-West Africa.

At the Premier recovery plant, the concentrates from heavy-media cones, and from the smaller material concentrated by jig, are placed in separate storage bins. Both concentrates are washed thoroughly to remove slime which otherwise would foul the grease tables.

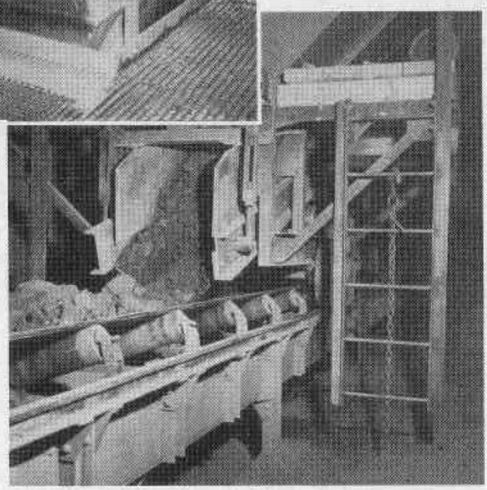
The concentrates from the Heavy-Media plant are graded into four sizes and are fed into separate grease tables with different slopes. The larger the size of the concentrate, the steeper the table. For example, material larger than three fourths inch in diameter is fed to tables with three decks, sloping at 25 degrees; materials from three fourths inch, to tables with a 20 degree slope, and smaller materials to tables with only a fifteen degree slope.

• Crushed blue ground is fed to the heavy-media cone by conveyor belt. In this picture three of the four belts used at the Premier plant are shown.





• **Crushed blue ground from a storage bin here being fed to a 16 x 5 ft. washing screen which separates blue ground into larger and smaller than ten mesh size.**

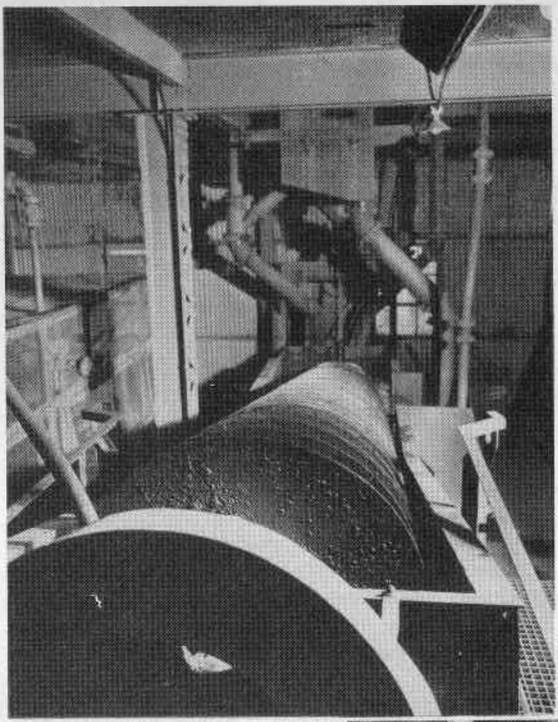


• **Blue ground from the 2,000 ton stockpile is fed onto one of the two main conveyor belts which transport it to the crushing plant.**

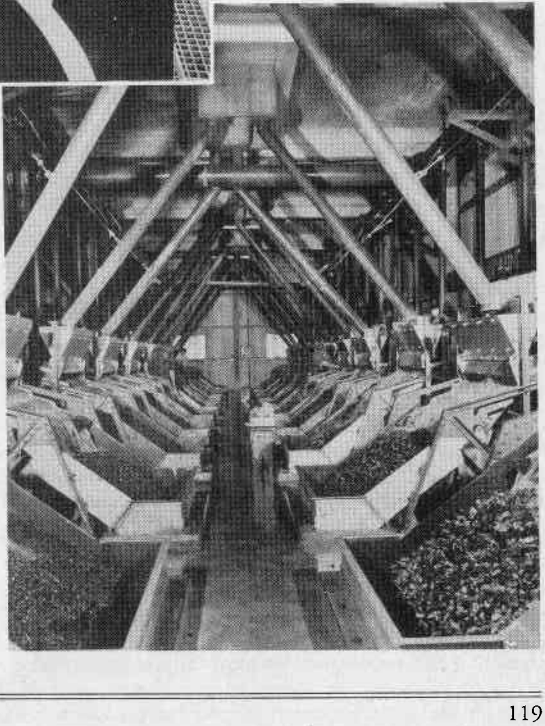
Material that comes out of the cone concentrates with a smaller than fourteen mesh size, and the jig concentrates, are fed to tables with a ten degree slope.

As in the past, the operations in the final stages of recovery are accomplished in the closely guarded confines of the sorting office. Once the diamonds are taken from the grease tables, remaining operations such as recovery from grease, cleaning, breaking off adhering blue ground in ball mills, and preliminary grading are conducted in the sorting office. Final grading, however, is done in the De Beers offices rather than at the recovery plant.

The heavy-media separation method seems to have proved itself in the short time that it has been in operation in Africa. In all probability it will, in the future, be extended to all pipe mines and to many of the alluvial mines as well.



• Part of the machinery used to recover media from concentrates and tailings. This unit charges the particles so they attract one another and concentrate at the bottom of a large water-filled vat.



• Slanting grease tables in which diamonds are caught at the Premier Mine. Slant of tables varies according to size of concentrates.

The Determination of Important Optical Properties Without Instruments

by

G. ROBERT CROWNINSHIELD *and* JOHN G. ELLISON

This article has been prompted by an observation which the senior author made several years ago. At that time he noticed that if he held a faceted transparent gemstone extremely close to the eye he could, by looking into the stone through the table, see numerous spectra caused by the dispersion of any image produced by a bright light. At first this was just an esthetic amusement, but later the authors discovered that by limiting the size of the light source they had stumbled upon a simple method of determining some optical properties, but one which promises to be of great value to a person with a good gemological background.

Toward this end several hundred gemstones of many species and varieties were observed and the following is a preliminary report of the results of these observations.

Primarily, this method of observation is of one looking through a faceted stone in a particular manner and analyzing the resultant spectra (or spectrum) of a dispersed image of a single sharp light source. It offers the advantage of being performed simply and without instruments.

By the proper application of the tests described below, it is possible in most stones to determine 1) Single or double refraction, 2) Comparative birefringence if present, 3) Comparative strength of dispersion, 4) Quality of polish, and in addition some stones will reveal unique spectral absorption, while others may show dichroism. The most important application however, is the test for single or double refraction.

The primary requirement for this type of analysis is a clean, flat faceted stone. It need not be unmounted as long as light can enter the pavilion freely. Curved surfaces will normally eliminate the possibility of using the test. The stone selected for testing should have good transparency, though depth of color does not eliminate the test.

The next requirement is the light source. It should be strong, well defined, and not too large. The light from a pocket flashlight is ideal, though in a pinch the light of a match or cigarette lighter will do nicely. In the accompanying photo an alexandrite is being tested using a one half inch opening in a 30 watt pearl candler. A candle will do if the observer will work at least six feet of more from it. In the field, a bright well defined reflection of the sun, from a tiny mirror or similar highly polished surface, or the sun itself will be satisfactory. For very critical laboratory work, the authors suggest a rectangular narrow aperture the edges of which are smooth and well defined. The room or area in which the testing is done should be free from bright reflections or light sources other than the one chosen, the shape of which is known.

Once these simple requirements have been established, the gem or piece of jewelry should be held in the fingers with the pavilion of the stone to be tested pointed at a 45 to 65 degree angle to the source of light, depending upon proportion. (See photograph.) The stone must be held as close to the cornea of the eye as possible, hence tweezers should not be used due to the possibility of the stone flying into the eye. In all cases, manipulation of the stone is best performed by use of the fingers, and the authors have tested stones as small as two millimeters in diameter with equally good results.

With the stone in this relationship to the light source, the observer should note any spectral images and be sure that they are the dispersed image of the known light source. He should disregard direct undispersed reflections. Ideal observations will be made by looking into the table at that part of the pavilion farthest from the source of light. (See diagram.) As in all cases of testing for single or double refraction, the line of observation must not be limited to a single direction. Therefore, it may be found that at times the observer will not find his best direction through the table, but will find that it is a direction through the girdle or in some cases, he may find it expedient to look through the pavilion, in which case it will be pointed at a 60 to 90 degree angle to the light.

Unless twin dispersed images of the light source are seen immediately (the proof of double refraction), it will be necessary to turn the stone, observing a single spectrum, until—if the stone is doubly refractive—the single spectrum separates into a twinned spectrum.

A twinned spectrum, in this case, is taken to mean a pair of spectra, one of which is slightly further from the light source than the other. One must discount other pairs of spectra that do not fit this definition. (See diagram.)

In stones of high birefringence the twinned spectra will be separate and distinct, while those of low birefringence will show twinned spectra which overlap to a certain extent. In the latter case, the violet of the leading spectrum will often combine with the red of the following spectrum making the leading color of the following spectrum a violetish red and might mislead one into thinking that he did not see a true twinned spectrum. If, after observing the stone in all directions, no spectrum is seen to twin, one must not conclude that the stone is isotropic, for absence of twined spectra is not proof that the stone is singly refractive. For this reason the test is comparable with the dichroscope test. However, due to the additional factors one may determine with this type of observation, it is not as limited as the test for dichroism.

After observation of the twin spectra, the stone should be carefully revolved to detect the direction of greatest birefringence By this means the strength of double refraction can be estimated. The authors have found it useful to use a quartz gem of similar size as a comparison. It will be seen that tourmaline will show about twice the distance between the twin spectra as quartz of a comparative size, while zircon will be roughly four times that of quartz. Rarely will gemstones with birefringence lower than that of quartz (.009) show a twinned spectrum which completely separates, overlapping being greater the lower the birefringence. For this reason, stones of low birefringence will give some difficulty. However, with not too much trouble and with experience, the double refraction of apatite can be estimated (.004).

With experience in testing numerous stones of many species and varieties, the strength of dispersion can be reasonably estimated by observing the relative width of the spectrum edges of the dispersed image. Some easily confused gemstones have characteristic strength of dispersion which can be used in some instances to separate them without the use of instruments. For instance, even if twin spectra are not seen in a purple stone which could be amethyst or glass, the dispersion of glass is usually so much greater than amethyst that this observation alone will normally separate them.

While observing the stone for the three factors already discussed, it is a simple matter to come to a decision as to whether the stone is well polished or not. If the dispersed image of the light source is sharp and well defined the stone is well polished. In a poorly polished stone these images are distorted and irregular. Stones that are molded or paper worn will give similar effects to those of poorly polished stone, and occasionally no decisions may be reached. Of course, the stone must be clean for all these observations.

Several stones that were observed have distinctly unique spectra. One such is the red glass which imitates garnet. In this case the green is almost completely absorbed. Garnet, on the other hand, has a clear-cut spectrum no matter how deep the color of the stone provided. Fine alexandrite will, in artificial light, show a unique spectrum in that the red is very strong and the blue-green is almost completely halved by a broad absorption band. In daylight, the red of the spectrum is very weak while the blue-green is strong, and the absorption band is weak. Other characteristic spectra and their use in identification will be discussed below as the various stones are mentioned.

Although this article is based upon a test for which no instruments need be used, if a check on whether a spectrum is really doubled or not is desired, a polaroid plate rotated between the stone and the light will quickly allow a decision to be made

• Proper position to hold stone in relation to light source is here demonstrated by G. Robert Crowningshield.

by revealing each image alternately. During this rotation of the polaroid plate it is also quite easy to notice dichroism if it is at all prominent. This latter test makes more readily visible any dichroism in a small stone than if the stone is rotated over a polaroid plate in the normal manner.

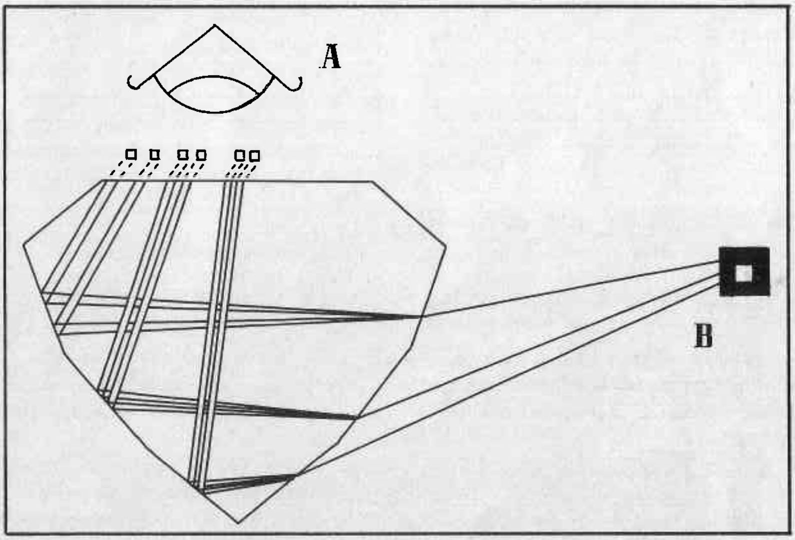
Below, we have noted several species or varieties and some of the characteristic results of testing by internal spectral analysis. We have not noted all species tested as some do not give results other than those expected.

is possible for an observer to attempt to analyze one of the twins, failing to note that the spectra are already twinned.

Benitoite with its strong birefringence and dispersion can be separated immediately from sapphire which it resembles.

Beryl, with its birefringence of .006 and dispersion of .014 is not among the stones easiest to test. However, except with a badly flawed emerald, all tests were satisfactory. The dispersion, as expected, is weak and the overlapping mentioned is almost always present.

• Illustration shows relative position of eye to stone when observing doubled and/or dispersed images. A. Eye of observer. B. Light source.



In andalusite, one of the twinned spectra is much stronger than the other depending upon the direction in which it is observed.

Apatite will show clear twinning in spite of its low birefringence. Also, the dispersion is quite evident though a figure for its dispersion is not available.

Transparent faceted aragonite and calcite show amazingly spread twinned spectra as one would expect. Because of this it

Chrysoberyl, like other stones of weak birefringence, other than the alexandrite variety mentioned, is somewhat difficult to test in this manner unless the polaroid plate is used. However, with experience the twinning of the spectra will be seen.

Synthetic and natural corundum may give some difficulty because of the weak spectra produced, and the fact that truly well polished stones are seldom encountered.

In ruby, the green is nearly absent and the overlapping of the violet end of the leading spectrum combined with the "absorption" of the green may be confusing. However, the spectrum is so much different from any stones likely to be confused with ruby that even if twinned spectra aren't seen, experience will enable one to identify a stone as red corundum, though unfortunately not as to natural or synthetic origin.

Diamond and other highly refractive stones are difficult to test as it is not easy to maneuver the stone into position where light will enter the pavilion. When a spectrum has once been located, however, the results are as one would expect.

A doublet of diamond crown and synthetic sapphire back was examined and gave results consistent with the sapphire back.

A doublet of two parts quartz gave inaccurate and distorted results because the two portions were not "matched" in optic direction.

Although fluorite has about the lowest dispersion of any gem material, a spectrum will be seen by this method, though as one would expect it is very weak and thus distinctive.

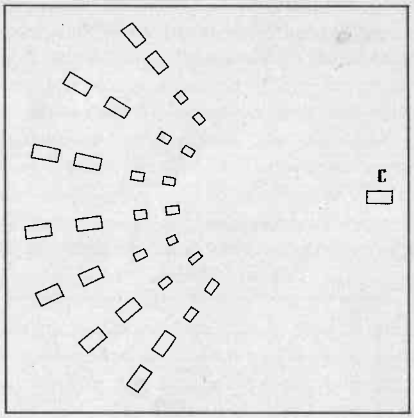
All transparent garnets will give excellent results even though of dark color. As expected, the spectra of demantoid are very pronounced.

The test is quite helpful for peridot because of the weak dichroism of this species. The separation of the dispersed images are pronounced, and the spectra are wide.

Quartz seems to give consistently reliable results in spite of the rather low optical properties for which we test.

Both natural rutile and the synthetic are excellent for testing because of the high dispersion and the high birefringence. A very dark red natural rutile showed only the red and orange components of the spectrum and because of the very wide separation of the dispersed images care had to be used to note that they were in truth twinned.

Some of the low type zircon examined showed practically no twinning of the dispersed images although the spectra were rather strong.



• Typical example of appearance of twinned spectra in a brilliant cut zircon. C. Distant light source.

High and intermediate zircon are excellent stones to test as the dispersed images are widely separated and show strong dispersion. The birefringence is almost always noticeable upon first examination.

Transparent dark brown idocrase tested gave results consistent with its optical properties.

Fine iolite gave results as expected, though the double refraction could be detected by the obvious dichroism to the unaided eye.

Two specimens of kornerupine, a light blue-green and a dark brown Ceylon gem, show excellent results consistent with the properties of the material.

Danburite gave results as expected in view of its weak birefringence and dispersion.

It is hoped that the information given will prompt others to investigate this method of observing gemstones, and that perhaps other uses for the method will be reported.

Australian Sapphire Fields Not Fully Exploited

by

V. STRATTON[1]

Australia's sapphire fields in Central Queensland embrace a 1200 square mile area of only partially exploited mineral wealth. They are situated in the Anakie district about 192 miles west of Rockhampton. At present only primitive mining methods are used on the fields, however, an increasing demand in the United States for Australian sapphires may stimulate greater activity and usher in an era calling for the application of modern mining techniques.

The center of this little publicized, but perhaps fabulously rich, sapphire-bearing district is Rubyvale, a "one horse" mining village comprising an old weatherboard hotel, two stores, one house, and a collection of nondescript shanties.

Rubyvale is not yet conscious of the place in the sun that it is destined to occupy. As you approach the village a painted flatiron sign, nailed to the trunk of an ironbark tree, attracts your attention. The sign reads, "Rubyvale Slow Down or You'll Pass." That is Rubyvale—unpretentious, easy going, and as unchangeable as the centuries-old river gravels from which its beautiful sapphires are unearthed.

But a new order is coming to Rubyvale whether Rubyvale wants it or not. This is

1. Prepared and furnished by Australian News and Information Bureau.

• **Miners dig for sapphires in distance.**

• **Washing sapphire dirt in a 100 gallon tank of water with a spring sieve.**

easy to realize when you consider that five Rubyvale sapphires, including the "Black Star of Queensland," have been collected by James and Harry Kazanjian, Los Angeles gem dealers, and have given considerable publicity to the district.

Although gemstones of great value have been found in this area, the fields—because of various factors—are being worked more or less spasmodically by a handful of miners, mostly aged men, and it is impossible to assess the field's potential.

Sapphires are found on the Anakie field on the surface of the ground to a depth of 50 feet. Individual miners sink shafts in likely spots and when they make a strike as often as not they "knock off," sell their sapphires, and "take it easy" while the money lasts. Then it is a case of sinking another shaft and gouging out some more spending money.

The golden sapphires recovered at Anakie have been described as the best in the world. The green sapphires are also of very high quality but the blues, the most popular type in the world's markets, are rather too dark generally for the connoisseur who favors the lighter-hued blue stones from India and Siam.

U.S. buyers are prepared to take all the green stones offered but are not so interested in the dark-hued blues unless they have some outstanding characteristic. Australian gem experts believe, however, that the Queensland golden sapphires will ultimately hold pride of place in the world market for sapphires. Two golden sapphires mined in the Anakie district this year are valued at 1,500 Australian pounds[2] each.

One of the most romantic stories on the field concerns the sale in the United States of the "Black Star of Queensland." This

2. Current value of Australian pound is $2.235.

• **View of miner on Rubyvale sapphire fields.**

• **Home of a miner on the sapphire fields. Early in the century this man was a big buyer for the German market. Today, at 76, he still digs for sapphires.**

sapphire had been used as a doorstop by an Anakie gem buyer before he decided to have it cut and offered for sale.[3].

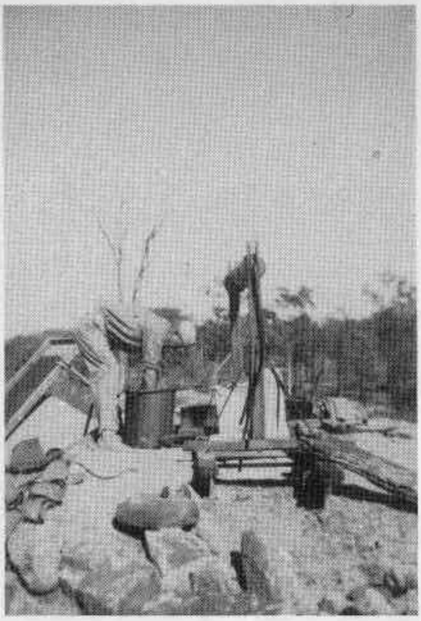
In spite of occasional outstanding sales, miners claim they receive little encouragement for their efforts. Because of the low return to the miner, the fields are not fully worked by the handful of men who are permanently domiciled in the area. At any one time there are never more than 50 men mining sapphires in the district.

There are many "hard case" old miners on the field with a naive, carefree philosophy. There is mystery man Michael Stonebridge, 65, who mines sapphires but never sells a stone. Michael has a sapphire which he values at a "quarter of a million." Experts say the stone, of rare size and quality, may be worth anything from 2,500 to 5,000 pounds.

On the other hand, there is a progressive young miner Clifford Donovan, an ex-service man who has a wife and two young children, and who has been on the field only two

3. This sapphire weighed 1156 carats in the rough.

• **Mining on the Reward claim where many star stones have been recovered.**



• **The mine here being worked is 35 feet under ground.**

years. Last year Donovan uncovered a flawless yellow sapphire weighing 21 dwts (163 carats) and valued at about 1,500 pounds.

One of the pioneers of the field, James Lidstone, who mined his first sapphire at Rubyvale in 1891, is now more interested in his vegetable garden than in his hoard of sapphires. He mined one of the great stones that excited American interest, but failed to recognize its value and sold it for a song.

The main gem buyer living on the fields, Harvey Spencer, pays miners a pound for a jam tin (can) full of rough stones. He has four and one half tons of these stones (value not known) in his tumbledown back yard shed.

And such is sapphire mining at Rubyvale.

Production on the fields is virtually at a standstill just now, (August 1951) because most of the regular miners have gone to other well-paid jobs such as sleeper cutting, and kangaroo shooting.

Arthur Wirth, Sydney jeweler who is also New South Wales president of the Gemmological Association of Australia, believes that in the not too distant future American interests will exploit the Anakie fields, using bulldozers and open cut mining to uncover the great wealth believed lying in the gravels of the old river system. "America has no sapphires apart from some low grade stones produced in Montana," he says.

"The Americans rely chiefly on Siam for their supplies but the political setup in that country is so uncertain that no one can depend on that source of supply. Australia beckons as the world's greatest supplier of sapphires."

• **Mother of this young miner watches her son sieve sapphire dirt for the precious stones.**

The Diamond Industry in 1950[1]

by

W. F FOSHAG, Ph D. and GEORGE SWITZER, C. G., Ph. D.
(Condensed by Kay Swindler, G.I.A. Public Relations Director)

Demand for both industrial and gem quality diamonds increased in 1950, especially during the last half of the year, breaking all records for diamond sales. Production increases shown for the year were credited largely to the reopening of the Premier Mine and added recovery of diamonds in the Belgian Congo. Production increases were also affected by the installation of Heavy-Media and electrostatic recovery equipment which increased efficiency and reduced loss in recovery. Some progress was also shown in the cutting industry and unemployment in the centers of the world was considerably alleviated due to the heavy demand for gem diamonds.

PRODUCTION

As in previous years, the Belgian Congo was far in advance of any other diamond-bearing country in production, with its heavy output of industrial stones. A steady increase in production has been shown yearly from this country with 1950 figures showing 66.5 per cent of all diamonds mined coming from the Congo. This is almost double the production of 1947. However, since only 5.5 per cent of diamonds mined in the Congo are of gem quality, production according to value was second to South Africa. Improvements by the producers in the Congo were made during the year and installation of new equipment and a hydroelectric plant was started. During 1950, 94.5 per cent of the 10,147,471 carats recovered were industrial which showed a slight increase of gem diamonds produced. The country continues to supply approximately 75 per cent of the world's crushing bort.

Second largest producer in 1950 was the Union of South Africa which produced a total of 1,747,868 carats from pipe mines and alluvial diggings. This is an increase of almost 500,000 carats over the previous year. Only two mines outside of the De Beers groups produced any diamonds of consequence and production from these two totaled only 12,660 carats. Largest single producer was the reopened Premier where 690,331 carats were recovered in 1950.

Total production, according to percentages, was divided as follows.

Belgian Congo	66.5
Union of South Africa	11.5
Gold Coast	6.2
Sierra Leone	4.3
Angola	3.5
British S.W. Africa	3.2

1. Published serially in *Jewelers-Circular-Keystone.*

Brazil	1.3
Tanganyika	1.3
French Equitorial Africa	0.7
Venezuela	0.4
British Guiana	0.2

Small amounts were also produced by India, Borneo, Australia, and Rhodesia.

Although Tanganyika's production was not far in excess of the previous year, its 195,274 carats in 1950 was more than twice the production of 1947. All of the Tanganyika mines are now owned by Williamson or Alamasi, Ltd.

Thirty-four per cent of the 655,474 carats recovered in Sierra Leone were gem quality diamonds, while French West Africa produced only seven per cent of gem quality. Production of the African Gold Coast alluvial fields showed a total of 15 per cent gem quality stones. Diamonds from this district are small however, the largest ever found weighing four and one half carats. Although production in Angola was considerably reduced during 1950, the proportion of gem stones increased slightly from 56 per cent to 57 per cent. Diamonds are produced in almost every state in Brazil but figures available are not considered reliable and the total of 200,000 carats reported is believed to be far less than actual carats produced. There was no activity during 1950 at the Arkansas deposits in the United States but one 3.93 carat stone was found in Miami County, Indiana. Considerable publicity was given to diamonds reportedly found in Vassan Township of Quebec but there has been no substantiation of this claim. There was small activity in India with a diamondiferous plug discovered near Panna.

Total production of De Beers Consolidated Mines, Ltd. amounted to 846,096 carats which is a decrease of 74,500 carats over the previous year, most of which is attributed to a decrease from the Kleinzee fields. Wesselton, Dutoitspan, and Jagersfontein Mines were in full production on a single shift basis throughout 1950 while development work only was carried out at Bultfontein. Systematic sampling of old tailings was also started and proved profitable. The Premier main plant went into production in February 1950 and 669,232 carats had been recovered by the end of the year. During the first two months an additional 21,098 carats were recovered in the pilot plant which was closed when the mine went into complete production.

Not only was an increase shown in the production of the Consolidated Diamond Mines of South-West Africa, Ltd., a subsidiary of De Beers, but average size per stone increased from 1.07 carats to 1.26 carats in 1950.

CUTTING

Due to the increased demand for gem diamonds during 1950, cutting centers were busier than in previous years. Efforts were made to correct a disparity in working conditions and hours, with some progress reported. During 1950 working weeks of the principal cutting countries were as follows: United States 38, Netherlands 40, Israel 47, and Germany 53.

In the United States, during 1950, 300 diamond cutting establishments were in operation. In Puerto Rica about 200 cutters were employed during the first half of the year and approximately 300 during the last six months. However, lack of suitable rough kept many cutters working only on a part time basis.

The beginning of 1950 saw a satisfactory recovery being made in the cutting industry in Belgium. This country has about 1,400 cutting factories and by the end of 1950 about 11,800 of the 15,000 to 16,000 cutters in the country were employed. It is believed that others numbered among the unemployed may have been doing some cutting in their own homes.

Unemployment in the Netherlands fell in 1950 although there were still only about 1,500 cutters employed as compared to the 6,000 who had been working prior to World War II. Loss of prominence of the cutting industry of Amsterdam to Belgium is attributed to higher wages paid and stricter government controls. There are between 60 to 70 factories active in Amsterdam. At Asscher's as small as 30 stones to the carat are cut in full brilliant, and as many as 40 per carat with 18 facets. Square and fancy cut stones are cut as small as 10 per carat.

Israel showed an increase in exports during 1950 but the 1,600 cutters employed are still far below the average of 4,000 to 5,000 working immediately following World War II. About 80 per cent of the rough diamonds allocated to Israel by the Diamond Trading Company is melee and the balance chips.

Since 1940, when diamond cutting was introduced in England, at the time refugee cutters from Amsterdam and Antwerp came to that country, the industry has been steadily expanding and 1950 saw approximately 700 men employed in and around London. Only larger sizes—ranging from one carat rough upwards—are cut in this country.

1950 was a reasonably good year for the cutting industry in South Africa although there was lack of rough material. During the year wages and the 40 hour week were standardized and 1,057 workers were employed by 57 factories.

In spite of efforts by Belgium and the Netherlands to boycott Germany, rough stones were still sent to Germany in 1950. This country continues to be the second largest cutting center of the world with about 6,000 cutters employed in 1950. Long hours and low wages are the rule in Germany's cutting factories and only small single cut stones are manufactured.

In India the industry has not been organized to any extent and the major portion of cutting done is recutting old stones, or cutting stones recovered in Panna or Hyberabad. 300 cutters are active. There is also a small amount of cutting done in British Guiana and Venezuela, but there too only local stones are cut.

INDUSTRIAL DIAMONDS

Although there was an increase of approximately 15 per cent in the production of industrial diamonds during 1950, the supply was still short of demand due to increased requirements of manufacturers engaged in defense work. This resulted also in a sharp rise in prices. Of the approximately 12,500,000 carats of industrial diamonds produced in 1950, 10,967,005 carats were imported by the United States.

IMPORTS BY U.S.

Imports of gem quality diamonds in the United States during 1950 were the highest of any year since 1946 and about 147 per cent of those in 1949. Total imports of rough diamonds was 819,083 carats with an additional 60 per cent of that amount imported in cut, but unmounted stones.

DIAMONDS IN FASHION

Little basic change was seen in fashions for diamond jewelry during 1950. The necklace was the most popular single item sold, while diamond wrist watches increased in popularity. More fancy cut diamonds were used in 1950 than since the twenties but the bulk sold were mounted with the standard brilliant, the emerald cut, and occasionally the marquise or baguette.

RETAIL BUSINESS

Diamonds were reported in adequate quantity throughout 1950 but fine quality and large sizes were in comparatively short supply. Due to the belief that there would be some relaxation of the excise tax law, diamond sales were low during the first half of 1950. With the advent of the Korean hostilities, all hope for reduction of this tax faded and sales picked up appreciably. The year ended with an overall increase, a part of which was no doubt due to a corresponding increase in the marriage rate after the outbreak of the Korean War.

Based upon the canvas of a large number of jewelers by an independent and reputable

(continued to page 134)

Thirty-Five Diplomas Awarded by the Gemological Institute of America

Diplomas issued by the Gemological Institute of America since the last *Gems and Gemology* was published number eight in the Theory and Practice of Gemology, and twenty-seven in the Theory of Gemology only.

Those who have completed all correspondence courses, as well as both resident courses of the Institute, and passed all necessary examinations which follow-entitling them to the diploma in Theory and practice are:

Frank Pace Hawk, Midland, Texas.

Robert A. Kotlen, Providence, Rhode Island.

A. W. Luciano, Amsterdam, New York

Charles E. Manz, Irvington, New Jersey.

Charles J. Parsons, El Cajon, Calif.

Fred J. Schoebel, Cleveland Heights, Ohio.

George Sekiya, Chicago, Illinois.

David Sunray, Port Chester, New York.

Those who have successfully completed the theory of gemology as presented in the correspondence courses of the Institute and been awarded their theory diplomas are:

Paul C. Alberts, Union, New Jersey.

Percy L. Anderson, Grand Forks, North Dakota.

Carl W. Appel, Allentown, Penn.

Clarence M. Bradbury, Jr., Brooklyn, New York.

John Donald, Tampa, Florida.

Robert R. Donaldson, Topeka, Kan.

Wesley R. Door, Kennewick, Washington.

Roy F. Dudenhoeffer, Greenville, Cincinnati, Ohio.

Vinton O. Edwards, North Hollywood, California.

Delbert A. Eisele, Lawrence, Kansas.

Max Wm. Gersiek, Elmont, Long Island, New York.

David Goldstein, Mattapan, Massachusetts.

Joseph Peter Held, Queens Village, New York.

Robert W. Johnson, Bakersfield, California.

Frank T. Krisky, New York, New York.

Milton Lyons, Washington, D. C.

Lawrence G. Neima, Fargo, North Dakota.

Galen Ogilvie, Pond Creek, Oklahoma

Monroe Wilment Orenduff, Sherman, Texas.

Richard R. Raihle, USS Cascade, New York, New York.

Robert V. Ramsey, Belmont, North Carolina.

Allan Robbins, Bayside, Long Island, New York.

Richard S. Searles, Newport, Vermont.

Arthur W. Versteeg, Portland, Oregon

Everett Wakeman, Jr., Hollywood, California.

W. Cameron Webb, Unionville, Ontario, Canada.

Wilbur C. Willis, Springfield, Mo.

Gemological Digests

AGREEMENT EXPIRES BETWEEN WILLIAMSON AND DIAMOND TRADING CORPORATION

Of extreme interest to the diamond trade is the expiration on December 31, 1951 of the agreement between Dr. J T. Williamson and the Diamond Trading Corporation, Ltd., which has not been renewed.

Because of the fine quality of the diamonds recovered in Tanganyika, it is one of the most important diamond fields of the world—especially to the jewelry industry. Figures for 1948 and 1949 indicate that 40 per cent of stones exported were of gem quality.

Although only 1.3 per cent of the world's output of diamonds for 1950 came from Tanganyika, all production was from alluvial deposits and its future potential is tremendous when, and if, underground mining is introduced.

The recently expired contract was signed by Williamson in 1948 and guaranteed exclusive sales to the Diamond Trading Corporation, Ltd., during the life of the agreement. In turn, one tenth of the world's total diamond sales were guaranteed to Tanganyika producers which now include only Williamson and Alamasi, Ltd., the J. H. Stanley White estate having been purchased by Williamson in June 1948.

Agreements between independent producers, Diamond Producers Association and the Diamond Trading Corporation assure the diamond property owner a market and at the same time regulate the release of diamonds, thereby preventing sales at fantastically high prices during a scarcity, or dumping at equally low prices when the supply is exceptionally large. The Corporation is owned by De Beers, the Consolidated Mines of S-W Africa, and one of its subsidiaries.

Approximately 95 per cent of the world's rough diamonds are marketed by the Diamond Trading Company and Industrial Diamonds, Ltd., for the Diamond Corporation. Diamond producers who have not signed with the syndicate include the mines of French West Africa, Brazil, Venezuela, and British Guiana. The companies or individuals operating in these territories assume their own marketing arrangements.

The first diamond was found in Tanganyika about 1910, and production began in 1926. In 1940, after several years of searching for diamonds in the area, Williamson was without funds, but in 1941 after years of perseverance and discouragements—he found an incredible diamond pipe at Mwadui by careful prospecting over 500 square miles of arid Shinyanga plain.

Operating with limited equipment and without adequate protection from thievery, he nevertheless increased production annually with 1949 increase in value of exports more than one half million pounds above that of the previous year. 1950 production in Tanganyika was 195,274 carats.

Kay Swindler, G.I.A.

FIRST EXAMINATIONS IN SCIENCE OF GEMOLOGY GIVEN IN SOUTH AFRICA

Although results of the first gemology examinations given in Johannesburg, South Africa were rather disappointing to the instructor, the introduction of such a course is encouraging to the future of the industry and to be highly commended.

During the year weekly lectures were given by Stanley Belcher, F.G.A., who, as a gem enthusiast, had been interested in the welfare of youths entering the manufacturing jewelry industry for some time past.

Of the 17 who attended the weekly lectures, only seven appeared for the examinations, two of whom passed satisfactorily. Although disappointed in the results of his first efforts, Belcher (in an interview with a *Diamond News* representative) commented, "I wonder just how many of the employers themselves would come through such an examination with a hundred per cent pass." Three hours were allowed for completing the examination which follows:

1. Give crystal system, hardness, specific gravity, refractive index, normal country of occurrence of the following stones: (a) Diamond, (b) Topaz, (c) Aquamarine, (d) Sapphire, (e) Citrine, (f) Emerald. State roughly any other interesting features of each stone. (20 marks)

2. (a) Describe prominent differences between a natural gemstone, a synthetic gemstone, and a paste (8 marks). (b) You are given three red stones, of the same color, cut, and weight. You are told one is a natural, one a paste, and one a synthetic. Describe how you would sort them out (8 marks).

3. Write on a page or two all you know about pearls, their imitations, and methods of identification (16 marks).

4. (a) Describe a refractometer (6 marks). (b) State how you use it (5 marks). (c) Describe another method of ascertaining a refractive index (5 marks).

5. (a) Describe step by step how you would obtain the S.G. of a gemstone, of say 20 carat size, by the hydrostatic method. (b) Describe how you would obtain the same result, by another method (16 marks).

6. State the name and details of all types of "cut" of gemstones known to you. Describe any two "cuts" (16 marks).

DIAMOND PRODUCTION REPORTED NEGLIGIBLE IN AUSTRALIA

Australian production of diamonds to the end of 1949, according to the *Diamond News,* totaled 206,956. Diamonds were first discovered in Australia in 1867 and the most productive decade was from 1896 to 1905 when the average yearly yield was 15,369 carats. Between 1928 and 1937 the annual average had fallen to 281 carats, and in 1949 only five carats were found.

DIAMOND INDUSTRY

(continued from page 131)

survey organization, average prices for one quarter and one carat stones were somewhat lower than in December 1949. Other sizes were about the same as the previous year. Jewelers contacted in this survey were located in 65 cities and were broken up into 57 per cent cash establishments, 38 per cent credit stores, and five per cent department stores. According to the findings of this survey, diamond jewelry represented about one quarter of the total jewelry sales of the typical jeweler in 1950. Sixty-one per cent of 109 jewelers questioned said that engagement rings made up at least one half of their diamond sales. Stone sizes in rings tended to be a more important consideration than quality to the customer purchasing rings selling for less than $400. For higher priced rings, the quality was most important to the buyer. The most popular price for diamond engagement rings sold in 1950 was $167 exclusive of tax. About 25 per cent of wedding rings sold were set with diamonds and the popular price for these was $79 exclusive of tax.

Book Reviews

Colorado Gem Trails by Richard M. Pearl. Published by Sage Books, Inc., Golden 4, Colorado. Price $2.50. Reviewed by Richard T. Liddicoat, Jr.

Richard M. Pearl, C.G., second man to complete successfully the courses offered by the Gemological Institute, author of *Popular Gemology, Mineral Collectors Handbook,* and co-author of *The Art of Gem Cutting,* is now an assistant professor of geology at Colorado College. His latest book relating to gem materials has just been published by Sage Books, Inc., and is entitled *Colorado Gem Trails.*

In his preface the author states that in the past fifteen years he has received more than one thousand letters inquiring about gem localities in Colorado and that this book was written to provide for collectors a detailed guide to the important occurrences in Colorado.

In 125 pages, Mr. Pearl has described localities and the nature of specimens to be obtained in what seems to be entirely adequate detail, together with sketch maps directing the collector to the important localities. There are mileage logs which would seem to be just what the collector needs.

One of the troubles facing collectors is that many gem mineral localities are given in reference notes only by county. Since counties in western states are often very large, it is difficult indeed to pinpoint the locality and to learn how best to reach it.

It is our opinion that such a book would prove valuable for collectors in Colorado and that similar books for each of the western states would be welcomed by gem and mineral collectors.

The author is to be congratulated on producing such a handy guide for the growing number of gem and mineral collectors.

Handbook of Gem Identification by Richard T. Liddicoat should need no introduction to readers of *Gems and Gemology.* With the publication of the first edition in 1947 gemologists and mineralogists were provided with a really usuable manual for the identification of cut gemstones and their substitutes. It should by now be a standard part of the library of anyone concerned with gem identification.

The new Third Edition is considerably enlarged. A section of more than forty pages in which all the important gemstones and most of the minor ones are quite adequately described has been added. The chapter dealing with synthetic gem materials has been revised and expanded to present newest techniques for their recognition.

The present edition, like its predecessors, is printed on a good grade of paper. This is especially significant in the excellent reproduction of some 117 illustrations, nearly half of which are photomicrographs showing characteristic inclusions and structures which aid in identification.

The slight advance in price over that of the original edition ($4.50) is indeed remarkable in the light of the present inflation.

Lynn Gardiner

First published by Sylvan Press, London, in 1951, *Your Jewellery* by J. Leslie Auld is now available to American readers from Chas. A. Bennett Co., Inc., publishers, 237 North Monroe Street, Peoria, Illinois.

The book describes methods of fashioning jewelry as learned by the author both through experience and from personal study of methods used in widely separated countries of the world. Table and formulae, bibliography, list of suppliers, an index, and 138 diagrams are included in the book.