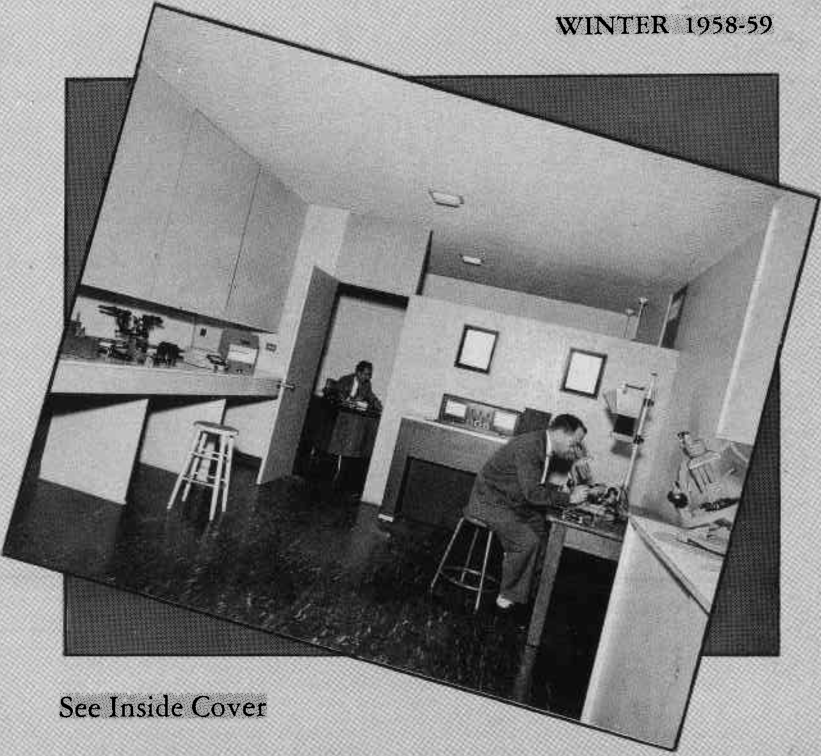
Gems and Gemology

WINTER 1958-59



See Inside Cover

Gems & Gemology

VOLUME IX WINTER 1958-59 NUMBER 8

IN THIS ISSUE

On the Cover

A section of the Los Angeles Laboratory. A few of the many instruments used in the identification and grading of diamonds and colored stones are shown.

GIA PHOTO

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Highlights at the GEM TRADE LAB in New York

by

G. Robert Crowningshield

One of the most unusual diamonds we have ever encountered was a greenish-brown stone in an all-diamond piece consisting of a dozen colored diamonds. The stone contained black needles oriented in three directions. Unfortunately, since the piece belonged to a client of the dealer who submitted it, we did not have sufficient time to remove it from the setting for study and photographs.

* * *

An "avant-garde" gold pin set with 24 yellow stones was in for identification. Most of the stones were golden Ceylon zircons, but one was a yellow-brown sinhalite and one was a yellow kornerupine, very similar in color to one that we received as a gift from student Earl Williams, Baltimore.

* * *

Recently, a parcel of 63 waterworn pebbles was submitted for identification. All but one, a blue topaz, could be identified by a combination of observation plus the use of the spectroscope. The stones consisted of zircon, chrysoberyl, topaz, spinel, garnet, brown tourmaline, blue and purple sapphires and sinhalite.

* * *

The damage that can be done by a jeweler who gives an "off-the-cuff" sight identification was well illustrated when a woman submitted a jadeite necklace for identification. A jeweler with whom she no longer plans to deal saw the necklace, a gift from her husband, and pronounced the stones imitation and of no value. In another instance a jeweler pronounced as natural two mounted star sapphires. On the basis of this opinion, the owner was advised to journey to the United States to sell them. At considerable expense he did so, only to find the stones refused by knowledgeable jewelers, who discovered them to be synthetic.

* * *

In the past few months we have identified more than a dozen mounted, loose and rough sinhalites, the largest of which was estimated to weigh more than 30 carats and which was part of a large insect pin set with a matching yellow zircon.

* * *

We have been critical of insurance-company operations before in this column and will probably continue to be. In the estate of a wealthy woman were two necklaces of similar appearance; however, each consisted of a different number of pearls and the center pearls were of different sizes. Nevertheless, from the policy it was impossible to determine which was the natural necklace and which was the cultured. An X-radiograph was required for positive determination. We have often seen policies in which the description of a diamond or other stone was so vague that it was impossible to determine size, quality or even cut. In several instances, synthetic sapphires and rubies have been insured for many years for a large amount on the assumption that they were natural. It is our feeling that in the field of accurate appraising, particularly with an eye to the services that can be rendered for insured customers, lies one of the most untouched opportunities for the trained jeweler.

* * *

We have received several calls and letters regarding the ultraviolet fluorescence test for synthetic emeralds. With the GIA hand fluorescence unit, we recommend that the stones be placed on a dull-black background (black velvet is ideal) in a darkened room. When the unit is held only an inch or so above the stones, the Chatham emerald fluoresces red, whereas all but a few natural stones remain inert. Attention must be paid to the fact that in the inexpensive units there is considerable visible violet light in addition to the ultraviolet radiations. Therefore, one should disregard the violet color when observing natural emeralds, particularly those from the Chivor Mine, which fluoresce faintly. When testing mounted stones, particularly in rings, it is recommended that a black cloth be pulled through the shank of the ring and the ultraviolet unit held directly over the table of the stone to observe if fluorescence is present; otherwise, too much of the suspected stone may be hidden by the mounting.

* * *

Recently, while examining a brownish-yellow diamond for evidence of color origin due to irradiation, we observed a heretofore unnoted strong absorption line at 5370 Å in the spectroscope. The stone also had the pair of lines at 5040 Å and 4980 Å. Although the line at 5370Å has been mentioned by B. W. Anderson and others as occurring in some natural brown diamonds with green fluorescence, we have never seen it. This stone fluoresced a subdued "sulphur" yellow under 3600 Å. Our report had to indicate that we are unable to identify the origin of the color of the by knowledgeable jewelers, who discovered them to be synthetic.

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* * *

The considerable interest in turquois on the part of the consuming public has evidently exceeded the supply. (On a recent cover of LIFE Magazine four or five out of a dozen socialites pictured were wearing turquois jewelry.) In an effort to profit from the stone's deserved popularity, far too many poorly treated stones are being offered to retailers. One unfortunate dealer recently had four necklaces returned to him, all within five weeks of purchase. The beads in one necklace had altered to an ugly whitish green in places, although some of the beads had retained what was evidently their original desirable color. Although the Laboratory was unable to determine how the beads had been treated, the fact that they faded when immersed in carbon tetrachloride suggested that at least some of the color had been induced by treatment with oil or paraffin. Unfortunately, it will take only a few such disappointed customers to have the interest in turquois descend to its former low position. For several years porous turquois has been powdered and bonded with plastic by a firm in Arizona. This results in a stone of permanent color and good durability. The popular spider-web turquois is duplicated by breaking the same material into irregularly shaped fragments and bonding it with a dark-brown plastic. It is reported that similar material is being produced in Germany. Other blue material is also being used in place of turquois; at least one specimen on which we had an X-ray diffraction made showed no turquois present. Almost certainly there are other methods being used to "improve" turquois other than the use of oil, paraffin, glycerin, sodium silicate and synthetic dyes. Actually, the artificial improvement of turquois is nothing new. Dr. Ralph Holmes of Columbia University reported reading in a 13th Century Persian work the fact that applications of yak butter would improve the color of poor turquois. It is the opinion of the Laboratory that a jeweler does a disservice not only to turquois but to the entire jewelry business by handling stones that give such unsatisfactory wear.

* * *

Coincidences in the Laboratory have been noted in this column before. Recently, in one day, we encountered a synthetic star ruby in a woman's ring, the top of which was so abraded that no star could be seen. Later in the day, from a different client, we received a synthetic star sapphire with the same amount of abrasion. Until that day, we had never seen synthetic star stones with so much wear. By mail, and also from a laboratory member on the same day, we received pearl necklaces, each of which had more than 800 pearls and the count was within 12 beads of each other.

* * *

We are indebted to Mr. Martin Ehrmann, Los Angeles, for a seven-carat brown kornerupine, in addition to a rough Burma peridot crystal and a

(continued on page 254)

Highlights
at the
GEM TRADE LAB
in Los Angeles

by

Lester B. Benson, Jr.

A very attractive diamond-and-platinum ring, set with two beautiful dark-green emeralds weighing approximately 1½ and 2¾ carats, presented a surprise to a Los Angeles dealer: when the stones were removed from the setting, their color lightened appreciably. They had been completely enclosed with a platinum bezel, and an examination of the bezel revealed that the inside edge had been covered with a hard, black enamel. The resultant darkening of the color of the emeralds was very effective.

* * *

Two bracelets set with yellow diamonds were received recently for analysis. One contained thirteen beautifully matched yellow stones of approximately one carat each and 104 small colorless brilliants. The other contained eleven yellow diamonds ranging from ¾ to three carats in weight, in addition to 88 colorless baguettes and brilliants. All of the yellow stones displayed the absorption spectrum that is typical of irradiated diamonds.

* * *

A yellowish-green mounted diamond of approximately eight carats received for testing displayed several small brown spots on the table and crown facets. Since this is characteristic of radium treatment, it was checked for radioactivity. Exposure to X-ray film for the usual twenty-four hours allowed for such a test produced an exceptionally strong picture. This was followed by a one-hour exposure, which also produced a distinct impression. Since the shorter exposure indicated a degree of radiation that could prove dangerous to the wearer, a precise measurement of the stone's radiation was made; this examination revealed that the amount of radiation was comparable to that emanated by some of the more heavily treated luminous watch dials. Since, unlike a watch, the stone had no metal backing, there were indications that continuous wear for several years could have adverse effects on the wearer. However, since this kind of ring is usually worn only occasionally, it should present no problem. A stone exposed directly to radium becomes radioactive as a result of the deposition of the metal radium-X on the exposed surface. Since radium-X has a half-life of 12½ years, and this stone is reported to have been in the possession of the same owner for much longer, the indications are that the initial radiation could have been dangerous if the stone had been worn continuously even for only a short time.

* * *

Anything can be valuable to someone, at least that was the implication when the Lab received a garnet crystal of about .001 carat taped to a letter bearing this request: "Please identify and appraise this gem."

* * *

Another interesting selection of snuff bottles was shown to us by Mrs. Lilla S. Perry of Los Angeles, a well-known collector on the West Coast. She also submitted for our criticism portions of a manuscript for a new book she is preparing on the history, nature and collecting of snuff bottles.

* * *

Also received for examination was a beautiful green jadeite cabochon set in a platinum-and-diamond ring that had been purchased in the Orient about seven years ago. Testing revealed that the color had been produced by dye.

* * *

A surprising number of jewelers are still not aware of the true nature of stones sold under such trade names as "Fabulite" and "Walderite." Letters are received frequently requesting information on these "new stones." Both are synthetics (i.e., strontium titanate and colorless sapphire, respectively); however, some of the advertisements, particularly those featuring Walderite, have claimed unusual properties implying that Walderite is not just synthetic sapphire, other ads have even featured synthetic sapphires as synthetic diamonds. One West Coast jeweler returned from an eastern buying trip, during which he purchased an exclusive franchise for the distribution of these "synthetic diamonds." He was understandably upset when a gemologist in his city finally convinced him that he was selling just synthetic sapphires that are available through any colored-stone supplier. It is encouraging to see the current efforts, both here and abroad, that are being directed toward more rigid control of nomenclature. Trade names have their place, but when jewelers themselves cannot identify a stone from an advertisement, it is obvious that the promotion is intentionally concealing the identity of the stone. As one dealer said when he was questioned

(continued on page 254)

Glittering Oasis

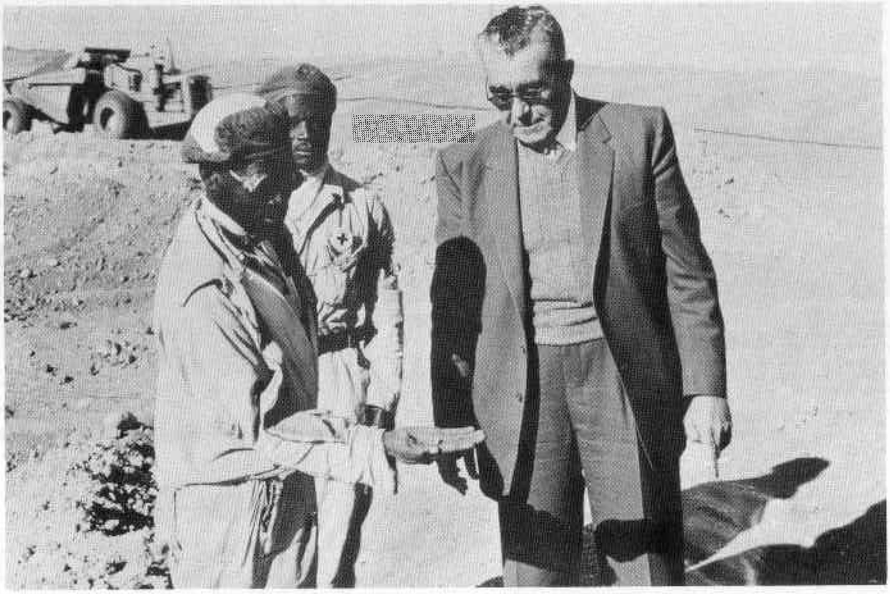
by

JOSEPH E. JESSOP, JR.

As our plane flew low over the African desert, I could see the Orange River winding its way to the Atlantic Ocean. Close by to the north, spreading out on the sand, was the town of Oranjemund, the headquarters of the Consolidated Diamond Mines of South West Africa, Ltd., a community standing by itself in what would seem at first glance a worthless desert waste. Below the endless stretches of sand lie the richest diamond fields in the world. About 98% of their production is gemstone.

Where did such a rich deposit of these valuable gemstones come from? There are two principal theories that attempt to explain the occurrence of diamonds along this desolate coast. One is that the gems were washed up along the shore from a volcanic kimberlite pipe in the ocean floor, the ocean currents transporting and distributing them on the beach. The other theory is that the diamonds originated in the interior of Africa and were carried to the ocean by rivers, the action of the sea concentrating them on the beaches. These diamonds washed ashore possibly fifty-two million years ago, and since that time the ocean has receded and the wind deposited billions of tons of sand over the gems.

The Consolidated Diamond Mines concession extends 220 miles from the Orange River north and from the Atlantic fifty to sixty miles inland, the best deposits being confined to the coastal fringe. To begin with, prospecting trenches approximately one to two miles long are dug at intervals of five hundred meters at right angles to the coast line (see map). Great quantities of sand must be removed before the diamondiferous gravel is reached. For an area one thousand feet square by twenty-five feet deep, about 1,250,000 tons of sand must be removed. After the gravel is reached, smaller trenches five meters long, one meter wide and one-half meter deep are dug; these are called *sections*. Each one-half meter additional



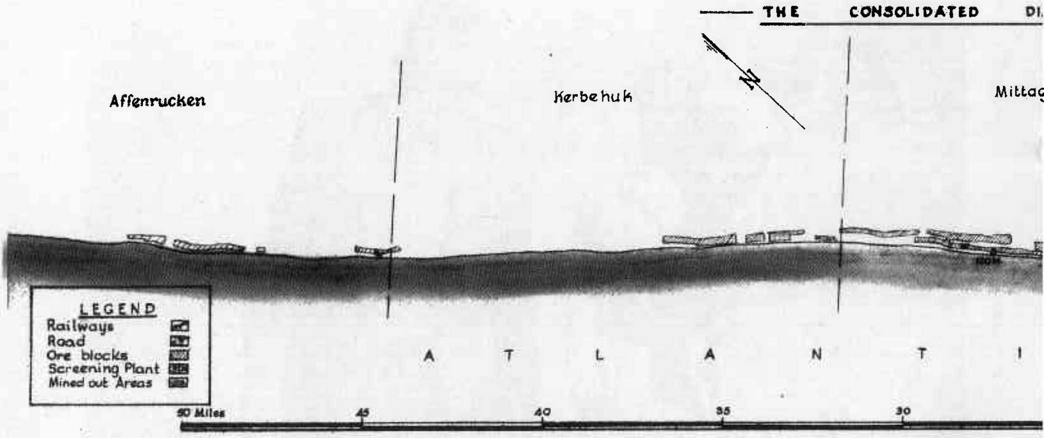
Native holding diamond crystal found just before I arrived. Crystal was about 25 carats. Gentleman at right is Mr. Eric Davies, who is in charge of all earth-moving operation.

Photo by author

increase in depth is known as a *zone.* When the contents of each section and zone have been checked, it is then decided whether to open up the area for actual mining.

Huge earth-moving machines, much like the ones used to construct a highway, are used to remove the sand. The most successful machines for prospecting are the diesel-driven four-wheeled scrapers. For large-scale stripping, bucket-wheel excavators, driven either by diesel-electric or electric power, are used. The bucket-wheel excavator would be of little value in removing the overburden if it were not for the portable stackers, which consist of a conveyer belt about ninety feet long mounted on the chassis of a Sherman tank that moves the sand away from the trench in any direction desired.

Once the area is opened for mining, and after the process of stripping the overburden has been completed, the diamond-bearing gravel is loaded into large dump trucks and taken to screening plants. These plants have been established in close proximity to mining activities, to avoid long hauls. From past experience it has been determined that gravel smaller than one-eighth inch and larger than one inch does not contain enough diamonds to make it economical to process; therefore, by passing the gravel through a series of screens, only the gravel of the size containing the richest concentration of diamonds is saved. During the screening

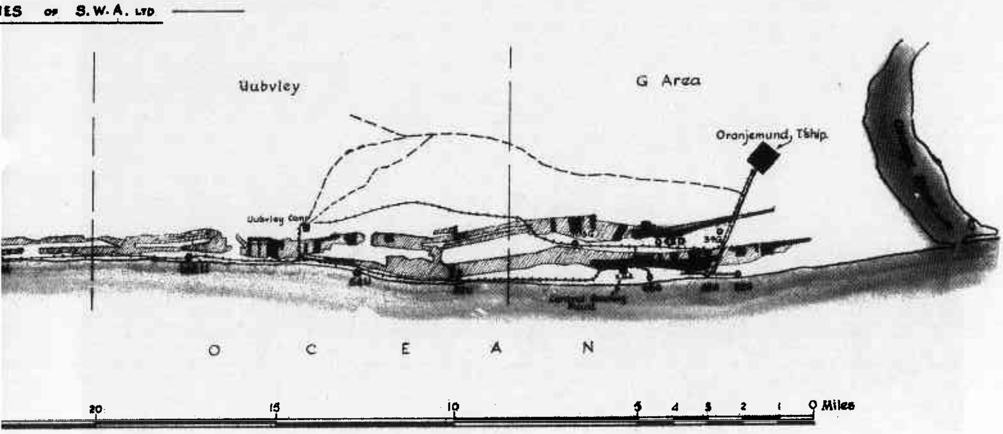


process about 85% of the gravel is discarded, leaving only 15% to be taken to the recovery plant.

As the gravel is removed from the mining area, the bedrock is finally reached. Because it is an ancient marine beach, it is often very uneven; it resembles the tidal sandstone beaches along the coast of Southern California. The most efficient way to remove the last valuable gravel from the bedrock is by native labor using shovels and brooms. Many fine stones have been found in sweeping the bedrock. The morning I visited one of the mining sites, a native showed me a twenty-five carat gem-quality diamond he had just found while sweeping the last bits of gravel from the ancient beach.

The most modern methods of recovery are used in Oranjemund. The gravel that is saved after the screening process is transported to the recovery plant. A heavy-media separation plant has been installed that eliminates a great deal of waste very rapidly. By the use of a ferrosilicon suspension, the specific gravity of the first heavy-media cone is 2.9 and that of the second cone 3.15. This system, which has proven to be 99.9% efficient, can handle about 110 tons of concentrate per hour. One disadvantage is that ferrosilicon is very expensive, ($135 per ton); therefore, special equipment is installed to recapture as much as possible.

After passing through the heavy-liquid cones, the diamondiferous gravel is classified into 6-, 10-, 12-, and 25-millimeter sizes. Those smaller than six millimeters, or about 25%, go through what is called an *electrostatic separator*. By employing high-voltage charges of electricity, the smaller diamonds are separated from the gravel with which they are associated. The separator is based on the principal that diamonds are nonconductors and the gravel is a moderate conductor. Thus, by passing the concentrate through the high-



voltage charges, separation can be achieved. It was found, however, that it was not practical or economical to pass the larger sizes through the electrostatic separators, so a separate method is used.

Alluvial diamonds, unlike those found in kimberlite pipes, will not adhere to grease; therefore, in order to effectively separate them from the gravel and still use grease tables, they must be specially treated. The concentrate is put into a solution of whale-acid oil and caustic soda and left to exactly two and one-half minutes. Then it is washed, the solution coming off the gravel but not off the diamonds. Thus, when the combination of gravel and diamonds passes onto the slowly revolving grease belt, the diamonds adhere to it. It is an unforgetable experience to watch these tables and see for the first time a diamond crystal stick to the grease!

The diamonds that have been recovered from the electrostatic separator and the grease tables pass through an additional stage. Since a small quantity of gravel is still associated with them, they are hand sorted.

This, then, in a brief and simplified form, is the process that takes place at Oranjemund. It is a marvelous and efficient operation — a big operation when one considers that eighty million tons of sand, gravel and rock must be removed and processed to get one ton of diamonds.

Much could be written about the town of Oranjemund, but that would entail a separate and lengthy article. Let me, then, mention just a few of the more interesting facts. The population consists of 5100 natives, mostly from the Ovambo nation, and nine hundred Europeans on the payroll, about 2500 including wives and children. The natives sign a contract for eighteen months and cannot bring their families with them, since they live in native compounds. We had the privilege of visit-

Ancient Marine beach exposed after moving overburden

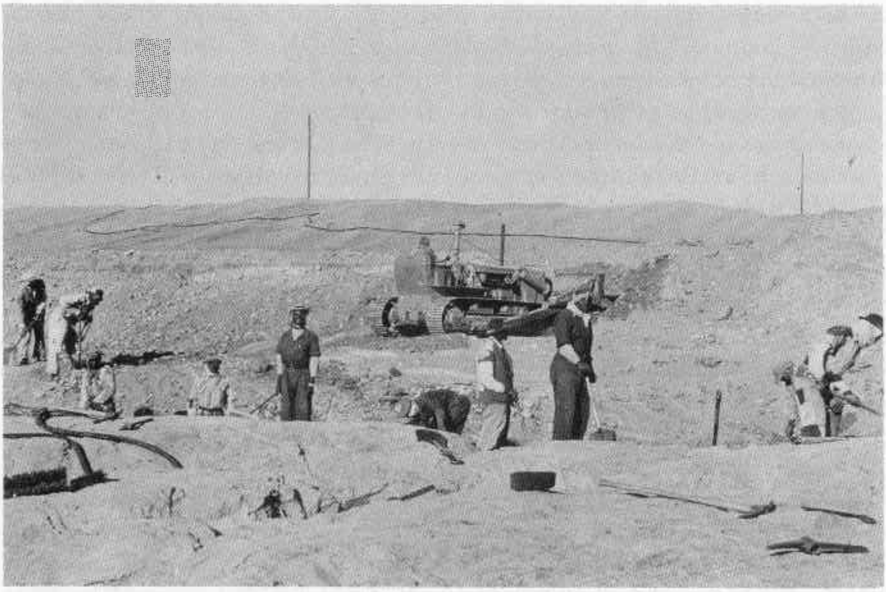
Photo by author

Prospecting crew in operation

Photo by author

Portable stackers; note Sherman tank chassis

Photo by author



Natives sweeping the bedrock

Photo by author

Large scrapers used for removing sand

Photo by author

ing one of the compounds and found it to be a very neat and clean group of concrete buildings. Advanced methods are used to test each man's ability, and efforts are made to place him in work that matches his capabilities. Every effort must be made to make the operations he will perform as simple as possible, because for a new employee this is usually his first contact with civilization. All tools that may possibly injure him are painted red on the portion that could cause a casualty. All are taught the basic rudiments of first aid, and all those who are to become boss boys (those who will be in charge of a group of natives) must know first aid completely. I was told that most Europeans would rather receive first-aid treatment from a native boss boy than from another European; to say that they make excellent nurses is an understatement. I visited their hospital, which has the same excellent equipment as the European one, and found it to be as clean, if not cleaner.

When I learned that all natives arrive in Oranjemund by air, I naturally was very curious to know how this was accomplished without a great deal of fear on their part. First of all, they have never had a crash; secondly, each passenger that makes the air trip receives a little pair of wings, which he wears with great pride.

During leisure hours, various trades are taught in schools that have been established for this purpose. I can assure you that if the suits I saw are any example, these men make excellent tailors. Movies are another pastime. The American western movie is a real favorite.

The concentrate containing the diamonds is finally flushed over vibrating tables covered with grease

Photo by N. W. Ayer & Son, Inc.

Even though what is said on the screen is not understood, they follow the plot and yell and shout like most American children at a Saturday matinee.

For the European, every effort is made to make life as pleasant as possible. There is a well-stocked modern department store with everything one could want, at prices that represent savings to the purchaser. A grade school, club house and church offer a well-rounded education for both children and parents.

One aspect that especially interested me was a trip to their hydroponics farm. Here tomatoes and other vegetables are being grown in chemicals. Although this is still in the experimental stage, the product is delicious. Most of the vegetables consumed are raised on company-operated farms near Oranjemund, and meat is bought from a contractor who farms near Windhoek.

A golf course and a beautiful little lake add much to the outdoor pleasure of the employees.

Many readers have no doubt heard of the extensive X-ray machinery used to check all employees. We visited this building and saw many interesting pictures that were taken for the purpose of showing how diamonds appear on X-ray film. Each employee's personal belongings, as well as his person, must be X rayed on departure. They are X rayed on arrival for medical reasons only.

Though not in a beautiful surrounding, Oranjemund has its own charm. When one considers what lies under the sand, it can truly be called a "glittering oasis."

Acknowledgements:

I wish to express my thanks to Mr. Francis E. Gerard, who made my trip to Oranjemund possible, and to Mr. Eric C. Davies of Consolidated Diamond Mines, for making my trip to Oranjemund so enjoyable.

Formations of Minerals
Physical Properties

by

RICHARD JAHNS, PH.D.

Professor of Geology
California Institute of Technology

This is a continuation of the article by Professor Richard Jahns on the structure of matter, the nature of crystals, formations of minerals and their physical properties that began in the Spring 1958 issue of GEMS & GEMOLOGY.

General Processes

Minerals can be formed from substances that are in either the gaseous, liquid or solid states of aggregation, and seven general processes are most important in this connection:

1) Crystallization from silicate melts
2) Crystallization from aqueous solutions
3) Crystallizations from gaseous solutions
4) Recrystallization of solid substances
5) Reaction between different solid substances
6) Reaction between solid substances and various types of fluids
7) Secretion by organisms, or precipitation effected indirectly by the activities of organisms

Typical examples of gem minerals formed by these processes are, respectively, as follows:

1) Diamond, beryl, corundum, feldspars, garnet, olivine, quartz, spinel, tourmaline, zircon
2) Beryl, calcite, gypsum, opal, quartz, turquois
3) Beryl, quartz, topaz, tourmaline
4) Calcite (limestone to marble), gypsum (alabaster to satinspar)
5, 6) Corundum, garnet, jadeite, quartz, spinel
7) Calcite (e.g., pearl, coral)

It should be recognized that some products of mineral-forming systems are developed by means of only one general process, that others can be formed alternatively by means of two or more different processes, and that still others can represent the combined effects of two or more different processes, acting either simultaneously or successively. Thus diamond, olivine, zircon and other essentially igneous minerals are mainly the results of process No. 1, whereas quartz, beryl and numerous other minerals that are found in igneous rocks can have been formed by processes Nos. 1, 2 and 3, acting either separately or in some combined manner. Similarly, jadeite ordinarily represents processes Nos. 5 and 6, whereas garnet represents both these and process No. 1.

Crystal Growth

The growth of a crystal can take place in response to a shift in physical conditions, such as a rise in pressure or a change in temperature, or in response to a change in chemical environment that prompts the formation of a new solid phase. In nature the processes of growth typically are governed by an interplay of many factors, and the actual mechanisms of growth rarely can be assessed in more than general terms. During recent years, however, much of value has been learned through intensified efforts, many of them successful, to grow large, clear crystals of quartz, micas, tourmaline, other synthetic minerals and numerous non-mineral compounds in the laboratory.

It can be assumed that the process of crystal growth begins with formation of tiny scraps of the appropriate crystal structure; i.e., with the formation of crystal nuclei. A nucleus may consist of only a few atoms or ions bound together, as in some types of crystallization from aqueous solution, either liquid or gaseous, or it may comprise large numbers of atoms or ions already bound together, as in natural or synthetic silicate melts. Whatever the size of the nucleus, the situation during crystallization is a highly dynamic one, in the sense that some atoms or ions are being removed from the nuclei while others are being attached. If more of them are attached than are removed per unit time, the nucleus will grow; even so, however, the removal of a few atoms or ions from very *small* nuclei can result in their destruction, and thus some nuclei can be obliterated during the same period when others are being formed and nourished.

One can conceive of a stability limit, in terms of size of crystal nuclei in a given system, below which a given nucleus is liable to annihilation through the chance loss of a few atoms or ions, but above which such a loss reduces the size of the nucleus but does not destroy it. The entire situation can be considered in statistical terms, involving the chances for survival of a given nucleus despite attritions and its chances for growth through additions; although the additions might well be greater than the attritions over a given period of time, the attritions might be in excess at any one moment.

Some crystals may grow through the addition of individual atoms or ions, but for most minerals the process involves the accretion of larger units of crystal structure, each of which developed from its own nucleus. In a crude way, the process can be likened to the placing of shingles on a roof, in contrast to the surfacing of the same roof one wood cell at a time. It is clear that the geometric perfection of a given crystal depends on the orderliness with which new units are added to it, just as one shingled roof may be laid in a very perfect pattern whereas another, less regularly constructed, may involve many elements that lie askew with respect to one another and to the roof as a whole. The internal perfection of the final product reflects the degree to which the new units are added in an orderly fashion, and the degree to which imperfectly oriented units can be rearranged into more appropriate patterns after they have become attached.

The ultimate size to which a given crystal can grow is a function of the rate at which new material can be brought to it through the enclosing medium, the time available during the period of crystallization, and the number of growing crystals that are competing for space within the system. The rate of growth is governed by the rate of transfer of material through the surrounding medium, as well as by the rate of heat escape from the system as a whole, the heat of crystallization of the solid phase or phases, and other factors.

Transparent gem minerals represent nature's closest approach to perfect crystals. They reflect conditions of growth that permitted accretion and internal rearrangement of atoms and ions most wholly in accord with the theoretically perfect geometry of that particular structure. Crystals that appear opaque megascopically, even though transparent in very thin slices, are highly imperfect in the sense that they are crowded with inclusions and contain numerous fractures or other structural discontinuities. Such imperfections ordinarily reflect relatively rapid growth of the crystal, a short period of time available for crystallization within the system, or other conditions that made it difficult to eliminate the imperfections within the crystal through appropriate migrations of ions and atoms. Thus crystals that are nearly free from geometric distortions and discontinuities, as well as solid or fluid inclusions, require highly specialized conditions for their development. It is scarcely surprising that the percentage of relatively perfect crystals in nature is exceedingly small.

Flow and Diffusion

Clearly implied in most of the foregoing discussions are various movements of matter through other matter. Where the openings within a substance or aggregate of substances are sufficiently large to permit a gas or liquid to move through them, the process is essentially one of *flow.* The flowing substance maintains its own gross identity as it moves. In contrast to this, much smaller units such as atoms, ions or molecules can move through a given substance by a spontaneous process known as *diffusion,* which tends to maintain a uniform concentration everywhere within the substance. Thus a gas, with its great internal mobility, becomes homogeneous through self-diffusion as its constituent molecules tend to scatter themselves at random within the enclosing container.

The essential differences between the mechanisms of flow and diffusion can be illustrated by a simple example. If a gaseous substance bubbles or streams through a liquid or solid, such a steam through a water-saturated silicate melt or through a fractured crystal of quartz, it can be regarded as moving by flow. If, on the other hand, the smallest particles of the same substance migrate individually through a liquid or solid, such as water molecules within the silicate melt or within openings of very small size in the crystal of quartz, the movement is accomplished by diffusion. Small particles can diffuse through matter in a random way in response to ordinary thermal agitation, or they can diffuse in specific directions in response to concentration gradients, temperature gradients or other conditions.

Nearly all processes of mineral formation and decomposition involve some kind of diffusion. To cite only a few examples, Mg^{2+} ions must move through a complex silicate liquid to participate in the crystallization of the olivine Mg_2Si0_4, Al^{3+} and 0^{2-} ions must be ordered into Al-O groups and these groups must move through an appropriate melt to premit formation of synthetic corundum (sapphire or ruby), K^+ and Na^+ ions must move through a homogeneous feldspar structure to permit exsolution of the two separate mineral phases of $KAlS_30_8$ and $Na\ AlSi_30_8$ to form moonstone, Na^+ and Cl^- ions must move out of their fixed mean positions before a crystal of rock salt can be melted or dissolved and they must move together to form NaCl molecules before the melt can be vaporized, and K^+ ions must move out of the $KAlSi_30_8$ structure to permit decomposition of this feldspar by weathering at the earth's surface.

Particle diffusion can take place through many types of openings in solid materials, including structural vacancies and other imperfections within crystals and the small, irregular voids that ordinarily are present along boundaries between adjacent crystals in rocks. It also can be accomplished by the movement of atoms or ions interstitially within a crystal structure, and even by exchanges in regular structural position on the part of certain ions or atoms. The rate of diffusion through solids is strongly dependent upon temperature, and in general the process is rapid within minerals only at temperatures within 20 percent of their melting points. Solid-state diffusion in lower ranges of temperature ordinarily is very slow, and it has been shown experimentally, for example, that at 500°C. K^+ ions can travel through the quartz structure at rates not greater than about 43 inches per million years. The rate may be increased enormously, however, if an interstitial fluid is present in connected openings within a crystal, whereby the particles can travel more rapidly through the fluid to widely dispersed points before moving into the "dry" portions of the crystal.

Other factors being equal, particle diffusion is fastest in crystals that originally grew the fastest, since such crystals generally contain large numbers of structural imperfections that serve as avenues of movement. It also is relatively rapid in crystals whose lattices are distorted by the presence of impurity ions, as well as in crystals whose ions or atoms are poorly suited to their coordination within the structure. For diffusion by means of a given mechanism, cations generally move more rapidly than large anions through crystals, and simple ions more rapidly than larger complex ions. As might be expected, diffusion within liquids of low viscosity is more rapid than within those of high viscosity.

Replacement

The term *replacement* is applied in a mineralogical sense to the gross exchange of materials that converts one solid substance into another solid substance. This can be accomplished in several different ways, and in general involves chemical attack of the initial substance, a two-way transport of materials, and deposition of new material at the site of the initial substance. At least some of the material in the newly formed substance is derived from external sources.

If one substance is first removed by solution or some other means and the resulting cavity is then filled by new material, the process is termed cavity-filling replacement. A small log of wood that is a part of a sedimentary rock, for example, could be wholly removed in this way and its position subsequently occupied by a crystalline aggregate of quartz whose external shape would crudely reflect the shape of the original log. On the other hand, the log could be progressively replaced by quartz in a much more intimate manner without an intervening stage of cavity formation, yielding petrified wood in which the most minute details of the original cell structure might be faithfully preserved. This process is known as *metasomatic replacement,* or simply as *metasomatism,* and the petrified log is said to be a *pseudomorph* of the original log. The most common type of pseudomorph encountered among minerals consists of a crystal or crystalline aggregate of one mineral that preserves the external crystal form of another, compositionally different mineral from which it was formed by replacement.

Metasomatism is by far the most widespread type of replacement, and its results can be observed in most mineral deposits and in numerous varieties of rocks. It commonly is referred to as a process of "simultaneous solution and deposition," although the process is not as simple as this phrase implies.

Replacement in natural systems occurs over a wide range of scales and involves many kinds of material. Whether a substance or aggregate of substances is organic or inorganic, crystalline or amorphous, or even solid or liquid (if the liquid is sufficiently viscous), it can be replaced by one or more other substances if the physical and chemical environment is favorable. The product ordinarily is an inorganic solid, and it can range from tiny isolated crystals to crystalline aggregates of enormous size. It may consist of one mineral or many, and may or may not occur as pseudomorphs of the original material. The process may involve little change in gross composition, as in the replacement of the silicate olivine by the silicate pyroxene, or it may involve drastic changes, as in the replacement of zinc sulfide by copper sulfide, carbonaceous matter by silica, or fluorite by quartz.

Mineral Identification

A mineral is identified in the most fundamental way through precise determination of (1) the nature of its constituent atoms or ions, and (2) the geometric arrangement of these components within the mineral structure. This can be accomplished by several methods, which in general combine highly accurate chemical analysis with structural determination by means X-ray analysis. A very useful and much simpler, though indirect, approach makes use of the polarizing microscope, which permits measurement of significant optical properties of the mineral. Less refined methods that also are useful include rough chemical analysis, qualitative chemical tests (among them the so-called "spot tests" for specific elements), various tests under the flame of a blowpipe, semiquantitative analysis by means of the spectroscope, and detailed visual examination directed toward various diagnostic physical properties.

Despite their great value in identification, many of these techniques are of limited use to the investigator who is working with gem materials, since they involve disfigurement, breaking up, or even decomposition of the sample to be tested. Unless some of the sample can be regarded as expendable, the identification must be based on some combination of tests that have no effect on the examined material. This requirement is best met by careful observation of diagnostic physical properties and by noting the effects of the material on various kinds of radiation.

X-rays, with their very short wavelengths, are diffracted by crystalline substances in a manner that is governed by the nature, type of bonding, and geometric arrangement of the constituent atoms and ions. Thus a given substance yields a characteristic diffraction pattern when X-rays are transmitted through it or reflected from it, and, with appropriate instrumentation, this pattern can be recorded on a photographic plate or translated directly into the form of a graph. The method can be used on powdered material, on crystalline aggregates, or on single crystals or parts thereof, and hence constitutes an excellent means for the identification of gems.

The polarizing microscope is a very useful instrument for this general problem, since it can be employed to assess the effects of a given mineral on radiation within the visible spectrum. Refraction, polarization, and absorption effects are governed by the fundamental characteristics of composition and structure, and are responsible for the so-called optical properties of substances. These can be readily determined by any careful investigator who has received a modest amount of training in the necessary techniques, whether or not he understands the rather complex theory of optical crystallography.

Every mineral species is characterized by a certain group of physical properties. Each property is specific and constant for a mineral of given composition and structure, and varies within well-defined limits if the composition is varied. Thus quartz that is perfectly pure has a very definite set of physical properties, but the introduction of even small amounts of impurities yields new sets of properties, and the changes in some of them, especially color, may be very noticeable. In an isomorphous mineral series, the properties of individual members, each with its own specific crystal structure and chemical composition, are definite and fixed; yet the entire series shows a systematic range in physical properties. Simple and straightforward as this concept may be, it is worth noting that only during recent decades have investigations of crystal structure and chemical composition made it possible to correlate these features with physical properties in a fundamental way. And many minerals and mineral groups still are not fully understood in this respect.

In some instances it is possible to identify a mineral by means of only one or two distinguishing properties, but ordinarily a firm identification depends upon the recognition of some combination of properties. Too, some properties are of greater diagnostic value than others, and some can be determined with much greater accuracy than others. Fortunately, we need to know only a few properties in order to identify most gem materials with confidence. In the following discussions of physical properties, emphasis is placed upon those features that are most useful to the gemologist in his work. An attempt also is made to point out those properties that are of greatest diagnostic value in connection with specific minerals or mineral groups.

General Properties

The orderly arrangement of atoms or ions within a crystal commonly leads to development of external faces that give the crystal a definite geometric *form*. Some of these faces are very smooth and flat, and meet adjacent faces to form sharp, straight edges, whereas others are striated, grooved, pitted or otherwise irregular in detail. Many crystals in rocks show no such external faces, but instead are bounded by very irregular surfaces that are in contact with adjacent crystals.

More than two centuries ago it was recognized that different mineral species are characterized by different crystal forms, and that specific crystal faces of a given mineral species always meet at constant angles regardless of the form and size of the crystals. Studies of the arrangement of crystal faces permitted a geometric classification of those minerals that show these external faces, and led to some surprisingly accurate deductions concerning the internal structure of crystals long before techniques for the investigation of such structure became available. During the past half century, studies of the internal geometry of crystals have confirmed most of these deductions.

The position and attitude of crystal faces are external manifestations of the internal packing pattern of the atoms or ions that compose the crystal. One can readily see, from an inspection of *Figures 3 and 10 in Spring 1958 issue and Figures 8 and 11 in Summer 1958 issue,* why halite commonly has a cubic form, beryl a hexagonal prismatic form, diamond an octahedral form, and graphite a hexagonal tabular to prismatic form. Whether or not external faces are well developed, or are even developed at all, depends in part upon the nature of the substance in question and in part upon the conditions under which the crystal grew. Thus, a given crystal is much more likely to develop faces if it grows wholly within a liquid or gas than if it is formed within a mesh of other crystals, and hence must adapt its shape to whatever space is available.

Under comparable conditions of growth, certain minerals are more likely than others to form well-faced crystals. Garnet and tourmaline, for example, show a strong inherent tendency to develop in this way, even when they are competing for space with adjacent crystals, whereas quartz and micas develop good external faces under only the most favorable conditions of unhampered growth, as in deposition from solutions in fissures and other cavities.

Some minerals have highly characteristic *shapes,* regardless of whether smooth external faces are present or not. In most instances, this results from early-stage growth without interference from adjacent crystals. Some species show considerable variations in crystal shape from one occurrence to another. Such differences can result from differences in composition of the crystals, in composition of the solutions from which the crystals grew, in the rate of growth, or in combinations of these and other factors. Thus the pattern of crystal shape and orientation commonly is useful in deducing some of the conditions under which certain minerals were formed.

The gross shape, or *habit,* of crystals ordinarily is described in terms of simple geometric forms. Thus, halite commonly is cubic, fluorite octahedral, garnet dodecahedral and quartz prismatic. More general terms, such as tabular, platy, elongate, equant (essentially equidimensional), rodlike, lathlike and acicular (needlelike), also are very useful. It is well to keep in mind, in observing the habit of different minerals, that some crystals are much distorted with respect to their ordinary, or "standard," form. Others are irregularly developed, and some even have faces that are curved or warped.

(to be continued)

Book Review

by

JOHN SINKANKAS, CAPTAIN, USN

GEMSTONES, G. F. Herbert Smith, revised by F. C. Phillips. Published by Pittman Publishing Company, New York City, 560 pages, well illustrated. Price $10.00.

Few books can claim to have exerted as much influence upon the study of gemology as Dr. Smith's *Gemstones*, which several months ago appeared in its extensively revised thirteenth edition. As readers will recall, death claimed Dr. Smith in 1953, and for some time it was feared that *Gemstones,* the most important achievement of his career, would eventually meet a comparable fate in an era of accelerating scientific progress where nothing stands still, not even established literary works of proven integrity. However, in 1955, F. C. Phillips, Reader in Petrology at the University of Bristol (England), was asked to undertake a new edition, to which he consented; and as everyone who has seen the book can attest, he produced admirable results. A careful comparison of preceding editions against the latest reveals numerous changes of a comparatively minor nature together with a small number of less extensive revisions, which, however, are of great importance. In the main, Mr. Phillips has exercised admirable restraint during revision, retaining the previous wording in those parts where changes seemed unnecessary and thereby preserving the somewhat stilted but distinctive style of his distinguished predecessor. If the services of Mr. Phillips are retained for future editions of *Gemstones,* we may pleasurably anticipate a continued beneficial association with this outstanding book.

Physically, the thirteenth edition is of the same size as previous editions (8¾ inches x 5½ inches), but it is appreciably thicker because of the addition of 23 pages of text, making a total of 560 pages. Some of the additional thickness may be partly due to the paper, which seems to be of better quality. The binding is decidedly improved over earlier editions, which, lamentably, were so poorly constructed that a short period of use resulted in a badly worn spine. Despite present improvement, the quality of the binding remains inexplicably poor, in view of the uncontested importance of the contents. The type face used is of the same style as before, but the entire book has been reset in order to accommodate the numerous changes found necessary in revision. Impressions are sharp and easily legible, except for the four color plates inherited from previous editions, which, by now, are becoming rather badly blurred and washed out in tone. New, well-executed line drawings, principally of crystal forms, are evident, but the total of text figures has been reduced from 145 to 138. Black-and-white photographic illustrations are also reduced in number from 40 to 23; this, however, is not a great loss, since it has always been my conviction that a number were originally added to relieve in some way the rather forbidding uninterrupted expanses of tightly woven text. In any case, I believe that readers who are unfamiliar with previous editions will consider those retained pertinent and adequate. Outstanding among the illustrations are several clear-cut examples of gemstone inclusions photographed through the microscope. The book is handsomely bound in green cloth and the spine is decorated with a red cartouche overprinted with the title in silver.

The general scheme of contents previously established has been retained in the thirteenth edition; that is, the text is apportioned among four major parts, as follows: *Physical Characters, Technology and History, Description,* and *Identification Tables.* A group of appendices follow and conclude the instructive portion of the book. Within each part are a number of chapters dealing with different subjects related to the general-part title. Small changes are apparent in some of the part and chapter headings; in addition, some rearrangement in presentation of individual species has been adopted, for good reasons, by Mr. Phillips.

In *Part I, Physical Characters,* the most extensively revised chapter is that dealing with crystal form and structure, which I am sure most readers of previous editions will recall as a bewildering and forbidding maze of mathematical symbols and numbers, cryptic drawings, and often unintelligible groups of words interlarding the whole. To professionally trained persons in the earth sciences, this section presented little that was new or startling; hence, it was essentially redundant. To those who were not so trained, it was too complex to make much sense, and therefore of little value to this class of readers. It is to Mr. Phillips credit that he recognized the defects of this chapter and took corrective measures. His remarks on this chapter, as well as another concerning optical properties, are interesting; they are quoted from the *Preface,* as follows:

> "The chapter on crystal form and structure, expanded in the tenth edition to constitute almost a treatise on crystal morphology, has been rewritten more succinctly to cover only those aspects of morphology and structure strictly relevant to the study of gem materials. Some reduction in length of the chapters on optical properties has been achieved by omission of the analytical treatment of the indicatrix, a simplified account sufficing to explain the behavior of

shadow edges on the refractometer."

Drastic revision of parts obviously so carefully and lovingly prepared by a previous author poses a vexing problem, especially if the announced intent is to make them more understandable and useful to that class of readers who study the text for instruction. Mr. Phillips must have suffered a few misgivings in jettisoning page after page of complex text, but I for one herewith tender my vote of confidence; in fact, I wonder if he has gone far enough. For example, Miller indices are explained in a lucid fashion in the chapter on crystal form and structure but are rarely used in the remainder of the book. On the other hand, a welcome innovation in this same chapter is a brief discussion on atomic sizes, the nature of the bonds that join atoms together, and the role played by each in the formation of ordered atomic structures. This discussion, in which the basic secrets of crystals and their properties are unfortunately no more than mentioned, deserves to be expanded and placed at the head of the chapter in accordance with its overwhelming importance. If a student understands clearly the significance of internal structure in crystals, he is in a much better position to make sense out of every outward manifestation and every internal property.

The next major revision occurs in the chapter on measurement of refractive indices, in which a paragraph is added on obtaining refractometer readings from curved gem surfaces, a method developed by Lester B. Benson, Director of Education, Gemological Institute of America, in 1948. The Becke effect is far more clearly explained, both in revised text and in several new line drawings that portray the behavior of light passing through the edges of gem materials immersed in refractive-index fluids. The interesting and useful immersion photography technique, which is based on this phenomenon and which was developed by B. W. Anderson in 1952, is also briefly described and accompanied by a photograph produced by this method. In the short chapter on luster and sheen, the altogether-too-brief explanation for play of color in opal, as originally penned by Dr. Smith, remains the same, despite the availability of recent reports strongly indicating that the true cause has been found at last. However, the most authoritative of these (Raman & Jayaraman, Vol. 38, *Proceedings of the Indian Academy of Science; same* in Vol. VIII, No. 1, *Gems & Gemology,* 1954) may have made its appearance at an awkward time in respect to publication of the new edition and thus missed being considered. A major revision occurs in the chapter dealing with double refraction, in which the curious behavior of light in doubly refractive gemstones is explained. Although Mr. Phillips, through his earnest efforts, has done much to simplify the presentation, the average reader will probably find that several close readings are necessary to assure himself of an understanding. Here, again, is one of those places in which every author is placed on the horns of a dilemma:

should he delve into the causes, and, if so, how much?; or should he dismiss this portion with a general statement and then launch into an explanation of *what* happens rather than *how* it happens? I think Mr. Phillips has chosen a tenable middle position in dealing with a subject that is one of the most perplexing in the entire field of crystal properties.

An entirely new chapter on the polarizing microscope has been added, in view of the increasing importance of this instrument and its accessories in the examination of gemstones and gemstone rough. The chapter is somewhat brief for a large subject, but the important points have been covered adequately. Short discussions are given on examinations in ordinary and polarized light, identification of inclusions, and methods of obtaining refractive indices. Following this chapter is another of no great length consolidating two former chapters that dealt with other less important physical properties and thus finishing the first part of the book.

The next part of the book, *Technology and History,* is little changed from the original, again with some regret that certain sections were not examined more critically by Mr. Phillips during revision. For example, in the chapter dealing with treatment of gemstones (i.e., cutting), the processes connected with diamond are explained in much detail, but the chapter then concludes rather abruptly with very little said about the treatment of all other gemstones. From a technical viewpoint, this portion does not reflect the advances made in equipment and polishing agents since Dr. Smith first placed these remarks on paper. Many drawings of cutting styles in this chapter could well be redrafted to reflect more accurately the geometry usually employed by lapidaries; as they are now, one receives the impression that gems cut in these styles surely must be lumpy and deformed. The page-and-a-half discussion on the formation of the Beilby layer on polished gemstones is fascinating for cutters, but if a future revision of *Gemstones* needs compensatory reduction somewhere in the text, this may be one logical place. The chapter on treatment is concluded in several paragraphs discussing the use of precious metals for mounting gems, a drastic reduction over the previous edition, in which about seven pages were devoted to the subject. I am inclined to believe that all reference to metals occupies space that could be much more usefully employed; therefore, I nominate even these few remnants for deletion.

The chapter on synthetic stones, an important aspect of gemology, receives carefully detailed treatment, including several additions such as the synthesis of diamond by General Electric, the preparation of strontium titanate, and a very few remarks about the work of Carroll F. Chatham, of San Francisco, in synthesizing emeralds. However, this chapter appears unbalanced as a whole, because much more space is devoted to detailed discussions of numerous failures or insignificant achievements than to the solid successes of recent syntheses. A reorientation seems in order. In the brief chapter on the formation and geographical distribution of gemstones, outdated figures on production are repeated from previous editions; by now, the accuracy of these figures should be regarded with misgivings. In discussing the production value of colored stones of the various continents, North America is listed last. This is a highly unlikely position, if we consider the enormous production of numerous varieties of chalcedony, other forms of quartz, turquois, opal, obsidian, rhodonite, serpentine, idocrase, nephrite, etc. True, no systematic and thorough compilation of production figures has been attempted by any central agency, either private or governmental, for some years; however, a glance at the numerous offers of material for sale in the several popular earth-science publications in America must form an impression that a vast quantity has been mined. Similarly, the abundance of standard Brazilian gemstones, which are available from dealers everywhere in the United States and Canada, indicates that the ranking of this continent is probably too low also. What Mr. Phillips can do to evaluate and rectify such brief statistics I do not know; perhaps the best idea is to forget the whole thing and merely indicate in a table the regions of the earth that have been important gemstone producers.

A major portion of *Gemstones* is taken up by *Part III, Description* (of individual species). It commences with a section on *Principal Stones,* in which the standard gemstones of commerce are treated; then a section on *Other Gem Material,* which discusses many of the rarer gemstones as well as natural glass; another section on *Ornamental Stones,* or those generally utilized in their massive form; and finally a somewhat shortened section on *Organic Products.* In general, this part is justly famed for its wealth of accurate detail. Only minor revisions are evident, except under *Diamond,* where over two pages of highly technical discussion on crystal structure has been deleted. Several errors are noted in connection with North American gemstones; for example, under spessartite (page 337), the important locality of Ramona, San Diego County, California, has been omitted, whereas the specimen locality in Nevada, where gem material has not been found, is cited. Under tourmaline (page 341), an oft-repeated but incorrect statement that California tourmalines show the reverse order of color zoning (i.e., a green core and a red exterior) has unfortunately been perpetuated. Actually, the so-called watermelon tourmalines occur commonly in the California mines and are essentially identical to those from other countries. There is also a minor spelling error in Connecticut River, which is given as "Conn" River. Similar small errors crop up elsewhere in connection with North American localities, and it is hoped that future editions will attempt to weed these out, admittedly a painstaking and time-consuming task but one that should considerably improve the already high quality of the information. One other revision appears desirable also; that is, to obtain the latest information on outstanding examples of cut gems or gem rough from museum curators for incorporation in appropriate sections of the book. As it stands now, the best available information is not always given. Only one example is cited to illustrate the point: under benitoite, the largest faceted gem of this species is mentioned as being over seven carats, but it is not stated that this gem is in the collection of the United States Museum in Washington, D.C.

Some readjustment in the space allotment for individual gemstones also seems to be in order for future editions. The abundant and much used chalcedony varieties are discussed all too briefly in four pages of text. Though Dr. Smith may have originally attached little importance to this gemstone, the tremendous volume of trade carried on in chalcedony overshadows by far that of many other species. Admittedly, including a dissertation on this gemstone is like opening Pandora's box, for, literally, there is no end to the forms in which it may be found. However, to say virtually nothing is like solving a problem by ignoring its presence. Very rare species such as rhodizite and taaffeite are given some space, a decision that pleases me personally, since I like variety in gemstones and I am sure others do too. But should not other rare or unusual gemstones such as augelite, petalite, scheelite, niccolite, smaltite, mesolite, to name a few, and even the relatively abundant cancrinite, be at least mentioned? In my view, nephrite is also dismissed far too lightly; close examination of the text fails to reveal any mention of its occurrences in the United States, British Columbia, and the State of Alaska. The production from these areas has been enormous; I daresay it exceeds by a comfortable margin that realized from a number of other world sources combined. My general impression of *Gemstones* has always been that, though it professed to be world-wide in scope, Dr. Smith had leaned too heavily on local sources of information and thus had unconsciously produced a book designed primarily for readers in the British Isles. Admittedly, it must have been far easier to obtain information on gemstones occurring in the numerous outposts of the Empire than in some state in the United States, but, though difficult to obtain, it has always been available and should have been consulted.

Part IV, Identification Tables, closes the text of the book and is only slightly changed, except in the rearrangement of individual entries in the Bibliography, a decided improvement.

Conclusion: An excellent book made even better.

Recommendation: An unsalted goldmine of information that should be purchased for every private and public library.

N.Y. LAB NOTES

(continued from page 229)

lovely waterworn pink spinel crystal.

From ex-student Joseph Dattoli we received a piece of rough yellow-green cat's-eye opal, a quartz "pagoda" stone, a specimen of Tiffany glass, plique-a-jour on glass (Japanese), laminated tortoise shell and a rose quartz epiaster.

We wish to thank Mr. Armand Moss of India Precious Stones, New York City, for specimens illustrating three qualities of emerald from the new Southern Rhodesian source. All show the fascinating inclusions so well pictured in Dr. Gubelin's article on these emeralds in the Fall, 1958, issue of GEMS & GEMOLOGY. From our limited observation of these stones it is quite apparent that the fine colors are outstandingly beautiful. However, it is improbable that they will be used extensively with Colombian stones, since the color is different; i.e., perhaps more yellowish than bluish.

From Mr. Ronnie Romanella, mineral dealer, New York City, we received a specimen of the rare "three-band" (in the spectroscope) Ceylon green zircon.

From Allan Caplan, gem dealer, New York City, we received some specimens of small dyed-green chalcedonies of such high transparency that they are being offered as emerald-calibre imitations.

From Mr. Herman Eldot, lapidary, New York City, we received a specimen of dark-blue aquamarine rough in which the difficult cleavage that is sometimes seen in beryl is incipient and shows excellent iridescence. It can be used effectively for class demonstration of this phenomenon.

L.A. LAB NOTES

(continued from page 231)

on his use of trade names: "You have to use them; if the public knows what the stones really are, they won't buy them." This attitude obviously works for the immediate benefit of just one person to the detriment of the whole industry.

* * *

David Widess, C.G., I. Widess & Son, a Los Angeles diamond and gemstone dealer, has the largest and finest demantoid garnet we have ever seen. It is a 9.73-carat pear shape set in a piece that is obviously old.

* * *

We are indebted to Mr. Widess for the following gifts: fifteen very-much-needed demantoid garnets, which will be put to a very good use in our practice sets and gem display; several carved rubies, sapphires and emeralds, for our gem display cases; and several specimens of rough black star sapphires.

* * *

From Karl Schwemmer, Reading, Pennsylvania, we received an assortment of natural and synthetic stones, which will be used for study purposes.

* * *

Student John Krzton, Chicago collector, donated several cabochons of dyed jadeite, a tourmaline cat's-eye, an orange jadite and a quartz cat's-eye for our practice sets.

From Dr. E. J. Gubelin, C.G., Lucerne, Switzerland, we received a large set of his remarkable color slides featuring gemstone inclusions. These slides, which so beautifully illustrate the characteristic inclusions in demantoid, brown star beryl, star aquamarine, agate, Brazilian emeralds and the new Sandawana emeralds, make a valuable addition to our collection of the Gubelin inclusion series.

* * *

From John Fuhrbach, Furbach Jewelers, Amarillo, Texas, we were pleased to receive an assortment of natural, synthetic and heat-treated stones for use in the GIA's practice sets.

ABOUT THE AUTHOR

Joseph E. Jessop, Jr., gemologist-jeweler, J. Jessop & Sons, San Diego, California, was born in San Diego in 1931. In 1953, he graduated from Pomona College, receiving a B.A. in business administration. Subsequently, he spent three years in active duty with the Navy, one of which was served at the London Headquarters of CINCNELM. Mr. Jessop is presently a Lieutenant in the United States Naval Reserve. Since he comes from a long line of jewelers (J. Jessop & Sons was established in 1890 in San Diego, having previously been in business in England) it was only natural that an inherent interest in gemstones would prompt him to choose it as a profession. He received both his Registered Jeweler and Certified Gemologist titles in 1958, and became a partner in the firm in September, 1958. Although he spent many months in concentrated study during 1958, he reserved several weeks in the Spring to accompany his parents on a European, African and Far East tour. His first-hand account of alluvial diamond mining in Southwest Africa entitled *Glittering Oasis* appears on page 232 of this issue of GEMS & GEMOLOGY.