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The Synthetic Emerald*

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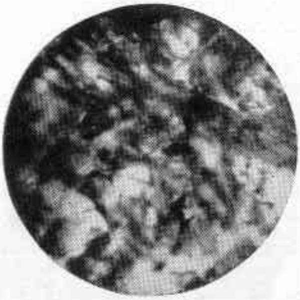
For many years past the synthetic emerald has been referred to as a notable and interesting product of the scientist's laboratory, available only to gemological organizations for the purpose of research or to museums for public display. It was long thought of as a commercially unimportant gem. However, the introduction of the synthetic emerald in the trade has now become a fact. Fashioned synthetic emeralds are now offered for sale in the United States trade; furthermore, caliber-cut stones have been found mixed in papers of genuine emeralds. Certified Gemologists, however, need not fear a disturbance in the gem market by the appearance of this new synthetic stone, as its detection is no more difficult than is the case with synthetic corundum or spinel, though the characteristics are much different.

Five synthetic emeralds, apparently produced but lately, were studied by Doctor Gübelin this winter. These confirmed previous statements on the characteristics of synthetic emeralds. Ten specimens were studied in the G.I.A. laboratory in Los Angeles by Robert M. Shipley, Jr.[1]

The synthetic emerald which the I.G. Farbenindustrie, the makers, markets under the name of "Igmerald," is not manufactured by the same apparatus which is employed to produce synthetic corundum and spinel. Hence, the products of the synthesis are not the well-known pear-shaped boules, but druses of well-developed crystals of very nearly the same habit exhibited by crystals of natural emerald.

When observed with the unaided eye, many of the synthetic emeralds do not differ externally from the natural stone. They show the same velvety green emerald color and the same luster as the genuine gem; and reveal similarly small and subtle impurities and inclusions, which, just as in natural mined stones, do not impair the impression as a whole.



—*Photo by Dr. Gübelin*

Figure 1
Anomalous Double Refraction in Synthetic Emerald.

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*G.I.A. Research Service.

[1] Ed's Note: These 10 specimens came from the agent of a manufacturer who claims to be making them in the U. S. A. by an independently developed process.

The synthetic emerald grows on druses as hexagonal prisms a(1010) and m(1120), determined by the basal pinacoid c(0001) and sometimes combined with short bipyramids p(1011) and s(1121), the same as natural emerald; and they sometimes measure more than half an inch in length. Stones of well over a carat may be cut from these; and synthetic emeralds of this size and smaller, are known to have been in the trade as genuine emeralds.[2]

Striae parallel to the basal plane frequently occur and they may readily be observed under the microscope in cut material. These are perhaps produced by periodic crystal growth accompanied by slight differences in composition and coloring pigment of the mother-liquor. Contrary to the typically curved striae in synthetic corundums, the parallel bands in the "Igmerald" are rigorously straight. All these properties are of no discriminative value and need, therefore, not be dealt with further in this paper.

It is the physical properties of the synthetic emerald as regards refractive index, double refraction, dichroism, absorption, fluorescence, absorption spectrum, density, and especially the inclusions as viewed under magnification, which afford reliable distinguishing features. Although some of the physical tests may appear to be negligible if carried out singly, summarized they procure accurate and authoritative results.

Beginning with the refractive index: measurements on all stones submitted thus far, both in Switzerland and in the U. S., reveal slight, but constant variations. In all cases the amount of double refraction remained around .003 and the highest values obtained for nw(the ordinary ray) did not surpass the lowest of ne(the extraordinary ray) of natural stones. The figures for several synthetic stones and those for genuine emeralds from different localities, as determined by Doctor Gübelin, are tabulated below:

Emeralds	Refractive Index for Sodium Light		Double Refraction*
	n_w	n_e	
Synthetic Emerald 1	1.562	1.559	-0.003
Synthetic Emerald 2	1.564	1.561	-0.003
Colombian Emerald, Muzo	1.569	1.564	-0.005
Brazilian Emerald	1.573	1.568	-0.005
Colombian Emerald, Chivor	1.575	1.570	-0.005
Russian Emerald 1	1.580	1.574	-0.006
Russian Emerald 2	1.582	1.575	-0.007
African Emerald 1	1.587	1.580	-0.007
African Emerald 2	1.587	1.580	-0.007

(2) Occasional very poor unevenly colored synthetic beryls have appeared in the trade in even larger sizes.

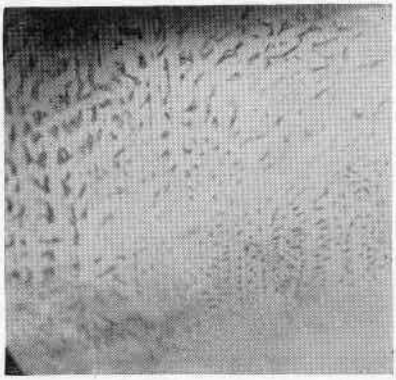
*No attempt has been made so far to establish the fourth place of decimals, since this would have been a matter of academic rather than practical interest.

The dichroism of the synthetic emerald also differs from that of a natural emerald, showing the following pleochroic colors:

Source of Light	***"Igmerald"***	***Emerald***
Artificial	weak yellowish green—green	distinct green—blue-green
Natural	weak yellowish green—bluish green	distinct green—blue-green

However, for older synthetic emeralds (1935) very strong dichroism was described as a means of distinction. The progress of manufacture has caused an important shift in this property.

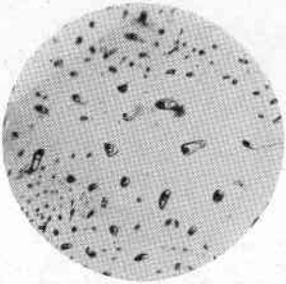
Another distinguishing feature is the pronounced anomalous double refraction of the synthetic emerald. Genuine emerald very rarely shows this effect, and when it is present, the pattern is less regular. The synthetic does not entirely extinguish in parallel polarized light as the stage of the microscope is rotated, but in the four positions of greatest darkness it displays birefringent patches, of which Figure 1 is a good illustration; in white light, interference colors are exhibited. This anomalous extinction is due to internal strain, which probably results from rapid growth.



—Photo by G.I.A. Lab.

Figure 2

Liquid Inclusions in Synthetic Emerald. (U.S.A.)



—Photo by Dr. Gübelin

Figure 3

Liquid Inclusions, with Enclosed Crystalline Particles, in Colombian Emerald.

The internal strain in "Igmerald" has also been described by B. W. Anderson, B.Sc., F.G.A. and C. J. Payne, B.Sc.[3] through Laué photographs, which were obtained in the direction of the hexagonal axis of the "Igmerald." The Laué photographs confirm that both natural and synthetic emeralds belong to the hexagonal system, since both are showing an exclusively six-fold symmetry. The strain in the crystal structure is proved by the doubling of the outer dots in the photograph of the synthetic stone.

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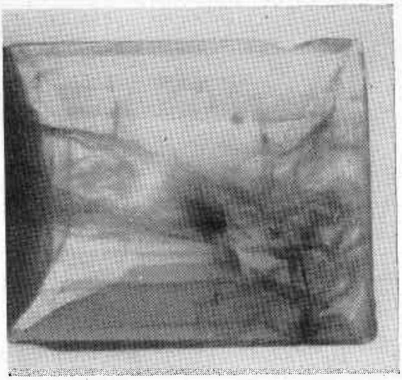
(3) "Igmerald—The German Synthetic Emerald," by B. W. Anderson, B.Sc., *The Gemologist*, Vol. IV, May 1935, No. 46, page 295.

The "Igmerald" has its own characteristics in the absorption spectrum, and in fact it exhibits features different from those of the absorption spectrum as known in any genuine stone. Besides the typical absorption bands of chromium which are perceived in the red end of the spectrum at wave lengths 6295A, 6460A, 6620A, 6740A, 6795A and 6828A, two additional bands appear in the orange-yellow at 5940A and 6060A, appearing most clearly in the polarized light. Moreover the whole spectrum of the "Igmerald" is somewhat more intense than that of natural emerald. The presence of these additional bands constitutes in itself a discriminating test for the "Igmerald." The bands are probably due to a chromium content in excess of that found in genuine emerald.

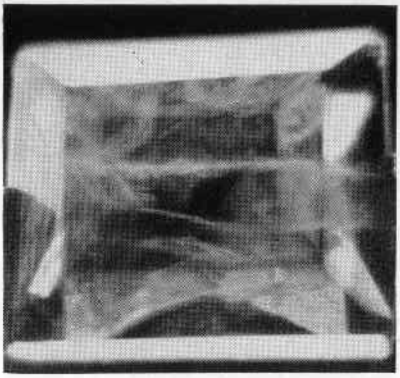


—Photo by G.I.A. Lab.

Figure 4

Wisp-Like Systems of Inclusions in Synthetic Emerald.

When we turn to the specific gravity of synthetic we again find lower values in comparison to the natural stone. The limits so far determined between 2.497 and 2.702 as against 2.670 to 2.750 for the genuine gem. In general, the density increases slightly with depth of color; i.e., with increased content of chromium as a coloring agent. Since these values overlap, this property is of little value as a means of distinction.



—Photo by G.I.A. Lab.

Figure 5

Inclusions in Synthetic Emerald as Seen Through the Diamondscope.

All of the above means of distinction depend upon instruments, which may not be found in the possession of the average jeweler. Therefore, a reliable test which may be performed simply, with a minimum of equipment, is desirable. Fortunately, the basis for such a test is found in the highly distinctive inclusions of synthetic emerald, as viewed under magnification.

The impurities in synthetic emerald may be classified as solid, liquid, or gaseous inclusions. The characteristic three phases of matter in one cavity as seen in natural emerald are absent in the synthetic, and this seems to furnish a reliable test. (See Figures 2 and 3.) Under high magnification, the usual inclusions in synthetic emerald are seen to be liquid or liquid and gas, but they lack the solid crystalline particles characteristic of the genuine material.[4] Solid inclusions in the form of minute particles spread swarm-like throughout the synthetic material. Under the microscope these appear black—under the Diamondscope, green in color.

Liquid inclusions shaped as feathers are the most characteristic type of inclusions in the synthetic. These appear as most delicate, wisp-like, veil-shaped formations resembling cracked lacquer or cloisonne.[5] High-power magnification (250 x) reveals these features to consist of countless tiny, single, liquid inclusions, each of which contains a little round gas-bubble. (See Figure 2.) They are grouped in broad, swarm-like lines, which cross the stone in slightly curved directions. (See Figures 4 and 5.) Systems of almost parallel rod-like inclusions (probably gas-filled cavities) are frequently present in synthetic emeralds. These seem to be more pronounced in stones of earlier manufacture, however.

Summarizing the preceding, it will be apparent that the synthetic may be distinguished from any genuine emerald by the following discerning qualities:

1. Low refractive index, birefringence, and specific gravity; and anomalous double refraction in parallel polarized light.
2. Single bands at wave lengths 5940A and 6060A in the absorption spectrum. (In Igmerald.)
3. Typical inclusions, especially wisp-like or feathery markings.

It will be evident from the foregoing facts that, though the synthetic emerald is very similar in color and external appearance to the genuine stone, and has the same chemical composition and crystal form, no danger may ever threaten the natural gem because of the many possibilities of accurate distinction. It seems unnecessary that its value should ever be affected as were those of rubies and sapphires when synthetic corundums were first introduced.

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(4) "Differentiation Between Russian and Colombian Emeralds," E. Gübelin, *Gems & Gemology,* Vol. III, No. 6, summer 1940, pages 89-92.

(5) "The Detection of Synthetic Emerald," *Gems & Gemology,* Vol. II, No. 10, summer 1938, pages 163-168.

(Continued from page 160)

Cullinan II. About 317 metric carats. Later placed in the King's State Crown.

Cullinan III. A Pendeloque or Pear about 95 carats. In the finial of the Queen's State Crown.

Cullinan IV. A square. About 63.7 carats. In the band of the Queen's State Crown.

There were five other gems from 18.85 to 4.39 carats, and 96 more with a total weight of about 8 carats.

DIAMOND GLOSSARY

This diamond glossary has been compiled to attempt to satisfy a definite need. Terms included are only those specifically related to the study of the diamond —for other gemological terms see the "Gemological Glossary."

Aberration. The failure of a lens or mirror to bring the light rays to the same focus. When due to the form of the lens or mirror it is called spherical aberration. When due to the different refrangibility of light of different colors it is called chromatic aberration.

Abrade. To rub or wear off; to waste or wear away by friction, as to abrade rocks. (Webster.)

Abrasion. A process of erosion. Material carried along streams is gradually worn away by contact with rock surfaces in the stream beds. Abrasion creates "water-worn pebbles," in which form many gems are found. See Waterworn.

Abrasive. A substance used for abrading, as for grinding and polishing.

Accidental Inclusions. See Kimberlite, Inclusions.

Acromatic Triplet. Corrected for chromatic aberration. See Loupe.

Adamant. A stone imagined by some to be of impenetrable hardness; a name given to the diamond and other substances of extreme hardness; but in modern mineralogy it has no technical significance. (Webster.)

Adamantine. Extraordinarily hard. From adams (Greek). The luster of the diamond.

Agulhas (Braz.). Oxides of titanium associated with diamonds. (Halse.)

Ajer-laut. Fancy diamond from Borneo of sea-green color. (Ball.)

Akbar Shah (Shepherd Stone). An Indian diamond. Belonged to Shah Jehan and presumably to his predecessor Akbar Shah. Arabic inscriptions on stone indicate ownership. Probably taken to Persia by Nadir Shah (1739); in 1866 purchased in Constantinople and brought to London where it was recut and drastically reduced in size from 116 carats to 71.7 carats. The inscriptions were destroyed in the recutting. Sold to Gaekwar of Baroda for $175,000.

"Alaska Diamond." Rock crystal.

"Alencon Diamond." Rock crystal.

Allochromatic (coined word). Minerals perfectly colorless or white when pure. Due to the presence of an accidental impurity, they are often colored. The majority of gem minerals are allochromatic.

Allotrope. One of the forms assumed by an allotropic substance; as the diamond is an allotrope of carbon. (Standard.)

Allotropy; Allotropism. The capacity of existing in two or more conditions, that are distinguished by differences in properties. Thus carbon occurs in the cubic system as diamond, in the hexagonal system as graphite, and in an amorphous form—charcoal.

Alluvial Deposits (alluvium). All deposits laid down on land by the agents of erosion. Many gems, especially diamonds, are found in this type of deposit.

Alluvial Sorting. Diamonds from poor original sources concentrated in smaller alluvial deposits, thus making mining commercially profitable.

Alluvium. Lyell's name for the deposit of loose gravel, sand and mud that usually intervenes in every district between the superficial covering of vegetal mould and the adjacent rock. The word is derived from the Latin word for an inundation. It was employed by Naumann as a general term for sediments in water as contrasted with eolian rocks. It is generally used today for the earthy deposit made by running streams, especially during times of flood. (Kemp.)

"Alpine Diamond." Pyrite.

Altered Stones. Diamonds or other stones which are coated or internally treated with some foreign substance to change their color or appearance. See, also, Coated diamond. See, also, Treated diamond.

American Cut. A specific style of brilliant cut. The angles of its bezel facets (34 30') with the plane of the girdle. Ideal proportions for maximum brilliancy and dispersion according to Tolkowsky.

Amygdaloidal Diabase. An igneous rock in which diamond has been found apparently at its point of origin in South Africa.

Angola. The Kasai River forms part of the boundary between the Belgian Congo and Angola (Portuguese West Africa). The alluvial deposits are not confined to the Congo side of the river. Also, the Angolese headwater tributaries of the Kasai yield many alluvial diamonds.

Angle of polarization. That angle whose tangent is the index of refraction of a reflecting substance. (Dana.)

Anomalous Double Refraction. Double refraction in a normally singly refractive substance caused by internal strain.

Anomalies. As applied to crystals, refers to lack of harmony of optical phenomena with apparent symmetry of external form. (Dana.)

Aplanatic Lens. A lens free from spherical aberration. See Aberration.

Aplanatic Triplet. Loupe corrected for spherical and chromatic aberration. See Loupe.

AP (absolutely perfect). See Perfect.

Arizona Diamonds. See United States.

Arkansas. Diamonds were discovered in Pike County, Arkansas, in 1906, in a pipe similar to those in South Africa. Never really a commercial source.

Arkansas Diamond. Diamond from Arkansas; also (incorrectly) rock crystal from Arkansas.

Ascension Theory. The theory that the matter filling fissure veins was introduced in solution from below. (Raymond.)

Assembled Stones. A term suggested by Shipley for any stone made of two or more parts of genuine and imitation gem materials. See, also, Foil backs.

Atherstone, Wm. Guybon (1813-1898). Pioneer in South African geology. Atherstone's identification as a diamond of a crystal found at De Kalk, near the junction of the Riet and Vaal rivers (1867), led indirectly to the establishment of the great diamond industry of South Africa. He encouraged the workings at Jagersfontein, and he also called attention to the diamantiferous neck at Kimberley.

Atom. When ordinarily used in mineralogy, or gemology, refers to the smallest particle of an element which exists either alone or in combination with similar particles of the same or a different element. See, also, Molecule.

Attrition. Act of rubbing together; friction; act of wearing or state of being worn; abrasion. (Webster.)

Augite. The commonest rock-making pyroxene. As distinguished from other pyroxenes, augite refers to the dark varieties with considerable alumina and iron. The name is used as a descriptive prefix to many rocks that contain the mineral, as for instance, augite-andesite. (Kemp.) See Pyroxene.

Australia. Diamonds were discovered in New South Wales in 1851. Diamonds are found in other localities in Australia and a few finds have been reported from Tasmania, but no deposits of importance.

Axis. In crystallography, one of the imaginary lines in a crystal which are used as coordinate axes of reference in determining the positions and symbols of the crystal planes. (La Forge.)

Baby. A trough or cradle in which gravel was washed for diamonds by early South African prospectors.

Bagagem (Brazil). One source of the finest Brazilian stones. Second diamond-bearing region to be discovered in Brazil, west of Diamantina in Minas Geraes. It was in this region that the 254-carat "Star of the South" was found. See, also, Bahia.

Baguette. A style or shape in which diamond gems are cut.

Bahia. A gem-bearing state (or territory) in Brazil. Diamonds were discovered here as early as 1755. Most important diamond-bearing region is in the vicinity of Cincora. Inferior to stones from Bagagem and Canavieiras. Also an important carbonado source.

Balance Fly Bubble. Bubble of gas in the liquid inclusion similar to a bubble in a carpenter's level. See, also, Gas inclosures.

Ball, Dr. Sydney H (obart). American geologist and authority on geology, diamonds and other precious stones. Dr. Ball has been assistant geologist of U. S. Geological Survey; chief geologist Soc. Int. Forestiere et Miniére du Congo; consulting engineer, U. S. Bureau of Mines; is on advisory board of Gemological Institute of America; president of Soc. Econ. Geol. ('30); twice president of Min. and Metal. Soc.; Member of Soc. Belge de Geol.; hon. mem. Chem. Metal. and Min. Soc. So. Africa. Dr. Ball is the author of many treatises and papers on geology and mineralogy.

Ball, Dr. Valentine (1843-1895). Authority on economic geology of India and made of occurrence and distribution of diamonds in India. English translator of the best edition of Jen Baptiste Tavernier's Travels in India.

Ballas (Modified form of the Portuguese "bolas" meaning a bullet). An important industrial variety of the diamond. Spherical masses of minute diamond crystals, arranged more or less concentrically; cleavage difficult; extremely hard and very tough.

(To be continued)

Colorado Lapis Lazuli*

by

HAROLD I. ROSENCRANS

Certified Gemologist, Longmont, Colorado

High in the Sawatch Range of the Colorado Rockies, on Italian Mountain, a prospector was finishing a day's work on his garnet claim where he had discovered Grossularite of the green variety and also the Hessonite variety commonly called Hyacinth garnet. From the claim near the base of the west side of the mountain to his cabin on the east side lay his path—a long, dangerous climb. A cold rain had begun to fall and the sharp north wind made the rain cut like ice as it struck his face.

Generally he worked his way along the crest of a ridge to the summit, but because of the cold wind and rain he decided to make his way to the top along the bottom of a gully which pitched steeply down the mountainside. The bottom of the gully was choked with slide rock which made climbing difficult. He had not traveled far when he noticed a rock one corner of which was of a decided blue color, especially so because it was wet from the rain. With his pick-a-dilly, or rock hammer, he knocked off a fragment and dropped it into his pocket. He did not give the blue rock much thought at the time, thinking that the color was probably due to copper stain. Then he made his way up and over the twelve thousand five hundred-foot summit and when safely in his cabin consigned the blue fragment to a pile of samples yet to be tested.

A couple of weeks later he came upon the specimen, and after examining it closely he was convinced that he had never before found anything like it. His tests were simple but revealing. He heated it and found that he could bring it to almost a red heat without its fracturing. Moreover, when the sample cooled its blue color returned. He applied acids and noted the characteristic odor of hydrogen sulfide. He tested the hardness and streak, and determined the specific gravity of the material and finally concluded that he had found Lazurite or Lapis Lazuli. Having a scientific attitude he was not fully convinced on the basis of such simple tests. He sent a sample to a testing laboratory, and when the report was returned it verified his conclusion. He had found the treasure of the ancients, Lapis Lazuli.

The prospector, whose name is Carl Anderson, returned to the locality in which he had picked up the Lapis and soon found the rock from which he had taken his first sample. From where he stood, he looked up the mountain for he knew that this rock had broken loose and rolled down from some spot on that broad, high slope. Back and forth across the steep slope he worked, hunting for some indication of the vein, and finally came to the top without success. For three days he repeated this procedure without finding even so much as a trace of Lapis. Then

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*A.G.S. Research Service.

he remembered a trick he had used with some success in the past. With a true prospector's determination he started up the slope again, and began to roll rocks about the size of the original mass down the mountainside. He continued to do this until two or three of the boulders stopped at about the place of his original discovery. But looking carefully around him he could see not even one fragment of Lapis. The slope here was quite steep and covered with disintegrated rock, gravel and soil. As a last resort he started to dig and before he had reached more than a foot below the surface, he began to find small pieces of Lapis. Below this, a few inches, he struck a vein of hard, metamorphosed lime rock. Here in this lime rock vein the Lapis was formed.

By digging he exposed this lime rock vein to a depth of five feet and discovered three veins of Lapis running through it. In places the Lapis stringers were seven to eight inches wide; in other places they pinched out completely. After locating the vein he was able to expose Lapis outcrops for a distance of three hundred feet along the face of the mountain.

Lapis Lazuli, the gem symbolic of truth, was worn and treasured by the ancients more than a thousand years B. C. In Biblical times it was known as the sapphire. In those ancient days it came from the mines of Afghanistan and was prized above gold and other precious objects. In modern times Lapis has been imported from Persia, Siberia and Chile. There is a deposit of poor-quality Lapis near Lake Mono in California.

Lapis Lazuli, the gem, is not a mineral but a rock formed of a mixture of Lazurite and several other minerals, usually diopside, amphibole, mica, calcite and pyrite. Lazurite is a complex silicate and the blue color is perhaps due to the presence of sulphur. It is an opaque stone of various shades of blue. Vivid ultramarine blue, light blue, greenish blue, and violetish blue are among the colors exhibited. Gem material containing a very large amount of white calcite or other minerals in proportion to Lazurite is called lapis matrix. It is apparently formed by contact metamorphism between limestone or marble and igneous rocks. Its crystalline character is cubic and gem material is in the form of a massive granular aggregate. The luster is feebly vitreous on a fractured surface. Polished surfaces are vitreous but never brilliant and often waxy. The hardness varies from 5 to 5½. The streak is white to light blue and its toughness is fair to poor. There is no cleavage. It has a subconchoidal to uneven fracture. Its specific gravity varies from 2.5 to 2.9 and its refractive index is 1.5. Lapis is decomposed by hydrochloric acid and the distinguishing features are its intense blue color and inclusions of calcite and pyrite crystals which are usually present.

Italian Mountain has been exposed in succession to folding and faulting and intense volcanic activity. Later glaciers carved into its sides great cirques depositing alluvial material in long moraines. Directly below the summit is a four-foot-wide vein of graphite, which unfortunately is worthless because it is amorphous.

In this section, sedimentary strata of the Mississippian period have been folded against the pre-Cambrian mass of the Sawatch range and have been profoundly folded and faulted. This folding and faulting occurred at about the close of the Cretaceous period. Igneous rock was intruded into the Paleozoic strata of which the Lapis-bearing limestone is a part. The intrusions were diorite porphyry. On the upper section of Italian Mountain the intrusive material is diorite. This difference is possibly due to more rapid cooling.

The lowest of the sedimentary beds is a thick layer of highly metamorphosed, almost black, limestone with a slatey structure. This bed rests upon the diorite porphyry. Immediately above the black limestone is the mineralized stratum, containing the three stringers of Lapis. Directly above is a 100-foot-thick layer of calcareous chert, called limey quartz by the miners of the district. Above the chert is another series of limestone beds. Capping the whole series of sediments is a mass of diorite. There is no sign of mineralization on this upper contact.

I have concluded from my yet not thoroughly complete investigations that the Lapis was formed by pyrometasomatic action. Any action of this type is characterized by the presence of large bodies of intruded magma. In this case, the diorite magmas enclosed the Mississippian beds containing much carbonaceous material, and converted the carbon to graphite, to form the above-mentioned vein. Ascending emanations consisting of hot, magmatic water and intensely heated gases attacked the carbonate minerals in the limestone, precipitating in their place Lazurite, pyrite and re-crystallized calcite. The constituents of these minerals were undoubtedly leached from both the magma and the limestone by percolating waters. This reaction is supposed to have taken place at a temperature of about four hundred degrees centigrade. As the temperature gradually diminished, the other minerals noted in the limestone, including serpentine, were deposited. In order to form the complex silicate known as Lazurite, the temperature and pressure factors must remain within definite limits. Also, the surrounding rocks must contain the proper elements ready for solution in the hot water and gases. These are the reasons Lapis is not more extensively found.

Since its discovery in September of 1939, the Lapis claim has been developed to a depth of about fifteen feet in one location and produced about one hundred pounds of Lapis. Development work is slow, because of the short season, the high altitude and the fact that the overburden is badly fractured and must be removed before work on the vein can proceed with safety.

The Lapis varies in color from almost black to intense blue; the best colored material coming apparently from near the zone of contact. It contains narrow veins and spots of calcite and it is all heavily charged with pyrite crystals, which in some pieces require magnification in order to be seen. Of the hand-picked material we have cut and polished, only about five per cent has been of the best color. So far the Lapis lacks the texture and hardness of good Siberian Lapis. Its specific gravity ranges from 2.82 to 2.85 and its luster is waxy to subvitreous on polished surfaces.

The deposit has not been sufficiently developed to make possible an accurate estimate of the quantity and quality of its production.

A GEMOLOGICAL ENCYCLOPEDIA

(Continued from last issue)

by HENRY E. BRIGGS, Ph.D.

SPODUMENE

Gem varieties of spodumene embrace two varieties, which are not only beautiful, but of rather high comparative value. Hiddenite is the green variety, the color of which varies from a light yellow-green to a deep emerald-green. Kunzite is a variety of delicate pink to violet color named after Dr. G. F. Kunz. Spodumene is monoclinic, occurring in crystals of enormous dimensions. However, the gem varieties are seldom found in crystals of large size. It has a highly perfect cleavage, in fact, so perfect is the cleavage that the lapidary must use great care in cutting such gems in order to prevent their ruin. A fall of a piece of jewelry set with a spodumene is indeed apt to shatter the gem and ruin it. Spodumene is rather hard, however, being 6 to 7, but due to its extreme brittleness and highly perfect cleavage, it is not usable as a ring set. The specific gravity of spodumene is 3.1 to 3.2, luster vitreous, mean index of refraction 1.66, biaxial and optically positive, pleochroism strong in gem varieties. Spodumene is a lithium aluminum silicate, $LiAl(SiO_3)_2$. The green variety comes from Alexander County, North Carolina, where it is found in kaolin veins. The kunzite variety is found at Pala, California, and in Madagascar, while a yellow spodumene comes from Brazil.

Kunzite is peculiar in that it will phosphoresce brightly for several minutes after being subjected to radiation by X-rays. Ultra-violet light also causes a similar effect, although not so marked.

DIOPSIDE

Diopside, when of good color and cut, is a rather pleasing gem, although it is not hard. The hardness is from 5 to 6, and, consequently, it is not durable for a ring set. The specific gravity is 3.2 to 3.3, crystallization monoclinic, luster is vitreous, color green, yellow, greyish and colorless, mean index of refraction is 1.68, biaxial and optically positive, pleochroism faint to distinct, composition calcium magnesium silicate, $CaMg(SiO_3)_2$. Principal localities for gem crystals are: Italy, Tyrol, Canada and New York State.

CASSITERITE

Transparent cassiterite, when of good quality and cut, makes an unusually nice looking gem. However, fine transparent gems are very rare, and, consequently, this gem is little known. Cassiterite is found in well-formed tetragonal crystals, sometimes twinned, and also in the massive state. The specific gravity is very high as gem materials go, being near 6.9. The hardness is 6 to 7, and being very tough, it is quite durable. The gem quality is transparent, and of a yellow, reddish brown or brown color. However, the bulk of the cassiterite crystals found are black and opaque, thus being not suitable for gem purposes. The mean index of refraction is 2.04, uniaxial and optically positive, pleochroism strong, composition tin oxide, SnO_2. It is the one important ore of tin. Gem quality crystals have been found in the Malay peninsula, in New South Wales, in Cornwall, England; in Saxony, in Nigeria, Africa, and in the U. S., in the Black Hills of South Dakota.

ENSTATITE, HYPERSTHENE, AND BRONZITE

Occasionally we see gems cut from one of these closely related pyroxenes. Enstatite from South Africa has a pleasing yellowish green to green color and is often cut and sold, sometimes as "green garnet." This is true of much of the green enstatite found in the diamond fields of South Africa. Hypersthene also is used to some extent as a gem, but it is usually cut en cabochon. Bronzite is not used as a gem, but is occasionally used as an ornamental stone for making paper weights, etc.

The hardness of these minerals is from 5 to 6, the gravity 3.1 to 3.5, luster vitreous, pearly to metallic or dull, translucent to opaque, mean index of refraction 1.67 to 1.70, biaxial and optically positive for enstatite and negative for hypersthene, composition of enstatite is $MgSiO_3$, magnesium silicate, hypersthene is $(Mg,Fe)SiO_3$, magnesium iron silicate. Bronzite is intermediate between enstatite and hypersthene in composition and properties. Enstatite of gem grade is found in South Africa and Norway. Hypersthene of a gem grade is found in California and New Jersey.

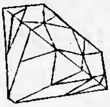
CHLORASTROLITE

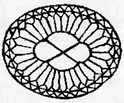
Chlorastrolite is used to some extent as a gem, but it is not widely distributed in commerce. It is found only around Lake Superior, especially nice pebbles coming from Isle Royale, and from the North Shore copper region. They are cut and sold in that locality as "Greenstones." The mineral is very closely related to prehnite, being a silicate of aluminum and calcium. It occurs in water-rolled pebbles, and exhibits a chatoyancy when cut. It is of a dark green color with unique markings of other shades of green or bluish. The hardness is 5 to 6 and the specific gravity near 3.2. When cut, the gem is very attractive, and is deserving of more attention than it has been given in the past.

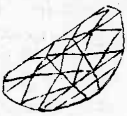
STAUROLITE

Staurolite, also known as Fairy-Stone and Cross-Stone, is used occasionally as a gem, although it is of little interest, except for its unusual twinning. Twin crystals form crosses which are rather novel, and when polished make nice looking watch fobs, charms and pendants. The crystallization is orthorhombic and twinned crystals are very common. The peculiar shape, resembling the cross worn by the clergy, has caused legends and superstitions to surround the twinned crystals, and in some parts they are held as being almost a sacred stone, even today. The color is brown to reddish brown, and the mineral is translucent to opaque. The luster is vitreous to dull, index of refraction (mean) 1.74, biaxial and optically positive, pleochroism distinct, hardness 7 to 7½, specific gravity 3.4 to 3.8, composition iron aluminum silicate, $HFeAl_5Si_2O_{13}$. The most important localities are Georgia, Brazil, Switzerland and Tyrol.

Important Diamonds of the World

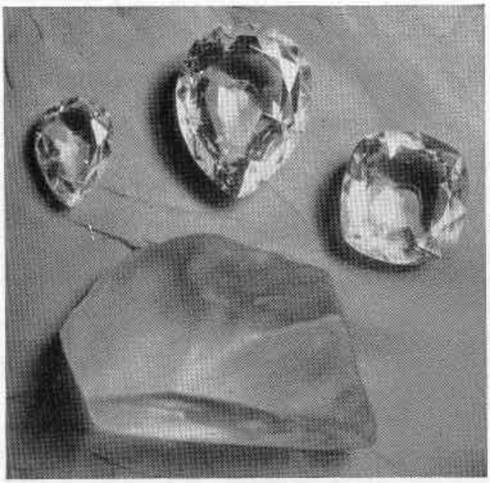






Robert M. Shipley

THE CULLINAN OR STAR OF AFRICA



The World's Largest Diamond (¼ Actual Size), and Three "Stars of Africa" Cut from it.

The great Cullinan diamond, found in 1905, is the world's largest diamond. The story of the discovery is thrilling. Mr. Frederick Wells, the Surface Manager of the Premier Mine in South Africa, was walking through the mine at the close of the day's work. Eighteen feet below the surface of the ground Mr. Wells' eyes were drawn to a shining reflection on the wall of the mine. Climbing the wall he found what appeared to be a large diamond crystal. Because tricks were common amongst the employees of the mine, Mr. Wells decided that someone had embedded a large piece of glass in the blue ground, and was lying in wait to watch his excitement when he should carry his "diamond" to the office. After loosening the large crystal, Mr. Wells then made tests and satisfied himself that he had really found a diamond—the largest diamond in the world. It weighed 3,106 metric carats (3,025¾ South African carats), or about 1 1/3 pounds avoirdupois. What Mr. Wells did not know was that he had discovered an almost flawless diamond, limpid in color like clear water. One can well imagine the excitement his discovery caused. Mr. Thomas Cullinan, President of the Premier Diamond Mining Company, was in the office at the time and the news of the great discovery soon reached England. The diamond was called the Cullinan. Later King George V asked that it be called the Star of Africa. In a short time it was on its way to England, insured for $1,250,000. For his discovery Mr. Wells received a gift of $10,000 from the DeBeers Company.

After reaching England the question was to find a purchaser for the gem. Various estimates of its value were made, some as high as $75,000,000. The stone was shown to many prospective customers, and when removed from the bank was insured by a "floater" policy of $2,500,000 even though it was guarded at all times by a squad of detectives. King Edward VII examined it and the cost of removing it from the bank for two hours was $725.00. It was suggested that the gem be purchased by public subscription for $2,500,000 and given to King Edward. Nothing ever came of this and in August, 1907, Premier Botha of the Transvaal, a former Boer general who had fought Britain, proposed its purchase by the Transvaal, as a gift to King Edward VII in appreciation of his having granted a constitution to that colony. The price paid by the Transvaal government has been quoted at various amounts, but it seems safe to state that perhaps slightly less than $1,000,000 is approximately correct. The diamond was presented to the king on his sixty-sixth birthday, November 9, 1907. The gift did not include the cost of cutting and His Majesty selected Asscher Brothers of Amsterdam, cutters of the Excelsior, for this task.

After months of study of the huge crystal, it was decided to cleave it into five parts. Mr. J. Asscher was assigned to the task. On February 10, 1908, at 2:45 p.m., the decisive blow was struck. Mr. Asscher placed the big cleavage knife in a previously prepared v-shaped groove one-fourth-inch deep. He struck the knife with a large steel rod. The crystal remained intact. The knife had broken. The second attempt was even more tense than the first. Failure might mean the complete destruction of one million dollars. There was no failure. The second time the gem cleaved exactly as planned, and Mr. Fritz Barkan of San Francisco, who was employed in the factory at the time reports that after the second blow Mr. Asscher fainted. A second cleavage in the same direction produced three principal sections. These sections were divided into nine principal gems. The polishing of the gems began March 3, 1908, and three men worked from 7:00 a.m. until 9:00 p.m. for a period of eight months, Sundays included. Doctor Kunz stated that "The cost of cutting the Cullinan stones was met by the sale of several of the minor diamonds."

The four largest gems are a part of the crown jewels of England.

Cullinan I, a Pendeloque or Pear, about 530 metric carats. Later placed in the English sceptre.

(Continued on page 150)