Gems & Gemology

GEMS & GEMOLOGY is the quarterly official organ of the Gemological Institute of America. In harmony with its position of maintaining an unbiased and uninfluenced position in the jewelry trade, no advertising is accepted. Any opinions expressed in signed articles are understood to be the views of the author and not of the publishers.

VOLUME IV SUMMER, 1943 NUMBER 6

◆

In This Issue: *Page*

◆

Published by

THE GEMOLOGICAL INSTITUTE OF AMERICA

541 South Alexandria Ave. Los Angeles 5, California

The Chemical Compound of Some Liquid Inclusions*

by

EDWARD GÜBELIN, Ph.D., C.G.
Lucerne, Switzerland

It is of importance to both mineralogy and gemology that there are means whereby to determine the chemical compound of liquid inclusions, because it is this knowledge which helps us to ascertain the origin of a given gem. We know today that the great majority of liquid inclusions consists of pure water, carbon dioxide, carbonic acid or dissolved salts, probably small particles of the mother liquor from which the gem stones have originated. Some, in which water or carbonic acid predominates, also contain gas in the form of spherical or elipsoidical vesicles.

Chemistry teaches us that the "critical point of temperature" of carbonic acid, that is the temperature by which carbonic acid turns from the liquid into the gaseous state, is 31.1°C. The fact is that the libella (= moveable gas bubble) of an inclusion containing carbonic acid disappears when the temperature is increased over 31.1°C, and that it reappears after consequent cooling off to the critical point and below.

When minerals containing liquid carbonic acid are split in lime water a precipitation of lime carbonate results. Also, the spectral apparatuses (emission spectrograph and absorption spectroscope) show the spectrum of pure carbon acid. Of late it has been noticed that the liquid carbonic acid occurs in a far greater number of gems than was formerly assumed.

We owe a great debt of gratitude to the researches of Sir David Brewster, Th. Simmler, H. Vogelsang, H. Geissler, H. C. Sorby and P. J. Butler which yielded us the information that the various liquid inclusions in a great many gem stones, such as emeralds, aquamarines, other beryls, alexandrites, sapphires, topazes and quartzes consist of carbonic acid, water or carbon dioxide either liquid or gaseous.

In 1835 the English physicist Sir David Brewster distinguished two types of liquid inclusions which were to be found either in separate cavities or together in one tube, yet never mixing. One liquid behaved very similar to pure water, showing a low refractive index and being of wetting and rather stable character, whereas the other solution was non-wetting, quite agile and revealed a high degree of expansion. He thought it to be carbon dioxide. He examined smoky quartz, sapphires and topazes.

Twenty-three years later R. Th. Simmler was able to confirm Brewster's observations as to the chemical nature of the included liquids. Yet, both based their assertions upon supposition.

Not until H. Vogelsang and H. Geissler from 1869 to 1879 worked by means of spectral analysis was

---

*G.I.A. Research Service.

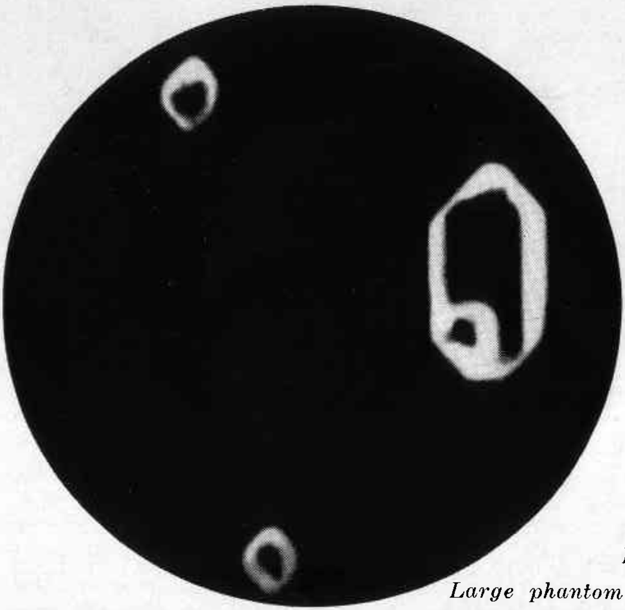


Photo by Dr. Gübelin

Fig. 1
Large phantom in a cairngorm at normal room temperature. 50x.

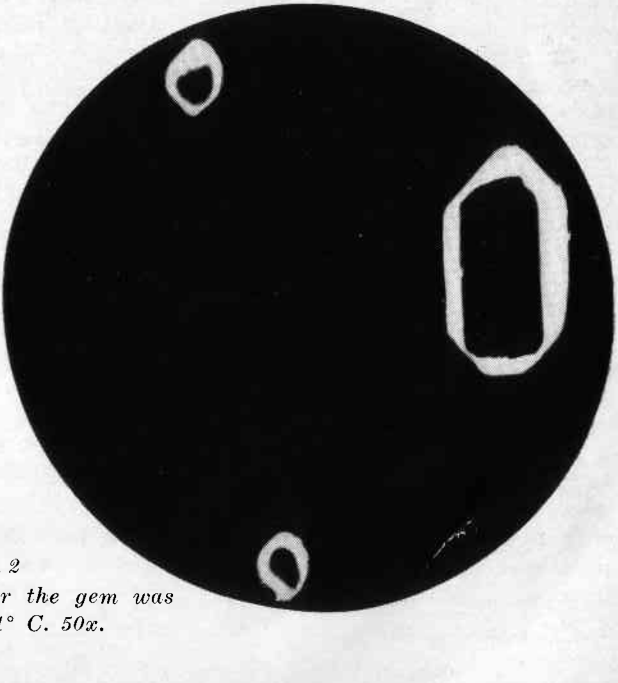


Photo by Dr. Gübelin

Fig. 2
Same inclusion after the gem was heated over 31° C. 50x.

it made clear that those liquid inclusions consisted of water and carbon dioxide.

H. C. Sorby and P. J. Butler (1858) extended their researches to rubies, sapphires and diamonds and published many detailed facts of physical and chemical properties of therein embedded liquid inclusions.

Recent and modernized research by the author upon the chemical composition of liquid and gaseous inclusions endorsed those discoveries of the last century and, at the same time, led to further results as to the genesis of the respective gems.

As is the case of many valuable examinations here again the magnificent G.I.A. Diamondscope proved to be of most beneficial service. The relatively high temperature developed by the little bulb inside the illuminator and controlled by means of the transformer may suffice to heat a stone properly. The degree of temperature may be read from a simple room thermometer which may easily be attached to the instrument. Thus one gets a highly efficient heating microscope for the determination of the nature of some liquid inclusions.

Many samples of different species were examined under various heating conditions.

As best objects for distinct observations, stones encasing liquid inclusions with one or more moveable gas bubbles may be chosen. These heavily bordered vesicles being spherical or elipsoidical in shape are strongly curved towards the surrounding liquid. This distinct and convex demarcation line between the liquid and the gaseous phase in the inclusion is called meniscus and it is the principal feature of the inclusion upon which measurements may be taken. The inclusions themselves may have all shapes and sizes; the larger ones generally lying along oriented crystallographic directions and assuming the crystal habit of the mother-gem or ranging downwards to small and microscopic, irregularly arranged and shaped drops of liquid.

For all inclusions which revealed to contain liquid and gaseous carbonic acid the observations proved to be constant; and to summarize the results achieved, the description of the investigations carried on upon a large phantom inclusion in a smoky quartz may serve as a typical example which counts for all.

By means of the stoneholder the gem was put on the Diamondscope and the bulb was heated by an electric current of 4 volts. Thus, the stone warmed very slowly and observation could be made at ease. The meniscus is strongly curved at about 20°C (the liquid clings to the walls of the cavity and partly embraces the bubble), but slowly and gradually it flattens the higher the temperature rises. Simultaneously the volume of the liquid increases and the gas diminishes. At about 29°C the meniscus is absolutely straight and the liquid phase fills about 4/5 of the cavity. At 29.9° ± 0.1°C (critical temperature) a sudden conversion of all liquid into gas takes place; in other words, the meniscus vanishes suddenly and all liquid gasifies. Upon slow cooling off the liquid phase returns visible because of the reappearing of the meniscus at exactly the same place (provided the stone has not meanwhile been inclined or rotated into another position) immediately after

Photo by Dr. Gübelin

Fig. 3

Group of phantoms and irregular inclusions containing carbonic acid in a light blue aquamarine at normal room temperature. 100x.

Photo by Dr. Gübelin

Fig. 4

Same group of inclusions after the stone was heated over 31° C. 100x.

a scarcely perceptible layer of haze has arisen. The quicker the gem is chilled the broader the cloud of mist; when the stone is suddenly cooled off by means of cold water the whole cavity appears foggy. Gas and liquid separate very quickly and afterwards a few bubbles rise in the clear liquid to join the large vesicle.

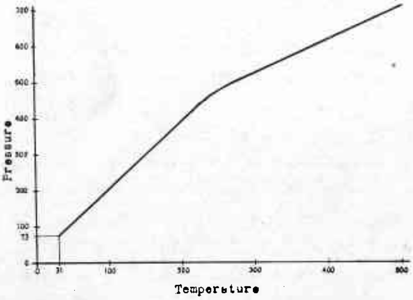
Within the same stone the critical temperature is equal for all liquid inclusions. There is no doubt that the tested liquid and gaseous substance is carbonic acid with but slight pollution of probably water and air. The critical constants of carbonic acid are the following:

Critical temperature: 31.1-31.35°C.
Critical pressure: 73 atmospheres.
Critical density: 0.464.

Impurities in the liquid may cause the critical temperature to be lower than 31°C, as it happened to be with the inclusion here referred to. The fact that no second phase of liquid matter seemed to be present in perceptible amounts justifies the assumption that the carbonic acid was practically pure. The diagram of pressure and temperature, in this case, will but slightly deviate from that of pure carbonic acid.

This fascinating phenomenon was also observed in Colombian emerald, Ceylon sapphire and Ceylon ruby, Ceylon alexandrite, various beryls, topaz, phenakite and various quartzes but it never occurred in tourmaline, chrysoberyl, nor in certain types of inclusions in topaz, nor in inclusions containing three phases of matter in Colombian and Uralian emerald. A moveable bubble may generally be considered as indication of the presence of carbonic acid.

Pressure-Temperature Graph



As a conclusion of those observations the following theory about the genesis of the respective gem stones and their inclusions may be derived.

(To be continued)

So-Called "Mexican Jade"

by

EDWARD WIGGLESWORTH, Ph.D., C.G.

A stone has recently been advertised in *Harpers Bazaar*, *Vogue* and *The Jewelers' Circular-Keystone*, under the name of "Imperial Mexican Jade." The advertisement implies that it is something unusual, and is being presented by the Imperial Gem Syndicate of 607 Fifth Avenue, New York. An A.G.S. Graduate Member purchased some of this material at a department store and it has been submitted to the G.I.A. Eastern Laboratory for identification. Previously, material advertised merely as Mexican Jade by a Detroit store had been submitted to Dr. C. B. Slawson at the request of Detroit Better Business Bureau, whose report on it caused the store at which it was sold to publish an advertisement of apology to their customers.

The specimen tested at our laboratory was a nearly opaque gem stone carved in the shape of a bird, but having one flat side. In color and luster it is suggestive of a piece of porcelain chinaware. Fortunately, it was possible to obtain refractive index readings which, while not very sharp, definitely showed two shadows —one at about 1.50 and the other at about 1.66. The specific gravity as obtained on the diamond scales, using carbon tetrachloride, was determined as 2.70. The hardness was 3. These tests suggested calcite and so a drop of cold hydrochloric acid was placed on the stone. This immediately effervesced, which confirmed that the material was in reality calcite. The material is banded, and the color varies with the bands, suggesting that it has been dyed.

This is apparently the same material as that tested by Dr. Slawson and identified by him as calcite and confirms the tests on this particular stone by the above-mentioned Graduate Member. It seems to add another instance of a material of little value being treated and sold under a misleading name.

U. S. Develops Synthetic Sapphire Industry

Release of Linde Air Products Company, Unit of Union Carbide and Carbon Corporation, Library Members, Gemological Institute of America, Inc.

Many are the near-miracles performed by American industry within the past two years, but few can equal in romance the story of America's new synthetic ruby and sapphire manufacture. For, cut off from the European supply because of the war, America has had to develop its own manufacture of boules, the raw material for both synthetic gems and jewel bearings. Boule quality and production have been developed—in less than two years—to the extent that one company, The Linde Air Products Company, a Unit of Union Carbide and Carbon Corporation, supplies boules in commercial quantities of quality unsurpassed by European manufacture.

To understand the accomplishments of American chemists and engineers, it is well to review the chemistry and history of the manufacture of synthetic rubies and sapphires, which, from a mineralogical standpoint, are classified as gem-quality types of corundum.

Natural rubies and sapphires are single crystals of the chemical compound, aluminum oxide, commonly known as alumina. The color is caused by the presence of metallic oxides such as those of chromium, titanium, iron, or cobalt. If gem-quality corundum is red, the stone is a ruby; if blue, clear, yellow, green, pink or violet, it is called a sapphire. Synthetic sapphire and ruby boules are of the same chemical composition as natural stones. To make any of these varieties synthetically, it is necessary to purify aluminum oxides; add to it a suitable pigment, which, in natural stones, was introduced as an impurity by nature; and by a suitable method crystallize it in boule form.

This can be accomplished by the oxygen-hydrogen furnace method developed by Auguste Verneuil, a French chemist, in 1902. Today, this process is universally used to produce synthetic material in crystal form.

The Verneuil process was originally intended for the manufacture of synthetic rubies. Improvements and modifications have now made it possible to produce sapphires of various colors as well as spinels. Essentially, the equipment consists of a powder dispenser from which alumina is fed into an oxy-hydrogen flame, and thence onto a pedestal where the fused material crystallizes as corundum. The corundum slowly builds up as a cylindrical or bullet-shaped mass (the boule), having its small end down. When the proper size of boule has been attained, the furnace is shut off and the boule is allowed to cool slowly.

European Production

The first boules made by this process in Switzerland, France, and Germany were small and contained many air bubbles, internal cracks, and other defects. As the furnace

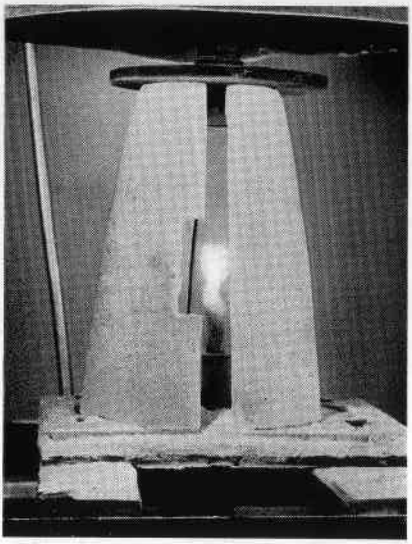


Fig. 1

Boules are manufactured in an oxygen-hydrogen furnace of this type. This has been partially opened for photography.

operators gained experience, however, imperfections became fewer, and larger sizes were made possible.

Until this year these three European countries were the only sources of synthetic corundum and spinel, the latter having been introduced about 1926. Production of all the European plants was last reported to be almost 1,000,000 carats a day, practically all of which were cut in Europe. Cut gems, jewel bearings, and, to some extent, boules were imported to the United States. Considerable quantities of these imports were used for ornamental jewelry, but a sizable proportion has been utilized for industrial purposes, such as for bearings for watches, electric meters, and precision instruments.

Recognizing, in the Autumn of 1940, that the dwindling imports of synthetic sapphires would soon not be sufficient to meet America's growing demands, despite the fact that users had built up stocks as fast as they could all through 1939 and 1940, the Government invited a number of domestic manufacturers, basically qualified, to attempt to produce this material. The Linde Air Products Company was in a particularly favorable position to investigate the problem and to set up facilities to manufacture corundum.

Problems of Manufacture

The production of synthetics was no easy task. No European experts were available to supervise manufacture. Many problems arose and each had to be solved by careful and tedious experimentation. Therefore, the production of the first small, clear crystal represented many months of intensive research.

From a single original laboratory furnace, the manufacturer went into small-scale production, and 18 months after the start, The Linde Air Products Company reported to the War Production Board that it was ready to furnish white sapphire in any reasonable quantity. The boules are, at the present writing, used entirely for essential industrial and military uses. It is hoped, however, that in the not-too-distant future the material will be available for other uses.

Advantages of Synthetics

The principal advantage of synthetic corundum for wear-resistant bearings is its great hardness. According to Mohs' scale, it is next to the diamond in hardness. There is a difference in hardness, however, between individual specimens of corundum, whether natural or synthetic. The high hardness and homogeneity of synthetic boule produces long-lasting wearing surfaces, thus increasing the accurate life of delicate mechanisms.

Practically, the synthetic gems are perfect, and this, coupled with the fact that the boule is of uniform size, offers decided economies in cutting not found in natural sapphire.

Synthetics in Jewelry

The use of American-made boules for ornamental jewelry holds the same advantages as are found in industrial applications. Naturally, economies of cutting are realized, the same as in cutting industrial gems. There is less stone wasted because cutting procedures can be standardized.

Colored boules grow more slowly than clear ones, and are usually smaller. However, when the pressure of war demands is relieved a variety of colors and color tones will be manufactured. In fact, very fine colored gems have already been made experimentally. In addition to this, spinel of many colors will be made after the war.

Identifying Domestic Synthetics

The white boules (sapphires) are the desired industrial product, although red boules (rubies) have also been made in some quantity. In general, all synthetic and natural corundums are chemically identical. The pigment has little effect on specific gravity and refractive index. Differences in hardness are exceedingly difficult to measure without elaborate equipment.

While at the present time attention is almost entirely focused on the production and fabrication of sapphire or jewel bearings, the material is destined to occupy an important position for other industrial peacetime processes. The properties of high hardness, high resistivity to chemical attack and thermal shock, and excellent dielectric properties, are characteristics which, singly or collectively, automatically select sapphire for such applications as insulators in vacuum thermionic devices, diesel engine injector nozzles, thread guides, oil burner nozzles, and special abrasives. Many industrial articles can and probably will be fabricated by jewelers and lapidaries as well as plants that specialize in the cutting of industrial sapphire products.

It is a tribute to American industry that it could so rapidly adapt its knowledge and experience to the making of such an exacting product. With the boule production problems solved in this country, it is believed that the domestic cutting and fabrication of synthetic sapphire will become more mechanized and the number of operators will grow to help form a complete, efficient, and lasting sapphire-fabricating industry.

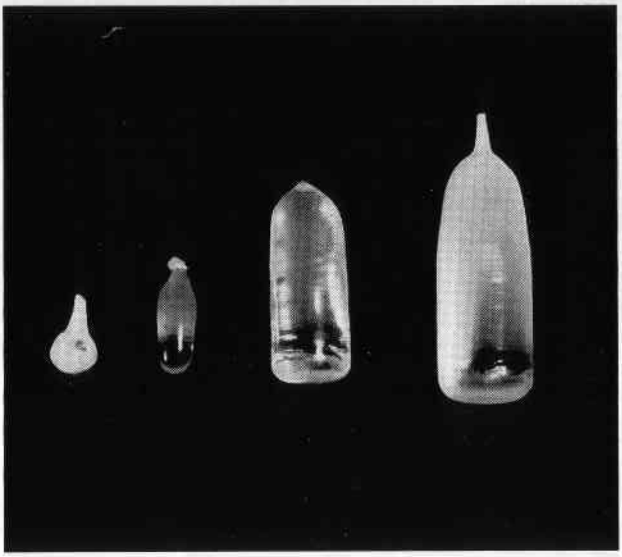


Fig. 2

Observe the comparison between these American-made boules. Left, a 14-carat, white, opaque, and shattered boule, one of the earliest attempts in December, 1940. Next, a 20-carat, clear boule made soon after —the first clear material made by Linde. Next, a 200-carat boule representative of present commercial material. At the extreme right, the "1943 model"—flawless, hard, and perfect in its formation, one of the most recent boules chosen for its outstanding size—about 350 carats.

TABLE I

Hardness of Mohs' Minerals and Sapphire

	Mohs' Hardness	Tukon Microhardness* (Knoop Indenter)
Gypsum	2	32
Apatite (parallel to optical axis)	5	360
Quartz (parallel to optical axis)	7	710
Topaz	8	1,250
Tungsten Carbide	9	1,450-1,600
Montana Sapphire	9	1,450-1,600
Burma Sapphire	9	1,600
Synthetic Sapphire (perpendicular to optical axis)	9	1,500-1,700
Synthetic Sapphire (parallel to optical axis)	9	1,600-1,900
Diamond	10	5,800-6,200

*Values provided through the courtesy of the National Bureau of Standards.

Gift from Switzerland

Edward Gübelin, C.G., of Lucerne, Switzerland, Sustaining and Endowment Member and postgraduate student of G.I.A., has presented the Gemological Institute with an incomparable gift, the result of many hours of careful research on his part—129 colored photomicrographic Kodachrome slides of inclusions in both genuine and synthetic stones. The slides include Burma, Siam and Ceylon rubies; Cashmere, Siam and Ceylon sapphires; Colombian and Uralian emeralds, aquamarines, beryls, alexandrites, cats-eyes, garnet, spinel, tourmalines, topazes, amethysts, citrine, iolite, and diamonds; also synthetic rubies and sapphires. The colors are unusually true. One minor but interesting feature is the reproduction of the dichroic colors of certain stones.

The slides are accompanied by a 19-page lecture which, among other things, explains the characteristic inclusions of rubies, sapphires and emeralds from different localities, and characteristic inclusions in synthetics and in glass imitations, many of them illustrative of Dr. Gübelin's valuable research reported by him in previous issues of *Gems & Gemology.*

The slides and lecture have been used with great success by Dr. Gübelin before the Rotary Club of Switzerland, the faculty and students of certain Swiss universities and natural history societies. A condensation of the lectures, in form of an article, recently appeared in the Swiss counterpart of *Life* magazine accompanied by amazingly beautiful and accurate color reproductions of 9 photomicrographs.

The slides and lecture will be made available to C.G.s and G.I.A. instructors for presentation at Regional Guild meetings of the American Gem Society and will probably be a feature of the G.I.A. educational program at the first postwar conclaves of that society. Under conditions which assure the safety of the slides they may be made available to universities and scientific societies.

This gift represents the first work of this kind ever to be reported to us and an outstanding contribution both to the Gemological Institute and to world gemology. In monetary terms its value is inestimable.

LEON S. DAVIS, CERTIFIED GEMOLOGIST

Leon S. Davis, 54, Certified Gemologist of Binghamton, New York, died on June 21, 1943, after a long illness. Mr. Davis was C.G. #48, having received his title on November 10, 1938. He was among the first jewelers in the eastern states to become interested in gemology. His contributions to the development of the North American gemological profession were important and numerous. He was Organizer and Past President of the Central New York Guild, A.G.S.; Past-Chairman, International Admissions Board; Past-Chairman, Eastern Division Advertising Committee.

Mr. Davis was born in Homer, Cortland County, New York, May 28, 1889. At the time of his death he was a partner in the firm of Darrow-Davis, Inc., Registered Jewelers, A.G.S.

The Pearls of Lower California

Editor's Note:

Max Miller's ***"Land Where Time Stands Still—Today's Story of Baja California,"*** is a vivid exciting and sympathetic book on Lower California, a land practically unknown to the vast majority of the citizens of the United States, and yet Baja California is the mother of Alta California—"the matrix from which our own California was struck."

One of the chapters tells the fantastic story of the death of the pearl oyster and the end of the La Paz industry that was a source of Mexican revenue for centuries. Through the courtesy of the publishers, ***Dodd, Mead and Company, New York City,*** we are permitted to quote the following:

"A mysterious epidemic to the pearl-oyster beds is what caused it. Everybody in La Paz will agree on that part of the tragedy. The pearl-oysters suddenly all died within a single season not very long before my arrival. The beds all died at once, even those which were a hundred miles apart. Nothing like it had ever happened before in the entire history of La Paz pearling.

"The synonymy of pearls and La Paz is a very ancient synonymy. And here it was just my luck to come in at the death of it.

"My mind had been all set on describing the pearling fleets. With any sort of luck I had hoped to make a cruise on one of the diving vessels. Well, I can *still* describe the pearling fleet of La Paz. Much of the fleet lay high, dry, and rotting upon the peninsula across the bay. I can *still* describe the diving equipment. It was all stacked inside a board fence next to the water front. Here were the diving pumps rusting and weathering—much after the order of the Little Tin Soldier.

"Nor does there seem much use for the diving pumps to wait, duty-bound, for the summons to go into action again. According to the stranded old pearlers around town, there will be no more action. The stricken pearl-oyster beds appear unable to make a comeback. Periodically, while I was in La Paz, scouts would return to town with a report that the oysters were growing once more. But to La Paz such reports already were becoming an old story. Yes, some of the oysters could be detected as growing—but only for a short time, and only until they reached a certain size (too little for commercial pearls, and then they would all die off again, killed by the mysterious epidemic, or blight, or whatever it is.

"The prevailing rumor in La Paz is that some Japanese experts are responsible. Nor does the war have anything to do with the theory. It was circulated a year before Japan became an enemy. The theory, in fact, was circulated as soon as the beds began dying. Some of the pearlers had seen strange goings-on by Japanese fishermen prior to the epidemic.

"La Paz, with its natural-colored pearls as well as its white ones, had remained the one serious rival to

Japan's pearl-culturing industry. Colored pearls, the blacks and the blues, cannot be deliberately cultured. For this reason the colored pearls were becoming more valuable and more in demand than the white ones. The buyer of a colored pearl knew he was not buying a cultured one. And the pearls of La Paz were noted for their colors. Japan, so they say in La Paz, began less and less to like the idea. It could prove serious. It could, in brief, knock the stilts from under the culture-industry.

"So La Paz, for the first time in the four centuries of history, has no more pearls. The pearl-oyster beds behave as if inoculated with a poison, a poison which has spread from a few diseased oysters in one bed to all the others.

"The pearlers can understand how such a thing might have happened naturally in a single bed. But they cannot understand how it could have happened in all of the well-known beds, hundreds of miles apart, simultaneously.

"The pearlers don't know. Nobody in La Paz knows. And so it was a town of sadness which I entered. It was a medieval town as well. It was as medieval as the seventeenth century."

THE GEMOLOGICAL INSTITUTE OF SWITZERLAND

Under the leadership of Edward Gübelin, Ph.D., C.G., this association has recently been organized.

The third nation-wide organization of its kind, it has been patterned on the Gemological Institute of America, even to the spelling of the name with but one "m."

Dr. Gübelin completed his gemological education at G.I.A. headquarters in Los Angeles by studying the Institute's courses, obtaining his Certified Gemologist title and pursuing postgraduate work.

The Swiss association has as its objectives not only a laboratory, the immediate needs of which is served by Dr. Gübelin's excellent laboratory, but the establishment of gemological courses.

DIAMOND GLOSSARY

(Continued from last issue)

Holohedral. The name given to the highest symmetry class of the cubic or isometric system. Diamond is in this class.

Hope. An Indian diamond, usually described as sapphire blue but sometimes described as a grayish or smoky blue, not unlike the familiar grayish blue of many Montana sapphires. Weight in the rough unknown, cut 44.5 c. Strong circumstantial evidence links it with the blue diamond which Tavernier bought in India in 1642 and sold later to Louis XIV. The Hope is probably the larger portion of the "Tavernier Blue" stolen from the Garde Meuble (Royal Treasury) in Paris in 1792. The diamond was probably cleaved and the larger portion appeared on the market in 1830. The diamond passed into the hands of Henry Thomas Hope and the family owned the blue gem for a number of years. In 1867 it was sold, passed through other hands until 1911 when it was sold to Edward B. McLean of Washington, the sale price in this case being $300,000. In 1938 Mrs. McLean was still in possession of the gem. See Brunswick; Tavernier Blue; Wittlesbach.

"Horatio Diamond". Colorless quartz from Arkansas.

"Hot Springs Diamond". Rock crystal from Hot Springs, Arkansas.

Hyderabad. A native state of India, also its capital. See Golconda, Nizam of.

I. (Abbreviation for imperfect). Term used in grading diamonds for comparative perfection.

Icy Flakes. A seldom used trade name for small cracks along cleavage planes sometimes caused by overheating stones during fashioning.

I.D.B. Act. Illicit Diamond Buying Act. A South African law which makes the buying of diamonds from native laborers and others not entitled to their possession, a criminal offense.

Ideal Brilliant. A term used principally in German publications referring to a brilliant which possesses those proportions and angles, which produce the greatest brilliancy. In the ideal diamond brilliant consideration is also given to maximum dispersion.

Igneous Rocks. Rocks formed upon the solidification of molten material or magma.

Illuminating Hand Magnifiers. Hand flashlights which illuminate the surface of a gem as it is observed through a magnifier incorporated in the assemblage. Sold under trademarked names such as Beam-o-scope, the light is reflected from the stone's surface, masking any imperfections it may possess.

"Imitation Doublets". A term applied in American trade to paste or glass imitations of gem stones, including diamonds.

Imitations. In its broadest sense, anything which simulates a genuine natural gem. Gemologically the term is applied only to glass, plastics and other amorphous compositions, distinguished from synthetics and assembled stones.

Imperfect. Term used in grading diamonds for 'comparative perfection. Containing imperfections easily seen unaided by any normal eye. See also Slightly Imperfect.

Imperfect, Slightly (S. I.). Term used in grading for comparative perfection. Larger imperfections than in Third Pique, but not in a conspicuous position, easily seen under a loupe or even by the unaided eye.

Imperfect, Very, Very Slightly (V.V.S.I.). Some dealers use term for Piqué, others use term for Clean. See Clean; Piqué.

Imperfection. A trade term used to refer to inclusions or faulty structure of any kind which is visible to the eye whether observed with or without the aid of a magnifier. Term is less rarely used to refer to faulty cutting or polishing.

Imperial Diamond. See Victoria Diamond.

Inclusion. In gemology; the general name inclusion is given to any foreign body inclosed within a substance, whatever its origin. They may be gaseous, liquid or solid; visible to the naked eye or requiring the use of a magnifier. In geology, a fragment, of whatever size, of another rock inclosed in an igneous rock.

Inclusions, Solid. More or less well formed crystals of the same or other minerals. However, crystals of other minerals are often included in gem minerals.

Incrustation. A crust or coating.

Indestructibility. Diamond is comparatively indestructible. It resists abrasion as does no other substance. It can be forced into steel. However, it can be destroyed by intense heat passing directly from a solid to a gaseous state. Sharp blows or the action of rapid temperature changes on inclusions may result in cleavage, breakage or disintegration.

Industrial. Diamond usually unsuitable for gems, used for industrial purposes. See Ballas; Bort; Carbonado.

Index of Refraction. Refraction is an optical property of the diamond and other substances; the index is a measure of the amount that light passing is bent as it passes from air into a more dense transmitting substance. The index of the refraction of the diamond is 2.42.

India. Diamonds were found generally along the eastern slope of the Deccan Plateau. The original source of these diamonds has never been discovered. The mines which were important from about 1000 A.D. fell into disuse after discovery of the Brazilian sources.

Indian Cut. A clumsy form of the single brilliant cut, adopted by East Indian cutters for the purpose of getting as much weight as possible after cutting.

Ingrowth. A small crystal which completed its growth and was then caught up and partially inclosed by the larger growth.

In Situ. A term used to describe the location of minerals when found in the place where they were originally formed.

Interference, Color. Colors produced by the destruction or weakening of certain wave lengths of a composite beam of light by interference. An important element in the determination of minerals in thin sections under the polarizing microscope.

(To be continued)