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.

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Gemstone Inclusions*

Photomicrographs arranged as an aid to identification of gem species and of the differences between genuine and synthetic sapphires, rubies and emeralds. All illustrations from kodachrome transparencies by Dr. E. Gübelin, C.G., of Lucerne, Switzerland, Research Member, G.I.A.

Reproductions of Dr. E. Gübelin's photomicrographs continues in this issue with a series chosen from his 129 remarkable Kodachrome slides, a gift to the Institute, which illustrate his lecture "The Inclusions in Gemstones."

For the purposes of comparison, Figure 39 is reprinted from an earlier issue.

Dr. Gübelin has photographed inclusions helpful both to the jeweler and the gemologist in distinguishing between genuine and synthetic stones.

Rubies were the subject of our last presentation. The studies on these pages are of inclusions in genuine and synthetic emeralds.

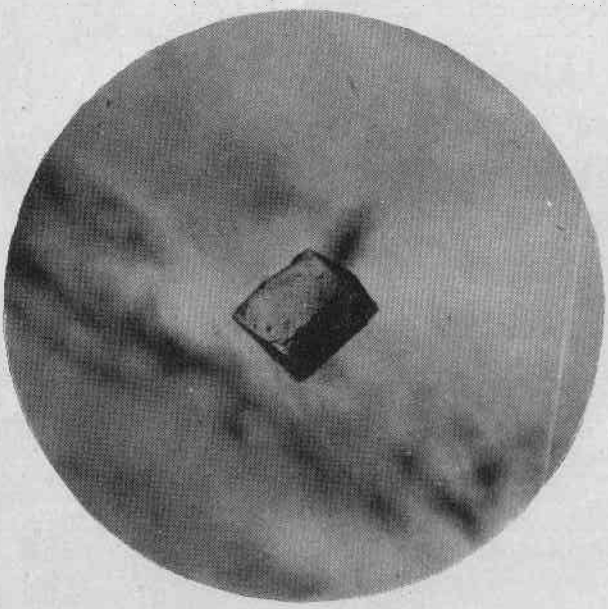


Figure 27
***A Colombian emerald** showing a remarkable inclusion which is a well-developed trigonal crystal of tourmaline.*

*A.G.S. Research Service.

Figure 28
A Colombian emerald *having an abundant distribution of smallest three-phase inclusions. The three-phase inclusions are most interesting, as they are cavities which contain the three phases of matter at once, that is, one or more crystals and one or more gas bubbles are bedded in liquid which fills the cavity.*

Figure 29
Synthetic emerald *with wisp-like feathers, the most prominent inclusions in synthetic emeralds, which under high-power magnification dissolve into countless tiny single liquid drops, each of which contains a little round gas bubble. They are grouped in broad, swarm-like lines, which cross the stone in slightly curved directions.*

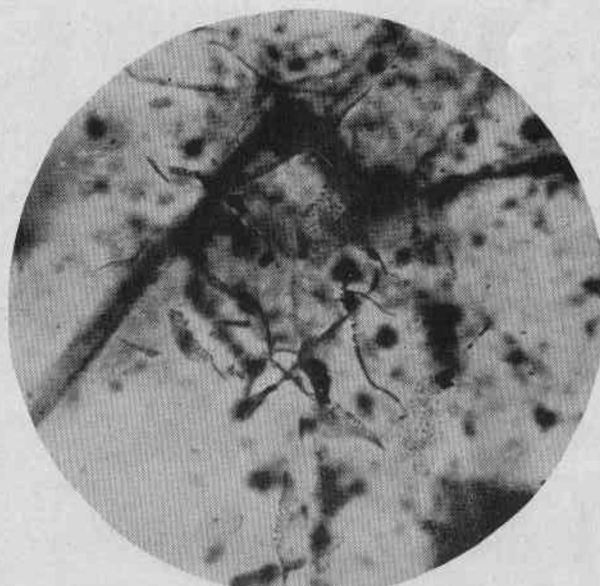


Figure 30
A Colombian emerald *with a very unusual but interesting air-filled fracture exhibiting a dendritic pattern.*

Figure 31
Synthetic emerald *exhibiting wisp-like inclusions, with the small particles of coloring matter sprinkled throughout.*

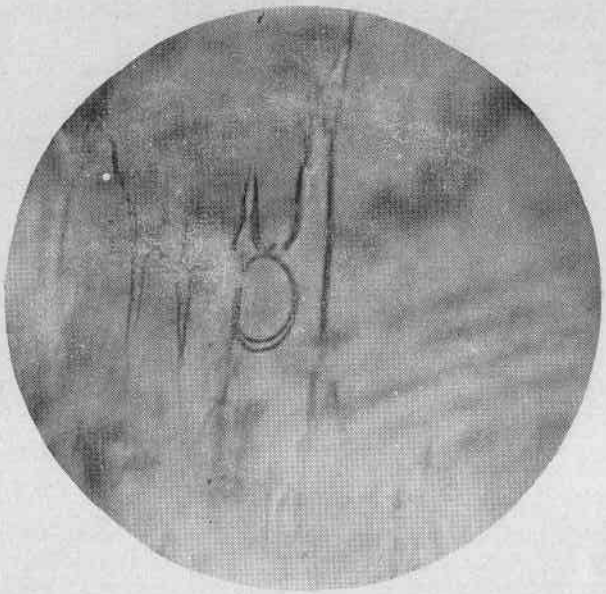


Figure 32
Genuine Colombian emerald *showing typically jagged inclusion with non-miscible liquids, these are liquids which are not capable of mixing. A still higher development of the filling is provided by the three-phase inclusions.*

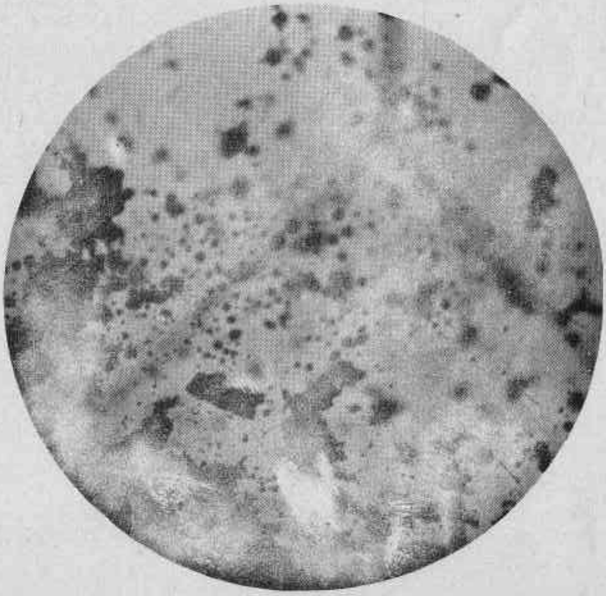


Figure 33
Synthetic emerald *showing smaller and coarser solid inclusions — particles of coloring matter. (Those small particles which are out of focus seem to be spherical.)*

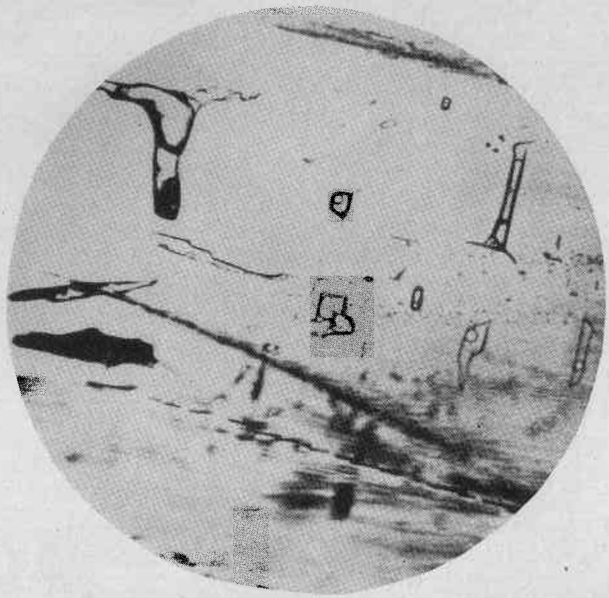


Figure 34
Natural emerald *having individualistic liquid inclusions of unknown provenience. Such inclusions would never occur in the synthetic material.*

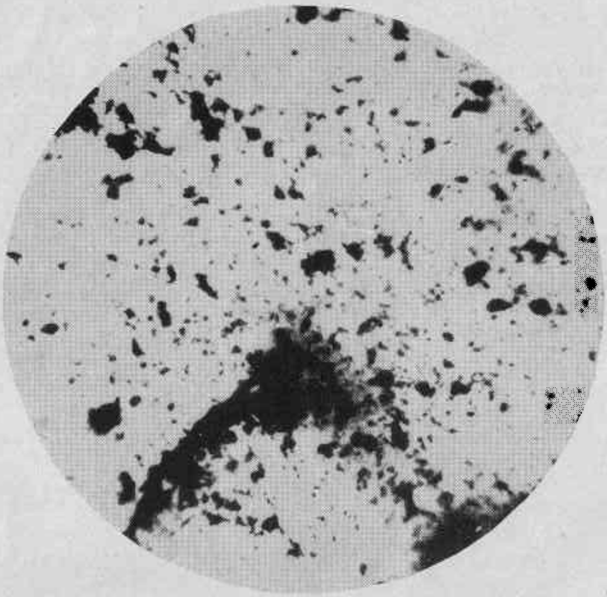


Figure 35
Synthetic emerald *exhibiting solid inclusions in the form of minute particles spread swarm-like throughout the synthetic stone. Under the microscope these appear black—under the Diamondscope, green in color.*

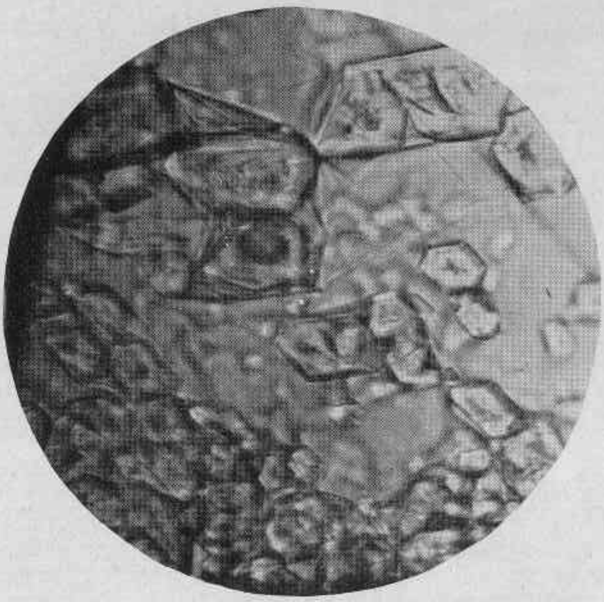


Figure 36
***Genuine emerald** exhibiting a great mass of calcite inclusions (presumably precipitation during growth of the host mineral) which is responsible for the slightly oily appearance of some of the most beautiful and highly priced Colombian emeralds.*

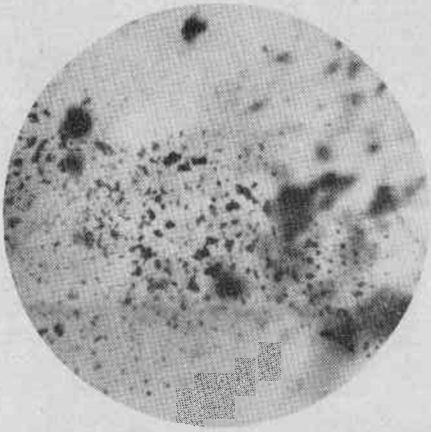


Figure 37
***Synthetic emerald** which shows swarms of solid particles.*
(Reprinted from Fall, 1940 issue)

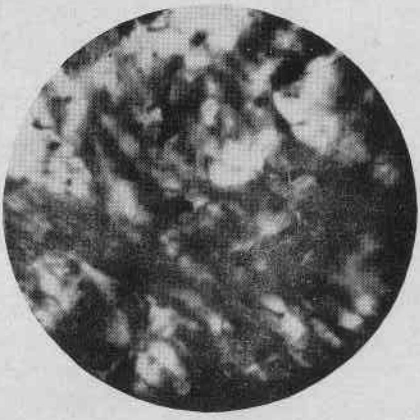


Figure 38
***Synthetic emerald** exhibiting anomalous double refraction.*
(Reprinted from Summer, 1941 issue)

Gemstones and the Spectroscope*

Absorption Spectra Due to Chromium

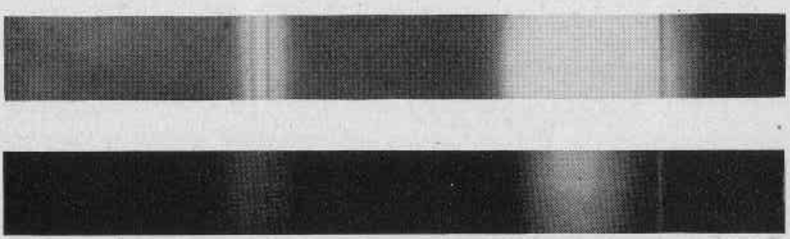
The Second in a Series by

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

In most cases the absorption bands seen in gemstones can be ascribed to the presence of one particular absorbing element acting as "colouring agent" in the mineral. Different colour-varieties of a species will usually have quite distinct absorption spectra

a

b



(a) Absorption spectrum and (b) fluorescence spectrum of ruby, photographed in grating camera on hypersensitive panchromatic plates; 15 seconds exposure.

—for instance red spinel, coloured by chromic oxide, has absorption bands entirely different from those of blue spinel, which owes its colour to ferrous iron. In describing the individual spectra I shall attempt to group them as far as possible according to the colouring element mainly responsible for the bands, as this seems the most logical treatment, though there are some spectra which cannot yet be ascribed with certainty to a particular element.

It is noteworthy that the elements which have a colouring action on the minerals or other compounds in which they occur form a contiguous series in the periodic classification based on atomic numbers, beginning with titanium (atomic number 22) and continuing with vanadium, chromium, manganese iron, cobalt, nickel, to copper (atomic number 29). Apart from these, some of the "rare earth" metals and uranous uranium also give distinctive absorption bands in certain minerals, though their action on visible colour is relatively slight.

Chromium and iron are the principal colouring agents in the gem minerals, and pride of place will be given to stones coloured by chromium, since these include some of the most important varieties, and their spectra are peculiarly distinctive. Chromium indeed is undoubtedly the aristocrat amongst colouring agents, providing the finest reds in ruby, spinel, and pyrope garnet, the finest greens in

*G.I.A. Research Service.

emerald, jadeite, demantoid, the rare green hiddenite, and chrome diopside, and also the curious half-way colour of alexandrite. In addition, we have detected chromium bands in pink topaz, pale green euclase, blue kyanite, and in the violet-blue chatoyant scapolite from Burma. It may be noted that all these minerals contain alumina as an essential constituent, and it is by small-scale isomorphous replacement of Al_2O_3 by Cr_2O_3 in the crystal lattice that the latter finds its home in these various minerals.

Without further preamble, I will begin the description of absorption spectra of the individual minerals coloured by chromic oxide.

Ruby

Ruby presents the richest and most clearly defined absorption bands of all the chromium-coloured minerals, and has several very distinctive features. Independent observations, with wave-length measurements, on the ruby spectrum were published by Miethe in Germany (1907), Moir in South Africa (1909) and Keeley in the U.S.A. (1911). Our own work in this field did not begin until the end of 1932, but, being then unaware of what had previously been published, we had all the excitement of "discovering" the phenomena in ruby for ourselves; in particular, the fluorescence spectrum described below. By photographing the spectrum on infra-red plates, and by careful scrutiny of exceptionally chrome-rich specimens, we added one or two previously unrecorded bands to the list: in all we measured twenty bands in ruby, though the majority of these are unimportant for diagnostic purposes and will not be detailed here.

The main feature of the ruby absorption spectrum is an intense broad absorption band covering the yellow and green regions, and to this, and to the complete absorption of the deep blue and violet, the colour of the mineral is due. The band is at its broadest in the direction of the optic axis, that is to say, in the "ordinary" ray. If ruby is observed at right angles to this direction and a polarising prism or filter is rotated between the stone and the spectroscope, the broad band can be seen expanding and contracting like a concertina in accordance with the well-known dichroism of the mineral.

More valuable than this main band from the point of view of identification are certain narrow bands seen in the red and in the blue regions of the spectrum. At room temperatures some of these are only 2 angstroms in breadth, and at liquid air temperatures they are comparable in sharpness to the Fraunhofer absorption lines in the solar spectrum. Some authors have referred to them as "hair lines" rather than "bands" for this reason. Similar narrow bands in the red are a typical feature of all transparent chrome-rich minerals and compounds, though the number and position of the bands is different for each species. It is also usual to find that the two strongest of the narrow lines form a close "doublet" in the deep red, which may appear as a single line in a small prism spectroscope. In ruby this doublet is very strong and has the strange characteristic of being "reversible" that is, it appears as **bright lines** on a darker background when the strongly illuminated specimen is viewed through the spectroscope at an angle ("scattered light").

(To Be Concluded)

BOOK REVIEWS

Dana's System of Mineralogy

By

EDWARD H. KRAUS

Dana's *System of Mineralogy*, Seventh Edition, Volume I. By Charles Palache, Harry Berman, and Clifford Frondel. John Wiley and Sons, Inc., New York. 1944. XIII+834 p. $10.

For over a hundred years, James Dwight Dana's *System of Mineralogy* has been recognized as a world authority and has frequently been referred to as the mineralogist's Bible. The first edition appeared in 1837 when the author was but 24 years of age. It was received most favorably and revisions appeared in rapid succession. The sixth edition was published in 1892 by Edward S. Dana, the son. This monumental volume was supplemented by appendixes in 1899, 1909, and 1915. During the succeeding decades, progress in mineralogy and the related sciences has been so great that a revision had long been hoped for. Accordingly, all interested in the earth sciences welcome the publication of the first volume of the seventh edition by John Wiley and Sons, Inc., New York, publishers of Dana's System since 1844. The authors are Professors Charles Palache, Harry Berman, and Clifford Frondel, all of the Department of Mineralogy of Harvard University. The revision was made possible by grants from the Geological Society of America and from the Holden Endowment of Harvard University.

Volume I includes the introductory chapter and descriptions of the elements, sulphides, sulphosalts, and the oxides. Volume II will contain descriptions of the halides, carbonates, sulphates, borates, phosphates, arsenates, and so forth, while volume III will be devoted entirely to silica and the silicates. Preparation of the second volume began in 1941, supported by a grant from the Penrose Fund of the American Philosophical Society, but was interrupted in 1942 by the war. As soon as conditions of peace will permit, work on the second volume will be resumed. Until all three volumes have been issued, according to the publishers, the sixth edition will remain in print.

Scientific Changes

The many scientific advances important to the study of minerals, which have been made since 1892, have required numerous changes in the new edition. It may be pointed out that X-rays were not discovered until three years after the sixth edition appeared, and radium and radio activity not until some years later. It is well known that modern X-ray analysis has led to a clearer understanding of the crystal structure of many minerals which has made new classifications necessary.

The new volume discusses in the introduction, the principles followed in classifying minerals, and presents data relating to morphological and X-ray crystallography, crystal habit, the physical, optical, and chemical properties, occurrences, alterations, syntheses, names, nomenclature, and synonyms of minerals. There is an excellent bibliography of important periodicals and independent volumes which includes 37 pages.

Those interested in gems and gem materials will be surprised that quartz is not described among the oxides. The authors inform us that this mineral will be considered with the silicates in the third volume. The section dealing with the elements has been changed greatly in that the metals, instead of nonmetals, are described first. Thus, the first element to be considered is gold, whereas in the older edition the description of the diamond appeared first. In the new volume the description of the diamond is quite concise. Some famous diamonds and their weights are listed but there is no reference to the cutting of the diamond for gem purposes or to the extensive use of diamonds in industry.

"Synthetic Diamonds"

Unfortunately under the subtitle of artificial preparation, the authors make the following statement covering the diamond: "Obtained by reaction of alkali metals, kerosene and bone oil in sealed iron tubes at high temperature and pressure. The numerous other reported syntheses are questionable." It is thus obvious that the authors have assumed that J. B. Hannay had succeeded in producing diamonds in 1880 for they give as the authority for this statement the article by Bannister and Lonsdale which appeared in the Mineralogical Magazine (London) in 1943. The readers of *Gems and Gemology* are well aware that in the winter issue of 1943, Volume IV, Number 8, the authenticity of Hannay's alleged artificial diamonds was questioned by Dr. Sydney Ball and me. The authors, unfortunately, erroneously credit Hey instead of Bannister and Lonsdale as having written the article on the Hannay diamonds, referred to above.

The new volume has entailed an enormous amount of diligent research and the careful weighing of evidence. Every effort has been made to have the data up to date and authoritative, but in a work of such a comprehensive nature, some errors are bound to creep in. The new volume will be greatly used and will contribute very materially to increasing the vitality and influence of Dana's System.

***Dana's System of Mineralogy*, Seventh Edition, Volume 1. By Charles Palache, Harry Berman, and Clifford Frondel. Price $10.00. (May be obtained from G.I.A. Book Department.)**

NOTE: Bold-face type was chosen by the editors for the opening paragraph under subhead "Synthetic Diamonds" especially to recommend it to the attention of gemology students.

GEMOLOGICAL DIGESTS

More Patents Issued on Modifications of Brilliant-Cut Diamonds

A United States patent was issued some time ago on the processing of a diamond upon which a girdle had been polished with 48 flat surfaces or facets. Patents have more recently been issued for a diamond containing 12 star facets, 12 bezel facets and 24 top break facets and a table on the crown, plus 12 pavilion facets and 24 bottom break facets and one culet on the pavilion, being 86 facets in all instead of the usual 56. At the same time a patent was issued for a 114-facet stone which would possess 16 star, bezel and pavilion facets and 32 top and bottom break facets instead of the 12 and 16 facets just mentioned. Furthermore, a 102-facet diamond is being advertised in jewelry trade periodicals as having patents applied for its processing or design, the number and placing of such facets as yet being unknown to this institute.

Claims for Increased Brilliancy Not Yet Verified

Claims of increased brilliancy are being made for most, if not all, of these cuttings and similar claims are being made or are implied for other diamonds recently announced under at least two different trademarked names, which diamonds seem to differ from standard brilliant-cut diamonds only by virtue of the circular polishing of their girdles.

The Gemological Institute has so far been unable to verify any such claims for increased brilliancy of any one of the above-mentioned modifications of the standard brilliant cut.

Polished Girdles Not New

Any implication that the polishing of girdles with or without flat surfaces or facets constitutes a new process or design is a deceptive implication since such polishing was extensively practiced on this continent decades ago.

Robert M. Shipley

Russian Diamond Production

A recent United Socialistic Soviet Republic Bulletin reports extensive diamond mining development in an area of the Western Urals. The Urals "Diamond Land" was discovered in 1829, when the first diamond was found in this area. Only 239 diamonds were mined during an entire century. Recent demands for diamonds, which are used in the mining, rubber, silk and weaving industries and most important in tank and aviation construction which has increased during the war, has resulted in new mining districts springing up. The equipment used is the latest and the living accommodations are the most modern.

New Imitation of Hematite

Imitation hematite intaglios are being advertised in the trade papers of the North American Jewelry industry and may soon be expected to appear in the trade.

These are not only similar to the mineral in appearance, but are not genuine intaglios, in that they are not produced by hand carving. They are offered under the name of *hemetine* which can easily be mistaken for hematite by unsuspecting buyers.

Represented as a semi-precious stone which is not a substitute of any other stone but which is "genuine stone material" processed in the laboratories of the patent applicant, it is apparently a friable mineral, earth or other substance, which appears to be so processed as to be either easily molded or easily die-struck into the form of an intaglio. A sample of hemetine, tested in the Institute's Boston Laboratory proved to be 6½ in hardness, 4.8 in specific gravity and to have a black streak. Under slight wrenching pressure the intaglio broke rather easily.

Genuine hematite has H. 5-6½; S.G. 4.9+ or 5.3 (specular hematite generally used for cameos, usually 5.2-5.3) and its streak is orangy-red to reddish brown.

Hemetine is obviously a different substance than the hematite substitute which was described in the Fall, 1940, issue of *Gems & Gemology,* which was a metal alloy.

American Synthetics Available

The Linde Air Products Company has recently announced that boules of the "Linde ruby" (synthetic corundum) are now available in any quantity without priority. They, of course, do not supply any cut stones. Linde synthetics have, however, already appeared in the jewelry trade in a gemologically interesting form. Sections of the rough synthetic crystals of the new, long, slender hexagonal type have been mounted, without cutting or polishing, in ladies' rings and clips.

Gifts to the Institute

An interesting gift of three rough natural green diamonds weighing 1¼ carats was recently received at International Headquarters for research. These diamonds were presented by Mr. Hersov, Chairman of the Anglo Transvaal Consolidated Investment Company, Ltd. They came from the gold sands of Witwatersrand Gold Mines. DeBeers Consolidated Mines, Ltd., were instrumental in making this gift possible.

A large, flat, polished stone, Lake Superior Agate, was contributed for our collection of stones from the States by Mr. H. W. Schmidt, R. J., Duluth, Minn.

Certified Gemologists and Their Activities

Editorial Note:

In this issue of "Gems & Gemology" we are presenting a new feature which is designed to give you the news of Certified Gemologists throughout the field. We have received letters from some who are changing their positions and from others who, even in the midst of a busy season, take time to prepare and deliver lectures on Gemology. Then there are those who are in the armed forces, some on the far-flung battle fronts. We hope that all Certified Gemologists will take the time to drop us a line, giving us the news of their activities, to be used in future issues of "Gems & Gemology."

H. PAUL JUERGENS, C.G., spoke on "Gems and Their Appreciation" on November 15, at the Museum of Science and Industry, Chicago.

HAROLD SEBURN, C. G., has become General Manager of Schwarzschild Bros., Inc., Registered Jewelers, of Richmond, Va. Mr. Seburn previously managed the jewelry store of Jones & Frasier Co., Durham, N.C., during the absence of Wm. A. Frasier, Jr. in military service.

RICHARD PEARL, C.G., is now residing in Cambridge, Mass., preparing for his Ph.D. in Mineralogy at Harvard University.

VIRGINIA V. HINTON, C.G.-F.G.A., formerly with Corrigan's of Houston, Texas, is now on the staff at International Headquarters in Los Angeles. Mrs. Hinton occupies the position formerly occupied by Ensign Richard Liddicoat, including the supervision of students' mail study and the publication of *Gems & Gemology*. While in Los Angeles she is also doing some specialized work on the Petrological Microscope, on gem minerals, under Thomas Clements, Ph.D., Head, Department of Geology, University of Southern California. Dr. Clements is a member of G.I.A.'s Educational Advisory Board.

ORLANDO PADDOCK, C.G., formerly Manager of Diamond Department of Davis and Hawley, Bridgeport, Conn., and later of Fred J. Cooper's of Philadelphia, became General Manager of Kohn and Sons of Hartford, Conn., on January 1, 1945.

LESTER V. FORSYTH, C.G., has been accepted into full partnership by John Vondey, C.G., formerly sale proprietor of Vondey's, Registered Jewelers of San Bernardino, Calif. Mr. Forsyth was certified as a gemologist in 1943, when in Klamath Falls, Ore. He joined the Vondey organization in 1943.

NEW CERTIFIED GEMOLOGISTS. The following have recently passed the three final examinations of the mail courses of the Gemological Institute of America and have been Registered by the American Gem Society as gemologists:

JAMES H. GARLICK, JR., member of the firm of J. H. Garlick & Sons, of Detroit, Mich., June 5, 1944.

GEO. CARTER JESSOP, member of the firm of J. Jessop & Sons, of San Diego, Calif., Oct. 26, 1944.

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(Spring, 1942—Winter, 1944-45)

Harry Berman, Ph.D.

Dr. Harry Berman, who was killed in an airplane crash in Scotland on August 27, 1944, was a recognized authority on mineralogy and his death is realized as a distinct loss to both the mineralogical and gemological fields.

At the time of his death Dr. Berman was on a special mission for the Government. He was on leave from Harvard, where he was Curator of Mineralogy.

He was co-reviser with Dr. Charles Palache and Dr. Clifford Frondel, both of the Harvard Department of Mineralogy, on the only recently available 7th Edition of Dana's System of Mineralogy (Vol. 1).

For the past several years Dr. Berman has served as a member of the Educational Advisory Board of the Gemological Institute of America.

DIAMOND GLOSSARY

(Continued from p. 172, last issue)

negative crystals. Angular cavities within a crystal or stone, the outlines of which coincide with possible crystal faces of the mineral in which they occur. They rarely occur in diamond.

negative inclusions. Same as **negative crystals.**

"Nevada diamond". Obsidian artificially decolorized.

New Eland mine. Diamond pipe in the Boshof area, South Africa.

New Rush. See **Kimberley mine.**

New South Wales. See **Australia.**

New Thor mine. Diamond pipe in the **Winburg area,** South Africa.

nicking. See **nicks.**

nicks. Term applied to small fractures on the highly polished surfaces of a diamond, which are usually caused by contact with a sharp object after polishing and which most commonly occur on the girdle, to a lesser extent on the facet junctions and occasionally on facets. The easy cleavage of diamonds makes them unusually susceptible to nicking.

Niekirk, Schalk Van. Boer farmer reported to have found (1867) first diamond in South Africa. In 1869 Niekirk also found, in the possession of a native, a fine white diamond weighing 83½ carats (the Star of South Africa, known also as the Dudley Diamond). This led indirectly to the establishment of the great diamond industry of South Africa.

Nizam, or Nizzam Diamond. An apparently unauthenticated stone thought to be in the treasury of the Nizam of Hyderabad (ancient Golconda) since before the Golconda diamond fields were exhausted. Reported variously to have weighed 440 c or 340 c in the rough and to have been broken during the Indian Mutiny in 1857. It was thought to weigh 277 c when polished. Models which have inexplicably been made of it represent a concave-based, elongated, domed stone, covered with irregular concave facets which may have been polished on with a leather wheel. If a diamond, it was, at least, the world's fifth largest rough stone.

nyf (nif). The surface of the crystal faces, i.e., the "skin" of a rough diamond. See **naif.**

oblong brilliant. An oblong modification of the brilliant cut, having fifty-eight facets, but not all uniform as in the standard brilliant cut.

occurrence. In gemology, a word which refers to the formation in which a mineral is found—a formation which may be either the original matrix or a formation of which it later becomes a constituent, such as a secondary deposit. Diamond occurs in pipes or volcanic necks, in a matrix consisting of the ground mass and nodules of kimberlite, in conglomerates or other consolidated sediments, in metamorphosed dikes, and in alluvial deposits; also in meteorites.

octagon work. In diamond-cutting procedure, the starting of the four main facets by truncating the edges so that the square table is converted into an octagon shape. This is the operation following cross work.

octahedral cleavage. Cleavage parallel to the faces of the octahedron.

octahedron. A crystal form in the cubic system having the appearance of two four-sided pyramids united base to base. This crystal form is the one in which diamonds most frequently occur. The principal cleavage is parallel to the faces of the octahedron. See **cleavage.**

octavo. Same as **oitavo.**

off-color diamond (or **off-colored diamond**). (1) In the American trade a diamond which has any tint of undesirable color, especially any tint of yellowish or brownish color which is easily apparent to an unaided but practiced eye without comparison with a stone of known color. An off-colored diamond may be of any of the grades formerly known as second Wesseltons and top crystals, as well as more inferior grades. (2) A term which has been used at the South African diamond mines for the grade below the Cape and Bye grades (of rough diamonds).

oillies. (1) In American diamond trade, a term which was synonymous with the trade term **Premier diamonds.** (2) In some European countries this term is said to apply to diamonds of a blue-green tint.

oil stones. A term used by South African miners for agates found associated with diamond in the alluvial diamond deposits.

oitava. A Brazilian weight for gems which is the equivalent of about 17½ carats. (Cattelle.) Also spelled **octavo.**

Old DeBeers Mine. A diamond mine located May, 1871, on the DeBeers farm, Vooruitzigt, about two miles from Dutoitspan. See **Big Five; DeBeers Mines; Kimberley Mines.**

Old DeBeers New Rush Mine. A diamond mine located on July 21, 1871, on Colesberg Kopje on the DeBeers farm, Vooruitzigt, about two miles from Dutoitspan. See **Big Five; DeBeers Mines; Kimberley Mines.**

old English cut. Another name for single cut.

old mine cut. (1) A trade term properly applied to those brilliant-cut diamonds almost all of which were fashioned before production of the South African mines entered the market. Hence the name referred to the old mines of Brazil, or occasionally, India. Such stones had much higher crowns and smaller tables than the present style of brilliant and the outline of their girdles were cushion-shaped and occasionally almost square. (2) A term occasionally and incorrectly applied to a somewhat more modern style of brilliant cut which also has a much higher crown and smaller table than the modern brilliant cut, but in which the outline of the girdle is circular or approximately circular—a style of cutting which is more properly termed a lumpy stone.

old miner. A trade term for an old mine cut diamond.

old mine stone. A term used to describe an old mine cut diamond. See **old mine cut.**

(To be Continued)