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 FALL, 1944 NUMBER 11

◆

In This Issue: *Page*

Gemstone Inclusions, *Edward Gübelin,* Ph.D., C.G. 158

Gemstones and the Spectroscope,
B. W. Anderson, B.Sc., F.G.A. 164

Gemological Digest 168
President Vargas Diamond
Punch Jones Diamond
Wyoming Jade

Diamond Glossary 171

◆

Published by

THE GEMOLOGICAL INSTITUTE OF AMERICA

541 South Alexandria Ave. Los Angeles 5, California

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.

The following eleven illustrations continue our presentation of material from the lecture "The Inclusions in Gemstones," by Dr. E. Gübelin, C. G., of Lucerne, Switzerland.

In this portion of his fascinating and invaluable study, Dr. Gübelin has photographed inclusions particularly helpful to the jeweler and gemologist in distinguishing between genuine and synthetic stones.

Studies of sapphire inclusions were presented in our last issue. This issue's reproductions are of inclusions in both genuine and synthetic rubies.

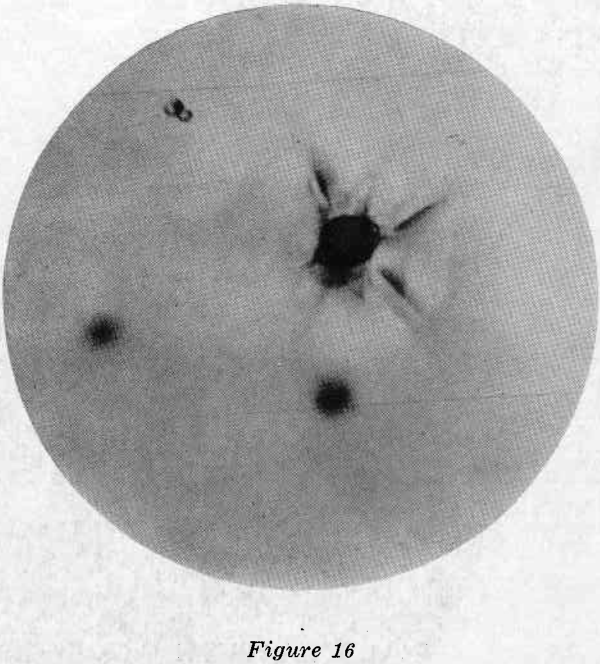


Figure 16

***Ceylon ruby** exhibiting small xenomorphic grain of radioactive zircon surrounded by a very fine pleochroic radio-halo.*

---

*A.G.S. Research Service.

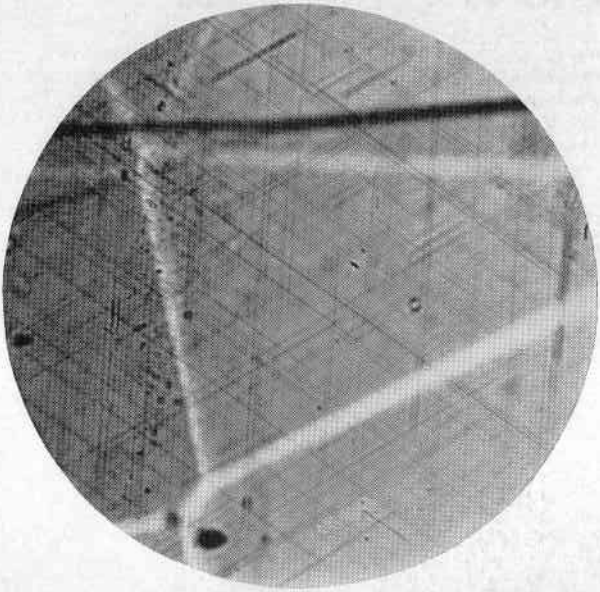


Figure 17

***Ceylon ruby** with subtle tissue of a hexagonally woven pattern of long slender rutile needles as seen through the microscope. Heavy white lines are reflections from facet junctions.*

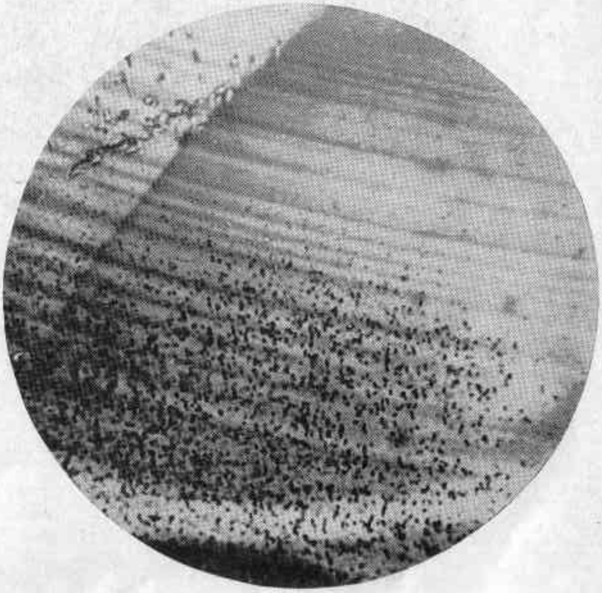


Figure 18

***Synthetic ruby** showing strongly curved striae and numerous minute air bubbles.*

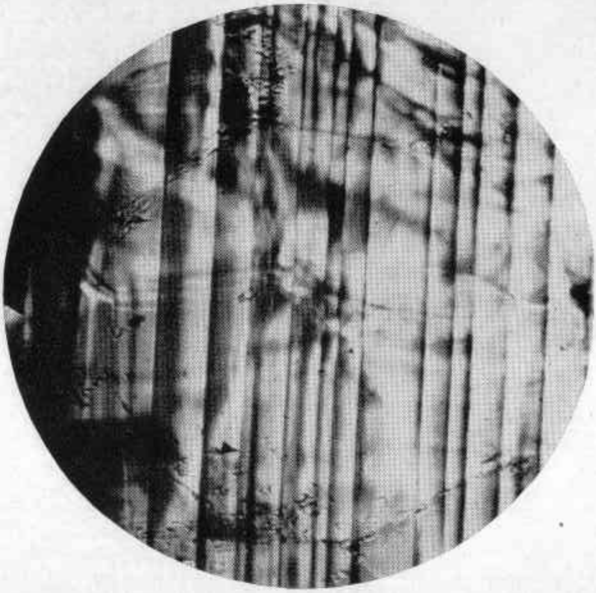


Figure 19

***Genuine ruby** whose closely packed laminations display straight parallel twinning striations. Parting or false cleavage is due to such twinning.*

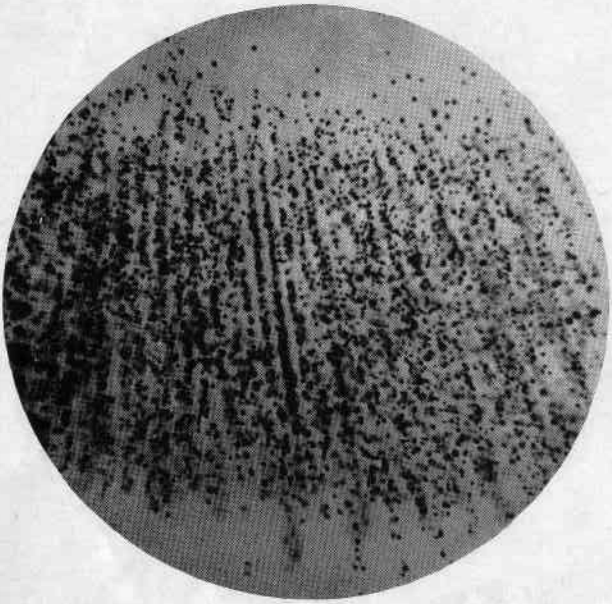


Figure 20

***Synthetic ruby** which shows an enormous mass of air bubbles. Under a jeweler's loupe these strings of bubbles might seem, to the inexperienced observer, to be straight striae which indicate genuineness.*

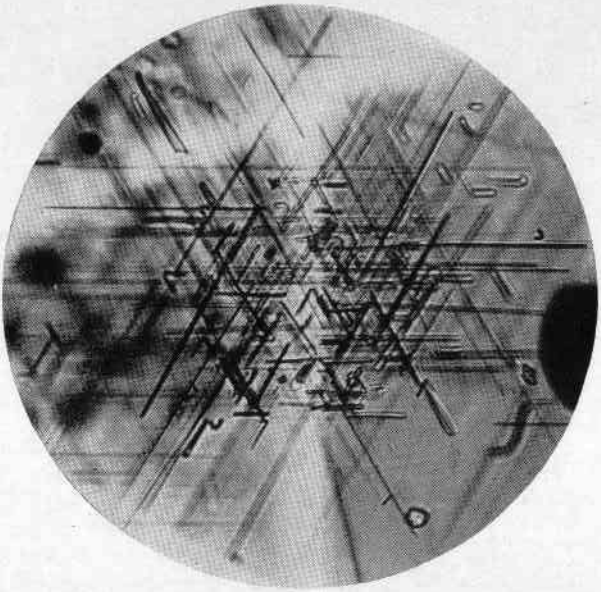


Figure 21

Genuine ruby *exhibiting a patch of fine rutile needles hexagonally arranged, and hence intersecting at 60° angles. This arrangement is in noticeable crystal symmetry and is characteristic of Burma rubies.*

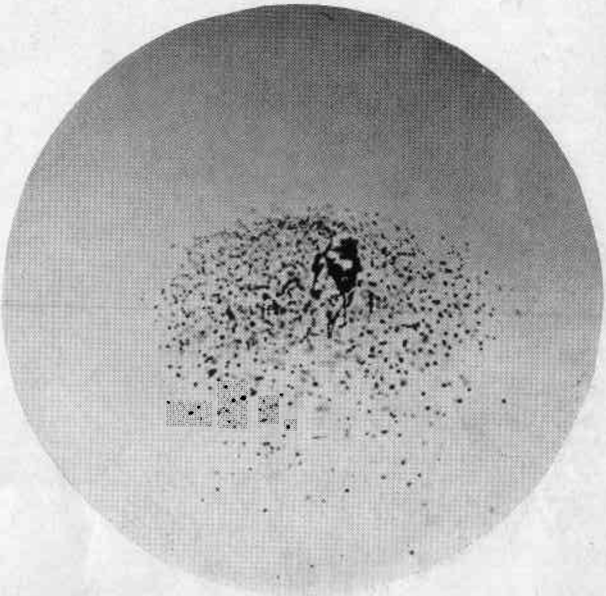


Figure 22

Synthetic ruby *showing a cloud of very fine bubbles and several irregular thread-like, gas-filled formations which occur very rarely.*

Figure 23

***Burma ruby** with inclusions of coarse rutile needles.*

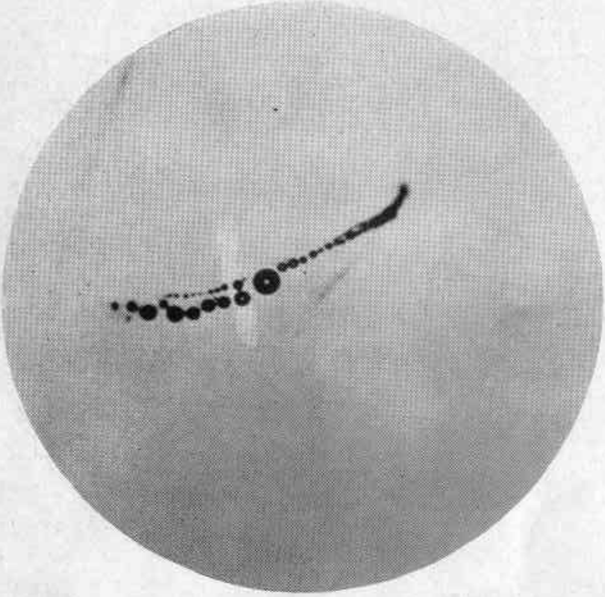


Figure 24

***Synthetic ruby** with slightly curved string of bubbles. The bright spots in the center are characteristic of bubbles seen in synthetics. Very high magnification is sometimes necessary for these to be discernible.*

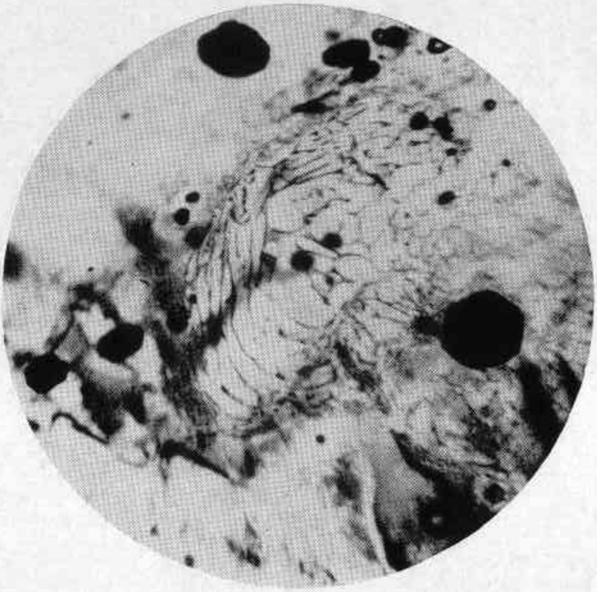


Figure 25

Siam ruby *containing typical slabs of ilmenite surrounded by characteristic web-like inclusions. The large dark inclusions might be mistaken for bubbles if observed under a lower magnification such as a jeweler's loupe.*

Figure 26

Synthetic ruby *showing curved striae and a group of bubbles. Coalescence of a number of such bubbles form the large very elongated bubble. Inclusions on the right are formed by the unification of two bubbles.*

Gemstones and the Spectroscope*

By

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

More than seventy years have elapsed since A. H. Church made the first observations on the absorption spectra of zircon and almandine garnet, and yet the spectroscope is still not accorded the important place in gem-testing equipment which it deserves.

A simple prism spectroscope is hardly more costly or bulky than a dichroscope and has a far wider application. It is capable of providing positive identification of a large variety of stones whereas the dichroscope can usually provide only accessory evidence. The spectroscope can be used equally well with cut or rough material, mounted or unmounted, and is incomparably rapid in use.

Moreover, the absorption spectrum method is aesthetically satisfying, which is an important factor where the routine testing of a large number of stones is involved. Just as, when faced with a problem which may be solved by a number of methods, the true mathematician prefers to use the most "elegant" proof, so does the skilled gemologist when identifying a stone avoid cumbrous and messy or time-consuming tests and employ the speediest and most satisfying means at his disposal, provided that there is no sacrifice of accuracy.

One reason for the appreciation of the spectroscope's powers is the lack of available data on the absorption bands to be seen in the various species and on the technique to employ if good results are to be obtained. Kraus and Slawson's excellent text-book "Gems and Gem Materials" devotes a few lines to the subject, but the diagrams provided are not sufficiently accurate and cover very few of the species. The best text-book account to date is in the 1940 edition of Herbert Smith's "Gemstones"; also in my own short book "Gem-testing for Jewellers" a simplified account is given of the technique involved and the more useful spectra are described.

It is more than ten years since my colleague C. J. Payne and I began concentrated work with the spectroscope and our early enthusiasm for the instrument has in no wise abated. Eventually we hope to publish a comprehensive paper giving all our results in full, but that must wait until Payne returns from active service. In the meantime, it is hoped that the following short account of the absorption spectrum method may prove useful.

First, as to apparatus. Useful results can be obtained with a wide variety of instruments. Edgar T. Wherry, to whom credit must be given for much pioneer work and for the first would-be comprehensive papers on the absorption spectra

---

*G.I.A. Research Service.

of minerals[1], favoured the microspectroscope—a small prism instrument with superimposed wave length scale, made to fit into the body tube of the microscope. Such apparatus is undoubtedly useful and easy to employ, but is rather expensive for the results obtained and has too small a dispersion for some purposes.

Prism instruments give far more brilliant results than those with a diffraction grating, but the dispersion increases progressively towards the violet, so that, where a low-dispersion spectroscope is used, the red end of the spectrum is very compressed, while with instruments giving larger dispersion, bands in the violet tend to become unduly broadened and vague. A happy compromise is a spectroscope having a dispersion of about 10°—barely sufficient to separate the D lines of sodium—and this, with adjustable slit but without the complication of a scale, should only cost about twenty dollars, and is capable of almost all that is needed for identification purposes. For research and wave length measurements more elaborate instruments are needed, and photography enables one to detect bands which are beyond the limits of human vision.

The source of light and method of illuminating the specimen are exceedingly important. The source should be as intense as possible: a low voltage "intensity" lamp or a projection bulb (as used in lanterns and epidiascopes) of 250 or 500 watts are very suitable though results can be obtained with an ordinary strong bench-lamp. If a microscope with an Abbe condenser is available, it is very convenient to place the specimens on a glass plate on the microscope stage, table facet down, and concentrate the light from the microscope mirror through the condenser into the stone under observation. Using a low-power objective (1″—1½″) and removing the eye piece, the focus should then be adjusted until a uniform glare from light which has passed through the specimen fills the microscope tube. To prevent undue dazzle while the adjustment is being made some dark colour filter (e.g. cobalt glass or "Chelsea" colour filter) can be used to view the effect while looking down the tube before using the spectroscope. With practice, to make all these adjustments is a matter of seconds. The hand spectroscope can then be held in place of the eye piece, resting lightly on the body tube of the microscope. In this way a good uniform spectrum free from "streakiness" is ensured.

Certain effects, such as fluorescence lines, are best obtained by scattered light, and these can be seen simply by directing the spectroscope from one side on to the brightly illuminated specimen on the microscope stage. As an alternative, no microscope need be used if the specimen is placed on black card or velvet and the rays from the light source are focused on to the specimen by means of a lens, with some form of screening to prevent unwanted glare. The spectroscope is then simply directed at the stone from a few inches distance.

An adjustable slit is a great convenience as by opening the slit one can often discern bands which are almost lost in the obscurity at the

---

[1] American Mineralogist, 1929, Vol. 14, pp. 299-308; 323-328.

ends of the spectrum, while on the other hand the sharpest results for clearly defined narrow bands are attained when the slit is very nearly closed. Streaks *parallel* to the length of the spectrum are due to dust on the jaws of the slit. While one must expect these to appear when the slit is very narrow, should they persist when the slit is widened an improvement can be obtained if the jaws are opened still more widely and cleaned by rubbing gently with the tapered end of an orange-stick or sharpened match-stick.

All spectroscropes have some form of focusing device to enable adjustment to be made to suit individual eyesight—usually simply by extending or shortening the sliding draw-tube to which the eyepiece is attached. The position of sharpest focus can best be ascertained by observing a bright-line spectrum from an arc-lamp, mercury or sodium lamp or the sodium light from a hot gas flame into which a sodium salt has been inserted. When the slit is nearly closed the bright yellow sodium doublet will be exceedingly sharp. Alternatively the Fraunhofer lines of the sun's spectrum can be used for the same purpose. These *dark* lines are simply the *bright* lines of the elements in reverse, that is, absorbing instead of emitting radiation of definite wave length.

In the descriptions of different absorption spectra which will be given in this series of articles, the positions of the various bands in the spectrum will be recorded in Angstrom Units (IA=1/10,000,000 mm). Many authors prefer to express wave lengths in millimicrons (1mm=10A), but these units are so readily translated at sight into the other that no difficulty should arise on this account.

Those new to spectrum work should accustom themselves to relating wave lengths to the rainbow colours of the spectrum. The ribbon-like band of colours seen when white light is viewed through a spectroscope is simply a countless series of overlapping images of the spectroscope slit which have been refracted or diffracted by different amounts by passing through prisms or a diffraction grating. From the glowing vapour of an element only light of certain definite wave lengths is emitted by the excited atoms, producing bright lines in positions characteristic of that particular element.

According to the complexity of the outer electronic shell of the atoms, the spectrum of an element may consist of only a few lines (as with sodium) or of many hundreds of lines (as with iron). This type of spectrum is known as an *emission spectrum* and forms a delicate means of chemical analysis. An incandescent solid, on the other hand, no matter what its chemical nature, emits a jumble of all wave lengths from deepest red to extreme violet, forming a *continuous spectrum.* It is such light which we need to employ when studying absorption spectra, since it is the dark bands crossing the bright background of the continuous spectrum of our light-source after the light has passed through the stone in question which tell us which wave lengths have been preferentially absorbed in passing through the stone.

There are no sharp divisions between one spectrum colour and the next, and it is a matter of opinion as to where exactly, for instance, the green ends and blue begins. Some writers interpolate "indigo" as a colour between the blue and violet but I personally cannot discern this distinction. A rough division of colours according to wave lengths is undoubtedly helpful to the beginner, however, and this is accordingly attempted below. For absorption spectrum purposes the limits of vision can be considered as 7000 A in the red and 4000 A in the violet, though the eye can detect bright emission lines considerably outside these limits.

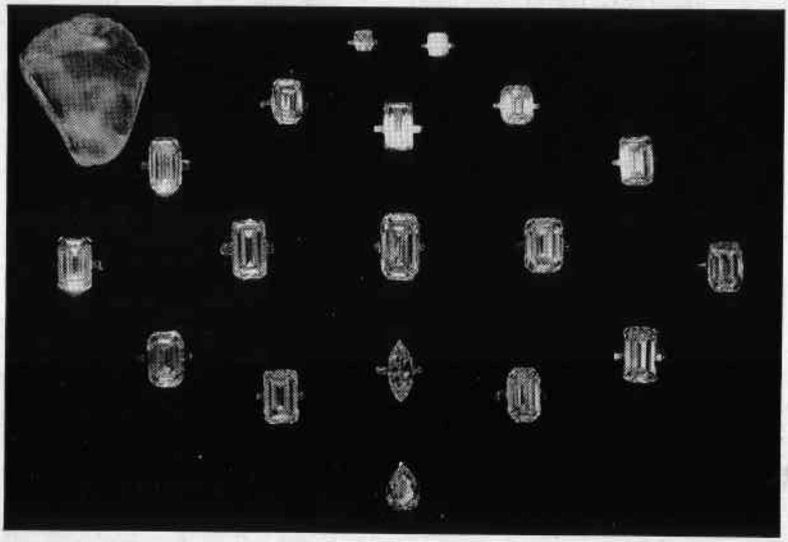
7000 A — 6400 A	Red
6400 — 6000	Orange
6000 — 5700	Yellow
5700 — 5000	Green
5000 — 4500	Blue
4500 — 4000	Violet

In ensuing articles I hope to give details of all the important gem spectra.

ERRATUM. Fall 1942 issue of GEMS & GEMOLOGY, p. 36: In the tabulation showing disparity of respective R.I. for Siam, Burma, and Ceylon sapphire, the first figure for Siam sapphire should be ${}^{e}{}_{d} = 1.767$; while the first figure for Burma sapphire should be ${}^{e}{}_{d} = 1.765$. All other figures remain the same.

Gemological Digest

ADDITIONAL NOTES ON THE PRESIDENT VARGAS DIAMOND



Courtesy Harry Winston, Inc.

The Vargas rough pictured with the 18 most important of the 29 stones fashioned from it. The pear-shaped stone was fashioned from a 21.65-carat piece sawed from the rough before the first cleaving.

Earlier notes on the President Vargas Diamond*, which were written at a time when plans for cutting the stone were just taking shape, left the story of the diamond at that point.

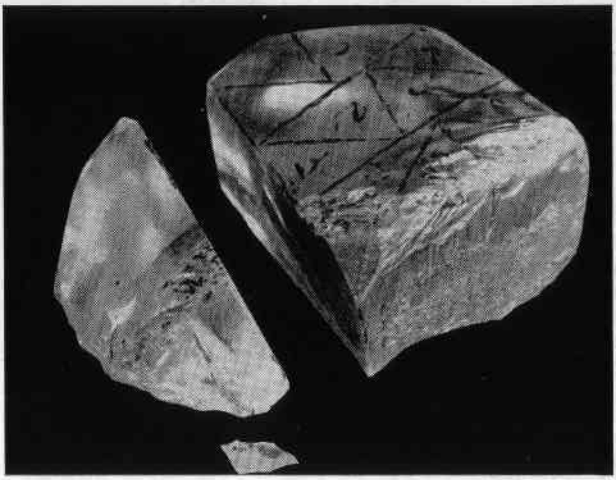
The illustration shows a model of the Vargas rough (third largest authenticated diamond in the world) together with the twenty-nine flawless diamonds which have since been cut from it.

Because of an anomaly in the growth lines in the upper portion of the stone, which apparently interrupted the continuity of the cleavage planes, a 21.65-carat piece was first sawed from the top. Cleavage was later accomplished along the cleavage planes then revealed.

The pear-shaped diamond was fashioned from the piece from the top. Subsequent cleaving and sawing pro-

---

*Spring, 1941 issue, *Gems & Gemology.*



Courtesy Harry Winston, Inc.

The Vargas as first cleaved. The 150-carat piece on the left and the larger 550-carat portion, produced 28 pieces in addition to the stone fashioned from the 21.65-carat piece first sawed from the rough.

duced 28 pieces from which the other stones were fashioned.

Weights of the largest emerald-cut stones are: 48.26, 30.90, 29.95, 28.05, 27.48, 25.35, 25.33, 24.33, 24.30, 23.36, 23.10, 22.97, 19.45, and 17.91 carats.

The marquise-cut stone weighs 12.82 carats, while the pear-shaped diamond is 10.05 in weight. Three small emerald-cut stones weigh 3.53, 2.75 and one triangle, 2 carats. In addition there were cut ten very small diamonds.

PUNCH JONES DIAMOND

A rough diamond weighing 34.46 carats was found by Mr. Grover C. Jones of Peterstown, West Virginia, in April, 1928.

This is said to be the largest alluvial diamond ever found in this country. The crystal form is well developed and the color is slightly greenish gray.

The rough stone was identified as a rough diamond by R. J. Holden, professor of geology at Virginia Polytechnic Institute.

The story goes that Mr. Grover C. Jones is the father of seventeen consecutive sons (all living) and the diamond was discovered while he and his eldest son were pitching horseshoes. The father wishes to have this diamond known as the Punch Jones Diamond in honor of his son, William P. (Punch) Jones, who is now in the Army.

The diamond is on loan to the United States National Museum.

WYOMING JADE

The discovery of nephrite in 1936, near Lander, Wyoming, has been of considerable interest throughout the industry. Gem stones of nephrite have not reached the market in quantity, which is probably due to the scarcity of gem cutters and the cost of cutting in the U.S.A. as compared with costs in China.

The colors in which this nephrite have been found are green and black. Some of the green is of very fine quality and one prospector claims that some of the black is as fine as has ever been found in the world.

The occurrence is in water-worn boulders and in angular blocks near the surface. The angular shape is more common. These boulders and blocks vary in size from small boulders up to very large ones weighing several tons.

There has also been a report of the discovery of veins of jadeite in this same locality, but investigations conducted by the G.I.A. have resulted in obtaining the statement from reliable sources, which have tested this material, that it is also nephrite and not jadeite.

DIAMOND GLOSSARY

(Continued from p. 156, last issue)

Mora Diamond. Probably quartz crystal.

Morrissey Diamond. Same as **Dewey Diamond.**

Morse, Henry D. A Boston diamond merchant and cutter accredited with originating the so-called "American-cut brilliant" in about **1865.**

mother liquid or liquor. (1) *Gemological:* A magma, especially a deep-seated magma in which diamonds may have formed. (2) *Chemical:* The residual solution remaining after its contained substances have become crystallized or precipitated.

mother rock. Same as **matrix.**

motichul. Hindu name for clear and brilliant diamonds.

Mountain of Light Diamond. See **Kohinoor.**

Mountain of Splendor. Murray refers to a MS "Sketches of Persia, 1838" as his source for the statement that this diamond was in the crown of Persia, weight 135 c., valued at £145,800. It may have been confused with another diamond.

muddy diamond. Trade term for a diamond of inferior brilliancy due to lack of transparency resulting from presence of numerous tiny inclusions or structural anomalies.

Multi-Facet Diamond. A trademark (applied for) used to describe a standard brilliant cutting with a polished or faceted girdle upon the circumference of which at least forty flat surfaces or facets have been polished.

Murray, John. Author of *Memoir on the Diamond,* the 2nd edition of which appeared in 1839.

"Mutzschen diamonds". Rock crystal.

Mwanza. See **Tanganyika.**

naat (Dutch). (1) Thin flat twinned diamond crystal. (2) The junction of the two individuals of a twinned crystal. See **macle.**

naif, naife, or naive. (Pl. naifes or naives). (1) A well-formed diamond crystal as distinguished from distorted crystal. (2) A thick or pointed diamond crystal, as distinguished from flat crystal from which only roses or thin stones can be cut (Murray). (3) A diamond crystal possessing bright or splendent faces (King). (4) The natural, unpolished faces of a crystal. See point naive. (5) The luster of such faces.

naif gem. A gem still possessing natural unpolished luster.

Namaland. See **Namaqualand.**

Namaqualand. Name of a region in Union of South Africa along Atlantic coast. It is divided by lower course of the Orange River into two portions: Little, or Lesser Namaqualand to the south, and Great Namaqualand to the north (formerly southern portion of German Southwest Africa). See **Luderitz.**

Namaqualand diamonds. Diamonds from Namaqualand, many of which have a whitish coating which neutralizes yellowish body color and deceives the cutter.

Namaqualand, Great. See **Namaqualand.**

Namaqualand, Lesser. See **Namaqualand, Little.**

Namaqualand, Little. Here the discovery of diamonds in wave-built terraces was made in the coastal region in 1926. The richest terrace has been called the "oyster line". See also **Namaqualand; "oyster line"; wave-built terraces.**

Napoleon Diamond. "A brilliant of 34 carats, set in a ring, was sold by Mr. Eliason [noted gem dealer. Ed.] to Napoleon Buonaparte for £8000, to be worn on his wedding day, when married to the Empress Josephine. It was not, however, a diamond of the first class" (Murray). Streeter adds that "Napoleon Buonaparte wore the diamond in the hilt of his sword on his wedding day but that it was known to have really been a very perfect stone." Present location unknown.

Nassak Diamond (also known as Nasik, Nassac, Nassack, Nessuck). Once among the treasures of a Hindu temple near the tower of Nasik, India, this stone fell into the hands of the Marquis of Hastings after the Mahratta War of 1818, and became a part of the "Deccan Booty". Later it was in the custody of the English jewelers, Rundell and Bridge. In 1831 was bought at auction by Emanuel Brothers at bargain price of £7,200. In 1837 it was purchased by the then Marquis of Westminster. In 1929 imported into America and offered for sale by Mauboussin, at a price of $400,000. When brought from India, weighed over 90 m.c. (89½ English carats). When recut, weighed 80.59 and was a stone of unusual beauty and brilliancy, which retained its original triangular form in pleasing manner. More recently purchased (1937) by an American importing firm which, in an effort to make it more salable in a modern market, refashioned it into an emerald-cut stone of 43.38 carats; dimensions, 23x19x13.8.

natural. Trade term for the natural surface of the rough diamond which is sometimes left by the cutter upon the girdle of a fashioned diamond when it is by some authorities considered an imperfection but not so by the majority. Its presence indicates to an employer that the cutter has preserved the greatest possible amount of the original weight of the rough stone, but critics claim that naturals are left on diamonds principally to preserve the weight at a sacrifice of beauty and good workmanship. Flat polished surfaces on the girdle where naturals have been polished out are also sometimes called naturals, at other times facets. Naturals on any portion of a diamond other than the girdle are, universally, considered an imperfection.

navet. A little-used English contraction of navette.

navette (cut). Same as marquise cut. Schlossmacher's definition as "a pear-shaped rose cut" may have an historical basis, but Eppler indicates that the German trade uses the terms "marquise" and "navette" interchangeably. The word in French means literally "little boat" and is applied to such shaped articles as a weaver's shuttle.

nayfe (Portuguese). Same as **naife.**

neck. See **volcanic neck.**

(To Be Continued)