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On the Cover

This outstanding design in diamond jewelry, by Coleman E. Adler & Sons, Inc., New Orleans, received an award in Diamonds, U.S.A. Awards sponsored by N. W. Ayer & Son, Inc. The necklace of brilliantly fashioned baguettes in various sizes, accented with rounds, has a stunning pear-shaped diamond pointing to to the last diamond in the streamer.

Photo courtesy
Dorothy Dignam
N. W. Ayer & Son, Inc.
New York

The Gemstones of Minas Gerais, Brazil

by

CHESTER B. SLAWSON AND

FRANCISCO MÜLLER BASTOS

For many decades the State of Minas Gerais, Brazil, has furnished the world with most of its gemstones. Prior to World War II it sent most of its rough to Europe for cutting, although Brazil has always maintained a small cutting industry of its own. There were in the 1930's four or five professional lapidaries in Teófilo Ontoni and one or two in Belo Horizonte who devoted their entire time to the lapidary art. In Rio de Janeiro there were usually a few professionals. Scattered through the State there were also a few individuals who made their livelihood at some other profession but periodically cut a few gems in home workshops.

During World War II the cutting centers of Europe were isolated and Brazil rapidly expanded its lapidary industry, both to supply its customers and to support its own gem-mining industry. Belo Horizonte was the center of this industry, which at its peak supported 250 workmen in that city. Most of these were engaged in sawing, dyeing, and cutting black onyx blanks, which were sold in the United States for signet rings. Teófilo Ontoni had perhaps 150 cutters, Rio 50 to 60, with others scattered in the southwestern part of Minas.

This rapid expansion of the cutting industry was aided by an influx of European refugees, many of whom were skilled in the art of diamond cutting but few were gem cutters. Their main contribution was on the business side and they became the importers, exporters and middlemen in this new industry. At first, as was indicated above, the bulk of the cutting was agate which was shipped north from near Soledade, Rio Grande do Sul, to Minas Gerais instead of to Idar-Oberstein. The refugees knew not only this source of supply but the markets in the United States, and without their help the lapidary industry could not have developed as it did. The black-onyx industry boomed during wartime but following the war it returned to approximately its prewar status.

Immediately after the United States entered World War II, it supported an intensive search throughout that part of the world which was favorably disposed to us

American Name	Brazilian Name	Number of Qualities Marketed in Brazil	% Natural Color	% Heat Treated	Color Before Heating	Remarks
BERYL	BERILO					
Aquamarine	Aqua Marinha	10	60	40	Bluish green	Most popular
Goshenite	Berilo Branco	1	100	0		More popular than quartz
Green	Berilo Verde	3	100	0		
Heliodor	Berilo Amarelo	3	100	0		"Boca do Fogo" Sp. color
Morganite	Berilo Rosa	3	10	90	Pale yellow	
GARNET	GRANADA					
Essonite	Essonita	2	100	0		Alluvials, schists, peg.
Pyrope	Piropo	2	100	0		Always alluvial
TOPAZ	TOPASIO					
Blue	Topasio Azul	3	100	0		
Colorless	Topasio Branco	1	100	0		
Pink	Topasio Imperial	2	30	70	Purplish yellow	
Precious	Topasio Imperial	3	100	0		
TOURMALINE	TOURMALINA					
Blue	Tourmalina Azul	2	50	50	Nearly opaque blue	
Green	Tourmalina Verde	3	60	40	Very dark green	
Rubellite	Rubilita	2	100	0		
Other colors	Outras cores	Several	70	30	Browns only	Become greenish brown
QUARTZ	QUARTZO					
Amethyst	Ametista	5	100	0		Gr. 4,5 only in Minas
Citrine	Citrino, -a, -e					
Light	Citrino Claro	1	100	0		
Light yellow	Citrino Amerelado	1	100	0		
Yellow	Amarelo	3	80	20	Dark red smoky	
Yellow gold	Amarelo Ouro	1	80	20	Dark yellow-red	
Red yellow	Amarelo Avermelhado	1	80	20	Dark red smoky	
Extra red	Amarelo Extra	1	10	90	Dark red smoky	Rare
Rock Crystal	Cristal de Rocha					Never cut in Brazil
Rose	Quartzo Rosa	2	100	0		Translucent only
Smoky	Quartzo Fumaça	1	100	0		Colorless after heating

and our allies for essential strategic minerals. Included among these were industrial diamonds, rock crystal quartz, high-quality sheet mica, cassiterite (tin), scheelite (tungsten), tantalite and columbite (rare earth metals), and industrial quality beryl for the production of metallic beryllium. Most of these minerals are found in pegmatites, the home of amethyst, citrine, smoky quartz, topaz, tourmaline, and all the gem varieties of beryl except the true emerald. A great many new pegmatites were discovered in Minas Gerais and Bahia but chiefly in the former State. Some of these are today the most important sources of gem rough. Some of the production today is from alluvials where a few water-worn pebbles and stones are found which have come from the erosion and weathering of pegmatites in past geological times. The famous Marta Roche aquamarine was an alluvial stone found on a farm near Teófilo Ontoni in 1954. It was named after the young Brazilian woman who took second place in the international beauty contest of that year. It was found by a seeker of rock crystal for the electronic industry, who did not recognize it himself as aquamarine but thought it was a variety of colored quartz. It weighed 74.8 pounds, of which 60% to 70% was cuttable. Most of the cuttable material was of the finest blue, and it since has become the standard throughout Brazil for judging fine color in aquamarine.

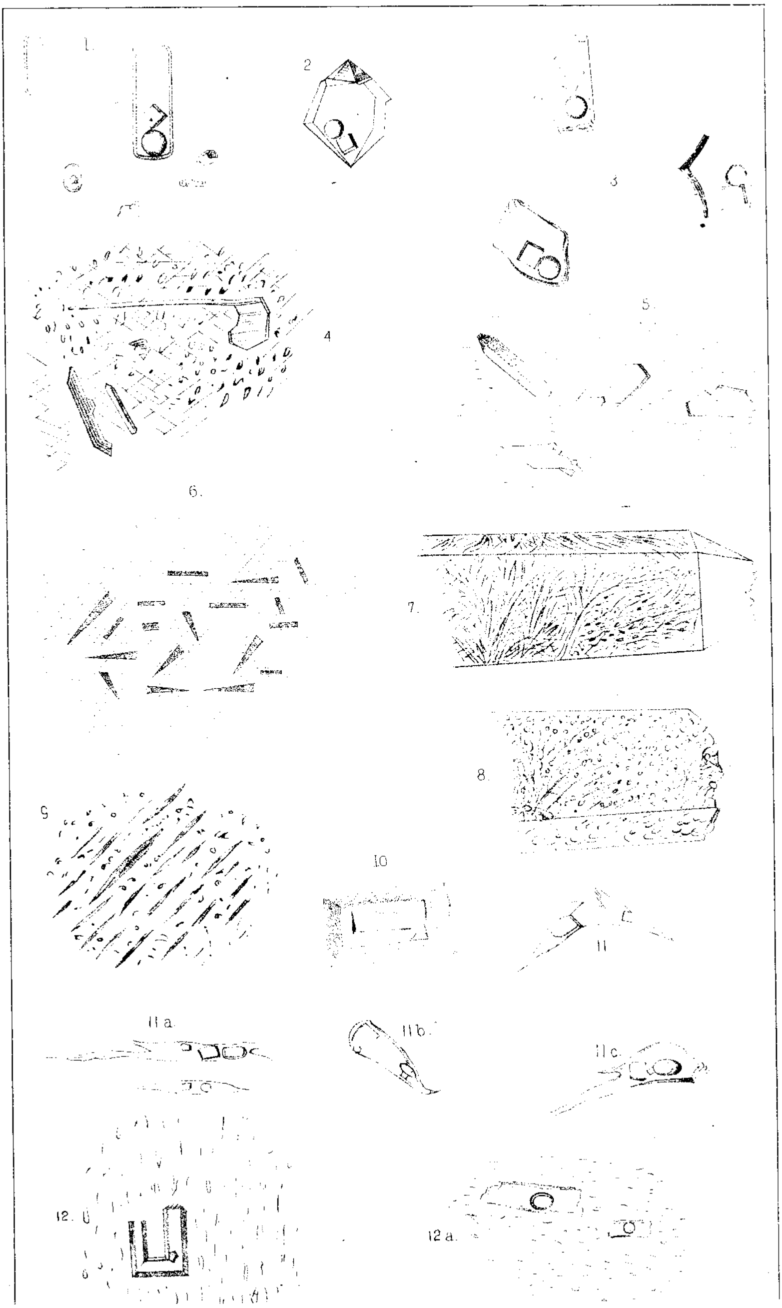
Today Brazil cuts more of its gem rough than it exports if we exclude agate. The quality of cutting is good, but it does not equal the prewar standards of Idar-Oberstein. Except for an occasional cabochon, usually of bicolored tourmaline, all stones are faceted. And again, with tourmaline as the exception, practically all stones are free from flaws. Quality is almost exclusively judged on the basis of color alone. If more attention were paid to the "make," it would in the long run be beneficial to the industry. Some of the better lapidaries are aware of the fact that if more attention were given to proper proportions, especially below the girdle, a more brilliant stone would result. However, buyers judge value only from color, spread and weight; consequently, the lapidary "cuts in" as much weight into the rough as possible, though he ends up with a stone too shallow to produce maximum brilliancy.

The cutting is done on tin and lead solder laps (75% tin, 25% lead solder), with silicon carbide as the abrasive. Polishing is done with tripoli on lead-coated cast-iron laps. Electrical power is universally used to drive old-style vertical laps with wooden-peg bearings. Too often the surface of the lap is allowed to become slightly concave, resulting in polished facets which are very slightly convex. Although the convexity is not readily apparent, it may be detected in nearly all Brazilian-cut stones by holding the stone about ten inches from the eye and observing (in the table) the reflection of a straight edge like a window frame, in the same manner in which one would use a small mirror. This is best done with the back toward the window and the stone in front of but slightly to one side of the observer. A nearly ideal situation is to observe the reflections of the panels of an open Venetian blind. In a perfectly flat surface the reflections would be straight lines moving across the surface. On a convex surface the line is curved. With experience the degree of convexity may be readily estimated.

Today in Belo Horizonte there are about 25 professional lapidaries and about 50 in Teófilo Ontoni. Governdor Valadares, Campo Belo and Rio each have a few professionals, but in Rio diamond cutting is more important than gem cutting. Scattered throughout the southeastern part of Minas Gerais one finds here and there a professional lapidary, and throughout all the country the occasional part-time cutter and the inevitable amateur who often is an exceptionally good workman.

From the standpoint of the American jeweler selling to the public, Brazilian-cut

(Continued on page 253)



Microscopic Crystals & Cavities in Gems

Further Notes on "Inclusions" in Gemstones, Etc.

by

ISAAC LEA, LL.D., MAY, 1876

Note: The following article is a verbatim reprint of one of three papers written for the Proceedings of the Academy of Natural Sciences of Philadelphia by Isaac Lea. (Reprints of two of these papers appeared in the Fall issue of GEMS & GEMOLOGY). These papers probably represent the first work done in this country on gemstone inclusions. The earliest paper carries the date of February 16, 1869. The Isaac Lea gem collection is at the United States National Museum, Washington, D.C.

The articles were made available for readers of GEMS & GEMOLOGY through the courtesy of George Switzer, Ph.D., Associate Curator, Division of Mineralogy and Petrology, Smithsonian Institution.

In a communication on microscopic crystals contained in *gems,* which the Academy did me the favor to publish in its Proceedings[1] a few years since, I gave some figures of these crystals which I have frequently since verified. I then observed that, beside these *inter-crystalline forms,* there were in most *gems, cavities* frequently so numerous that they amounted to tens of thousands.

Since the period of the publication of my paper, I have made very large additions to my cabinet of *gems,* and particularly those of the *Corundum* group, *Sapphires, Rubies,* and the so-called *Oriental Topaz, Oriental Amethyst, Asteria,* etc. In the numerous fine blue *Sapphires* of my collection, I have rarely explored one without finding numerous cavities, and ordinarily also finding the beautiful microscopic acicular crystals, which, when the specimen is cut *cabochon,* cause the three bands, and these by crossing form the star in *Asteria.* The cuneate microscopic crystals are also quite common.

Cavities, with or without the fluids, are so frequent in *crystals,* from the soft *Calcite* to the hard *Corundum,* that little may be said as to their occurrence, as they are so common.

Cavities in quartz crystals inclosing fluids have been observed by the older mineralogists, but the kind of fluid, and gas or air, was not ascertained by them. Sir Humphry Davy, in 1822,[2] investigated the contents of these cavities, and found them generally pure water. The gas bubbles were sometimes found to be *"azote."* Sir David Brewster, in 1823,[3] published a memoir of great research

1 Feb. and May, 1869.
2 Trans. Roy, Soc. Ed., 1823.
3 Phil. Trans., 1822.

and value. He first had his attention called to the examination of fluid in cavities by the explosion of a crystal of *Topaz* when heating it. He found cavities and air bubbles in nearly twenty different substances, and these inclusions were carefully examined by him. In some of these cavities he observed two fluids[1] and crystals, and these are figured in his plates. Subsequently, Mr. Sorby published a long and admirable paper[2] on ***Fluid cavities and crystals*** in minerals, with numerous and interesting figures. He considered that the cubic crystals were probably *Chloride of Sodium*. In his investigation he proved, by forming artificial crystals, that, in a natural state, the fluid cavities, with their "inclusions," must have been formed by aqueo-igneous forces. He gives a figure of fluid in mica, but I have never seen any in that mineral, although many hundreds have passed under my microscope in looking after crystals of *Magnetite,* etc. Mr. Sorby also published a paper on cavities in quartz in the Phil. Mag., vol. xv. p. 153; also with Mr. Butler in Proc. Roy. Soc. London, vol. xvii. p. 299. Kirkel on Microscopic Minerals, Neues Jahrbuch, 1870, p. 80, mentions bubbles and cubic crystals in quartz. He found iron glance and fluid in *Elaeolite* = *Nephelite*. In *Emery,* from Naxos, he found fluid in cavities.

In 1872, Proc. Roy. Soc. Edin., p. 126, Mr. Sang published an account of water in cavities of *Calcite.*

Very recently, Prof. Hartley, King's College, London, has published a very able paper on the subject of the fluid in quartz, etc.[3] He says that Simmler in 1858, offering an interpretation of Brewster's observations, concluded that the expansible liquid was carbon dioxide. Professor Hartley states that in many cases the liquid in quartz is water but that in some cases he found the two fluids, and his very satisfactory and careful experiments show conclusively that the most volatile of the two fluids is carbonic dioxide. He found in every experiment, that the fluid disappeared when exposed to 31° C., and reappeared on cooling. Prof. Hartley accords with Mr. Sorby in his reasoning that "at the time of its assuming the solid state, the solution endured a high temperature."

Calcite has been found to contain nearly a quart of this fluid,[4] but it is not as common to be found in small cavities as it is in quartz.

Fluorite, — Cavities in this mineral are rarely found, but they are sometimes seen with fluid and air bubbles.

Apatite, — I have never observed cavities in this mineral, but I have not given it much attention in microscopic examinations.

Feldspar Group, — In a former paper,[5] I gave the result of the examination of many specimens of various species. Since then I have examined numerous specimens of *Labradorite,* and found no cavities, but the black crystals were very numerous. In the *Moonstone* of this country, I have not observed cavities or crystals, but in two specimens, out of about one hundred from Ceylon, I have seen a series of very regular quadrate cavities or crystals which do not appear to have any fluid. Fig. 10, Pl. 2.

Tourmaline, — This interesting mineral is found beautifully crystallized and of almost all colors, white, brown, green, red, black, etc. The finest are found at Mount Mica, near Paris, Maine.[6] Some of these specimens have small internal elongate crystals, which are terminated. A red specimen *(Rubellite)* in my collection has many irregular cavities. One green one from Ceylon has cavities with fluid, and another has very minute black acicular crystals in one direction. In brown crystals from Lower Dianburg, Corinthia, there are rough objects in the interior, evidently another mineral inclosed, which do not require the microscope to detect them.

[1] These two fluids, Prof. Dana without any analysis has called *Brewsterlinite and Cryptolinite.*
[2] Journ. Geol. Soc., vol. xiv., 1858, Microstructure of crystals.
[3] Journ. of the Chem. Soc., London, Feb. 1876.
[4] Specimen in the collection of the late Dr. Chilton of New York.

[5] Prod. Acad. Nat. Sci., May 11, 1869.
[6] Dr. Hamlin has published a beautiful little work on the Tourmaline, with illustrations.

Cyanite. — Of the white and the blue varieties I have not observed any well-defined cavities or crystals, but in the gray-bladed *Cyanite*, found at Cope's Mills, near West Chester, Pennsylvania, there are always, I believe, small black masses which do not take a regular form, but are usually elongate. These may easily be detected by splitting a crystal along its eminent cleavage, and examining the cleavage face with a lens of small power, but a higher power is preferable.

Quartz takes upon itself many colors. In it are found cavities in very great numbers, particularly in the clear fine crystals. Those which exist in such an abundance in Herkimer County, New York, and which are so limpid, and finely and doubly terminated, are sometimes furnished with thousands of cavities, even in small specimens, and these are of many various forms, frequently containing fluid. In some cases the fluid may be seen to move by the unaided eye. In these Herkimer crystals, carbon in the form of *Anthracite* is of very common occurrence, and in one of my specimens a small portion moves in the fluid of a cavity. These cavities often exist in an entire sheet, almost across the prism of a crystal.[1] In *smoky quartz*,[2] these cavities are much rarer, as also in *Amethyst and wine-color and green quartz*. The *Amethyst* is frequently penetrated with crystals of *Rutile*, and these are often very large, sometimes 1 to 4 inches long. The Chester county specimens usually have numerous curved filamentous crystals, easily detected with a common lens. In Way's Feldspar Quarry, near Dixon's, Delaware, there is a very peculiar form of *quartz* which is nearly transparent, but somewhat clouded. The fragments of all sizes, from that of a pin's head to that of a small walnut, are inclosed in a mass of *Deweylite*. These fractured pieces are of indefinite forms. They are evidently cryptocrystaline, and look as if they may have been heated and suddenly cooled, and thus fractured. When these pieces are subjected to a high power, there may be detected in them very minute *oval cavities* in great numbers, and the major axes usually placed in one direction. I have never seen cavities in *milky quartz* or *blue quartz*. Sir David Brewster found many cavities in rock crystal from Quebec with "water and mineral oil."

Topaz. — In the various beautiful crystals which this mineral presents, there are frequently found cavities with fluid, and sometimes in this fluid may be seen the cuboid crystals described by Sir David Brewster. He found a single fluid in some cavities, and in other two fluids with "air bubbles." He says the fluid does not expand with heat. The Saxony transparent white crystals sometimes have cavities, as well as those of pale wine-color. The Brazilian gold-yellow specimens have these cavities very frequently. The clear pinkish are more free from them. I have never observed any microscopic acicular crystals in *Topaz*.

Emerald, Aquamarine, and Beryl. — Constitutionally the same — differ very much in regard to their possession of cavities and their commercial value. So far as I have been able to examine fine specimens of *Emerald*, it is rare to see one without cavities. One which I have, of very fine color, has many cavities of various forms, in which are included a fluid enveloping generally two perfect cubic crystals of an unknown mineral. In all cases in this specimen, the second crystal is much the smaller. Fig. 11, Pl. 2.

In *Aquamarine*, cavities are not frequent, and in *Beryl* I have detected them only in a specimen from Unionville, Penn. Fig. 12, 12*a*, Pl. 2. In this there is a biangular cavity with a small cubic crystal at an inner angle. Throughout the mass there are small suboval cavities.

Garnet. — As a precious stone this is by no means rare, but it is lustrous and of fine color. Cavities and microscopic crystals are

[1] Sorby, Journ. Geol. Soc., 1858, found many cavities, and thinks that the cubic crystals inclosed are probably chloride of sodium, as mentioned above.
[2] The smoky quartz of Pike's Peak has hexagonal spangles, which may be mica.
[3] Trans. Roy. Soc. Ed., vol. x.

very common in this gem.[1] The cavities are usually irregular and rough, and never to my knowledge have fluid. On a polished surface of a piece of garnet from North Carolina, nearly an inch long, the reflection of these crystals covered the whole surface with prismatic colors.

Cinnamon Stone, — This beautiful variety of *garnet*, from Ceylon, as far as I have been able to observe it, and I have some twenty cut specimens, and numerous rolled pieces, has irregular cavities and some crystals, as I have stated in a former paper.

Zircon. — With its high refractory power, this is used frequently as a *gem,* and sometimes sold as a diamond when white and perfectly transparent. One of the numerous specimens which I have examined has cavities[2] and microscopic crystals, and a specimen from Ceylon has remarkable dark brown, elongate, fusiform spots, with numerous dotted ones intervening. Fig. 9, Pl. 2.

Chrysoberyl, — The few specimens I have of this beautiful *gem* have neither cavities nor microscopic crystals, but Brewster observed "strata of cavities and both the fluids."

Chrysolite = *Olivine,* — In some of my specimens I have observed small cavities with fluid. Brewster met with them containing "fluid and bubbles of air."

Spinel. — This *gem* occurs of several colors. The ***Spinel-ruby,*** so called, sometimes is very close in color to the true *Ruby,* but it has not by any means the depth nor brilliancy of the true *Ruby.* In a pale-green specimen of great beauty which I have received recently from Ceylon, I have not been able to detect cavities or crystals. In my former papers I have expressed uncertainty in this matter.[3]

Iolite. — This *gem* is inferior in hardness, color, and specific gravity to *Sapphire,* but is valued for its peculiar change of color, being dichroic. One of my specimens is without inclusions. The other is filled with blue four-sided prismatic crystals, which are long, and inclosed in a nearly white subtransparent mass. These crystals are sometimes broken and their parts prolonged in the mass, and they are all lying in nearly the same direction.

Turquoise, with its peculiar and agreeable blue, is never transparent, and neither cavities nor microscopic crystals are found in it.

Opal, — This exquisite gem, which displays such brilliant colors, is very highly valued. It is but little harder than glass, and is indeed considered as volcanic glass. Its remarkable flashes of color are attributed to fissures, in accordance with the theory of Newton's colored rings. I have never been able to detect either cavities or minute crystals in this beautiful gem — except in two cases. One of my specimens has a brown, terminated crystal, a six-sided prism of an unknown substance, about one-fifth of an inch long, and terminated by a single oblique plane; the other has several smaller ones.

Lapis-lazuli. — This was used by the ancients as a favorite *gem,* but it is not now valued as such. I have not been able to detect cavities or minute crystals in any specimen in my possession.

Corundum. — This very interesting mineral, when in perfect transparent crystals, is highly valued as a *gem,* under the name of *Sapphire, Ruby,* etc., according to color. When yellow, it is called *Oriental Topaz;* when purple, *Oriental Amethyst.* When purely white it is sometimes sold as a *Diamond.* In this country we have two localities only of *Corundum* where any large quantity has been found, that of Chester County, Pennsylvania, and Franklin County, North Carolina. From the mines in Chester County, several hundred tons have been taken, but no transparent crystals. Some opaque ones are bluish and some pinkish. The North Carolina locality has produced some very large crystals, and numerous small ones. Of the latter there have been found many quite pure and transparent, and these are sometimes

1 Proc. Acad. Nat. Sci., Feb. and May, 1869.
2 In a specimen in Dr. Leidy's fine cabinet there are anastomosing cavities.
3 Proc. Acad. Nat. Sci., Feb. and May, 1869.

blue and sometimes red. But none of them yet found are of value as *gems*. The fine *Sapphires* and *Rubies* are chiefly from Ceylon, and they form some of the most beautiful objects in nature. I have many of these in the form of worn pebbles, and some in fine hexagonal form, as well as hundreds of cut specimens. I have examined carefully more than one thousand specimens, with a view to discover whatever "inclusions" they might possess. In a communication to the Academy,[1] I described and figured some microscopic crystals in these and other *gems*. Since then I have added a very large number to my collection, and among these several hundred large and small transparent crystals. In a careful microscopic examination of these I found a large number which contain cavities and minute crystals, the former sometimes scattered irregularly through the mass, and sometimes forming a sheet or film. These cavities are of all forms, but usually sub-elliptical; sometimes tubular, and these tubes frequently anastomose in a very beautiful manner. These cavities are so numerous that they frequently give a cloudiness to the specimen which is less valuable as a *gem*, but most interesting in a scientific point of view. In some specimens these cavities exist by tens of thousands, and Sir David Brewster stated that in a specimen under his observation there were about 37,000 of these cavities. I am sure that in one of my large cut specimens there must be more than double that number. It is a very common thing to see hundreds of these cavities in the Ceylon specimens, partly filled with the fluids previously alluded to in these notes. But it is quite rare that they are found in the specimens from North Carolina. Still I have seen them in the transparent small fragments of deep blue crystals, and sometimes in the transparent light-colored ones. In one specimen of the latter, I discovered some most interesting cavities, which contained, beside the *fluid*, each a *single cubic crystal*, Figs. 1, 2, and 3, Pl. 2. I had never observed an included crystal in any cavity in the numerous Ceylon specimens which I have examined. These cubic crystals have the exact form and appearance of those in the *Emerald* described herein.

In regard to the microscopic crystals in *Sapphire*, having described and figured them in the papers before alluded to, I have little to add now. Further observation has confirmed what I then stated regarding the radii of *Asteria*. Very recently I have received a number of these *Asteria* of various colors, blue, white, red, and dove-color; several three-quarters of an inch in diameter. The red and purple specimens are of peculiar beauty, and when examined in the sun, or any strong light, they both exhibit the microscopic acicular crystals with peculiar beauty, displayed as they are in hexagonal form, and reflecting the spectral colors. The *Ruby Asteria* is certainly among the most beautiful objects in nature, and the purple are very little less so.

In some crystals of *Corundum*, there is a strong bronze reflection, and this is the case with some of the large hexagonal crystals which were imported by Mr. S. S. White from India for commercial purposes, and which he distributed with so much liberality to our mineralogists. These bronze crystals have also been found at the Black Horse and Village Green localities in Delaware County, Pennsylvania. When examined with a good power, these bronze reflections are at once seen to be caused by minute acicular crystals, and these may sometimes be seen in bunches.

A pale *Ruby*, "Rubicelle," which I lately received from my friend Hugh Nevill, Esq., Ceylon, about three carats, is a most interesting and beautiful *gem*. It has the depth and brilliancy almost of the diamond. It is nearly of a rose-color, and is perfectly transparent. It is cut with a top table and not entirely symmetrical. Its refractive power is unusually great. Yet when this brilliant transparent *gem* is examined with a high power and strong light, the whole mass may

[1] Proc. Acad. Nat. Sci., 1869.

be seen to be filled with long acicular crystals in three directions, parallel to the prismatic planes, and interspersed are numbers of very minute and delicate cuneiform crystals.[1] It has also a small cloud of exceedingly small cavities.

Another remarkable specimen may be mentioned here, which has small cavities and minute microscopic crystals. It is of a pale yellow or straw-color, and of a depth and brilliancy scarcely exceeded by the diamond.

During the examination, about two years since, of some hundreds of small crystals of *Sapphire,* perfectly transparent to dark blue, I discovered one which had very singular plumose impressions on the planes of the prism. This induced me to examine carefully all those which I subsequently procured, and I have now over a dozen specimens which exhibit this very singular character.[2] I am entirely at a loss to discover the cause of this form of minute impressions on so hard a substance. It evidently has been formed by some collateral mineral substance, against which the molecules in crystallization have been arranged.

Diamond. — The hardest of all substances stands first among *gems*. It has not, however, much interest to the microscopist, as no cavities with fluid have been, so far as known, observed, nor has it included crystals of foreign substances. They are often very imperfect, containing rifts and discolorations. Some of my specimens have beautiful triangular impressions on the surface of the planes. My friend, Dr. Hamlin, of Bangor, Maine, is engaged on an extended work on the diamond. Such a work is much needed, and I know no one as capable as he to accomplish it. This gem sometimes occurs of various colors. In my cabinet I have six different colors.

REFERENCES TO PLATE 2

Fig. 1, 2, 3, Plate 2. Represents cavities and crystals in a specimen of transparent *Corundum* from Franklin, North Carolina. In no other specimen of the numerous ones I have examined have I found cavities with a fluid and included crystals both, while it is very common in the Ceylon *Sapphires* to have cavities without an included crystal.

Fig. 4. A *Sapphire* from Ceylon, given to me by Dr. Ruschenberger, has cavities without fluid; the cavities being in the form of crystals in the larger ones, but in the numerous small ones subrotund. These cavities are interspersed throughout the mass with numerous acicular crystals running generally in two directions.

Fig. 5. A specimen of blue *Sapphire* (Ceylon), with four nearly perfect subhexagonal crystals, somewhat flattened. These are surrounded by an immense number of minute cavities, some of which anastomose. The crystals seem to be filled with a black fluid. There are also very minute acicular crystals.

Fig. 6. In the same specimen with the above, there is a group of very different crystals which are here represented. These can only be seen with a proper angle of light. Then they reflect all the colors of the spectrum. This group consists of very perfect cuneate and acicular crystals, and is somewhat like that figured in my pl. 9, fig. 2, Proc. Acad. Nat. Sci., May, 1869, but the crystals are much more defined and perfect than in that plate.

Fig. 7. Represents a small blue *Sapphire* one-fourth of an inch long. The very remarkable plumose impressions cover all the six prismatic planes.

Fig. 8. A blue *Sapphire* similar to Fig. 7, about three-sixteenths of an inch. The prismatic planes here are covered with impressions more in a dotted form. These two (Fig. 7 and 8) were examined with a power of one hundred diameters.

Fig. 9. A specimen of *Zircon* from Ceylon has very singular, dark brown, elongated fusiform maculations in one direction. These are surrounded with numerous dotted ones.

(Continued on page 254)

1 Proc. Acad. Nat. Sci., May 11, 1869.
2 Figs. 7 and 8, Pl. 2.

Some Freaks and Rarities Among Gemstones

by

COMMANDER JOHN SINKANKAS, C.G.

(Continued from Fall 1955)

RHODOCHROSITE

The John Reed Mine at Alicante, Lake County, Colorado, has long been famous for its lovely crystallized rhodochrosite specimens. The clear pink rhombs sprinkled over a slab of matrix have always excited the admiration of mineral collectors the world over. Recently, good fortune permitted the acquisition of a large cleavage fragment of this mineral. When cut and polished it yielded a nearly flawless step-cut gem of a little over eight carats. The finished stone did not appear as pure a pink as in the rough material; instead, a slight cast of orange was noted. When checked with the dichroscope, a strong pink was seen in one window and a very pale yellow, almost colorless, in the other. It is perhaps the latter which imparts the orange cast referred to.

NODULAR TOURMALINES

A peculiarity of certain tourmalines noted by miners and cutters of this gemstone, especially in crystals emanating from Maine and California, is worth commenting upon, because it may be helpful to those who contemplate having rough material cut. It may also explain the mysterious fractures which sometimes appear spontaneously in tourmalines kept in storage and not subject to any unusual stresses which the owner is aware of. This spontaneous rupture is fairly common in those varieties which show concentric color zoning about the principal axis of the crystal; it does not occur in those which are zoned in bands along the length of the crystal. Not only are cut stones subject to this self-destruction, but raw material also spalls off or chips in curved, conchoidal flakes, until oftentimes the only solid portion left of the original crystal is a spherical or lenticular core – the "nodule."

The explanation for this curious and interesting phenomenon perhaps lies in the fact that color zones often represent areas in which the crystal lattice is under considerable stress as a result of accommodating the foreign atoms giving rise to the color. It is now well recognized that in most minerals of ideal chemical composition, the crystals are colorless. If color appears, it means that another element, not normally present in the compositional formula and possessing about the same atomic size and chemical characteristics, has usurped the place of one of the normal atoms. Where this replacement is extensive, a mineralogical "series" is formed in which the end members are quite different but the individual species between the extremes vary gradually and imperceptibly from one end member to the other, depending upon the quantity and kind of atoms involved in the replacement. In such series minerals, the crystal lattice adjusts itself in accordance with the changing composition, showing this change in varying interfacial angles and cleavage angles. The latter is significant because it shows that an adjustment has been made by the crystal to accommodate the change in composition, perhaps thus preventing the accumulation of internal stresses. However, tourmaline is not a member of a series; it is merely one species and is remarkably constant in its habits of crystallization. Yet its composition is both complex and varied, which leads to the belief that the presence of ill assorted foreign elements within the crystal must place it under a considerable stress which cannot be relieved by changes in mode of crystallization. It may be significant to note that dead-black tourmaline is rarely found in an unshattered condition and that the lighter colored varieties are often found in large, strong sections, even after being blasted from rock.

Continuing along this line of reasoning, and assuming that colored areas in tourmaline represent areas of stress, we may expect that specimens showing pronounced colored changes may crack when additional stress is applied. Several lapidaries who have cut considerable quantities of multicolored tourmaline have become expert in detecting those crystals which are sensitive to breakage. The signs appear to be numerous basal cracks, often fine and barely penetrating the skin; also, sharp fracture discontinuities at the broken ends of crystal pencils. The latter often show a thin peripheral portion which is normal to the prism axis but the center portion is bulged or raised. Sometimes the raised portion is almost spherical in shape. Such crystals seem always to show a pronounced concentric color zoning, with a change of color exactly at the point where the normal fracture and the spherical fracture join. The cutting and polishing of such crystals is possible if the outside layer containing the fine cracks or the sharp fracture discontinuity is ground off first. If one side is cut only, then the crystal may crack even when not being subject to any stress.

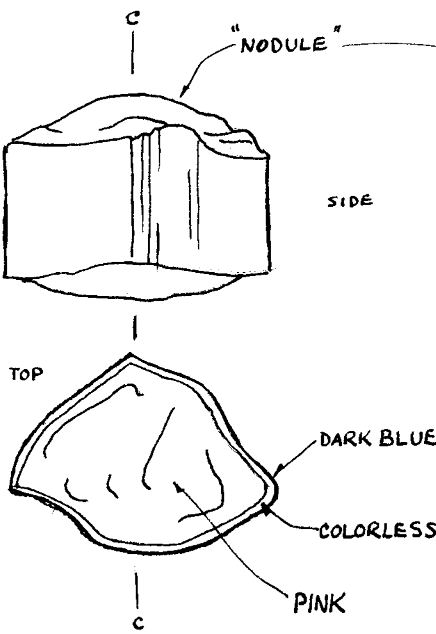
The most striking nodular tourmalines noted thus far have come from the pegmatite deposits of Maine, particularly the Berry Quarry at Poland. The San Diego County tourmalines have also shown this phenomenon frequently, as well as some specimens originating from Mozambique. Brazilian tourmalines, on the other hand, seem to be relatively free of this difficulty.

CAT'S-EYE NEPHRITE

The chilly fastness of the Kobuk River region provides nephrite in various colors of green. Not infrequently, slabs sawed from stream-rolled boulders show areas where the usual felted structure has been replaced by straight fibers of a lighter, grayish-green material, presumably, still nephrite. Carefully cut, taking the easily split nature into consideration, these portions provide fair cat's-eyes. The line of light is distinct but not sharp.

VESUVIANITE OR IDOCRASE

At one time, in a quarry near Laurel, Quebec, a considerable quantity of yellow vesuvianite was mined for gem purposes. Clear areas in the material provided lovely



Tourmaline Crystals Showing Spalling and Creation of the so-called "nodules". Pala District, San Diego County, California.

faceted gems. The well-known jewelers Henry Birks & Sons, Ltd., Canada, were interested in this gemstone and for a time sold some under the trade name of "Laurelite." However, for one reason or another, the promotion did not succeed and the stones soon disappeared from the market.

From time to time, collectors go to the locality and obtain a few fragments, and it was through the kindness of one of these collectors that I obtained some for faceting. The finished gems, though small, are very attractive. Most contain numerous but barely noticeable flaws, whereas the color, a rich yellow with faint overtones of green, is quite unlike most other gemstones. It is unfortunate that more and larger specimens are not available, since this can become a fairly important gemstone. The fragments furnished me did not cut gems in excess of 75 points in weight.

DIOPSIDE

Most readers are familiar with the dark bottle-green diopsides from Madagascar, the most productive locality for this rather scarce gemstone. Less well known, however, is the diopside which once came from a locality near Richville, DeKalb Township, St. Lawrence County, New York. According to

Kunz, in his "Gems And Precious Stones Of North America," crystals were found here which yielded gems of six to eight carats in weight; others were estimated to be capable of cutting into gems of as high as 30 carats. It is doubtful that any diopside from this locality was ever cut of the last-mentioned size, but the smaller crystals were found frequently.

A small squarish terminated crystal of the Richville diopside was obtained some time ago from an old collection and cut into a faceted gem of slightly over five carats. In color, it is a pale green tending toward olive. It is difficult to say what the pleochroism is, there being scarcely any change in hue between windows regardless of the angle from which the stone is viewed. Although the green color is not outstanding, the lightness and clarity make this stone more attractive than any of the Madagascar stones observed so far.

DATOLITE

This gemstone is usually mentioned in connection with the opaque massive varieties formerly obtained in some abundance from the copper mines of the Lake Superior region. The use of transparent crystals for faceting purposes, however, is not mentioned by any important authority other than G. F Herbert Smith in his comprehensive treatise "Gemstones." Presumably, the late Dr. Smith had reference to the faceting quality of datolite, since he furnished the characteristics which would be useful to a gemologist called upon to identify a clear gem of this mineral.

For some years now, the Lane Quarry at Westfield, Massachusetts, has produced exceptional crystallizations of large datolites. One vug section in the collection of the U.S. National Museum is over a foot in length with one side completely covered by pale yellowish-green crystals, each about an inch or more in length. From such crystals it is easy to obtain clear and flawless sections suitable for faceting, although loose fragments of datolite found in chlorite-filled pockets in the Westfield rock are likely to be of better quality. The datolite from New Jersey quarries, also well known to the mineralogical fraternity, is not as large as the Westfield material and is seldom as clear. Occasionally, faceting material has been found in the same copper region about Lake Superior mentioned earlier.

In cut form, datolite makes a brilliant and attractive gem. The color is exceedingly pale and the slight trace of greenish yellow is easily apparent only when the specimen is resting upon a dead-white background. Birefringence is large and is noticeable to the unaided eye of average keenness. Although the hardness is stated to be five, lapidary treatment indicates it to be considerably harder, possibly as high as six.

LEUCITE

A most intriguing series of small gems were cut recently from some clear trapezohedrons of Italian leucite. The locality was stated to be in the volcanic rocks near Villa Senni, Grotto Favata, Alban Hills, the same rocks which are famed for their production of a wide variety of characteristic lava minerals. Most of the crystals were less than a pea in size, sometimes beautifully regular in their external geometry and usually somewhat translucent. A few of the better ones proved quite clear and, upon cutting, showed an unexpected degree of "fire." This was most unusual in view of the very low refractive index and an explanation was immediately sought. Dana's "Textbook" states in regard to leucite that it "Usually shows very feeble double refraction: alpha 1.508, gamma 1.509. Under crossed nicols shows weakly birefringent twinning bands." Checking the four stones in my possession on the refractometer, it was found that each showed a fairly constant refractive index at 1.51, with a rather narrow colored band between the dark and light fields. Lacking monochromatic light for these readings, they must be considered approximate at best; however, the narrowness of the colored bands in ordinary light confirmed the fact that the "fire" was not due to dispersion but to some other cause.

The stones were next examined under the polariscope, and at once they assumed amazingly vivid colors and strong anomalous double refraction effects under crossed polaroids. Some of the color bands were circular and gave promise of an optical figure but none could be materialized. Under magnification, each gem showed fine parallel striae and, when turned about slowly to a certain position, exhibited a patch of vivid color. There were several such patches in each gem and as far as could be seen; each was perfectly flat and oriented parallel to a set of the striae. They did not appear to be diffraction effects necessarily, since no physical separation of layers was noted which could give Newtonian rings.

In size, these leucites do not exceed about 80 points. The style of cutting has no effect, of course, on the display of this "fire"; it is like the color in opal, independent of any outside shaping for its existence.

KYANITE

Seldom seen in collections, kyanite owes its scarcity to the extreme difficulty encountered in cutting. The slightest misstep in preparation results in a shattered stone. This is due not only to the excellent cleavage but also to the wide variation in hardness exhibited by certain planes in the crystal. However, an experienced lapidary can usually complete one successfully if forewarned of its properties.

In the last several years, various mineral dealers in this country have imported kyanite blades from Sultan Hamud, Kenya, and also from Brazil. The Kenya material comes in large pieces, sometimes as much as four inches in length and about a half inch thick. In suitable pieces, clear areas exist which provide faceting possibilities. The colors range from deep blue, through greenish blue, pale blue, to colorless. Often several bands of color will fall within a space of less than a quarter of an inch. Brownish, straight, tapering inclusions oriented across the length of the crystal are common but do not detract seriously from the appearance of a finished gem. The Brazilian material is blue to colorless with various shades of blue between the two extremes. The finest blue is extremely handsome and would do credit to the best Kashmir sapphires. Unfortunately, the Brazilian crystals are quite small and furnish cut stones of less than a carat if they are cut with sufficient depth.

In the United States, Yancey County, North Carolina, was once noted for fine green kyanites. This area provided single crystals, stubby and compact, which yielded larger cut gems than either the Kenya or Brazilian crystals. The green color was exceptionally attractive, reminding one of greenish aquamarine. Also, the crystals were very clear and afforded perfect stones in this respect.

ULEXITE

Several months ago I heard of a fascinating curiosity: the so-called "Television Stone." It seems that some of the fibrous massive ulexite from one of the borax mineral deposits of California had fallen into the hands of an imaginative amateur lapidary of Los Angeles. He noted that the extremely fine tubes in this material were so straight and so clearly reflective that the image of an object placed at one end of the tubes would appear reflected at the other. He had a hunch that this could be made up into something unique; accordingly, he cut and polished a cross section to check.

The reflecting effect turned out to be astonishingly strong and clear; newsprint placed against one polished face appeared as if by magic on the other, even with an intervening distance of an inch of material. Observing this, our unsung genius dubbed the gem "Television Stone." Needless to say, all available specimens of ulexite promptly

(Continued on page 254)

Book Reviews

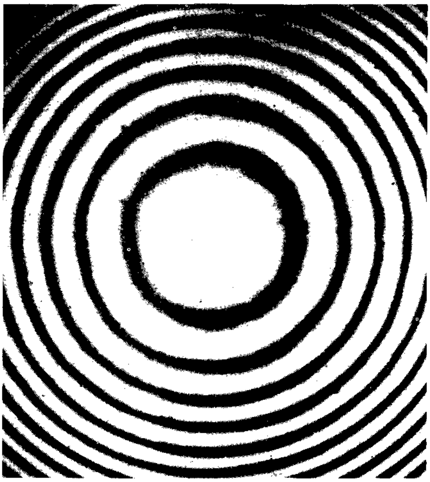
MICROSTRUCTURES OF DIAMOND SURFACES ***by Prof. S. Tolansky, Ph.D., D.Sc., Department of Physics, University of London, Published by N.A.C. Press Ltd., London.***

Professor Tolansky has brought his ten years of research in the techniques of high magnification to the study of diamond surfaces in this valuable work. The diamonds to be studied were furnished by Industrial Diamond Distributors, Ltd. The study was important to this unit of the Diamond Corporation because of the valuable data potentially available through this type of research. The results should be useful in the preparation of some industrial diamonds and have a bearing on diamond cutting as well.

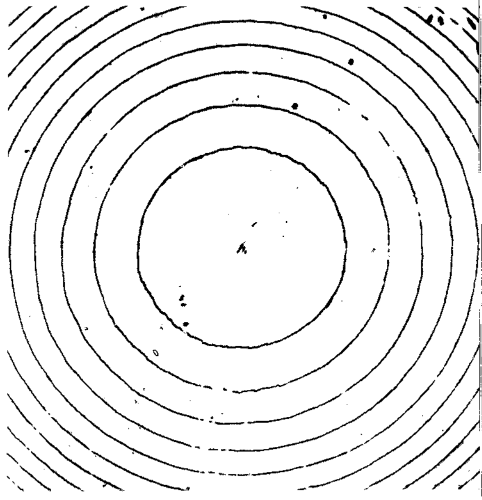
The techniques used were two-beam interferometry, multibeam interferometry, high dispersion interference contrast and light profile. Tolansky points out that despite their early discovery, it was only late in the 19th century that it was realized that Newton's rings provided, in effect, an optical contour map of the shape of a lens. Tolansky reasoned that similar results could be obtained between flat surfaces at a small angle to one another. It is possible by this method to contour surfaces and get effective magnifications many times larger than what would normally be expected from the elements employed. Tolansky says that when the detail to be examined is so small in extension as to tax the maximum microscope resolutions available, two-beam interferometry was used. The techniques of multibeam interferometry permit much higher powers to be employed in measuring height and depths but at the expense of using more limited magnifications in extensions; i.e., across the surface. It is possible in the most favorable cases to resolve height-depth features as small as 1/500 of a light wave; i.e., only 10A (Angstrom units), or one millionth of a millimeter. Such a distance approaches molecular dimensions. It is remarkable that such powers can be made available by a very simple, inexpensive means and that effective magnifications of even 500,000x can be secured. Tolansky says, "Multibeam fringes have the same general topographic outline and are the same in location as the two-beam fringes, but they are highly sharpened through the multibeam interference effects. This sharpening makes possible much closer results." In other words, either method produces fringes, which contour the surface studied, but multibeam fringes are sharper. See Figure 1 (Plates 1 and 3).

Using these and other techniques, Tolansky has made some very interesting observations regarding the surface of diamonds. He has studied natural faces of various crystal shapes of diamonds, cleavage surfaces, and the results of etching, polishing, and percussion on diamond surfaces. The trigons found on octahedral faces and oriented exactly in reverse to the octahedral face were shown to Tolansky's complete satisfaction to be a growth phenomena and not, as some investigators have thought, a result of etching. See Figure 2 (Plate 9). He found that the trigons were shallow and had only very slightly sloping sides; usually a trigon has a flat base. Tolansky states that it is probable that this region is flat to within atomic dimensions and may well be a truly atomic plane. "For it can be established that uniformity of tint within a high dispersion area implies flatness to within less than 10 A, possibly less than 5 A." Apparently trigons are to be found on every octahedron face. See Figure 3 (Plate 16).

His study of the trigon has led Tolansky



(Plate 1)



(Plate 3)

Figure 1

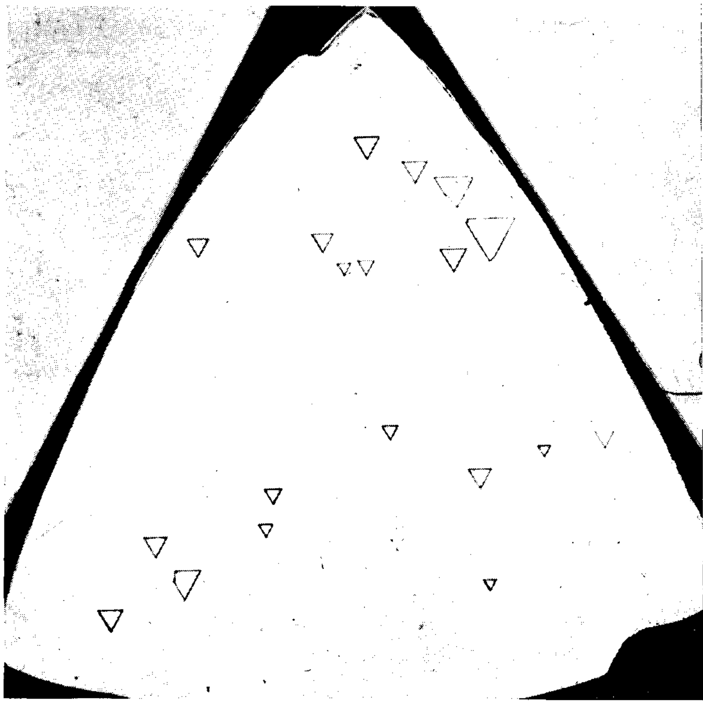


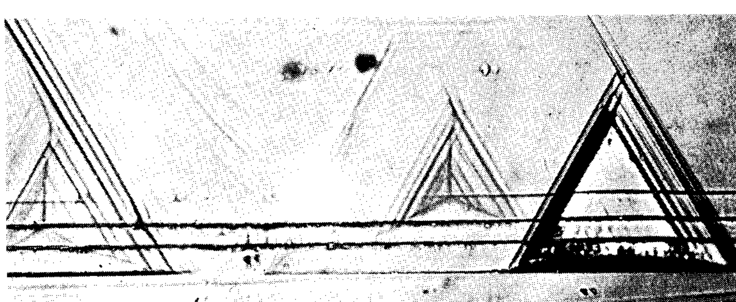
Figure 2
(Plate 9) 50X

Figure 3
(Plate 16)
260X

to believe that diamond grows by accumulation of atoms in wave fronts across each successive plane. In other words, he believes that atoms accumulate much as bricks would be placed on successive parallel walls. Since on an octahedron face these are advancing from three directions at 60 degrees to one another, if growth is held up for some reason over a straight-line edge, then a triangular depression will form whose base level will be exactly on the original flat region. Tolansky says further, "As to the origin of the trigons, it is possible that they are built on linear dislocation regions in the crystal lattice. Growth progresses until a linear dislocation is reached and then growth sweeps around this. Ultimately, of course, the trigon will be filled in, for, as the crystal grows, the trigons are filled in and disappear."

One feature noted by Tolansky is probably what is often referred to as a twin line in diamond. See Figure 4 (Plate 53). That is a line which the diamond grader notes in a cut stone as a definite line across the crystal without cleavage or any other obvious reason. Higher frequency of trigons along such

Figure 4
(Plate 53)
400X



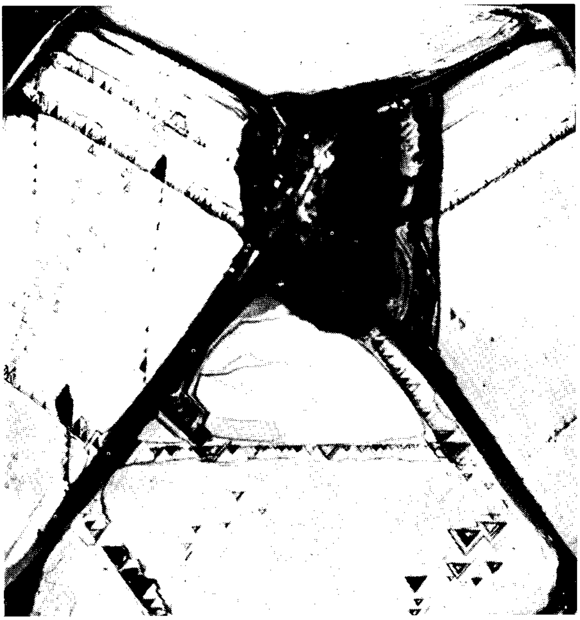
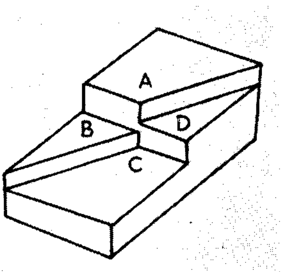


Figure 5
(Plate 54)

Figure 6



(Plate 50) 130X

(Plate 49 130X

lines was encountered. See Figure 5 (Plate 54). It has been assumed that this is the result of twinning or crystallographic slip. Some of Tolansky's excellent photomicrographs show faultlike surface discontinuities which he attributes to such a slip. See Figure 6 (Plates 49 and 50). He favors the slip hypothesis over twinning, believing that if the mechanism were due to twinning, it should be more common on macles and other types of diamond twins, whereas it seems to be no more common on those than on other diamonds.

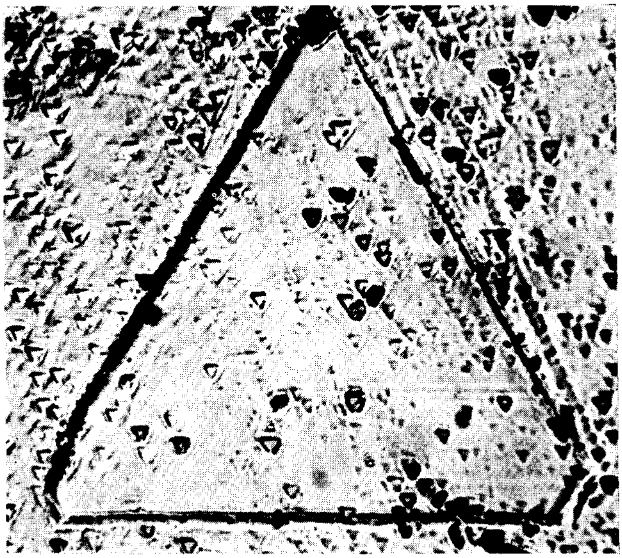


Figure 7
(Plate 62) 600X

In his study of etching, Tolansky found proof for the fact that trigons are growth rather than etching phenomena, because he found that trigons formed by etching were oriented with the sides parallel to the faces of an octahedron rather than reversed as are trigons. See Figure 7 (Plate 62). The temperatures at which etching took place first were of interest. He states that in each case etching was accomplished by immersing the diamond in hot potassium nitrate. "Etching in a subtle way begins very much earlier than investigators have reported. Numerous diamonds have now been etched and the temperature range has been as low as 500 to 700 degrees C. Marked etching sets in at 525 degrees C for all diamonds examined." Tolansky records the various stages of etching and the various patterns which developed. Some of the photomicrographs are most interesting. See Figure 8 (Plate 74).

In his studies of cleavage, Tolansky found that cleavage faces on Type 2 diamonds are much better than those on Type 1 (Type 1 and Type 2 are two modifications recognized for their different transparency to ultraviolet). The more common Type 1 transmits less of the ultraviolet than does Type 2. To quote Tolansky: "It turns out that the characteristic type of cleavage (the traditional "perfect" cleavage) is, to interferometrical standards, a very rough affair indeed. See Figure 9 (Plate 96). The surfaces are broken again in a conchoidal fashion to such extent that it is quite impossible to apply precision interference methods. On the other hand, the Type 2 cleavage is likely comparable with the very perfect cleavage of such crystals as topaz."

Another study made by Tolansky was of percussion marks on diamond. He found that cracks appeared parallel to the cleavage on whatever surface the load had been placed. See Figure 10 (Plate 115). Thus on octahedron faces, the percussion marks are hexagons, and on cube faces, squares, with the sides at 45° to the cube edges. He found that the diamond deformed in a plastic manner, rising up to the outer edges of the cracks, with the inner portion tending to be either at the same level as the surface or slightly depressed from it. See Figure 11 (Plate 121). Tolansky found that it is not difficult at all to produce percussion marks on diamond

Figure 8 **(Plate 74) 1200X**

and indeed found many on the natural surfaces. He produced percussion marks by placing a ball-ended cylinder of diamond with a rod of .4 mm. and set up an apparatus so that the diamond faces could receive the diamond ball under minor pressure. It has been found that with loads as light as 4kg., permanently oriented ring cracks can be formed. Tolansky states, "The astonishing thing is the ease with which ring cracks can be introduced using relatively small loads on the diamond ball." Of course, these are minute and it is conceivable that many could be found on the surface of a diamond which is flawless under 10x.

Studies made of commercially polished diamond surfaces show that considerable departures from optical flatness existed. It was found, for example, that the average surface has an appreciable cylindrical curvature. Even a three-stage experimental polishing method much more exact than that employed com-

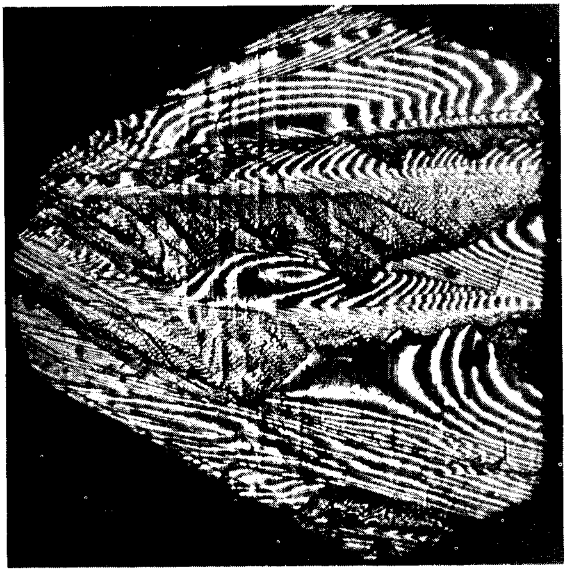
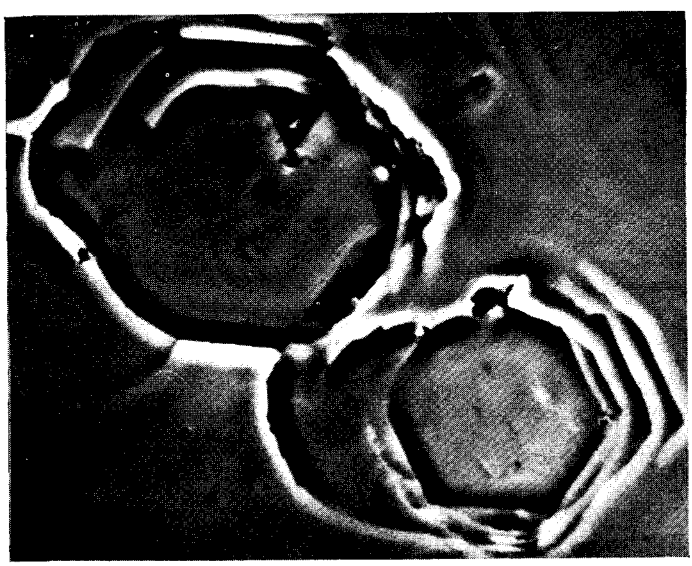


Figure 9
(Plate 96)
30X

Figure 10 **(Plate 115) 560X**



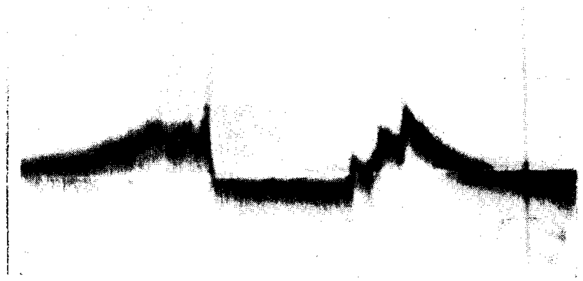


Figure 11 **(Plate 121) 400X**

mercially left polishing marks. From this and other evidence, Tolansky concludes that no Beilby layer forms on polished diamond. He states, "It is therefore to be concluded that diamonds cannot be polished as flat as glass."

On studies of the surfaces produced by sawing by commercial methods, Tolansky found that in some regions the surface was flat and smooth and in others, chopped and irregular. The latter are so irregular that polishing is more laborious and the weight loss great. Investigation showed a correlation between the charging of the saw blade and the rough areas. He believes that more uniform surfaces will result if the saw is charged only at the beginning. If this is not enough, continuous charging is recommended.

Tolansky's studies add up to a significant contribution to the technology of the diamond. The photomicrographs are beautifully reproduced and make a fascinating record of his achievements.

THE PEARL AND I — the Diary of an ex-Millionaire by Leonard Rosenthal, published by Vantage Press, New York; 223 pp. $3.00.

The PEARL AND I is an autobiographical work of the later years of a man once very important in the pearl markets of the world. The late Leonard Rosenthal wrote a number of books including "The Kingdom of the Pearl," published by Brentano's in 1920 (a limited deluxe English language edition of a book published in France in 1919), and "The Pearl Hunter," an English adaptation of "Memoires d'un Chercheur de Perles," in 1949. Rosenthal died a short time ago at the age of eighty-three, just as his new book was going to press.

Mr. Rosenthal's last book deals mostly with his life from the time he left France in 1940 to 1952; Pearls and other gemstones play a somewhat insignificant part in the story. However, Mr. Rosenthal provides a rather interesting appendix on pearls and cultured pearls, entitled, "All About Pearls," in which he describes in detail the historical background and role of natural pearls as well as present activities in the cultured-pearl industry. The importance of gems in his life, aside from the fortune he built on them early in his career, is traced to the fact that it was only pearls and other gemstones concealed in tubes of paint that he was able to take with him when he escaped from Paris in 1940. Rosenthal states:

> "Time and again, in the half century that I spent in France as a dealer in precious gems, refugees from political or racial persecution reached Paris with only

their gems as a lifebelt. Among these people were princes and granddukes; countless times I purchased their gems from them, providing them with ready money. Sometimes the market in gems was flooded, because of the waves of refugees, and consequent prices were relatively low. But the fact remained: it was possible to have a better price on gems than on other rare objects — art masterpieces, antique furniture, and so forth — which usually flooded the market in similar periods.

"Apparently here in America, at present there are many people anxious to provide for an uncertain future by investing in gems. In fact, I am very frequently called upon here in New York to advise potential purchasers of 'secondhand jewels' —which again, represent a sound investment."

Rosenthal says further:

"How sound an investment are gems? What gems are the soundest investment? These are questions often asked me even today. But they were asked particularly during the 1930 panic, and during the years leading up to both world wars. Ever since the beginning of history, gems have been regarded as the equivalent of gold bricks, and with the added advantage of being more easily transported and negotiated.

"In France, where time and again wars have caused the devaluation of the franc, people with any money at all invest in gems. You will often see a respectable middle-class woman rather shabbily dressed but wearing important jewels; they are a safer way to provide money for a rainy day than any bank account."

Mr. Rosenthal writes in an entertaining, even vivid style which makes for rapid and fascinating reading. He has some interesting comments on the preferred position enjoyed by a gem expert. He relates the case of a man of wealth who at a social gathering remained silent when the conversation "turned on the characteristics, desirable and otherwise, of aristocrats. Asked at length to contribute his share to the conversation, he frankly said, 'I am not qualified to speak. My forebears were butchers. Behind his back, he heard a scandalized voice remark, 'When one has such a background one remains silent!' On the other hand, I do not recall ever having been made to suffer any humiliation of the sort, although my father was a shopkeeper and I was a self-made man. Perhaps this was because I had made my fortune in gems."

Mr. Rosenthal continues:

"The gem expert throughout the world and in every epoch enjoyed special privileges, meeting with a degree of respect not granted to experts in other merchandise.

"In India, land of the caste system, the art of appreciating precious gems has been, from the 16th century onward, highly esteemed. Perhaps it was because the study of gems was not reserved exclusively for merchants, but also engaged in by poets and princes. Each generation of gem experts in India was expected to contribute its remarks on the subject in writing. These writings, known as the *Ratnaparîksâ,* a compendium on the appreciation of gems, are a mine of information for any would-be expert today, as well as for the historian of traditions, superstitions, and customs. We gather from these writings and from certain inscriptions on tombs that the skill of the gem expert was one that kings liked to honor. One tomb inscription reads: 'His eyes were the blue of a clump of blue lotuses; with a rapid glance from them he could perfectly discern the qualities of beauty existing among elephants, horses, men, and women. But how describe the skills with which he discerned the value of diamonds and other precious stones!'

"Elsewhere in Hindu writings we find the gem expert described as a 'treasure difficult to find' and are told that when such an expert is encountered, his help should be solicited humbly; he should be welcomed by the host and offered a chair, should be presented with perfumes and garlands.' According to one text, the gem expert is a person 'who knows the contemporary world, possesses the art of pleasing kings, is acquainted with the prices of goods upon the market, and has mastered the rules of computation.'

"In Italy in the 16th century the gem merchant enjoyed almost as much prestige as the artist. And that is to say a great deal, for the artists were sometimes allowed literally to get away with murder.' Take the case of that superb artist in gold and jewels, Benvenuto Cellini. When the hot-tempered artist, too quick with his dagger, had committed three murders in two years, it was expected by everyone that Pope Paul III would issue orders for his punishment. On the contrary, the Pope issued a statement to this effect: 'Know then that men like Benvenuto stand above the laws.' "

By Rosenthal's account, he was instrumental in forcing early dealers to label their cultured pearls as such through legal action in Paris. He tells of his early efforts to make a living in the gem field in America before finding that his old nemesis, the cultured pearl, provided his best opportunity.

All in all, "The Pearl and I" makes interesting and pleasant reading.

GEOLOGY OF SOUTHERN CALIFORNIA Bulletin 170

Bulletin 170 of the Division of Mines of the State of California is a monumental report on the geology of Southern California. The report consists of ten chapters entitled: General Features; Geology of the Natural Provinces; Historical Geology; Structural Features; Geomorphology; Hydrology; Mineralogy and Petrology; Mineral Deposits and Mineral Industry; Oil and Gas; and Engineering Aspects of Geology. The geologic guides for five selected field trips covering most of the area add great interest to trips for those who are interested in the geology and mineral resources of the area. In addition, there are 34 map sheets of the geology of 25 different areas and nine oil fields. There are many other smaller maps and cross sections included in the ten chapters mentioned above.

The principal editor is Dr. Richard H. Jahns, Professor of Geology at the California Institute of Technology and GIA Technical Consultant. Other members of the editorial committee consisted of Dr. A. O. Woodford, Professor of Geology at Pomona College; Dr. John C. Crowell, Professor of Geology at the University of California at Los Angeles; L. A. Norman, Jr., and Lauren A. Wright of the State Division of Mines. The editorial board had the assistance of 103 authors. Dr. Jahns contributed a significant portion of the articles. Included among his contributions are the following: "Investigations and Problems of Southern California Geology," "Geology of the Peninsular Range Province, Southern California and Baja California," "Geology of the Transverse Range Province, Southern California," "Marine-Nonmarine Relationships in the Cenozoic Section of California," "Pegmatites of Southern California," "Northern Part of the Peninsular Range Province."

Bulletin 170 was prepared for the Los Angeles meeting of the Geological Society of America in 1954, but it was not published until mid-1955. This outstanding work will undoubtedly provide basic information of real value, assisting toward a better understanding in the study of natural resources in the State and as a background in the development in the mineral industries. The "Geology of Southern California" should be of particular interest to mineral and gem collectors and to those planning trips in the area.

Bulletin 170 may be obtained from the Division of Mines, State of California, Ferry Building, San Francisco 11, California. Price $1.00.

GEM CUTTING a lapidary's manual by John Sinkankas, C.G., D. Van Nostrand Company, New York, 347 pages, 94 illustrations. 14-page index. $8.95.

John Sinkankas's book on lapidary techniques is one that both the lapidary and hobbyist will find valuable. A number of books have been written on the subject, but this lapidary manual is the most comprehensive of any published to date. Some of the gem minerals discussed are so rare that only a few are known to have been cut, and the essential details which pertain to the cutting of the latter are now in print for the first time. Many of these stones are cut infrequently because, due to perfect cleavage and resultant fragility, they present a very difficult project. On others a satisfactory polish is extremely hard to obtain because of their low hardness. However, each mineral is discussed and the correct orientation, cutting angles, types of laps and abrasives are given, together with any special treatment necessary for the production of a beautifully finished gemstone. Many of the stones will present a challenge to the lapidary or hobbyist who enjoys cutting the unusual and dares to experiment with the difficult.

The author, a career naval officer, is a well-known lapidary who has cut gems for many years. Many beautiful and rare stones, the result of his superior workmanship, are displayed in the National Museum in Washington, D.C. Out of his wide range of experience, he has gleaned valuable information on all phases of the lapidary art and has presented it in his book. This dissemination of information, well organized and presented, the amateur lapidary and hobbyist has long awaited.

In the well-illustrated book containing 16 chapters, an appendix and index, every interesting phase of the lapidary art is covered. The initial chapter entitled, "How to Get Started," discusses equipment needed, costs, how to set up a lapidary shop, the various types of lapidary equipment on the market, the intricate details of assembling your own equipment, and the fabrication of many types of cutting and polishing laps. There are chapters on the manufacture, operation and care of various types of saws and the special advantage of each, grinding and lapping equipment, and numerous sanding procedures. Also presented are many money-saving shortcuts, essential for the average novice. The chapters on cabochon cutting and the faceting of gemstones are supplemented by chapters furnishing general information on the sources, selection, and buying of rough material.

Beadmaking, drilling, and spheremaking are discussed, with several pages devoted to this phase of the lapidary art.

To the potential lapidary the author has this to say:

> "Anyone can cut gems. The idea of cutting and polishing gemstones is frightening at first to most people, because they cannot see how they can ever duplicate the skill so obviously displayed in the sparkling finished products gracing jewelry counters. Actually, it is far from being so difficult that only a favored few can master it."

He is the proud owner of an outstanding collection of gemstones which run the gamut of the mineral kingdom.

Commander Sinkankas has been writing on the subject of gemstones for several years. Readers of GEMS & GEMOLOGY will remember his article entitled, *The Gem and Ornamental Stone Market of Hong Kong Today,* in two parts, which appeared in the Summer and Fall, 1955, issue of GEMS & GEMOLOGY. Part I of a later article entitled, *Some Freaks and Rarities in Gemstones,* appeared in the Fall, 1955, issue of GEMS & GEMOLOGY. Part II appears in this issue and completes the article.

Gemstones of Brazil

(Continued from page 229)

stones have two shortcomings. First, the average size is too large to be considered in good taste in our country. Secondly, too little attention is paid to producing calibrated stones which would fit standard American mass-produced mountings. Consequently, expensive custom-made mountings must be used which necessitate higher prices for the finished articles than most Americans are willing to pay. In Brazil, with its low wage level, custom-made mountings in 18-karat gold are the rule. Government regulations do not permit alloys of lesser gold content to be sold as solid gold. The Brazilian industry is an individualistic craftsman's industry. The miner, the cutter and the goldsmith work alone or with one or two helpers at the most. In the entire mining and manufacturing industry there are probably fewer employees than there are self-employed workers. There is in Brazil little room for the manufacturing jeweler, as we use the term in the United States, except for the less expensive jewelry. Those people who are making a sizeable investment in jewelry prefer to buy the stone and choose the type of mounting.

This works better than we in the United States might suspect. With craftsman labor so cheap, the seller can have one or more designs drawn up by an artist which the customer may choose from or modify. The final design is rendered in 18-karat gold or platinum at a price that cannot be met in the United States even with mass-produced mountings. Irrespective of the cost situation, this method of merchandising has one feature, customer participation, which should interest the American jeweler. The Brazilian customer is not simply buying a piece of merchandise — he is buying a work of art, in the creation of which he has played a part. He can do this because, unlike the American customer, he has a rather intimate knowledge of the stones he is buying. He knows quality when he sees it and is willing to pay for it. He wants and will pay prices for fine blues in aquamarine and looks with disdain upon the pale blues commonly sold in the United States. Likewise, he buys the lighter green and the blue-green tourmalines which we rarely see in our stores. He knows the quality of the stones worn by the wives of his friends.

The American customer buys only by name. If he wants an aquamarine but wishes to put more than a hundred dollars into his purchase, his jeweler adds that value by using side diamonds in a platinum-iridium mounting. Why decorate a $35 aquamarine with $350 worth of diamonds and platinum?

The answer lies in the ignorance of both the customer and the jeweler. Neither have been educated to appreciate quality in colored stones. Granted, few Americans would pay $350 for an aquamarine today, nor will they do it tomorrow or ten years from tomorrow unless the jeweler first educates himself and then his customers. As a first step the American jewelry industry should demand a better make in his colored stones.

The Brazilian lapidary is well aware of this situation and that is the reason we see so many "fisheye" aquamarines in American jewelry stores. He does his good work on his good stones for the Brazilian trade. As one remarked about the American trade. "They buy by the carat, don't they; why should I cut away weight when they will not pay for a properly proportioned stone?"

"Inclusions"

(Continued from page 236)

Fig. 10. Among all the numerous specimens of *Moonstone* which I have examined I have found two only with "inclusions." These have numerous parallelograms which look like cavities, but may be true crystals of some foreign substance. There is no appearance of fluid in them.

Fig. 11, *a, b, c, Emerald.* A very fine specimen in my collection is filled with exceedingly interesting cavities with included cubic crystals, enveloped by fluid. The forms of the cavities are exceedingly varied, and the cubic crystals — generally *two,* a small and larger one — are remarkably perfect. These characters make this specimen one of very great interest.

Fig. 12 and 12*a, Beryl* from Unionville, Pennsylvania. Fig. 12 represents a remarkable biangular cavity with a cuboid crystal at one of the interior angles — has no fluid. Fig. 12*a* represents in the same specimen two cavities with fluid and air bubbles. Both figures represent the numerous irregular cavities and imperfections which exist throughout the mass.

Note. — I have made these drawings with great regard to correctness, and the artist has well represented them.

Freaks & Rarities

(Continued from page 241)

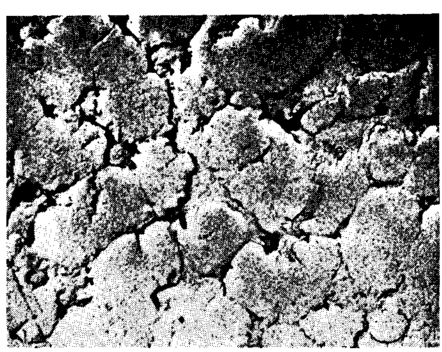
disappeared from the market when news of this spread.

Ordinarily, ulexite has been used for making cat's-eyes but it is extremely soft and fragile. The cat's-eye effect is exceptionally strong, however, and it is worthwhile to take the considerable trouble involved in preparing the stone. The "television" effect referred to above can perhaps be found also in the finer qualities of satin-spar gypsum from England.

CORRECTION

An error occurred in the placement of one of the photomicrographs in the article entitled "Electron-Microscopic Observation of Aragonite Crystals on Cultured Pearls," in the Fall, 1955, issue of GEMS & GEMOLOGY.

A duplicate of Figure 5 was inadvertently used for Figure 2. The photomicrograph for Figure 2 is shown herewith.



Problem of the Two Types of Diamond

(from the Diamond News)

Dr. J. F. H. Custers, of the Diamond Research Laboratory, Johannesburg, writing in "Nature," says that in an article on "The Problem of the Two Types of Diamond" by Prof. G. B. B. M. Sutherland, D. E. Blackwell and W. G. Simeral, it is remarked that "in our experience all large diamonds of gemstone quality are always type I diamonds."

Actually the four largest and finest diamonds we have come across at the Diamond Research Laboratory since 1951 were all type II.

Some details are given in table I.

The difference between types IIa and IIb is that IIa is an excellent insulator for electricity whereas IIb is a temperature-sensitive semiconductor. Type IIb shows, moreover a green-blue phosphorescence after having been irradiated with short-wave ultraviolet (resonance line of mercury, about 2536 A.) whereas type IIa does not. None of the diamonds of table 1 fluoresces in the near ultraviolet, that is, about 3650 A. At the time when the 34½-carat diamond was examined, the existence of type IIb diamonds was still unknown.

The diamonds of table 1 are all of the finest gem quality, and it is my firm opinion that nearly all the larger gemstones belong to this category. However, it is true that not one of the larger gem diamonds shows a regular crystal form. Quite a few of them show not only growth triangles but also growth figures of a hexagonal shape.

Finally it is worth mentioning that the Premier Mine produces a very much higher percentage of type II diamonds than any other mine.

See:
Summer 1954 GEMS & GEMOLOGY
Volume VIII, No. 2
"Discrimination Between Natural Blue Diamonds and Diamonds Coloured Blue Artificially" by J. F. H. Custers, Ph.D., H. B. Dyer, Ph.D.

Type	Weight in carats	Colour	Origin	Transmittance in ultra violet.	Laminations	Lit. reference.
II	34½	Pure White.	Premier Mine	Down to 2250 A.	Present.	Research 4,131 (1951).
IIb	66	Pure white.	Premier Mine.	Down to 2750 A. and probably shorter.	Present.	Physica, 18,489 (1952).
IIa	160	Pure	S.-W.	Down to 2375 A.	Present.	Laboratory Report No. 94, May, 1, 1951. Gems and Gemmology 7,275 and 287 (1953).
IIb	426½	Pure white.	Premier Mine.	Down to 2375 A.	Present.	J. Gemmology, 4, 300. (1954).