Gems & Gemology

GEMS & GEMOLOGY is the quarterly official organ of the American Gem Society, and in it appear the Confidential Services 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 III SUMMER, 1939 NUMBER 2

In This Issue: *Page*

Published by

THE GEMOLOGICAL INSTITUTE OF AMERICA

541 South Alexandria Ave. Los Angeles, California

STAMPING PRECIOUS METAL

by
G. H. NEIMEYER
Chairman, Jewelers' Vigilance Committee, New York, N.Y.

Comment:

The manufacturer may designate the proportion of the alloyed gold to the weight of the entire article if he wishes.

No quality mark may be used on gold less than 10K, and both the sterling silver and the gold must assay up to the requirements of the National Stamping Law.

Comment:

As the National Stamping Law does not cover articles made of precious metals in combination, this Commercial Standard has, in a large measure, corrected the misuse of the "Sterling" and "Karat" gold marks and has eliminated a very definite trend toward unfair competition.

Marking of Gold Filled and Rolled Gold Plate Articles Other Than Watch Cases
CS47-34

Gold Filled:

The term "Gold Filled" may only be used if the article stamped or described has a gold coating which is 1/20 or more of the weight of the entire article. The karat of the gold coating must also be indicated and must in no case be less than 10 karat.

When the term "Gold Filled" is used, it must be accompanied by a fractional mark indicating gold content which must precede the karat mark. Example: "Gold Filled 1/20—12K," "1/10—10K Gold Filled."

Rolled Gold Plate:

Exactly the same conditions that apply to the use of the term "Gold Filled" govern the use of the term "Rolled Gold Plate"—*except* that there is no minimum limit as to gold content. Quantity and quality marks must also accompany the term "Rolled Gold Plate." Example: "1/30th—10K Rolled Gold Plate," "1/40th—12K Rolled Gold Plate."

When the quality marks "Gold Filled" or "Rolled Gold Plate" are used, they *must* be accompanied by the name or registered trade-mark of the manufacturer or seller of the article. Initials may not be substituted.

Comment:

The adoption and enforcement of this Commercial Standard has had the effect of classifying gold-covered articles, clearing up much confusion and "chiseling" in the trade, and enabling the retailer and consumer to distinguish qualities of plate.

The question is asked as to what the retail jeweler can do to help to enforce these "Standards." My suggestion would be that

1. Every retail jeweler insist that every piece of jewelry has a quality mark stamped upon it.

2. If a quality mark is used, see that it is accompanied by the name or trade-mark of the manufacturer.

3. If you are suspicious of the quality by reason of the price or appearance of any article made of gold, silver, platinum or plate, send it to the Jewelers' Vigilance Committee for examination and test.

(The interpretations of the Commercial Standards as given in the above summaries are abbreviated for your convenience. Anyone desiring to obtain copies of the Standards may do so by writing to the Superintendent of Documents, Washington, D.C.

(The end)

The Use of Clerici's Solution to Determine Specific Gravity

by
D. H. WILSON
Lieutenant, U. S. Navy

It is a difficult and tedious job to obtain the S.G. of a stone by the usual method of comparing the weight of a gem stone in air to the weight of the water displaced by the stone. One must be very careful in weighing to avoid inaccuracies, particularly if the stone be small. If the stone be small, the water displaced by the suspended wire must be calculated. The use of heavy liquids, particularly Clerici's solution, solves this problem very nicely whether a rough S.G. is desired or whether an accurate S.G. is required.

Dr. Samuel G. Gordon, of the Academy of Natural Sciences, Philadelphia, has been using Clerici's solution to obtain S.G. of gem stones for several years. It is made up from thallium carbonate, malonic acid, formic acid and water. It will float all the usual gem stones and is miscible in water. In order to decrease the S.G., I have only to add water; to increase S.G., I must evaporate water. I have a range of S.G. from 1.00 to well over 4.00. The cost is about $14.00 and will last for several years if the bottles are not broken and the solution lost. It is poisonous even to the hands; however, no trouble will be had if the hands are washed with soap and water at frequent intervals.

The equipment required consists of a block of wood with six or more drill holes, into which fit the vials and a glass spoon used to fish the stone from the liquid. The vials should be about ½" in diameter and about two inches long. These should be made of pyrex as the stones scratch the bottle and the scratches eventually turn into small cracks permitting the liquid to escape. If cheap glass vials are used, place these vials inside a larger vial so that the liquid will be saved in case the inside vial breaks. The glass spoon can be made over a bunsen burner from a glass rod. A metal rod should not be used in the solution.

Ordinarily, the S.G. need only be obtained within certain limits to identify gem stones. For quick use, I have five vials, one of S.G., 4.03 with a ruby in suspension, one of 3.73 with a chrysoberyl, one of 3.5 with a diamond, one of 3.1 with a tourmaline and the last of 2.6 with a piece of quartz in suspension. I am now given an unknown stone. As a rule, I have eliminated several stones as possibilities by use of the loupe, the polariscope and the refractometer so that by now I have the unknown stone narrowed down to a few possibilities. Suppose I have a red transparent stone, isotropic, with a R.I. of 1.71. It might be a spinel with a S.G. of 3.6 or a pyrope garnet of S.G. 3.78. To get the approximate S.G., I drop the stone in bottle No. 3 of S.G. 3.54.

Suppose the stone sinks rapidly to the bottom, I now know that the S.G. of the unknown stone is greater than 3.54. I now fish out the stone with the small glass spoon, wash it in water and dry on a silk cloth and avoid touching the liquid as it is poisonous even to the hands, making the skin white. I next drop the stone in vial No. 4 with the chrysoberyl in suspension, S.G. 3.73, and the stone still sinks, but more slowly. I fish out the stone, wash and dry it again and then drop it into vial No. 5 with the ruby in suspension, S.G. of 4.03, and find that the stone floats. I now know that the S.G. of the unknown stone is between 3.73 and 4.03. The only red isotropic stone that has S.G. between 3.7 and 4.0 and R.I. of 1.71 is pyrope garnet. This entire process takes no longer than five minutes and can be used for any stone. This method is a very handy and quick check on other observations.

Again I wish to warn all that this solution is poisonous and will affect the hands if not washed frequently with soap and water. Do not put your hands in your mouth or on your eyes while working with Clerici's Solution—or with any solution made from thallium salts.

A rough idea of how close the unknown stone is to the specific gravity of the solution in the vial may be made by observing how quickly the stone sinks; also, compare the behavior of the unknown stone to that of the known stone in suspension in each bottle. With a little experience you can tell whether the unknown stone is closer to the S.G. of the solution in which it sinks, or in which it floats, or midway between the two.

We have now found out how to get quickly the approximate S.G. of any stone. To obtain an exact S.G. a variation of the method is used. I drop the unknown stone into a solution heavier than the stone so that the stone floats. I now add water carefully to the solution, stirring the while to get a mixture such that the stone is just held in suspension, neither floating nor on the bottom. This must be exact. In adding water, the chances are the stone will sink before you get it exactly in suspension. From this point add solution from the vial of next higher gravity. When it floats, add solution from the vial of next lighter solution. Continue this operation until a nice balance is obtained. I now take a small pycnometer or S.G. bottle and weigh it as accurately as my scale will record. Next, I fill the pycnometer with water, insert the stopper permitting the excess water to leak out of the tube through the hollow stopper, wipe the bottle dry and weigh it, subtracting the weight of the bottle from the weight just obtained gives you the weight of the enclosed water. Now fill the pycnometer with the solution which held the stone in suspension and weigh. Subtract from this the weight of the bottle and you have the weight of a bottle full of a solution of the same S.G. as the stone. Divide the weight of the solution by the weight of the water and you have an accurate S.G.

(To be concluded)

GEMOLOGICAL GLOSSARY

(Continued from last issue)

(With phonetic pronunciation system.)

Terms in quotation marks are considered incorrect.

"Prismatic Moonstone." Clouded chalcedony.

"Prismatic Quartz." Iolite.

Proton (proe'ton). The name for the particles or electrical charges which make up the nucleous of an atom.

Pseudo (sue'doe or psue'doe). A word meaning false.

Pseudo-crocidolite. Quartz pseudomorphous after crocidolite; the well-known tiger-eye and hawk's-eye used for ornamental purposes.

Pseudochrysolite. Moldavite.

Pseudodiamond. Quartz crystal.

Pseudoemerald. Malachite.

Pseudohexagonal, pseudotetragonal, etc. Having false and misleading resemblance to crystals of the hexagonal, tetragonal system, etc.

Pseudojade. Name applied to almost any mineral resembling jade in appearance.

Pseudojadeite. Some of the material collected as jadeite from the jadeite quarry in Upper Burma was found, on examination, to be albite. See also Jadeolite.

Pseudomorph (sue'doe-morf). (False form.) A mineral aggregate having the form of a crystal of another mineral, due to alteration, replacement, etc.

Pudding Stone Jade (pood'ing). Nodules of nephrite cemented together by a darker olive-green variety.

Pulsator (pul-sae'ter). Machine used to separate heavy minerals from lighter. Used, for instance, in process of recovering diamonds from blue ground in South Africa.

Pulverulent (pul-ver'oo-lent). Powdery, finely divided, incoherent material.

"Pyralin" (pie'ra-lin or pi'ra-lin). Variety of celluloid.

Pyramidal (pi-ram'i-dal). Possessing the form of or pertaining to the pyramid, a crystal form the faces of which commonly intersect three crystallographic axes.

Pyrite (pie'rite). A mineral sometimes used for gem purposes. Opaque, very light yellow, metallic. Iron disulphide, crystallized in the isometric system. Specific gravity 5.0, hardness 6-6½. Usually sold as marcasite, which it resembles closely.

Pyroelectric (pie"roe-ee-lek'trik). Electrical currents or effects produced by heat.

Pyrope (pie'rope). A species of garnet. Hardness 7¼, refractive index 1.75, specific gravity 3.7. Transparent red to slightly orangy-red. Incorrectly called "Arizona Ruby," "Cape Ruby," etc.

Pyroxene (pie'rok-seen). A mineralogical group of minerals which includes spodumene, jadeite, and enstatite.

Quartz (kworts). A mineral which includes many varieties of gem stone. Refractive index 1.55, specific gravity 2.66, hardness 7.

Quartz Cat's-eye. Quartz with cat's-eye effect.

Quartz Glass, or Fused Quartz. Pure

fused rock crystal. See also Imitations. Glass.

Quartzite (kwort'site). A very well-compacted sandstone.

"Quartz Topaz." Transparent yellow to brown quartz; correctly should be called topaz quartz or citrine.

"Quebec Diamond" (Kwee-bek'). Quartz crystal.

Quinzite (kwin'site). Rose-colored common opal.

Quoin-facets (koin or kwoin). Same as top corner facets.

Radiated (rae'di-ate"ed). Having fibers, columns, scales, or plates diverging from a point.

Rainbow Agate (rane'boe). Iridescent agate.

Rainbow Quartz. Same as Iris Quartz.

Rati (rut'ee). Hindu weight, variable in quantity of mass according to use, time and place.

Ratine (ra-tene'). The cottony or fuzzy appearance seen in a mixture of alcohol and water. The body appearance of most brilliant cut zircons.

Ratti (rut'ee). See Rati.

Realgar (ree-al'gar). A red to orange-yellow semitransparent sulphide of arsenic, very rarely used as a gem. Refractive index around 2.6; higher than that of diamond.

Reconstructed Amber. Same as pressed amber.

"Reconstructed Emerald." See Smaragdolin.

Reconstructed Stones. Made from small particles of genuine stones. Ruby formerly was reconstructed. Today, only pressed amber is produced by this process.

Rectangular (rek-tan'gue-lar). Making a right angle, or an angle at 90°.

Redmanol (red'man-ol). Name of a phenol resin molding composition and varnish somewhat similar to Bakelite.

Reduction (ree-duk'shun). Loss of oxygen chemically.

Reef (refe). The earth immediately surrounding diamond chimneys. *Floating Reef.* The same earth found in the blue-ground of the pipes.

Reflection (ree-flek'shun). The returning of light which strikes a surface.

Reflectometer (ree"flek-tom'ee-ter). A term which strictly would be correctly applied to the instrument generally known in gemology as the refractometer, since this instrument is generally used to employ the principle of total reflection. See Refractometer.

Refraction (ree-frak'shun). Bending of light rays. The deflection from a straight path suffered by a ray of light, heat, sound, or the like, in passing obliquely from one medium into another in which its velocity is different, as from air into water or from a denser to a rarer layer of air.

Refractive (ree-frak'tiv). Having the power to refract.

Refractometer (ree"frak-tom'ee-ter). Instrument measuring refractive index. See also Reflectometer.

Refrangible (ree-fran'ji-b'l). Capable of being refracted, as rays of light.

Rejections (ree-jek'shuns). Diamonds thrown out of the mixed lots at mines as undesirable.

Reniform (ren'i-form). Kidney-shaped.

(To be continued)

COMMENTS MADE ON THE TESTED SYNTHETIC DIAMONDS

by

J. WILLARD HERSHEY

Head of the Chemistry Department
McPherson College, McPherson, Kansas

The paper given in the Kansas Academy of Science is a very brief report on our work on synthetic diamonds up to 1929. We endeavored to begin where Moissau left off. Since 1929 the methods have been revised in most of the details and other methods added.

Through the request of Mr. William D. McNeil, American National Retail Jeweler's Association of New York City, June 19, 1938, five specimens were sent to the Gemological Institute of America, Los Angeles, in numbered glass vials. They were simply called gems and synthetic diamonds. My preference for not telling at the beginning until they made the tests was to see how their tests checked with mine. Number 1 was a bort, an uncut natural diamond; number 2, a synthetic diamond made in our laboratory; numbers 3 and 4 did not test for diamonds but some hard gem which did not dissolve in J. T. Baker's chemical pure hydrofluoric acid for sixty hours. These therefore could not be quartz. Number 5 was a synthetic diamond and tested as such in the chemistry department of McPherson College. These tests for all five were made here before sending them to Los Angeles.

July 26, 1938, Robert M. Shipley, Jr., of G. I. A. wrote me and said in part that the stones 2, 3 and 5 seemed to be material produced at McPherson College, whereas stones 1 and 4 on account of their clearer crystal form apparently are genuine diamonds. In order for us to proceed in anything like a logical manner to complete this research we will have to know the exact nature of each of the specimens. To this letter of July 26 I replied on July 30 in part as follows: of those that I sent, number 1 was a genuine uncut diamond (bort). The remaining four were our own synthetic gems.

The methylene iodide which is usually used for determining the specific gravity of diamonds is obtained from Merck and Company and has a specific gravity of 3.33 at 15° C. instead of 3.51 mentioned in the paper. In this I realize that I made a mistake in the decimal part, but so far as I know it is the nearest specific gravity to diamonds of any liquid. The specimens number 2 and 5 weigh .013 and .024 carats respectively.

Relative to European investigators in making synthetic diamonds, I would suggest Sesta's article in the Philosophical Magazine, and Journal of Science, No. 43, March 1929, who made a very careful examination of Moissau's work.

As for confusion of our experiments even if we take it for granted that there is a possibility of some confusion, but we can feel assured that they would not all be so. We have from one to three students and myself to check on all that are made

here and we keep a numbered file of every one that is made as to time and how they are produced.

With reference to what Sydney H. Ball has pointed out I am quoting one paragraph of a letter that Science Editor Waldemar Kaempffert with his permission that he wrote Mr. Ball when he criticised an article that Kaempffert had in the January 12 number of 1936 of the New York Times concerning my work on synthetic diamonds. Dear Mr. Ball:— "For the life of me I cannot see the point for your letter of January 21st. We certainly made it clear enough that the alleged diamond produced by Hershey has no commercial value because of its small size. How then is the diamond industry injured?"

DEMAND FOR IDEAL PROPORTION IN DIAMONDS*

The decrease in purchasing power among more discriminating diamond customers has resulted in an increase in the demand for "spread" diamond brilliants by a majority of retailers. This overbalances the increasing demand from gemological graduates and students for diamonds which approach as closely as possible the ideal proportions established for the so-called American-cut brilliant. Until this situation changes, the cutters cannot be expected to make and stock a special line of diamonds which will approximate ideal proportions.

Gemological students and graduates should keep in mind that while ideal proportions are desirable for maximum brilliancy and fire, the important point they have been taught is that variations from such proportions decrease value per carat in corresponding amount. If ideal proportions are unobtainable, those which closely approach such proportions offer a reasonably non-competitive item to sell to more discriminating customers. But spread stones are also necessary in an attempt to meet price competition.

* A.G.S. Research Service.

BOOK REVIEWS

***Gems, A Classification According to Color,* by H. Paul Juergens, National Jeweler, Chicago, 1939.**

This small book, of 59 pages, was prepared by a Certified Gemologist of Chicago for the particular purpose of giving a jeweler a guide for identification of unknown stones. Though it falls short of being of sound practical value in this regard, it is of undoubted value for the jeweler's contacts with his customers, and especially for its clear separation of the trade grades of ruby, sapphire, and emerald. The book does contain in its introduction a number of valuable points on identification. For instance, the fact that anomalous double refraction is more likely to be seen in light-colored stones than in dark is of value to anyone engaged in identification of unknown gems.

Each important gem stone, with certain exceptions, is given a page, or several pages, to itself. Gem stones are classified not according to the mineralogical method of giving each species separately with its varieties as sub-heads, but under varieties according to color. This method should be of distinct value to many jewelers and gemologists by giving them a clearer idea of the various trade qualities of the more important gem stones. This portion of the work contains the report of specific and co-ordinated observations made by the author.

At the bottom of each page is a so-called "comprehensive key" designed to facilitate identification of the gem stone described. This key gives, in order: hardness, specific gravity, index of refraction (that is, whether doubly or singly refractive), and dichroic colors. Only two colors are given, even though the stone be pleochroic in three colors, as is alexandrite. The type of refraction is given for such crystalline stones as chalcedony, jadeite and nephrite; however, the instructions in the introduction do not describe the method of distinguishing between single and double refraction in such material.

In the "comprehensive key," hardness is the first test listed, although it is obvious to anyone who appreciates fine gems that hardness is a test which can be used only as a last resort, and in some cases not at all. More important, the text includes only a very few of the many gem species which may be encountered from time to time. Even though it might be assumed that only once in a hundred times or so would any colored stone appear which was not included in this book, one incorrect identification on the part of a jeweler would obviously undo the results of ninety-nine which were accurate.

The book closes with two pages on pearl and cultured pearl. Mr. Juergens has had long and intimate experience with pearls and his material on this subject is of distinct value. Diamond is not included in this text.

SELECTED BIBLIOGRAPHY

GEM DIAMOND

(Continued from last issue)

GENERAL

Smith, Marcell Nelson.
Diamonds, pearls and precious stones; where they are found, how cut, and made ready for use in the jeweler's art, their composition and value. Boston. Printed for Smith-Patterson co., by Griffith-Stillings press, 1913.

Sutton, J. R.
Diamond, a descriptive treatise. London, Murby, N.Y., Von Nostrand, 1928.
Some notes on ancient ideas concerning the diamond. In Roy. Soc. of S. Africa, Trans. 9:305-313'21.

Stephenson, Matthew.
Diamonds and precious stones in Georgia, with their comparative value in all ages of the world, and their present localities; together with a condensed enumeration of their mineralogical accompaniments and geological formation; their chemical composition and mode of mining for them; with an appendix.

Walls, R. R.
Geog. of the Dia. Scot. Geog. M. 45:193-205. Jl. '29.

Williams, Gardner, F.
Diamonds. (in his Diamond Mines of South Africa, pp. 2-86.)

Zepharovitch, Victor Leopold, ritter von.
Der diamant ein populärer vortrag. Gratz, 1862.

Zerrenner, Carl Michael.
De admante, dissertatio. Lipsiae (Leipzig). G. Engelmann, 1850.

This concludes the Selected Bibliography on the Gem Diamond—General. Selected Bibliographies on Genesis of the Diamond, Crystallography, Physical and Optical Characteristics, Sources of Diamond, Cutting, Polishing, Famous Diamonds and allied subjects will follow.

GEM SOURCES OF THE SOUTH ATLANTIC STATES

(Continued from last issue)

by
GEO. C. BARCLAY
Certified Gemologist, Newport News, Virginia

Another locality, although in the same county as the Culsagie Mine, is the Mincey, where some good ruby corundum occurs along with a bronze variety which has the property of asterism. Similar rubies and sapphires with asterism have been found in Cowee Valley and at several other points in the state. At the Cullakenee Mine in Clay County, masses of emerald-green to grass-green amphibolite (also called smaragdite) are found, through which are desseminated particles of pink and ruby corundum. In Macon County small crystals of rich ruby corundum are found, these are reported as equalling those coming from Burma. Some of these cut stones are now in the U. S. National Museum in Washington. It is to be noted that up to the time of the finding of gem corundum in North Carolina that these gems had never been found in place. Finding them in their matrix, therefore, in North Carolina was a valuable scientific discovery.

Beryl-Emerald and Associated Gems

In Alexander County, North Carolina, emerald crystals had been found loose in the soil left there by the disintegration of the country rock. In 1874 began a systematic search for emeralds and other valuable gems in that region. Later, emeralds were found at several different points in Alexander County, chiefly near Stoiny Point, 16 miles northeast of Statesville. They are found associated with quartz, rutile, pyrite, muscovite, dolomite and garnet and closely associated with hiddenite, the green gem variety of spodumene. These two, emerald and hiddenite, are frequently found filling the same cavities in the vein rock.

For those who are mineralogically minded, a brief description of the formation in which the gem material of Alexander County is found is given. The surface of the county is rolling, the altitude about 1000 feet above sea level. The soil is a red gravelly clay, resulting from the decomposition of the gneisoid country rock. This rock is decomposed to a depth of from 8 to 36 feet. As depth is reached, this country rock has retained its hardness and stability. It is traversed by quartz veins which have a general east-and-west strike and a northward dip. These quartz veins are usually quite narrow, but widen or bulge at intervals, forming cavities. It is in these cavities that the gem material is found. This material generally consists of quartz crystals, clear, smoky and amythestine, rutile, monozite, mica, hiddenite, beryl, and emerald. The walls also are sometimes coated with crystallized dolomite, calcite and transparent apatite. There are other quartz veins traversing the gneiss which maintain a more or less even width throughout their course, no widening or pockets occurring. These veins do not produce gem material.

In 1881 definite mining operations

started in this locality, to be carried on for a number of years. Many emeralds were recovered. The largest one measured 8½ inches long, weighed nearly 9 ounces. It was one of nine crystals of emerald contained in the same pocket. One of the others measured 5 inches, and another 3 inches. The largest of these crystals, along with other specimens and cut stones, are in the American Museum of Natural History in New York City. This district produced a quantity of fine gem-quality hiddenite during the time of operation. Hiddenite, as mentioned above, was found associated with the beryl and emerald in the vein pockets. The hiddenite crystals averaged for gem cutting better than the emeralds. Hiddenite is a transparent green variety of spodumene, as kunzite is the pink variety.

It would be well to mention here two other important gem stones from North Carolina: the first is rhodolite, one of the garnet group. It is a pale rose-red or purple garnet, corresponding to two parts of pyrope and one part almandite. These garnets are found in Macon County. Some $50,000 to $70,000 worth of the garnets have been found in Mitchell County. A fine example of this cut stone is to be seen in the United States National Museum.

The other important gem species occurring in North Carolina is the quartz group. Clear rock crystal, smoky quartz, rutilated quartz and amethyst are found in a number of localities in North Carolina and—except for the rutilated quartz—also in Virginia. In Amelia County in Virginia, at Amelia Court House and nearby, beryl, topazolite (a variety of andradite), microcline (Amazon stone), albite, and oligoclase (var. moonstone) are found either in or associated with the pegmatites. Near Fairfax Court House is found a greenish colored banded quartz, a milky white chalcedony and smoky quartz. In Amherst County are found beautiful amethyst crystals associated with the white quartz veins. In Amelia County are also found gem quality garnet (spessartie). Some cut stones of the latter have weighed as much as 100 carats.

At the present time very little is being done in either state toward the production of gem material although, potentially, these states as gem producers appear to have a future.

(The end)

A GEMOLOGICAL ENCYCLOPEDIA

(Continued from last issue)

by HENRY E. BRIGGS, Ph.D.

CHRYSOLITE (Continued)

Chrysolite is the only gem which we have that comes to us from celestial space. It is found in meteors occasionally; it also occurs in basalt and lavas. Also we occasionally find tiny grains in serpentine. It occurs in orthorhombic crystals, in water-worn pebbles and in granular masses. The mineral has a pinacoidal cleavage in two directions. The fracture is conchoidal and the streak white, or lighter than specimen. The mineral is biaxial and optically positive. Double refraction is high, being .04, and the mean index is 1.68. The dispersion is .018. Pleochroism is very weak in the mineral and is scarcely noticeable in the light shades. However, in the darker bottle-green gems it is noticeable, though with difficulty. Some authors state that this gem shows strong dichroism, but the author has carried out a long search for a sample which would even show a moderate difference in the twin colors and has been unable to find one. It is true, as stated, that the dichroism can be detected by a fine dichroscope, but it is not plainly visible. It is presumed that in the case of others who state that chrysolite showed strong dichroism, tourmaline of a similar color was mistaken for the mineral chrysolite. There should be little difficulty experienced in distinguishing the two minerals, however, for tourmaline is not of the same gravity and is of distinctly different optical character. Chrysolite ranges from 6½ to 7 in hardness and from 3.2 to 3.7 in specific gravity. The composition of chrysolite is usually written $(Mg, Fe)_2SiO_4$. The magnesium and iron freely replace each other in this gem. However, both are usually present and account for the color of the gem. The colors range from shades of yellow through the greens to brown, reddish and greyish. Some authors mention this mineral as occurring in colorless, but it is very doubtful that the mineral ever occurs in a colorless state. The author has never met with a colorless sample of true chrysolite but has had many samples of mineral supposed to be chrysolite which were colorless, but which proved to be topaz or some other mineral upon examination. The color in chrysolite is not due to impurities, but rather is inherent in this mineral, hence the statement that it is doubtful if it ever occurs in a colorless state. Since various works seem to conflict so much on the character and properties of this mineral the author has given only such data as has been checked and rechecked for accuracy.

Chrysolite is found in gem quality in Egypt, on the island called Zebirget; in Ceylon; Burma; Queensland, Australia; Brazil, and in the United States in Arizona and New Mexico. Dr. Kunz stated that most of our modern supply comes from old jewelry.

SPINEL

The spinel group is one of the most colorful of all the gem groups. The colors embrace almost every shade of spectral color, ranging from colorless through violet and down to deep reds. Spinels of the proper color are often sold as "rubies," "sapphires," etc. However, it is not a difficult matter to distinguish spinel from the corundums as it is singly refractive, while the corundums are anisotropic. Thus spinels will show no sign of dichroism while corundum, of even the lighter shades, are quite strongly dichroic.

Spinel crystallizes in the cubic system and is, therefore, isotropic. The index is usually about 1.72 and the dispersion is .020. The fracture is conchoidal and the streak white. Cleavage is imperfect octahedral. The luster is vitreous and often of glimmering intensity. In hardness the spinel is rather high, being 8. The specific gravity ranges from 3.5 to 3.7. The composition of spinel is $Mg(AlO_2)_2$. It owes its color to impurities: usually cobalt, iron, or chromium.

The gem varieties of spinel embrace the following: "Spinel ruby," red; "Balas ruby," pale red to pink; rubicelle, orange to yellow; almandine spinel, violet to purple; sapphirine, blue. Chlorospinel is an iron spinel of a grass-green color often sold as "Oriental emerald," as is its cousin, green corundum.

Spinels are made synthetically by the same process as is used in making synthetic corundum. They can be detected by the methods outlined for detection of synthetic corundum.

Spinel of gem quality occurs in the gem gravels of Ceylon, Burma, and Siam, with corundum. Also it is found in India, Brazil, Norway and Sweden, and in France. In the United States, spinel occurs in New Jersey, New York, and Montana.

ZIRCON

Zircon is one of the gems which has gained popularity only recently. This is due to the fact that the supply has been rather limited heretofore. In later years, however, mines have been opened in Siam and Australia which produce sufficient quantity that the gem has gained rapidly in favor and is now one of the most popular of the colored gems.

Zircon is of fair hardness, being 7½. Its luster is adamantine and the index of refraction high, being 1.94 (mean). The dispersion is high also, being .038. The system of crystallization is tetragonal; the cleavage imperfect and the fracture conchoidal. Zircon is optically positive and is uniaxial. Oftentimes, however, it is abnormally biaxial and in such cases the mean index is usually lower, ranging from 1.79 to 1.85.

Zircon is an oxide of zirconium and silicon. The formula is usually written $ZrSiO_4$. Some authors classify it with the silicates. Zircons are usually very impure and owe their color to impurities.

The varieties used as gems, and the colors of them, are:

Hyacinth—Yellow to orange transparent stones.

Jacinth—Red to brown stones.

(To be continued)

Photography in Gemology

(Continued from last issue)

Exposure may be judged either from the object itself or from the ground glass which is used with the camera. In photographing objects as small as gem stones are it is much easier to judge exposure from the ground glass. If an exposure meter is used, it is seldom, if ever, possible to get an accurate reading from the gem itself as the stone is too small to fill the aperture of the exposure meter. But an exposure meter can be used with good results against the ground glass of the camera.

Many expert photographers judge exposure by watching the image on the ground glass while stopping down the lens and noting the point at which the image approximately disappears. This system, however, may cause trouble in the photography of gems, since with certain equipment it is not possible to stop down and exposure must be made upon the basis of the appearance on the ground glass at full aperture. The method used in the G.I.A. laboratory is to place a Weston exposure meter directly against the ground glass and take the foot candle reading from the galvanometer needle. The underexposure ("U") arrow is then set opposite the foot candle reading on the special calculating disk of the meter and the reading opposite f 4.0 is taken as the exposure. If the ground glass is at all evenly lighted, this method is highly accurate, even sufficient for use in connection with color film, which must be exposed with great accuracy. If another exposure meter than the Weston is used, a similar interpolation can be made. For instance, with a Bewi exposure meter the reading is taken from the ground glass in the usual way and 1/20 of the exposure indicated for f.1.5 is given. Whatever exposure meter is used, it can easily be calibrated by making a series of test negatives at various exposures. A record must be kept, both of the exposure of each photograph, and also the reading of the exposure meter. When the negatives are developed, the best "shot" is noted and its exposure, together with the reading of the meter, are combined as one of the points of calibration of the meter.

Filters are seldom of value in gem photography, since it is usually desirable to reproduce the gem in as nearly as possible the same tonal values as it has to the unaided eye. However, it is sometimes desirable to make a colored stone in a mounting appear somewhat darker or lighter than its true tone in order to produce a more dramatic and interesting effect. This variation and contrast can easily be accomplished by means of suitable filters. In general, a filter of the same hue as the stone will cause the stone to appear lighter, whereas a filter whose color is the complementary of that of the stone will cause the stone to photograph darker. For instance, a ruby mounted in a dark yellow gold ring will, when photographed without filter on panchromatic film, appear approximately the same tone as the mounting. A dark red filter will cause the ruby to appear much lighter than the mounting and a dark green filter will cause the ruby

to appear much darker than the mounting.

Photography through the microscope—photomicrography, to use the most technical term for it—presents many problems, but it is easily mastered by anyone accustomed to using delicate equipment. When a photomicrograph of an interior of a gem is desired, the first step is to make a very thorough study of the gem under various magnifications, making notes of the features which are to be photographed and of the magnifications at which these features appear best. These notes should be written out and it is of considerable value to make a rough sketch of the stone, greatly exaggerated in size, showing the approximate location of each of the inclusions which is to be photographed. After this study is made the stone is left in place on the stage of the microscope and the camera is set up. By means of the notes and the "map," the inclusions can be located fairly readily by focusing on the ground glass.

Often the facets of a cut stone will prevent sharp focus or clear illumination. In these cases it is valuable to immerse the stone in a liquid with as nearly as possible the same refractive index as that of the stone. This liquid reduces refraction at the stone surfaces to a minimum and overcomes the distortion encountered when the stone is photographed in air.

The illumination of gems for photomicrography is accomplished by one of three distinct methods. The first of these is transmitted light, passing directly through the stone and into the objective of the microscope or camera. This method is the simplest to use, affording as it does, greater control over the illumination. The second method is vertical illumination, or its equivalent, with light falling on the stone from the same side as the camera. This method has the great disadvantage of producing direct reflections from facets which in many cases destroy the sharpness of the image. The third method of illumination is by a dark-field illuminator; the illuminator base for the Diamondscope and the Diamond Imperfection Detector is of this class. Dark-field illumination has the great advantage of causing inclusions to stand out bright against a dark field and, therefore, to be much more prominent than it is possible to render them by transmitted light. The primary disadvantage of dark-field illumination is the difficulty of judging the exposure correctly, since the photograph is to be taken of small bright areas while the great majority of the image is comparatively dark and, therefore, does not register on the exposure meter.

In making photomicrographs the judgment of exposure is necessarily confined to the ground glass. Furthermore, since this work is generally done through a standard microscope, the method of stopping down the lens until the image disappears cannot be used and the only reliable exposure guide is the use of the exposure meter directly against the ground glass as explained above. The same factors are used with the Weston and Bewi exposure meters for photomicrographs as when used against the ground glass of the camera when used without the microscope.

(To be continued)