

Gems and Gemology

SUMMER 1957



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On the Cover

An award-winning diamond necklace called "Fire Concerto" by Birks of Montreal, Canada. The creation features a highly flexible setting of three strands of diamonds—two consisting of baguettes and one of brilliant-cut stones, all of which are caught at one side with a rosette of pear-shaped diamonds that terminates with two streamers of baguettes, each tipped with a large pear-shaped diamond.

*Photo courtesy Dorothy Dignam
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New or Unusual Gem Materials Encountered in the Institute's Gem Trade Laboratories

by

G. ROBERT CROWNSHIELD

*Adapted from a lecture delivered to the
American Gem Society Conclave,
Philadelphia, April, 1957.*

One of the many joys of being associated with the Laboratories of the Gemological Institute of America is identifying unexpected gem materials that may heretofore not have been widely reported, if at all. Each year we receive for testing and also as gifts various unusual materials, some of which may have a commercial potential.

During the past year we have examined an unusual number of specimens that were technically rocks, being made up of more than one mineral. The first such stone came to our attention when some freshly polished lapis-lazuli tablets were used in class work. Students consistently misidentified the stones because they were obtaining an R.I. of 1.68 rather than 1.50, as universally recorded in textbooks and tables. X-ray diffraction, plus

thin sections of the material made by Dr. Ralph Holmes of Columbia University, showed that the material was essentially lazurite granules evenly distributed in colorless diopside.

A mineral with which lapis is sometimes confused and that can occur technically as a rock is sodalite. Recently this mineral has been coming to the United States market from Ontario in great abundance. It is readily separated from lapis by its R.I. of 1.48 (as opposed to 1.50 for normal lapis) and its low S.G. of approximately 2.20 (as opposed to a low of 2.45 for lapis that is lacking in pyrite, to a high of 2.90 if much pyrite is present). Incidentally, the presence of pyrite is not proof of lapis, since specimens of sodalite with veins of pyrite are

not uncommon.

Another rock that proved troublesome consisted of a group of tumbled stones that were composed of three distinctly colored materials, purportedly from the nephrite area of Wyoming. These stones were proved to be a rock composed of green nephrite, pink thulite, and a grayish-brown zoisite. We are indebted to Dr. Brian Mason of the American Museum of Natural History for the necessary X-ray diffraction work.

Another rock, the identification of which we also owe to Dr. Mason, was presented to the Laboratory as a string of spherical, mottled, white-and-dark-green beads. The beads were offered in New York as jade, but proved to be a combination of white albite feldspar and green actinolite. At the same time, a string of all white beads was proved to be composed of approximately equal numbers of albite and matching white prehnite beads; these were being offered as "Japanese" jade.

Another jade problem came to our attention when a manufacturer presented some pieces of carved jade in an attractive mottled green-and-white color, with the complaint that many of them broke readily in setting. Normal gemological tests, including R.I., S.G., and spectroscopic analysis, indicated jadeite, but under the microscope certain veins and areas showed great undercutting; and wherever veins of white occurred, one could pick away the white material with the fingernail. Again, it was necessary to resort to nongemological tests. Dr. Holmes was able to prove by X-ray diffraction that the green material was jadeite; however, a study of thin sections showed that it was highly brecciated and that the white, soft material was kaolinlike in nature, thus indicating that the material had been metamorphosed and recompact at some time in the past. Again, we have what might technically be called a rock.

Another rock in the form of highly attractive cabochons came in for identification. The material consisted of opaque ruby-

red patches in an opaque dark-green ground-mass with an occasional black splotch. Tests quickly proved the red substance to be ruby and the green material to be zoisite. In a communication from Dr. Edward Gubelin, Lucerne, Switzerland, we learned that the rock occurs near the border area of Kenya-Tanganyika, and in the past has been found in large sizes suitable for carving into bowls, vases, etc.

Among the unusual specimens examined in the Laboratory can be mentioned a polished slab and several rough waterworn pebbles of sillimanite (or fibrolite) from Idaho. The material has been widely publicized as "gem sillimanite"; however, we have not observed any that would warrant such a description, for it is semitranslucent and only faintly chatoyant. Transparent violet-blue to grayish-green faceting-quality stones are known to have come from Burma and Ceylon, and some fibrous material from these localities has cut excellent cat's-eyes. The Idaho material we have seen, although it does not produce fine cat's-eyes, does take an excellent polish and would appeal to amateur lapidaries.

Some unusual cat's-eye-type stones were offered for sale briefly in New York as ulexite — the so-called "television stone" mentioned by Captain John Sinkankis in the Winter, 1955-1956, issue of *Gems and Gemology*. Specimens tested in the Laboratory appeared to have greater constants than those listed for ulexite in Dana, who lists an S.G. of 1.65 and a hardness of 1. Our specimens seemed to have a hardness greater than 2 and an S.G. near 2.00. Since we were unable to secure material for mineralogical tests, we cannot be positive if they are ulexite or some near-borax relative. Obviously, the stones are only suitable for collector's items, since they do not have sufficient durability for use in jewelry.

Synthetics in several little-known forms came to our attention last year. In one of these, an unusual treatment of synthetic spinel imitating lapis-lazuli, identification

was made easy because of the high R.I. and because of the residual purple color as the stone was held over a strong light source. Professor K. Chudoba, writing in the Winter, 1956-57, *Zeitschrift der Deutschen Gesellschaft Fur Edelsteinkunde*, suggests that it should be correctly called lapis-lazuli-colored sinter spinel, rather than synthetic spinel, since it is a sintering process developed several years ago in West Germany. To date, no great commercial activity has been reported in the U.S. for this rather handsome and serviceable stone.

Another synthetic spinel, the only specimen of which we have seen was given to the Institute by student Aldert Breebaart, Nijmegen, Holland, is a rather good imitation of moonstone. Whether it becomes anything more than a scientific curiosity is still to be seen.

Perhaps in the same category are the tiny red spinel brilliants received by the Institute as a gift. They are clearly of Verneuil manufacture, and their small size perhaps suggests the difficulty in making this color of synthetic spinel.

For years we have sought a specimen of natural green spinel. Although this color is included in all lists of gem materials, we have never seen a salable green spinel. We were gratified to receive for testing three transparent dark-green stones that proved to be the zinc spinel (gahnospinel). The R.I. of the stones was approximately 1.805 and the S.G. 4.44. The polariscope showed that the stones were all fairly badly strained.

During 1956, several cases came to our attention where heat-crackled synthetic rubies had been represented as natural stones to uninformed and unsuspecting jewelers. Another swindle was attempted, probably by the same team, with green heat-crackled glass imitations of emerald. Although heat-crackled (or, as they have been called, quench-crackled) stones are not new, it was appalling to see how some jewelers could be so readily duped by stones whose style of cutting suggested synthetic or glass.

The emerald filter is gradually losing much of its former importance as a means of testing emeralds. First, the I.G. Farben synthetic emeralds and later the Chatham synthetic emeralds were developed, both of which turn red under the filter (as do natural emeralds). Later, natural emeralds from India reached the market; these stones, instead of turning red under the emerald filter, react in the same manner as glass; i.e., no reaction at all. Later, the appearance of triplets composed of two parts of rock crystal and a green cement that turns red under the filter further undermined the value of the filter. The latest reason to suspect the value of the filter with emeralds was the appearance of a green plastic coating on poor-quality emerald and pale-green beryl. The plastic makes the stones appear quite transparent as well as a highly desirable green. The plastic coating turns red under the emerald filter. Although normal instrument tests or an educated "feel" test would indicate that something was "wrong," we have encountered a sufficient number of stones that were accepted as natural to make it worthwhile to mention it here. In one case, an expensive pair of platinum-and-diamond earrings was completed before it was discovered that the stones about to be mounted were actually plastic-coated worthless beryl. Because of these reasons, we have begun to call the filter merely the "color filter" or "spinel filter," because of its value in testing synthetic blue spinels.

High-index glasses (i.e., those used for refractometer hemispheres and prisms) are universally quite yellowish, a color that is undoubtedly caused by the metallic oxides used in the melt to attain the high index. The Institute's student study sets do not contain any glass imitations with an R.I. higher than 1.70. A colorless brilliant with an R.I. of 1.78 was given to the Institute last year, but not before several file tests had proved its softness (approximately 5). The tests, of course, had been done on the

(continued on page 61)

Are Present Diamond Rulings Adequate?

by

RICHARD T. LIDDICOAT, JR.

*Adapted from a lecture delivered to the
American Gem Society Conclave,
Philadelphia, April, 1957.*

Jewelers know that the public is inclined to consider diamonds the blindest of blind purchases. The chief problem is that such divergent claims are made that it becomes obvious that some firms are dishonest or ignorant. The credo of the American Gem Society is that titleholders are neither. However, despite the existing AGS and Federal Trade Commission rulings, two Registered Jewelers, or any two ethical jewelers, could offer at retail stones they purchased as flawless, top-color, well-made one-carat stones at the same average markup but at prices \$750 apart. How can this be? An examination of both AGS and FTC rulings, the usual interpretations given these rulings, and the wide gaps not covered by rulings, provide an answer.

Ethical jewelers vary from those who accept the importers' grades without checking to those who grade every item they sell on a perfectionist basis. Just this difference in attitude on color, imperfection and make

grading creates a fantastic difference in price, because existing standards are not specific. You may say that at least perfection grading is specific, yet the definitions of perfect and flawless leave gaps to any but the perfectionist.

What is a perfect diamond? From the new Federal Trade Commission Rulings, Rule 24 states: "(A) It is an unfair trade practice to use the word 'perfect' or any other word, expression, or representation of similar import as descriptive of any diamond that discloses flaws, cracks, carbon spots, clouds, or other blemishes or imperfections of any sort when examined in normal daylight or its equivalent by a trained eye under a 10x corrected diamond eye loupe or other equal magnification. (The use, with respect to a stone that is not perfect, or any phrase such as 'commercially perfect,' containing the word 'perfect' or 'perfectly' is regarded as misleading and in violation of this rule.) Paragraph A of this rule shall not be con-

strued as approving the use of the word 'perfect' or any word or representation of like import as descriptive of any diamond that is of inferior color or make. Nothing in this rule (24) is to be construed as inhibiting the use of the word 'flawless' as descriptive of a diamond that meets the requirements for 'perfect' set forth in paragraph A of this rule (24)." In other words, "flawless" may be used for a stone that fits the term "perfect," except that it has inferior color or make.

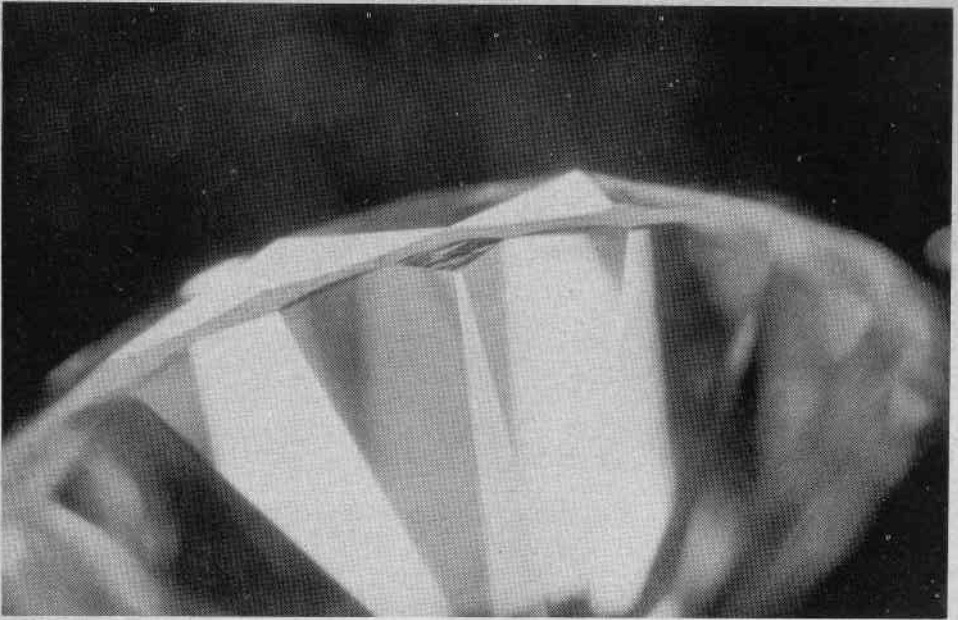
The American Gem Society defines "flawless" as follows: "The term 'flawless' shall be used to describe a diamond that is free from all internal and external blemishes or faults of every description under skilled observation in normal, natural, or artificial light with a ten-power loupe corrected for chromatic and spherical aberration; binocular examination under dark-field illumination is preferred."

At first glance, the two rulings seem exceptionally specific. On the subject of internal flaws, they leave almost no argument. If something of almost any description is seen by a "trained eye" or "skilled observation" under 10x, the stone cannot be perfect or flawless. Almost the only point on which some jewelers seem to take exception is the classification of knot or twin lines as flaws. Other inclusions, cleavages, and fractures visible under 10x are accepted as flaws almost without cavil. We all know that some firms sell diamonds containing internal flaws as "perfect" stones. However, violations in this sphere seem to be less flagrant and certainly easier to deal with than even a few years ago. Most of the problems involving internal flaws are occasioned by those who believe they will be given the benefit of the doubt on stones with minor flaws they sell as "perfect" or "flawless." This seems to apply to some mounted lines in which every center stone is sold as "perfect." However, there will always be those who try to gain an advantage by operating on the borderline.

The situation with surface blemishes is

somewhat less clearly defined. Here is where the perfectionists and the noncritical are separated more frequently. To cite a few examples: Is a rough or bearded girdle a flaw or a blemish, or should this be disregarded?; is poor symmetry a blemish?; is a natural a blemish?; are wheelmarks blemishes?; should minute nicks or scratches (that almost every stone possesses) be labeled blemishes?; in the presence of fairly regular symmetry, should facets that fail to meet be called blemishes? If you are a perfectionist, perhaps you will say that every item mentioned is sufficient to rule out the use of the term "flawless." If you have a pragmatic approach, you will probably contend that they should be considered blemishes only if bad enough to warrant it. The major point is that the perfectionist and the rigidly honest person are placed at a distinct disadvantage by the failure of the FTC and AGS rulings to specify in more exact terms what can and cannot be called flawless.

In many respects, the rulings pertaining to diamond qualities that jewelers have imposed upon themselves are much more restrictive than public protection or even public desire warrants. For example, flaws that are not visible to the unaided eye and that do not affect either brilliancy or durability hardly seem to justify the 40% price reduction from a flawless condition encountered in an otherwise fine stone. However, so long as rules exist they should be so clear that there is only one possible interpretation, if they are to be just to all. At present, certain variations in the interpretation of diamond-quality terms work to the detriment of the ethical jeweler. It seems that it would be only fair to amend both perfect and flawless rulings with respect to the term blemish by specifying, to some extent at least, what is considered a blemish. The perfectionist may feel that each of those items mentioned are clearly blemishes, so why is elaboration recommended? Let us consider wheelmarks, for example. Wheelmarks can be seen on any stone, if one uses



• Showing a natural on the girdle of a diamond.

sufficiently high magnification. When must they be regarded as flaws? Are they wheelmarks and therefore a blemish when seen by the unaided eye, or are they wheelmarks only when seen under 10x? Since the ruling specifies 10x magnification, it would seem that this would be the deciding factor. However, it is possible to illuminate a stone in such a manner that even to an expert no wheelmarks are visible under 10x, but when placed under different lighting, such as very strong side lighting, they may become obvious.

When is poor symmetry a blemish? Some will say, even perfectionists, that poor symmetry is classified under make and should not be given any consideration in the term "flawless." However, if a stone is considerably off round, if its culet is considerably off center or very large, and if the table is not parallel to the girdle, to call the stone flawless by American Gem Society standards is considered by some to be overstepping.

Perhaps the most frequent source of controversy is naturals. Some jewelers argue that the original lustrous "skin" of the diamond crystal left in one or more places on the girdle cannot be regarded as a blemish. However, many perfectionists now call any natural a blemish, although they do not detract from the beauty of a diamond in any way so long as they are no wider than the average width of the girdle and do not leave visible flat spots. Most of them are on the underside, so they have to be fairly large in order to flatten the girdle. It is obvious that the subject of naturals should be treated in the same manner by all.

How about a rough or bearded girdle? Certainly a bearded girdle is a make deficiency. Yet, it leaves tiny breaks in the stone that are visible under 10x; therefore, it would seem by present definition that they constitute blemishes. However, we have all seen many stones labeled as flawless that had bearded girdles.

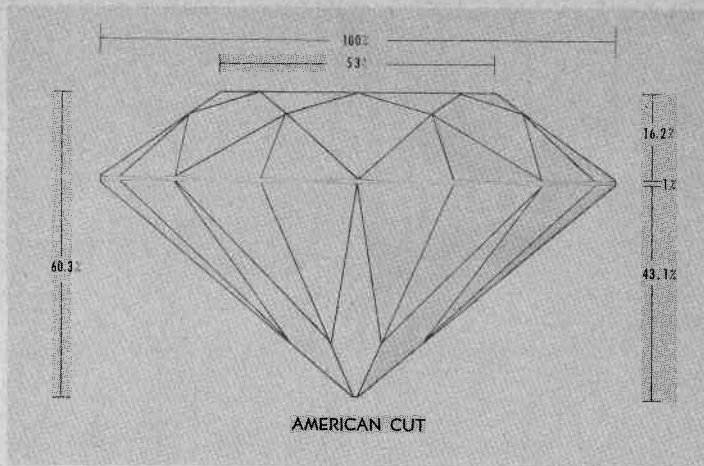
To some, such a detailed discussion may seem unnecessary. However, even a cursory examination of a large number of stones offered by various firms (some of them importers), that are labeled as flawless or perfect, demonstrates clearly that the honest man should be protected by so clearly defining the terms flawless and perfect that there could be no doubt as to their meaning. For the most part, the differences may be resolved readily by definitions of what constitutes a blemish. So that this will not become simply a polemic on the subject, a group of specific suggestions is being submitted to the American Gem Society and the Federal Trade Commission for consideration or rejection. Since the wording of the definitions is vital, it seems advisable as a first step to submit proposed statements or definitions that could then be taken up by the appropriate committee, if the Society favors adoption of more specific ruling. Here, then, are the recommendations:

- 1) Wheelmarks, or polishing marks, are considered blemishes when visible under 10x with a corrected loupe in normal diffused light (this eliminates the use of very strong side lighting).
- 2) A natural is a blemish when it either flattens the girdle when examined from the crown in the table-to-culet direction, or if it is wider than a medium girdle width for the stone being considered.
- 3) Twin lines or knot lines are blemishes when visible under 10x.
- 4) Poor symmetry should not be considered under imperfection grading, unless the stone is distinctly misshapen to the unaided eye. This could be pinpointed by specifying as misshapen any brilliant in which the difference between widest and narrowest girdle diameter exceeds 5% of the narrowest diameter.
- 5) A rough, or bearded, girdle is an imperfection if any chips or breaks are visible under 10x.

6) Any surface nick, scratch or other abrasion visible under 10x is a blemish, regardless of whether the stone is without internal flaw.

Undoubtedly, the points suggested to make existing rulings more specific could be simplified and clarified; however, they serve to illustrate the interpretive problems. They also serve as a starting point.

The area in which the greatest misrepresentation exists, dollar-wise, is in "make." Yet neither the FTC nor the Society goes further than to imply that an "old miner" or an obvious "fisheye" should not be referred to as well cut. One could save over \$300 a carat, at the retailers' cost, in one-carat sizes, and still sell a stone as flawless, fine color, and well made. Here, for example, is what could happen with two jewelers both offering "well-made" or "beautifully cut" one-carat stones: one jeweler could sell an ideally proportioned stone at keystone, and the other could sell a spread stone at a three-time markup at a lower price. Actually, it is only necessary in classifying the make of stones to specify the range of proportions that are acceptable under various terms. For example, a stone could be called well made if it had a depth-to-girdle-diameter ratio from 59 to 61%, a table of 53 to 57%, and a girdle-to-pavilion main facet angle of $41^\circ \pm 1/2^\circ$. It does not take excessive training or practice to make the determinations necessary to make these findings. The depth ratio requires only the girdle diameter and the table-to-culet measurements, plus arithmetic. The table size can be measured accurately by eye, and the pavilion angle by a proportion screen or several other methods. Make could be referred to as good if the stone had a table size from 58 to 63%, a depth-to-girdle-diameter ratio from 57 to 58.9%, and a pavilion main facet angle of $41^\circ \pm 1^\circ$. This term could also apply to a thick stone having a table of 49 to 52% and a depth of 61.6 to 63%, with the same pavilion-angle tolerance. A classification of



fair would perhaps be used for a stone with a 64 to 68% table and a depth-to-girdle-diameter ratio of 55 to 56.9%. All other brilliant-cut stones would be referred to as poorly cut. Obviously, these terms and the figures specified could be adjusted; they are offered only as initial suggestions. With such fairly simple specifications, the terms "ideally cut" and "well made" would become something definite and meaningful.

Color is considerably more difficult to pinpoint, but the American Gem Society now has Colorimeters, so it would not be difficult to establish minimum standards for the use of such terms as fine color, best color, top color, blue-white, gem color, and other terms indicative of ideal color or total absence of body color.

In conclusion, it seems grossly unfair to continue to penalize a man for his honesty. We at the GIA are in favor of selling a wide range of qualities, from the best to the poorest in diamond merchandise. However, they must be sold for what they are, and the perfectionist should be protected legally at least against the gross misrepresentation that is possible while still operating within the letter of established rulings. As it stands, in the vital fields of perfection grading—and even more important in make grading—there

are too few specific rulings to protect the public or the honest jeweler. That two one-carat stones described by the same color and imperfection grade can today be offered at the same reasonable percentage markup at prices \$750 apart is ridiculous—especially when both are offered as well cut. It would seem that this is a gap that the Society should lead the way to filling in. The next step would be for jewelers to see that such rulings were enacted into laws in their respective states. In this fashion, the customer and the ethical merchant would have real protection against the dishonest practices that are so prevalent today.

With clear-cut rulings with respect to imperfection, color and make terminology, established by state law, there would remain but two actions to make legal protection of the buying public complete:

- 1) Insistence that advertising making quality claims for one attribute include all three attributes (to prevent the implication that flawless stones are also of fine color and finest make).
- 2) A requirement that sales slips or receipts contain quality claims in writing (to insure legal recourse on misrepresentation).

Formulas for the Weight Estimation of Colored Faceted Stones

by

JOHN ELLISON

The primary purpose of this article is to provide assistance in the appraisal and evaluation of faceted forms of colored gemstones. In order to properly appraise any gemstone, one of the basic necessities is a knowledge of the weight of the stone, since it has an important effect on value. For example, we will consider a large, fine-quality mounted sapphire, the value of which has been determined to be \$300 per carat. A difference in weight estimation of only three carats would cause a difference in evaluation of about one thousand dollars. Also, many gemstones show a sharp rise in the value per carat when they reach a certain size.

The following pages are devoted to a description of formulas and methods for estimating the weights of colored faceted stones. These will prove very helpful with mounted stones that are accepted for appraisal. Although these formulas are based on scientific determinations of volumes of

such shapes, they have also been tested and adjusted by actual practical usage.

Colored faceted stones of the same variety and of exactly the same length, width and depth will often show great differences in weight because of extreme variations in cutting techniques. In order to adjust the basic formulas to fit such variations, certain correction factors have been devised that must be used in conjunction with these formulas.

Colored-stone dealers who have handled nothing but colored gemstones for many years consider themselves experts if they are able to estimate the weights of such gemstones within 10% of the true figure. Therefore, we can consider that a weight estimation that is within 10% of the exact weight is accurate enough to be usable in the appraisal of mounted stones. Even these long-experienced dealers occasionally make a serious error in estimating the weight of a stone that has an unusual form or style of

cutting or that varies greatly from the weight of the average gemstone of such measurements.

Because of the tremendous variety of shapes that might possibly be encountered, formulas were not devised to cover every possible form. Instead, they were evolved for the most common shapes and for those in which the most important gemstones are usually fashioned. Because of extreme variations in the cutting of such stones, weight estimations can only be approximated. However, by careful use of the following formulas and allowance tables, the average jeweler should nearly always be able to estimate within 10% of the exact weight of any stone.

It will be noted that the formulas are somewhat complicated. This has been found to be necessary in order for the weight estimations to be accurate within the prescribed 10% limits. In a like manner, the accuracy of estimation will also depend on the accuracy of the measurements. Therefore, it is suggested that such measurements be made with an accurate millimeter measuring gauge, such as the Leveridge Gauge or a millimeter micrometer.

In order for the jeweler to become familiar with these methods of estimating weights, it is advisable that he practice with loose gemstones. In this way he can check the accuracy of his computations and allowances by actually weighing the stone.

Formulas

Note: All measurements are to be made in millimeters. To insure accuracy, measurements should be made to $\frac{1}{10}$ millimeter.

I. Round Faceted Stones

Radius squared x depth x .009 x S.G. of the material = carat weight.
(To square the radius, multiply $\frac{1}{2}$ of the diameter by $\frac{1}{2}$ of the diameter.)

II. Oval Faceted Stones

Length minus $\frac{1}{3}$ of the width x width x depth x .003 x S.G. = carat weight.

III. Rectangular Faceted Stones

Length minus $\frac{1}{3}$ of the width x width x depth x .0037 x S.G. = carat weight.

IV. Square Faceted Stones

Length minus $\frac{1}{3}$ of the width x width x depth x .0037 x S.G. = carat weight.

V. Emerald-Cut Faceted Stones

Length minus $\frac{1}{3}$ of the width x width x depth x .035 x S.G. = carat weight.

VI. Cushion-Shaped Faceted Stones

Length minus $\frac{1}{3}$ of the width x width x depth x .0033 x S.G. = carat weight.

VII. Navette, or Boat-Shaped Faceted Stones

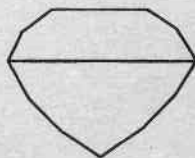
Length minus $\frac{1}{3}$ of the width x width x depth x .0033 x S.G. = carat weight.

VIII. Pear-Shaped, or Teardrop-Shaped Stones

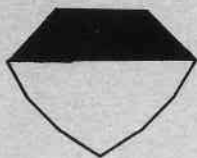
Length minus $\frac{1}{3}$ of the width x width x depth x .0026 x S.G. = carat weight.

Allowances

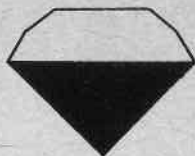
Following are described and illustrated the allowances that must be made to compensate for variations in cutting.



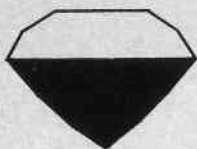
• Normal faceted colored stone showing average bulkiness of crown and pavilion (all of the formulas are adjusted to compensate for this type of cutting).



• Top has no bulkiness (like a diamond) — subtract 5%



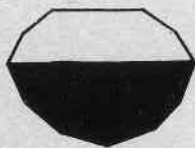
• Bottom appears somewhat like a medium cabochon — add 10%.



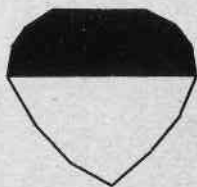
• Bottom has no bulkiness (like a diamond) — subtract 10%.



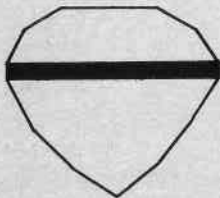
• For a very bulky crown — add 5%.



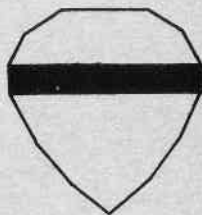
• Bottom has very slight bulkiness — subtract 5%.



• For a very heavy girdle — add 5%.



• Bottom almost appears like a flat cabochon — add 15%.



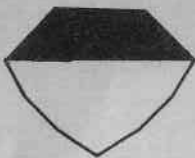
• For an extremely heavy girdle — add 10%.

(pages 44 and 45)

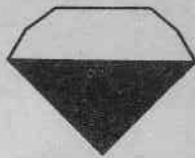
V. Emerald-Cut Faceted Stones

Length minus $\frac{1}{3}$ of the width x width x depth x .0035 x S.G. = carat weight.

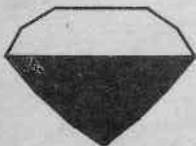
VII. Navette, or Boat-Shaped Faceted Stones

Length minus $\frac{1}{3}$ of the width x width x depth x .0022 x S.G. = carat weight.

• Top has no bulkiness (like a diamond) — subtract 5%



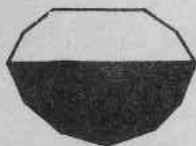
• Bottom has no bulkiness (like a diamond) — subtract 10%.



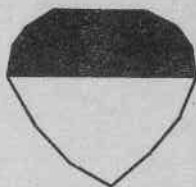
• Bottom has very slight bulkiness — subtract 5%.



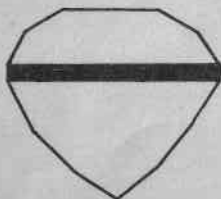
• Bottom almost appears like a flat cabochon — add 15%.



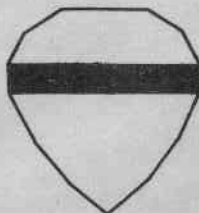
• Bottom appears somewhat like a medium cabochon — add 10%.



• For a very bulky crown — add 5%.



• For a very heavy girdle — add 5%.



• For an extremely heavy girdle — add 10%.

An Introduction to Spectroscopy in Gemtesting

by

G. ROBERT CROWNSHIELD

*Adapted from a lecture delivered to the
American Gem Society Conclave,
Philadelphia, April, 1957.*

It has been nearly a hundred years since Sir Arthur Church first described absorption bands in gemstones as seen through a spectroscopic instrument, but the credit for establishing the instrument soundly in the list of "musts" for the gemologist must go to men now living. Actually, it has been only in the past thirty years or so that gemologists, headed by B. W. Anderson, Director of Precious Stone Laboratory of the London Chamber of Commerce, have described and recorded the results to be expected from this instrument.

A spectroscope is essentially an instrument that will spread light into its component wavelengths. It is well known to most of us that white light is composed of the colors of the spectrum and that each color has a characteristic wavelength. Visible light is actually only part of a series that varies in wavelength from the relatively gigantic wavelengths of electricity and radio; through

infrared; to the visible wavelengths that diminish in wavelength from red; through orange, yellow, green, blue, and violet; passing into the even shorter and invisible ultraviolet, X ray and gamma rays; and finally to cosmic rays. The whole is known as the electro-magnetic spectrum. In order to measure visible light, a unit of measurement, the Angstrom unit, is used; it is 1/10,000,000 of a millimeter. For practical purposes, we usually think of the visible spectrum as extending from a bit more than 7000 Å to 4000 Å.

One of the first men to study sunlight through a prism was Sir Isaac Newton. Many of us, I am sure, are familiar with the picture of him holding a prism in the path of sunlight streaming through a small opening in a shutter of an otherwise darkened room. Perhaps the first man to advance spectroscopy in a manner leading to its use with gem minerals was Joseph Fraunhofer (1787-

1826). He studied the spectrum produced by sunlight. He noted that his prism not only separated light into the component colors of the spectrum, which we see in a rainbow, but he also noted many dark lines, the strongest of which today are known as "Fraunhofer's lines." Angstrom, the great Swedish physicist, mapped the solar spectrum in 1869 with a spectrum containing more than 1000 lines. One of the most persistent lines in the spectrum of the sun is actually a pair of emission lines at 5896 and 5890 Å. It was about a hundred years ago that the significance of these lines was discovered; they are due to sodium. Since that time, the causes of most of the other lines in the sun's spectrum have been found to be due to vaporized elements in the sun's atmosphere (as well as our own). With these initial discoveries, the spectroscope was turned to other uses, among which can be mentioned its part in the discovery of both ultraviolet and infrared wavelengths — both invisible to the human eye. The spectroscope's use in the study of astronomy is well known, as is the fact that it was used in discovering helium, an element apparently missing in the sun's spectrum. In 1833, David Brewster described the typical broad absorption bands in blue glass as being due to cobalt. His was the first use of the instrument on a cold solid. Today, commercial spectroscopes find great use in the analysis of chemical elements, blood samples, etc. Through the vaporization of various compounds, as little as 2% of certain elements in a compound can be detected. For this purpose, elaborate instruments, many too expensive or unwieldy for the gemologist, are made.

The spectroscopes recommended for use with gem materials are of two types, both of which are available in small size and are known as hand spectroscopes. Perhaps the most serviceable is the direct-vision prism spectroscope, in which the spectrum is produced by the use of three glass prisms, two of crown glass and one of flint glass. An-

other type uses a diffraction grating on glass instead of prisms to separate the light into its colors. It has the advantage of producing a spectrum that is more evenly spread, whereas the prism type concentrates the red end of the spectrum but extends the blue end. However, the diffraction-grating spectroscope requires much more light, with the result that the prism type is usually regarded as the more satisfactory for other than strict laboratory setups. All spectroscopes for use in gem testing should have an adjustable slit to control the amount of light that enters the instrument. In addition, some spectroscopes are made in which two spectra can be observed for comparison purposes, and others in which a scale marked in Angstrom units from 7000 to 4000 is superimposed, thus permitting actual measurement of the absorption lines observed.

Although the first use of the spectroscope was to observe lines brought about through the vaporization of substances resulting in emission spectra, the use of the spectroscope with gems requires an understanding of absorption spectra.

The color of a transparent gemstone is the result of selective absorption and transmission of light that passes through the material. Therefore, if a beam of light is first passed through a stone and then onto the prism of a spectroscope, it is dispersed into the familiar spectrum, and it is sometimes possible to see the results of this selective absorption imposed on the light by the stone as dark bands crossing the spectrum vertically. For example, if a stone fails to pass any yellow light, the spectrum will be complete in all colors except yellow. In other words, the stone absorbs the yellow and the spectroscope shows this by a dark band varying in width according to the wavelengths absorbed by the stone. Absorption bands for gemstone may be exceedingly sharp and narrow or wide enough to cover large parts of the spectrum. In addition, the width and appearance of the absorption bands may vary from specimen to specimen

of the same species and variety.

Only a small number of common gemstones absorb a sufficient amount of light in various portions of the spectrum to result in absorption bands or lines that are visible with the hand spectroscope. At times, a normally reliable variety may fail to show the bands expected, or not as prominently as expected.

For some gemstones the cause of the absorption bands may be ascribed to the definite presence of certain elements. In other cases the cause may be unknown or uncertain.

One element that is known definitely to be responsible for absorption bands in several stones is chromium. Chromium is known to be responsible, moreover, for the colors that we see in most of these stones. For convenience, the absorption of chromium-colored gemstones can be divided into two groups: red and green.

The red group includes ruby (and, unfortunately, for distinguishing between them, synthetic ruby), natural red spinel, chrome pyrope (typically from Arizona), and pink topaz. Chromium absorption bands are found mainly in the red end of the spectrum.

Another metallic element known to be the cause not only of the color but of the characteristic spectrum of gem materials is iron. The grouping here depends on the valence of the iron and can be separated into the ferric group and the ferrous group. In the former are natural green and blue sapphires, demantoid garnet, yellow and brown chrysoberyl, and epidote. In the ferrous group are included almandite garnet, peridot, and blue spinel. Absorption bands caused by iron are mainly found toward the blue end of the spectrum.

Zircon may have as many as 16 bands or, for some natural reddish-brown colors, none at all. The strongest band, at 6535 Å, may frequently be the only one present and is usually visible even in heated blue and colorless stones. The spectrum is believed to be caused by uranium.

A final group of absorption spectra is caused by unknown or uncertain elements, the most important of which is diamond. A narrow band in the deep blue at 4155 Å is most commonly observed, particularly in slightly yellowish and Cape-colored diamonds and especially pronounced in those that fluoresce blue in ultraviolet light. Some rare stones that have a brown to greenish-yellow body color and that fluoresce a greenish color show a strong band at 5040 Å, along with other bands.

The observation of colored diamonds in the spectroscope has been somewhat confused by the appearance in the jewelry trade of brown and golden-yellow cyclotron- and atomic-pile-treated stones, in which the artificially induced color often prevents the observation of the original ultraviolet fluorescence.

Recently, in observing a large yellow diamond in the New York Laboratory, we noted a strong line in the spectrum at approximately 5960 Å, which appears just a bit beyond the sodium line used as a scale regulator. We were unable to discover any reference in gemological literature to the occurrence of this line in diamond. On a hunch, we requested permission of Mr. Theodore Moed, a dealer in cyclotron-colored diamonds, to examine as many treated yellow stones as possible. To our surprise, we noted this line in every treated yellow stone, whether pile or cyclotron treated. Correspondence with Mr. B. W. Anderson, in London, brought the information that he has observed a weak line in natural yellow diamonds but so rarely that it was not included in his recent comprehensive serialized discussion of the spectroscopy, in *The Gemmologist*. We thereupon sought as many purportedly untreated yellow diamonds as possible to examine. Of some 62 stones, the only one in which we detected this weak line was a small greenish-yellow .61-carat stone that fluoresced an intense green. Although we cannot at present base a definite identification of artificial color-

tion upon the presence of this line in the absorption spectrum of yellow diamonds, we hope that further work may produce positive evidence of its value.

Cobalt, which is used for coloring both synthetic blue spinel and some blue glasses, gives a characteristic absorption spectrum consisting of three broad bands in the red, yellow and green. Vanadium, which is used to color synthetic alexandrite sapphire, gives, in addition to a general absorption of the orange and yellow and violet, a narrow line at 4750 Å, which can be useful in identification.

At Eastern Headquarters we are frequently asked when we find the spectroscope most useful. In thinking about this question, I recall a visit we had from a student. He arrived late in the day and we were under considerable pressure for time, but I did want to see his collection of more than 60 colored stones and to check his identifications for him. With only the spectroscope and an observation of the color, it may surprise the reader to know that I was able to identify more than half of the stones. In a few of the fancy sapphires it was necessary to check for natural origin, either by eye or with the microscope. It was possible to identify quickly each of the more than a dozen fancy zircons, the peridots, natural blue sapphires, alexandrites, blue and red spinels, green garnets, yellow chrysoberyls, and even one sinhalite! The spectroscope was of no help, of course, with the fancy-colored spinels, topazes, yellow Ceylon sapphires, tourmalines, or quartz stones. Nevertheless, the entire parcel of stones required less than 15 minutes to identify, including the use of the polariscope, the refractometer, and the microscope, with those stones where the spectroscope was of little or no help.

Recently, we found a situation in which the spectroscope was of great value: the identification of the newly marketed dyed jadeite. Here, instead of the three bands in the red that are seen in similarly colored

natural material, we noted one broad band in the medium red. The characteristic jadeite band at 4370 Å was missing, because it was masked by the absorption band caused by the dye. The line appears, however, when the color is removed with acid, alum, or heat. The "Imperial-green" jadeite doublets (triplets?) show an even stronger band in the red than the dyed material. We have also noted this same absorption band in green-dyed serpentine.

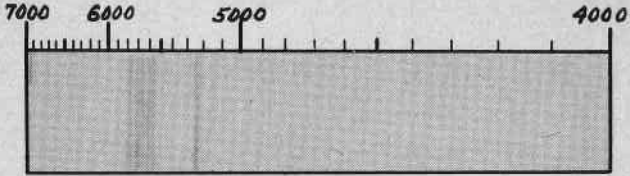
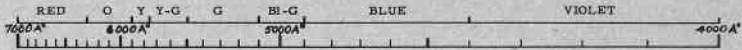
Frequently, ultraviolet light is needed in addition to the spectroscope to identify a flawless natural-yellow sapphire. It has been fairly well established that the two main sources of yellow sapphires are Ceylon and Australia. We find that Ceylon stones fluoresce pinkish yellow, unless their color has been temporarily deepened with Xrays. Australian stones have characteristic absorption bands in the blue. Synthetics show neither.

In the Laboratory we often find the spectroscope useful in separating small almandites from dark rubies, especially if they are in closed mountings. It is also very helpful with natural blue sapphires, since the line in the blue is almost always seen in the natural but not in the synthetic. Ruby cannot be separated from synthetic ruby, nor can the Chatham synthetic emerald be separated from its natural counterpart with the spectroscope.

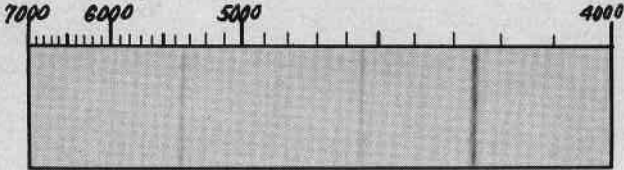
Some of the less frequently encountered gemstones have distinct absorption spectra. The spectrum of yellow apatite, for example, is thought to be caused by the rare earth praseodymium. Chrome diopside, kyanite, californite, enstatite, epidote, greenish-yellow spodumene, spessartite, and iolite have more or less consistent and characteristic absorption spectra that may be very useful, especially, as so often happens, if they are uncut crystals or fragments.

Another frequent question asked is how best to observe the stone and how to set up the light for use with the spectroscope. Various methods have been suggested; e.g.,

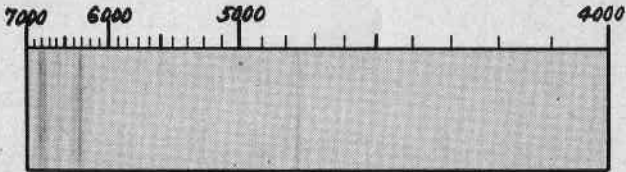
TYPICAL ABSORPTION SPECTRA



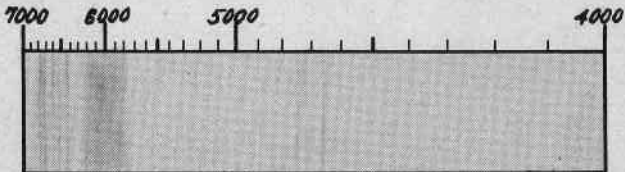
APATITE (green to yellowish green)



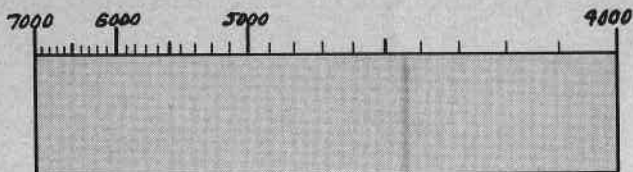
BERYL (AQUAMARINE)



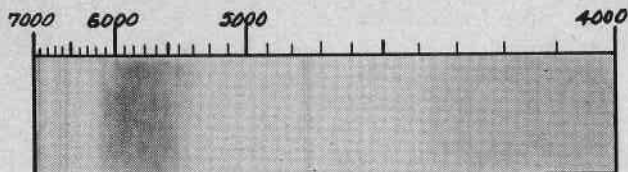
BERYL (EMERALD)



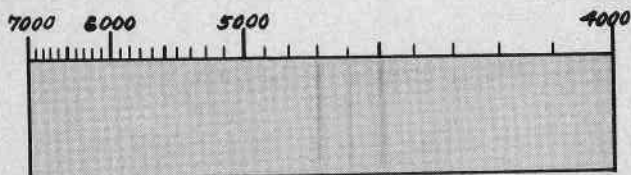
CHRYSOBERYL (ALEXANDRITE)



CHRYSOBERYL (CHRYSOLITE)



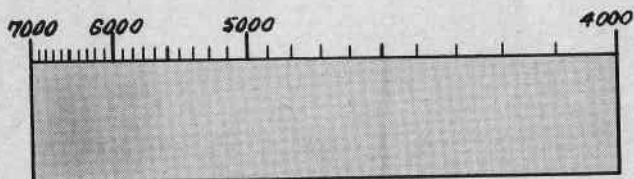
CORUNDUM (RUBY)



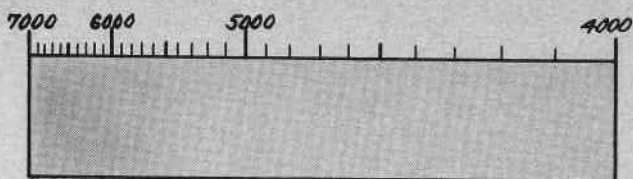
CORUNDUM (yellow Australian sapphire)



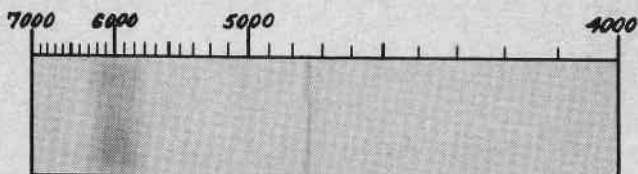
CORUNDUM (GREEN SAPPHIRE)



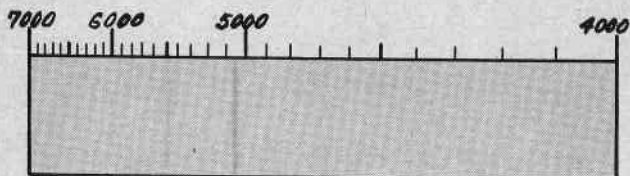
CORUNDUM (BLUE SAPPHIRE)



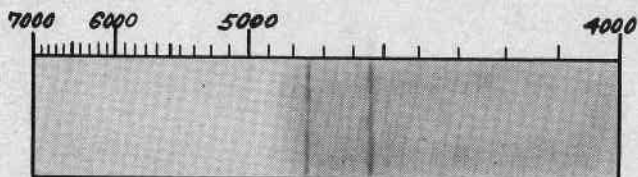
SYN. CORUNDUM (SYN. BLUE SAPPHIRE)



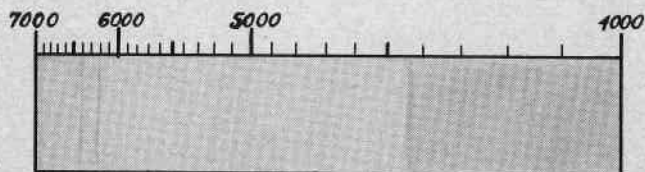
SYN. CORUNDUM (ALEXANDRITE TYPE)



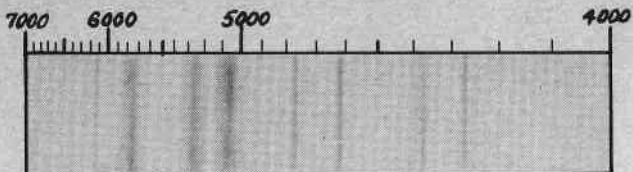
ENSTATITE



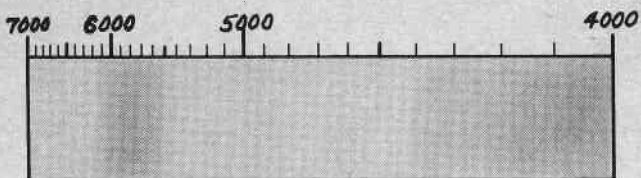
EPIDOTE



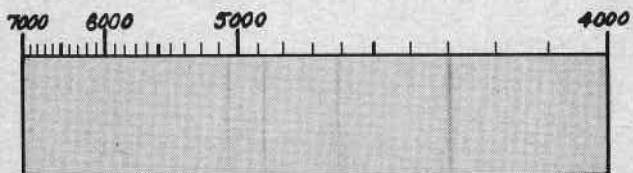
GARNET (DEMANTOID)



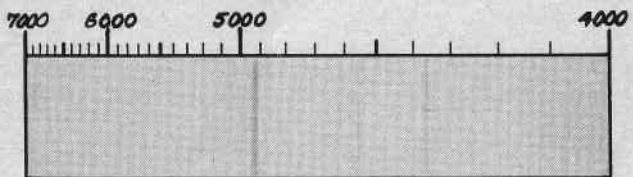
GARNET (ALMANDITE)



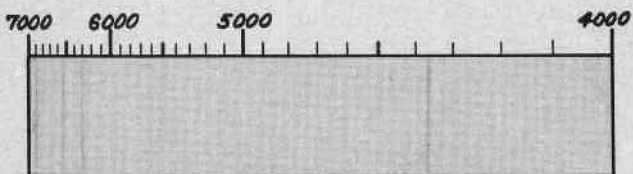
GARNET (PYROPE)



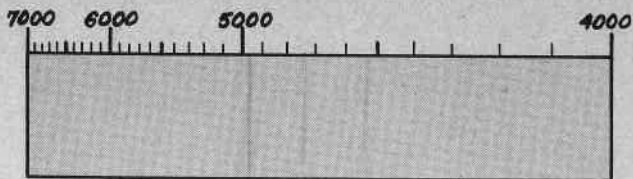
GARNET (SPESSARTITE)



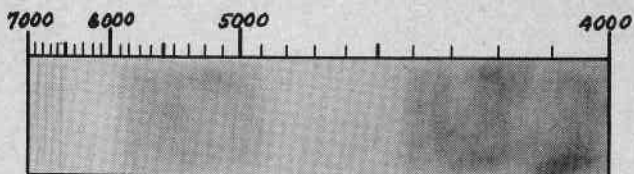
IOLITE



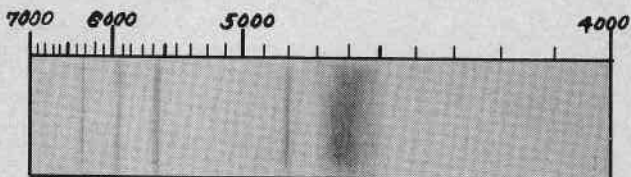
JADEITE (green)



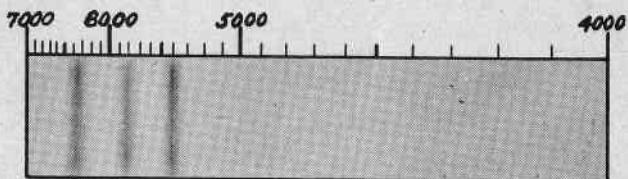
PERIDOT



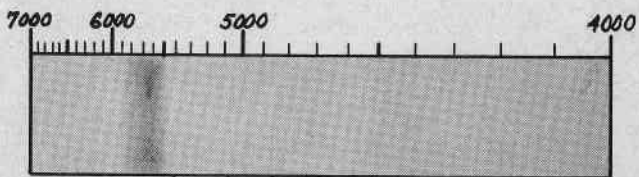
SPINEL (red)



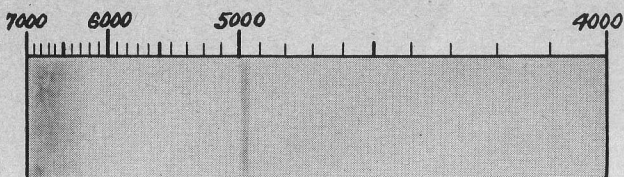
SPINEL (blue)



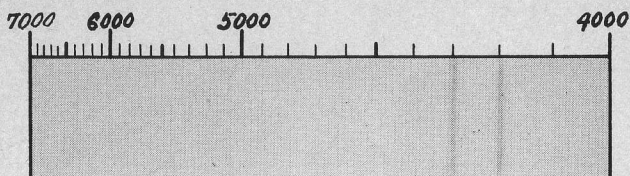
SYN. SPINEL (blue)



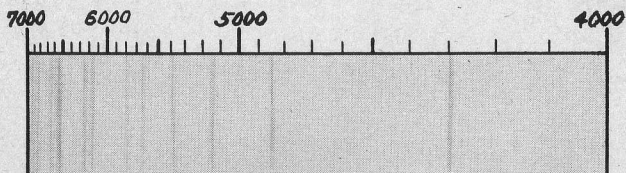
SYN. SPINEL (Alexandrite type)



TOURMALINE (blue and green)



TURQUOIS



ZIRCON

using the instrument in place of the eyepiece of a microscope and reflecting a strong light through the stone, placing the stone over a strong light source as one would candle pearls, etc. In the Laboratory, we use a 50-watt bulb in a pearl candler that has openings to accommodate stones of various sizes. If a dark stone is encountered, we sometimes use our 300-watt projector with an adjustable iris diaphragm to allow the light to be focused directly through the stone. Difficulty is sometimes encountered in getting the light through a highly refractive stone. Immersion in a high-index liquid or even smearing the stone with oil will usually allow light to leak through for study. When testing a pale stone, we sometimes place it table down on black velvet and project a strong beam of light through

the pavilion. In this manner the light is reflected from the back side of the table and refracted out the opposite side of the pavilion to the instrument, thus permitting lines to be seen that would not otherwise be visible when using the pearl candler. Some workers have found that a diffused light giving better results can be produced by using a finely ground glass plate directly over the stone in the pearl candler.

The latest models of the Diamondscope and Gemolite, both of which have an iris diaphragm and a 50-watt light source, make a quite convenient arrangement for using the spectroscope with either mounted or, particularly, with unmounted stones.

The most often repeated mistake observed when the novice first begins to use the in-

(continued on page 62)

Diamond Substitutes

by

LESTER B. BENSON, JR.

*Adapted from a lecture delivered to the
American Gem Society Conclave,
Philadelphia, April, 1957.*

In recent years, both the public and the trade have been besieged by advertising featuring a number of new trade names for materials reputed to have diamondlike characteristics. For the most part, these names are merely new attempts to merchandise some of the common synthetics and imitations. Although there is no law nor FTC ruling prohibiting the use of trade names, certain restrictions have been imposed. For example, the name *Kenya Gem*, which was used in the promotion of synthetic rutile, implied that the stone was natural and from Kenya, Africa. An FTC ruling has been adopted prohibiting the use of any locality name alone in the promotion of manmade stones. Actually, no name should be used for manmade stones, unless the advertisement clearly indicates their manmade character. Unfortunately, this ruling is not always adhered to in advertising, particularly much of that which has stemmed from other than retail jewelry firms. Because of the extent of many of these promotions,

jewelers should be familiar with all of the materials involved, the methods of testing them, and the trade names under which they are sold. The following is a review of these common diamond substitutes.

Strontium Titanate. This is the newest of the synthetic stones on the market. It is quite fragile with a hardness given between 6 and 6.5. However, the surfaces of a polished stone test nearer a figure of 5 to 5½. It is colorless to the eye, singly refractive, and has a refractive index similar to diamond. The dispersion is considerably higher than diamond, resulting in very attractive cut stones. This material was first introduced under the trade name of *Starilian* and has since appeared as *Fabulite* and *Ultamite*. Unmounted stones can be identified easily by a specific-gravity test, since the density is approximately 5.13, compared with 3.52 for diamond. Mounted stones may be deceptive if they are well polished and properly proportioned. A hardness point should *never* be used on any suspected diamond

substitute, since most of them are rather fragile and invariably will be damaged. When placed under a moderately diffused light, either a fluorescent tube or north light, strontium titanate does not equal the diamond in brilliancy, although the dispersion is greater. Magnification almost always reveals at least a slightly poor polish and abraded facet junctions. Since these stones are a product of the Verneuil process, gas bubbles will be found in many. Careful examination under magnification will also reveal that the finish of the girdle does not duplicate the bruted girdle of a well-finished diamond. To date, there has been a relatively small amount of strontium titanate sold on the market; however, promotions are just getting under way and the average jeweler can expect to encounter it frequently.

Synthetic Rutile. A number of trade names have been used in the promotion of synthetic rutile. These include:

Titania
Kenya Gem
Titangem
Diamothyst
Rainbow Diamond
Titania Midnight Stone.
Kiru Gem
Miridis
Sapphirized Titania
Star Tania
Kimberlite Gem
Rutile
Synthetic Rutile
Titanium Rutile
Rainbow Magic Diamond
Johannes Gem
Titania Brilliant
Astryl
Titanstone
Rainbow Gem
Java Gem

Most of the advertisements for synthetic rutile have claimed superior brilliancy to

diamond, and some have gone so far as to make exaggerated claims for durability. Although the refractive index is higher than diamond, the polish and transparency of the average diamond is considerably better than for rutile. Refractive index by itself does not determine brilliancy; instead, it is a combination of refractive index, transparency, polish, and proportioning. Since the transparency of rutile does not equal that of diamond, and the quality of cutting, due to its softness, is invariably quite inferior to the average diamond, these stones fall far short of competing with the diamond in brilliancy. In contrast, this material does have an extremely high dispersive factor, with the result that even poorly proportioned stones display much more dispersion than even a well-cut diamond. Since rutile is comparatively soft, it is easily scratched, and the average stone possesses numerous polishing marks and rounded facet junctions. In contrast to diamond and strontium titanate, synthetic rutile is doubly refractive and displays extreme birefringence. If a stone is cut with the optic axis parallel to the table, a pronounced doubling of the pavilion facets and the culet will be visible through the table. If a stone is cut with the optic axis perpendicular to the table, maximum doubling will be seen only on those facet junctions observed through the stone in a direction approximately parallel to the girdle, but doubling is easily visible to within a few degrees of the optic axis. Synthetic rutile has never been produced in a colorless form, but normally displays a slight yellowish cast. Stones subjected to various heat-treating processes can be changed in color to orange, green, blue, etc.

Synthetic Sapphire. Colorless synthetic sapphire, although it has been produced for many years, has had little popularity as a gemstone because of its very low dispersion. Recently, however, several firms have been promoting this material under other names. One name advertised frequently has been

Waldelite. Exaggerated, and in some cases fraudulent, claims concerning properties have resulted in the sale of rather large quantities of the stones. The nature of most of the ads leads one to believe that the material is a totally new synthetic. The hardness, for example, has been listed as 9.25 on Mohs' scale. To begin with, Mohs' scale is not a precise hardness classification; instead, it simply lists the major stones in the order of their hardness. Corundum has been assigned the hardness of 9 on this system, a value that also applies to synthetic corundum. A simple refractive index determination, plus magnification to detect the nature of the inclusions, will easily identify the average specimen. The only advantage of synthetic corundum in preference to the other diamond substitutes is its greater durability.

Synthetic Spinel. Colorless, synthetic spinel has also been available for many years, but only recently has it been promoted as a diamond substitute. Most of the advertisements have featured it as *Alumag*, a name adapted from the chemical formula of spinel; i.e., a magnesium aluminate. As with synthetic sapphire, many of the claims for synthetic spinel have been exaggerated. In general, it can be said that synthetic spinel tends to be a little more brilliant than synthetic sapphire. It takes an excellent polish, is highly transparent, and, of course, is singly refractive. The difference in brilliancy between synthetic spinel and diamond is readily observed when the two stones are compared side by side under any form of illumination; however, synthetic spinel by itself, under very bright lights, can be quite deceptive. The stones that have presented the most difficulty are those fashioned in the emerald-cut style, rather than the brilliant. The main reason for this is because the average emerald-cut diamond has a very spread table and is usually shallow. Thus, the average jeweler doesn't expect much dispersion in a diamond cut in this

style. The lack of dispersion common to synthetic spinel thus becomes less emphasized when competing with this style of diamond. The refractive index of approximately 1.73, and the distinctive type of strong anomalous double refraction, provide an easy identification of synthetic spinel.

Zircon. Colorless zircon has been one of the most popular diamond substitutes for many years. It is usually well cut and displays dispersion comparable to that of a diamond. The most attractive stone is that which is cut with the optic axis perpendicular to the table, thus minimizing the effects of the rather strong birefringence. Unfortunately, colorless zircons are the result of heat treating colored rough, and many have a tendency to revert to their original color or become more cloudy and slightly tinted. Although fairly hard, heat-treated zircons become quite brittle; thus, pitting along the facet junctions is a common characteristic, even of those worn for a short time. When observed under ten or more magnifications, the only stone that zircon could possibly be confused with is synthetic rutile. A side-by-side comparison of the two, however, reveals immediately that the maximum doubling of facet junctions in a synthetic rutile is several times that of a zircon of comparable size. The same holds true of the dispersion. The indices of both stones, of course, are above the limits of the refractometer.

Assembled Stones. The range of assembled stones used as diamond substitutes is quite extensive. It can consist of many combinations of the above materials, including other colorless stones such as quartz, beryl, glass, etc. The most important of the assembled diamond substitutes are diamond doublets. In general, they are made by recutting two rose-cut diamonds, one to form the pavilion of the stone and the other to form the crown. These parts are then cemented

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CHART OF DIAMOND SUBSTITUTES

Stone	R.I.	S.G.	Disp.	Hardness	Characteristics Sometimes Present & Visible Under Low Magnification
<i>Important Substitutes</i>					
Strontium Titanate	2.409	5.13	.190	6-6½*	Gas bubbles & high dispersion; no doubling of back facet junctions.
Synthetic Rutile	2.62-2.90	4.25	.330	6½-7	Gas bubbles & extreme doubling of back facet junctions; high dispersion; little white brilliancy.
Zircon (High)	1.92-1.98	4.70	.038	7½	Doubling of back facets; facet junctions abraded; subadamantine luster.
Zircon (Medium)	1.87-1.90	4.32	.038	7½	Doubling of back facets.
Corundum	1.76-1.77	4.00	.018	9	Parting & "fingerprint" inclusions; straight color zoning; negative crystals & rutile needles.
Synthetic Corundum	1.76-1.77	4.00	.018	9	Spherical bubbles & curved striae.
Synthetic Spinel	1.73	3.65	.020	8	Spherical bubbles; pronounced anomalous double refraction.
Glass	1.48 to 1.70	2.30 to 5.00	0 to .049	5-6½	Bubbles & flow-lines; vitreous conchoidal fracture; back facets may be molded.
Assembled Stones	Varies	Characteristics will vary widely depending on materials used.
<i>Less Important Substitutes</i>					
Topaz	1.61-1.62	3.53	.014	8	Cleavage cracks; liquid & gas inclusions.
Beryl	1.57-1.58	2.72	.014	7½-8	Two-phase inclusions.
Quartz	1.54-1.55	3.66	.013	7	Negative crystals & liquid inclusions; uneven color distribution common.

* Polished surfaces test nearer 5 to 5½. -----

Emerald Outlook in Colombia

by

RUSS ANDERTON

President Anderton-Colombia Mines, Ltd.

Prospects have brightened for augmented emerald production in Colombia in the current year. The Ministry of Mines has been working for some time on what will be known as the *Emerald Decree*, and will regulate emerald mining and marketing in general. As of the moment, the *Decree* will grant mining rights for a period of twenty years with a nominal percentage of the production to be paid to the government. Under Colombian law, as the old Spanish law, minerals of most categories do *not* belong to the owner of the land, but are the exclusive property of the government until they are conceded to companies or individuals. Consequently, the Ministry of Mines can and does grant exclusive mining rights while the owner of the property in question receives payment only for such damage to his land as the mining operations may bring about.

There was considerable agitation among the Colombian gemcutters to prohibit the exportation of rough emeralds. However, the writer, in company with a gem buyer from Jaipur, India, pointed out that low-grade rough, known here as *moralla*, can only be cut on a businesslike basis in India,

due to the extremely low cutting costs. Also, in India, a piece of rough emerald, worn touching the skin, generally on a chain around the neck, no matter what quality, is many times prescribed by the Ayurvedic physicians as a sure cure for whatever ailment torments the patient at the moment, depending, however, on his birthdate and horoscope in general. Pointing out that international relations might conceivably be strained, the Minister assured that the exportation of rough *would* be allowed under the new decree, health problems being what they are in India.

The Banco de la Republica, which leases and operates the Muzo Mine, a Government property, recently put on sale approximately 1000 kilos of Muzo rough of a very low quality that has collected over a long period.

Exportation was allowed for the poorer lot, and a smaller but better quantity was sold with the proviso that it be cut in Colombia. About one-half consisted of sand-like green gravel, with no commercial value whatsoever. The larger pieces were of poor to fair cabochon material and the prices asked were extremely high, even for the Banco. A private offer was finally accepted

of approximately thirty thousand dollars.

The Chivor Mines, operating under receivership for the creditors (with claims totalling 2,000,000 pesos), have installed their first automatic compressor and hope to increase production this coming year although the current output is of low quality.

Directly opposite Chivor, at a location known as Buena Vista, emerald of fine quality has been unearthed, although the sizes range from one-half to one carat only at the present time. When the new *Decree* is issued, Buena Vista will operate commercially.

Muzo Mines have been plagued with landslides during the recent wet season, but what rough is being mined, is of an increasingly better size and quality. All indications point to a sizeable recovery sometime soon. Cosquez, adjacent to Muzo and also leased by the Banco, is still inoperative.

The new Gachala Mines are under heavy police guard at the moment to prevent *contrabandistas* from operating further, although fine rough from unknown sources is currently being cut in Bogota. The writer has mapped and applied for all concessions with the Ministry of Mines, and the matter will be considered and delegated once the awaited *Decree* is in force.

Prices for good- and fine-quality cut stones remain relatively high on this market, due to the influx of buyers from as far away as Japan and India. However, with eleven applications for new emerald locations already on file with the Ministry, the prospects are bright for more and better rough and consequent leveling of emerald prices.

NEW OR UNUSUAL GEM MATERIALS

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table of the stone! To date, we have not seen this glass being used in any commercial quantity, although it is undoubtedly being used in costume jewelry.

One of the most commercially significant stones to be identified in the New York

Laboratory in 1956 was dyed-green jadeite. Heretofore, it was believed impossible to inject dye into jadeite, the crystalline aggregate structure supposedly being too compact. It was a surprise, therefore, to find that half of a green cabochon lost all of its green color when heated in sulphuric acid. A similar piece of untreated jadeite lost some of its polish, but none of its color.

In August of 1956, a Midwestern jeweler asked if jadeite fades. We told him that we had no record of such occurrence. He complained that a green jadeite cabochon had faded after being exposed to strong sunlight in his west-facing store window. Recent light tests have shown that some dyed material will fade both in sunlight and if exposed for varying lengths of time to a lighted 40- or 60-watt bulb. At this writing, the tests for fading are being continued.

Tests for the identity of the material are not difficult. First of all, the green coloring appears to be confined to tiny fractures that have the appearance of threads in a bank note. It should be mentioned that this appearance is also seen at times in provable untreated material. If a drop of cold (room temperature) acid is placed on the dyed material and observed under magnification, the green color soon begins to disappear and is replaced by a brown to blackish color. Through the spectroscope, the dyed material does not show the three absorption bands in the red (due to chromium) that are characteristic of similarly colored untreated material, but instead shows one broad absorption band in the medium red. Should any doubt remain, and if a stone can be sacrificed, one can use the sulphuric acid test mentioned above to remove all color. Color can be removed equally well by heating the stone in a concentrated solution of boracic acid and water (one teaspoonful boracic acid crystals, 1 teaspoon water). Also, all color can be made to disappear quickly by placing a small piece of alum on the stone and applying heat.

At about the same time as the tests for

dyed jadeite were being conducted we were shown a cabochon triplet that had been made by hollowing out a piece of nearly colorless, translucent jadeite, filling the depression with an unknown transparent green material, and then cementing to the back of the cabochon a flat piece of jadeite. Mounted in a bezel setting to hide the separation plane, these stones have been reported to sell for hundreds of dollars, as well they might, since they imitate the rare Imperial-green jadeite. Again, the spectroscope gives an immediate indication that something is amiss, since the absorption is "wrong" for natural chrome-colored jadeite. Under magnification, some of the more recent triplets have shown bubbles just under the "shell" of jade at the apex of the cabochon next to the green filling. Out of the mounting, the separation plane of a stone of this type would be visible, thus making identification an easy matter.

DIAMOND SUBSTITUTES

(continued from page 58)

together by any one of various cements, one of the best of which is said to be garlic juice. Careful observation, even with low magnification, will easily identify these doublets, although stones that are mounted with closed bezels can easily be overlooked with just normal inspection under a bright light.

A number of doublets have been made with diamond crowns and other materials used for the pavilion. These include synthetic corundum, quartz, glass, etc. It would not be unreasonable to expect the appearance on the market of doublets consisting of a diamond crown and a strontium titanate pavilion.

GLASS. Glass has probably accounted for the greatest number of diamond substitutes sold in America, if we take into consideration costume jewelry. Rarely, a rather large, beautifully cut piece of glass will be encountered in an expensive mounting as a diamond substitute; however, this combina-

tion is unusual. Even the finest glass substitutes do not possess properties that take them out of the range of normal glass, and thus a combination of refractive index and optic character will easily identify them.

AN INTRODUCTION TO SPECTROSCOPY

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strument is in not adjusting the slit, which should be manipulated with the left hand in the Beck-Hand instrument. The slit must be adjusted for each stone if the intensity of color varies from the last stone observed; however, it must be as nearly closed as possible and still allow the colors to come through. Frequently, horizontal lines will be seen running the length of the spectrum. These lines are caused by dust in the slit, and it must be carefully removed with a fine brush. A few such lines are not serious; in fact, they usually indicate that the slit is not opened too far.

Depending on the diffusion of the light used, a phenomenon consisting of bright red lines caused by ultraviolet fluorescence may be observed in the far red in rubies, synthetic rubies, and in some red spinels and synthetic red spinels.

Although the spectroscope has been generally slighted in American gemological literature, it is heartening to see that more and more gemologists are working with it and finding it to be a useful instrument.

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Diamond Possibilities in Colombia

by

RUSS ANDERTON

President Anderton-Colombia Mines, Ltd.

Musty records in Bogota show acknowledgement from Philip of Spain for a gift of rough diamonds from Bogota. The gift was made by the Jesuits here, and they claimed their source was a secret mine past the Tequandama Falls, some twenty miles outside Bogota. cursory exploration has been done, but neither diamonds nor a pipe has been discovered to date.

Stretching for thousands of miles south of the Andes behind Bogota is the great flat land of Colombia, known as the *Llanos*. This is the great cattle-growing section, so large that the state of Texas could be easily superimposed with more of the *Llanos* extending over all sides. The rivers feed two sections: Venezuela and Brazil. It is entirely logical that a pipe or pipes from this section could be the source of the diamonds found in the rivers of both Venezuela and Brazil.

Recently, in the Andes mountains, on the *Llanos* side, the author heard of a great rough diamond found in a mountain stream that was traded to the local priest for an extensive farm, or *finca*, many years ago.

The son of the finder, who was present at the time, it was found, stated that the surrounding territory in the immediate vicinity was very sandy. Giving him a choice of several colors that the sands might have been, he replied that they were entirely of a blue color.

On a recent trip over the *Llanos*, most of which is uninhabited, stretching flat from the windows of the plane for as far as the eye could see, the author realized the tremendous difficulties involved in the search for a diamond pipe. On exploratory trips for emerald formations in the high mountainous country, an occasional slip or landslide will indicate the mineral formation generally hidden by the dense undergrowth. The *Llanos*, however, is without such tell-tale aids to the explorer. A well-equipped modern expedition might narrow the search by small plane for river sampling from Colombia in a general direction of Brazil, being facilitated by the fact that a small plane can land anywhere in perfect safety on the world's largest natural airstrip.