Gems & Gemology

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In This Issue:

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New Diamond Grading Equipment†

Jewelers, especially those trained in Gemology, have long wanted some device affording critical examination of the inclusions—that is imperfections—in diamonds. Such an instrument required two features: First, a built-in illuminating and magnifying unit which overcame the difficulties of illuminating and observing the diamond inclusions, including the elimination of surface reflection on the facets; and second, a set-up which would hold a diamond stationary so that it could be viewed more critically and conveniently under magnification either by the jeweler or (if he so desired) by his customer.*

FIGURE 1
Diamondscope with Bausch and Lomb AK with Drum Nosepiece.

After almost five years of research and practical experiment, a new illuminating device has been perfected in the laboratory of the Gemological Institute of America. During the period of experimentation, many known illuminating principles were tried and a few quite radically new ones were developed. As work progressed, and the experimental instruments came nearer to achieving the desired result, it became evident that the dark field principle, which was brought to perfection sometime in the 19th century, was the most successful. The reasons for its superiority to other methods is explained below. Even after the dark field principle was decided upon, five different actual working models applying this principle were made, and each thoroughly tested in practical work. Those students of the Gemological Institute of America and American Gem Society who attended the Chicago Conclave in May, 1937, will remember the experimental design (No. 5) of the illuminator which was exhibited. For those who did not see it, it embodied the same system of illumination which now appears in the final model, but the working parts were enclosed in a sheet metal case much too large and awkward to be really practical in a jewelry store. After receiving criticisms from experienced jewelers both at the Chicago Conclave and at the many points which Robert M. Ship-

†A.G.S. Research Service.

*A development which occurred independent of the gemological movement was that of the showing of diamonds to customers (under binocular microscopes) by an increasing number of retailers during the last five years. Special features to meet this demand have been incorporated in instruments described here.

ley, President of the Gemological Institute of America, visited during his trip in the spring of 1937, four months were spent in redesigning the *exterior* of the illuminator, the final result being the unit which is illustrated on these pages. This is the final model of the instrument.

In order to better understand the reason for the effectiveness of this illuminating device some understanding of the true nature of the characteristic inclusions in diamond is essential. By far the greatest proportion of diamond inclusions are either white or colorless. However, a considerable proportion of these look dark, and, therefore, are often called carbon or carbon pin points incorrectly, because by the *usual* methods of illuminating a diamond for study with an eye or hand loupe, they are made to stand out in contrast with the brightly-lighted body of the stone. As the light is transmitted through the stone, some of it is absorbed or deflected by these inclusions, causing them to appear as dark or even black spots against the white or lighted body of the stone. However, as the result of actual study of many stones, it has been proved by the Research Department of the Gemological Institute of America that of the stones sold in the United States, surprisingly few contain opaque black inclusions which might strictly be defined as *carbon*. Obviously, therefore, the common practice of illuminating inclusions by transmitted light does not provide the best contrast of very tiny inclusions against the background, as it is simply an intensification of the comparatively slight contrast existing between minute white or colorless inclusions and the colorless body of the stone. If (1) it were possible to light only the body of the stone, leaving the inclusions entirely unlighted, or (2) to light only the inclusions while the body of the stone was kept dark, a much greater contrast between inclusions and the body of the stone would be afforded, and all inclusions would, therefore, be much more easily observed. Neither of these effects can be produced by transmitted light, and the first can be achieved by no means of which we know at the present time. The second method of illumination, that is, the illumination of the inclusions while keeping the body of the stone unlighted, is exactly the function of dark field illumination.

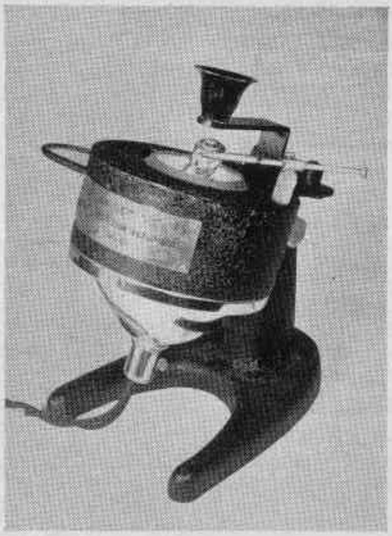


FIGURE 2
Diamond Imperfection Detector, with G.I.A. 10x Loupe.

In the new illuminator, by means of a unit which consists basically of a light source, two reflectors, and a light stop or baffle, light is lead into a stone from all sides, but none is transmitted or passed directly through the stone. Given ideal conditions and a perfectly flawless piece of material, all the light passes through the material from side to side, and none, therefore, reaches the observer whose eye is placed directly above the illuminated point. If, however, there are even the most minute inclusions in the material, these impurities reflect some of the light which would otherwise pass straight through the material, and that portion of the light which is directed upward reaches the eye of the observer, outlining each inclusion as a bright spot or area in a generally dark field. Thus the imperfections which usually require careful search to locate, are made immediately visible. This is the effect which is produced by the inclusions in a diamond or in any other gem stone. As a matter of fact, the illuminator is not quite so perfectly efficient as the foregoing would indicate, because the facets of a cut stone tend to redirect some unwanted light upward. However, by carefully designing the curves of both reflectors, it has been possible to largely avoid this unwanted reflection from any but the most poorly cut diamonds, and even when some such reflection is experienced, its detrimental effect is minimized by the use of a diffusing reflector which prevents direct bright light from confusing the observer. By means of this illuminating system, even the tiniest imperfections are readily visible. Small internal cleavages, usually overlooked but extremely undesirable, are quickly seen.

The illuminating device is provided with a changeable baffle which will convert the instrument to give types of light other than the dark field illumination described above. By sliding the baffle out of its slot, turning it over and replacing it, a bright-finished or almost white metal surface is brought under the stone being observed, and the field against which the inclusions are seen is comparatively light rather than dark. By removing the baffle and replacing it with the other end first, a translucent glass is brought into the system, thus giving transmitted light. Transmitted light, of course, is of particular value for observing directly black inclusions when they do occur.

By any of the above methods of illumination, an intense light is thrown into the stone, so much light in fact, that by comparison the ordinary surface reflections which make it so difficult to see within the stone are practically eliminated.

The illuminating device consists, in brief, of two castings, two spun reflectors, the baffle assembly, a six-volt lamp, and either a resistance coil or transformer for stepping down light current to the necessary six volts. The top casting, which houses the reflectors and baffle assembly, is of aluminum, while the bottom foot of the instrument is of brass. This combination adds to the stability of the instrument by concentrating the weight in the base. The two reflectors are joined by means of a bolt and hand nut, permitting tilting of the instrument, and also whatever magnifier it carries, into any desired position. The top reflector is of unplated spun aluminum, affording diffused rather than direct reflection. The bottom reflector has a bright surface, chromium plated to prevent deterioration.

The table of the illuminator is tapped with two screw holes, either or both of which may be used for attachment of a stone holder or holders.

The stone holder itself is one of the most difficult problems which had to be overcome in the manufacture of this instrument. After many experiments, it has reached the final form illustrated in figure 3. It will be seen that the holder consists of a pair of tweezers closed by spring tension, held in a sleeve which permits sliding the tweezer ends toward or away from the illuminated center of the field. In addition to this backward and forward adjustment, the tweezers can be moved from side to side, rotating about the axis of the post upon which they are mounted. The third plane of motion, up and down, is afforded by the axis upon which the sleeve which carries the tweezers is mounted. The tweezers are so constructed that they will hold the very smallest stone or one of over 20 carats equally well. Also, the spring tension is great enough to hold even a man's heavy ring in place. The entire holder assembly is attached to the stage of the illuminator by a friction post and, therefore, the unit can be slipped off at will in order to pick up a stone, the holder being used as an ordinary pair of tweezers for this purpose. After being replaced on the stage, the holder is adjustable in any direction, permitting any object held in or by the tweezers to be brought into the center of the field. After the object is located, the friction-tight joints of the holder keep it in a fixed position, even when the illuminator is tilted or moved about, as for demonstration to a customer.

The principal advantages of the stone holder are three: First, because it holds the object stationary, it permits a closer study of the stone, and ready observation of inclusions too small to be located if the stone were being moved about, a condition which it is impossible to overcome if

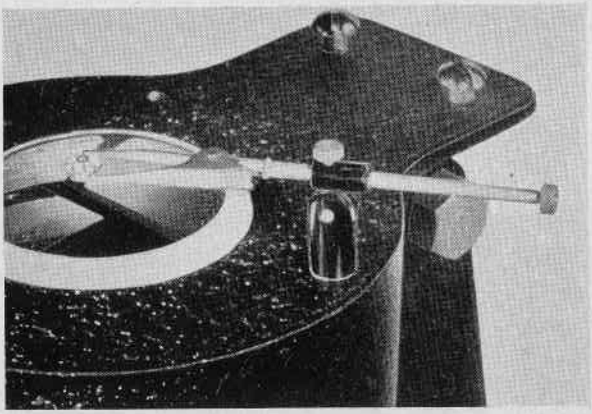


FIGURE 4
Close-up to Show Stone Holder.

the stone is held in place by hand. Second, by means of this holder, inclusions or the lack of them in a diamond can be demonstrated to a prospective customer. The stone can be set in place and the illuminator shifted and tilted if necessary so that the customer can look through the magnifier. Third, it has been suggested that its use will prolong the diamond merchant's years of acute vision, since by use of former unscientific methods the continued movement of tweezers held by hand results in much greater strain upon the eyes.

It is obvious that by the use of this illuminator imperfections can now be quickly detected which might easily be overlooked by the former methods ordinarily in use in the trade. *Application for patent has been made.*

Figure 2 shows the illuminator with the Gemological Institute of America registered 10x aplanatic,

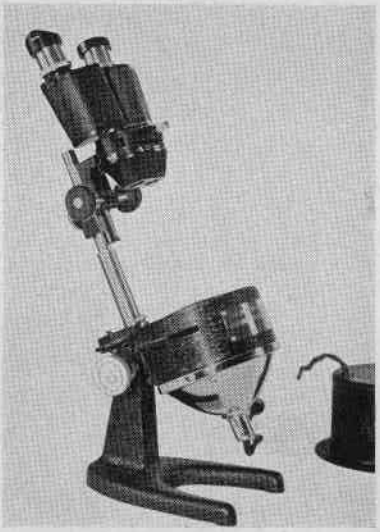


FIGURE 4
Diamondscope with Zeiss XII.

achromatic loupe as a magnifier, a set-up which is called the G.I.A. *Diamond Imperfection Detector*. Figures 1 and 4 illustrate the illuminator with Zeiss and Bausch & Lomb binocular microscopes, respectively. Equipped with any approved binocular microscope, the apparatus is known as the G.I.A. *Diamondscope.*

The Imperfection Detector (with the 10x loupe), of course, reveals some inclusions which cannot be seen with the 10x loupe under ordinary conditions, and also makes much more accurate grading of a diamond for imperfections possible because of the critical illumination afforded, and because both stone and loupe are held stationary. With standard binocular microscopes, magnifications from about 6x to over 100x are practical. Of these magnifications, those above 30x are used primarily for detection of synthetic stones. The dark field type of illumination is of particular value for study of the bubbles of synthetics; it has even been proved that some inclusions which cannot be found even with the special gemological microscope show up as bright, though unresolvable, points under the dark field illuminator.

The Diamondscope has several points of superiority over the Detector. A range of magnifications is available, the method of binocular vision is generally believed superior to that afforded by only one optical system in reducing strain on the eyes and also in giving a perspective which enables the observer to locate an object definitely in a vertical direction, and from a practical selling standpoint, the microscope is probably more impressive to a customer. Those who thus wish to use it need not exhibit a diamond to a customer under any higher magnification than the standard 10x.

A 10x aplanatic, achromatic loupe has just been established by vote of the American Gem Society as a standard for diamond grading. Its use with the illuminator as a G.I.A. Imperfection Detector creates an even more critical standard. The 10x magnifications which are available with the Diamondscope are, of course, also more critical than this A.G.S. standard. It is believed that these instruments offer the most searching method known for diamond grading.

Binocular Microscopes*

In making the recommendations below, the following points were considered: 1. Width of field covered at a given magnification. 2. Flatness of field. 3. Brightness of field—a very important point in locating inclusions in gems. 4. Price, i.e., the amount of practical microscope for the money. The *prices* listed are for each microscope fitted to give one magnification, as nearly 10x as possible.

The wide-field binocular microscopes, believed most practical for the jeweler, of the four leading manufacturers—Bausch and Lomb, Leitz, Spencer, and Zeiss—were tested thoroughly. Other makes are probably available but were not offered us for testing.

In the summaries below, total magnifications may be learned by multiplying the power of any objective by that of any ocular (eyepiece). The instruments are listed in the order in which we recommend them. A summary of the actual tests may be had from the G.I.A., 3511 W. 6th St., Los Angeles.

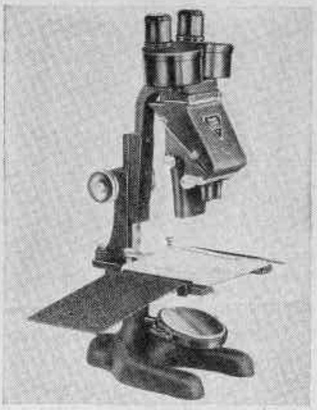


FIGURE 1
Bausch and Lomb AK, with Shuttle Nosepiece

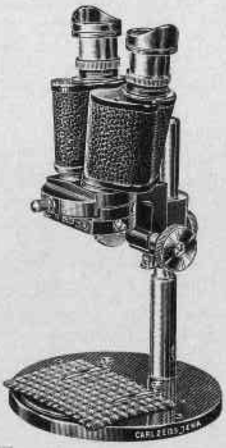
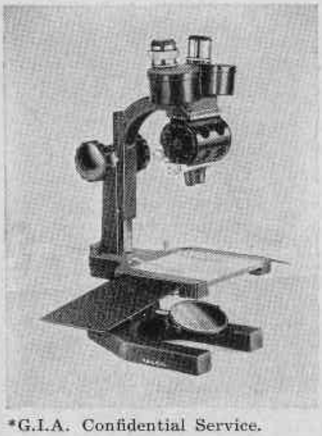


FIGURE 2

Right: Zeiss XII.
Below: Bausch and Lomb AKW, with Drum Nosepiece.

FIGURE 3



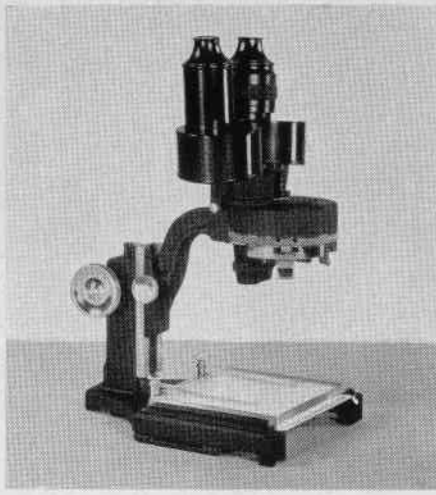
Bausch and Lomb AK (Fig. 1) $98. Widest field (23 mm at 10.5x). Flatness second only to Zeiss XII and B. & L. AKW. Field brightness average. Objective changers: either drum nosepiece for 3, or shuttle nosepiece for 2 objectives; neither takes .39x obj., only drum takes .7x, which is built in. Objectives: .39x, .7x, 1.5x, 2.0x, 4.0x, 7.5x; Oculars: 10x, 15x, 20x.

Zeiss XII. (Fig. 2) $113. Narrow field (15 mm. at 10x). Field absolutely flat except at highest power. Field brightness low. From a critical optical standpoint, the finest of all. No objective changer. Obj.: ½x, 1¼x, 2½x; Oc.: 8x, 12½x, 17x.

Bausch and Lomb AKW. (Fig. 3) $106.50. Optical characteristics same as B. & L. AK, except slightly flatter, less bright, field. Larger stand with longer focusing movement than AK; however, these are of no particular value to jeweler. Nosepieces, Obj. and Oc. same as AK.

*G.I.A. Confidential Service.

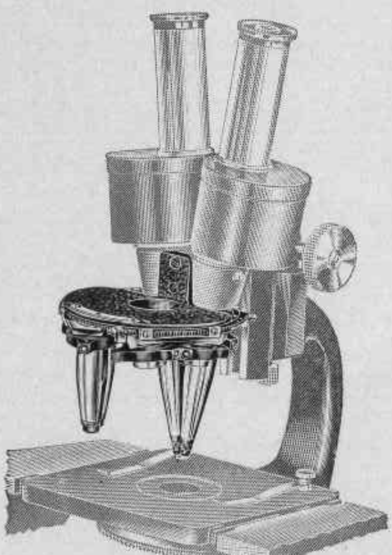
Leitz Bi-C. (Not illustrated) $103.00 approx. Optical qualities above average, but inferior to other three except for brightness of field. Multiple (3) objective changer. Obj.: .75x, 1x, 2x, 3x, 4x, 6x, 8x, 12x; Oc.: 5x*, 8x, 12½x, 18x.



Spencer 56, with Revolving Nosepiece.

Spencer 56. (Fig. 4) $111.50 approx. Though mechanical construction is excellent, optical quality is below average. Field flatness poor, width of field low to average, brightness of field low. Revolving nosepiece (3) objective changer. Obj.: .6x, 1x, 1.7x, 2.3x, 3.4x, 4.8x, 6.8x; Oc.: 6x*, 9x, 12½x, 17x, 25x, 30x.

Zeiss X. (Fig. 5) $141.00 (12x); $121.00 (25x). Field brightness highest of all, but field flatness very low, field width average. Revolving (3) nosepiece. Ob.: 2x, 3x, 4x, 6x, 8x, 12x; Oc.: 6x, 12½x, 17x, 28x.



Zeiss X, with Revolving Nosepiece

Each of the above manufacturers also makes a binocular microscope with inclined eyepieces, permitting the observer to sit more comfortably if the stand must be used without tilting—a necessity rarely encountered with gems. Of these inclined bodies, the ones made by *Spencer* and by *Zeiss* were tested. These both rated appreciably lower in optical characteristics than the comparable stands without the inclining feature.

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*Eyepieces to be used only with 1x objectives or lower.

A GEMOLOGICAL GLOSSARY

(Continued from last issue)

Lynx Sapphire. Very dark blue sapphire.

Lynx Stone. Iolite.

Maacles (mak'ls). Name given to flat, triangular twin crystals of diamond.

Macle (mak'l). Same as maacle. Also, a seldom-used name for chiastolite.

Macled Stones (mak'ld). Twin crystals of diamond.

Macroscopic (mak"roe-skop'ik). Large enough to be observed without the microscope.

Madagascar aquamarine (Mad"a-gas'kar). Trade term used to describe beryl whose color is a medium to light tone of blue, a darker and more intense blue than the usual aquamarine.

"Madeira Topaz" (ma-dee'ra). Citrine quartz.

Madras Pearls (ma-dras'). Fine white pearls from the Ceylon fisheries, so called because marketed principally in the city of Madras.

"Magic Stone." A white, opaque variety of hydrophane, in rounded lumps, with a chalky or glazed coating; has been found in Colorado.

Magma (mag'ma). Molten (liquid) rock material within the earth; the molten mass from which any igneous rock or lava is formed. The glassy base of an igneous rock.

Magnetic (mag-net'ik). Capable of attracting the magnetic needle or being attracted by a magnet.

Mahabharata (ma-ha-ba'ra-ta). A Hindu epic containing early information regarding India.

Maiden Pearls. Pearls newly fished and never worn.

Make (of diamond). The term includes all the operations of fashioning a diamond, including cleaving, sawing, rounding up (cutting), grinding and polishing facets. As used in the trade, "make" usually refers to the correctness of the proportions and to the polish of a fashioned diamond.

Malachite (mal'a-kite). An opaque green copper carbonate mineral used as a gemstone or ornamental stone. S.G. 3.8; R.I.; 1.65-1.91; Hardness 3½-4.

Malacolite (mal'a-koe-lite). A light-colored variety of diopside from Sweden. See Diopside.

Male Sapphire. Deep-colored sapphire.

Malleable (mal'ee-a-b'l). Capable of being hammered or rolled into a sheet.

Maltesite (mol-teze'ite). A variety of andalusite resembling chiastolite.

Mammillary (mam'i-lae-ri). Having a smooth, hummocky surface, with curved protuberances larger than botryoidal. See Botryoidal. See Reniform.

Mangelin (man'g'line). Hindu weight equal to 1⅜ carats.

Mantle. Two flaps arising one on either side of the body of a mollusk or other bivalve.

Manufactured Stones. A term applied to all kinds of gem substitutes made by man, which either duplicate or imitate some genuine stone. See names of Manufactured Stones, i.e., Synthetic, Imitation, etc.

Manul. Loose or soft sand sea-bottom. (Ceylon.)

Maori-Stone (ma'oe-ri, colloq. mou'-ri). Name given nephrite of New Zealand from its use by the Maori natives.

Marcasite (mar'ka-site). Iron disulphide crystallized in the orthorhombic system. Opaque bronze or grayish yellow with metallic luster. S.G. 4.9; Hardness 6-6½. The term is also applied to marcasite cut for use in jewelry, and incorrectly to pyrite cut for the same purpose. See also Pyrite.

Margaritifera (mar"gar-ri-tif'er-a). Term loosely applied to the salt-water pearl-bearing mollusks, i.e., *meleagrina*. Strictly, Boutan applies it only to the Tahitian variety of meleagrina, the Grande Pintadine, Avicula Margaritifera, or *Meleagrina Margaritifera*, largest of the pearl-bearing mollusks.

Marquise (mar-keze'). A style of fashioning, varied from the 58-facet brilliant, with one girdle width extended to form a more or less slender double-pointed (lens) shape.

"Mascot Emerald" (mas'kot). Trade name for genuine Beryl Triplet. See also "Emerald Triplet."

Masculine (mas'kue-lin). Term applied to stones of a deep and rich color.

Massive. Not occurring in crystal forms or shapes, but not necessarily non-crystalline.

Massive Amber. A compact, almost colorless to dark orange-yellow variety of Baltic Amber.

"Matara Diamond" (ma'ta-ra). Colorless or faintly smoky zircon from Ceylon, the pale-brown zircons are sometimes decolorized by heat. (Matura.)

Matrix (mae'triks). The rock in which a mineral is contained. When the gem mineral is cut together with a portion of this matrix, the resulting stone is known as the matrix of that stone, as for instance, turquoise matrix.

Matto Grosso (mat'oo grose'oo). A gem-bearing state or territory of Brazil.

"Matura Diamond" (ma-tue'ra). Same as "Matara Diamond."

Mayaite (ma'ya-ite). The "jade" of worked objects left by the ancient Mayas in Central America, grades from tuxtlite to nearly pure albite. The name Mayaite from Maya nation, is applied to this series of rocks.

Meager or Meagre Feel. Rough or harsh to the touch; the opposite of smooth and greasy feel.

"Medina Emerald" (mee-deye'na). Green glass. See Imitations, Glass.

Meerschaum (meer'shom or shum). See Sepiolite.

Megascopic. (meg"a-skop-ik). Visible to the unaided eye; in contrast with microscopic; same as macroscopic.

Melange (mae-lanzh'). An assortment of diamonds of mixed sizes.

Melanite (mel'a-nite). Black andradite garnet.

Meleagrina (mel"e-a-gree'na). The genus of mollusks which includes the principal producers of Oriental Pearls and of pearl shell.

Melee (mae"lae'). Small diamonds (generally used in embellishing settings of larger gems).

(To be continued)

Eastern Meeting of A. G. S.

On August 23rd and 24th, at Waldorf-Astoria, New York City, occurred an experimental educational meeting, followed by a short business session arranged for gemological students and graduates in the Eastern and Southeastern states.

The American Retail Jewelers' Association acted as hosts, allocating two banquet rooms, and the sessions, which occurred previous to and during its national convention, were opened by an address of welcome by its President, Wm. D. McNeil.

Important features of the program were talks by well-known *gem* authorities who are members of the Educational Boards of the Gemological Institute. These and other members of the Educational Boards presided at the educational sessions or assisted in supervising the various gem-testing tables. At the Monday morning diamond session, Dr. Sydney H. Ball, the international diamond authority, read a paper, "Progress in Diamond Trading," the text of which may be found in recent American and English trade journals as having been delivered at the A.N.R.J.A. Convention. Tuesday afternoon Dean Edward H. Kraus, co-author of "Gems and Gem Materials," presented a lantern lecture on "The Gem Cutters of Idar-Oberstein," followed by a talk by Dr. Chester B. Slawson, his associate at the University of Michigan, on "The Development of Gemological Education in America."

In addition to the session on diamonds and diamond grading on Monday morning, there was a called meeting on Tuesday for attending Members of the A.G.S. Diamond Nomenclature Board, followed by a general discussion of proposed new rulings for obligatory observance by Registered Jewelers and of ethical requirements for students enrolling in gemological courses. Luncheon meetings of the A.G.S. Publicity Committee and G.I.A. Board of Governors also accomplished constructive results.

All members of the G.I.A. Examinations Board were in attendance, and a three-hour meeting of these and other Members of G.I.A. Educational Boards placed limits upon (1) the number of retakes possible in the Certified Gemologist examinations; (2) the length of time intervening between examinations; and (3) ruled that the diamond grading examinations now required of retailers should also be required of non-retailers before they be allowed to use their title in the trade. Members in attendance: Mr. Thurber, Chairman; Messrs. Ball, Clark, Faust, Kraus, Kaufman, Hawkins, Slawson, Spies and Wigglesworth.

As an experiment, a method of instruction, differing from the Central Conclave plan, was pursued. At a master identification table, unknown stones were given to student-members, who then progressed past a series of tables at each of which they made observation of one or more of its properties with gemological instruments under the supervision of Members of the G.I.A.'s Students' Advisory Board or Certified Gemologists. After completing the necessary steps for the identification of this stone, they returned to the master table, where their findings were approved or criticized and, if correct, another unknown stone was allotted to them. This method proved especially constructive, sixty student-members devoting five hours of intensive and uninterrupted work to this feature.

Educational Leaders at Monday Session

The following assisted at the tables Monday:

No. 1. *Master Identification Table.* Unknown stones were here allotted to students, whose determinations at Tables No. 2, No. 3, No. 4 and No. 5 were later checked by Chester B. Slawson, Ph.D., Member G.I.A. Examinations Board and Advisor Eastern Michigan-Northern Ohio Study Group, assisted by John S. Kennard, C.G.

No. 2. *Loupes, Immersion Vessels, Imperfection Illuminators* (for study of inclusions). Leader: Geo. T. Faust, Ph.D., Advisor New York City Study Group; assisted by Nolte C. Ament, C.G., and Leopold Kahn, Jr., C.G.

No. 3. *Polariscopes and Dichroscopes.* Leader: Edward Wigglesworth, Ph.D., Advisor of Central New England Study Group; assisted by Leon Davis, R.J., and Lieut. D. H. Wilson.

No. 4. *Refractometers.* Leader: Fred B. Thurber, C.G., assisted by Harold Seburn, R.J., and Kenneth Woodward.

No. 5. *Specific Gravity Scales and Liquids.* Leader: Earl E. Jones, C.G., assisted by D. J. Cooper, J.G., and J. Arnold Wood, J.G.

No. 6. *Gemological Microscopes Adapted for Determination of Positive and Negative Uniaxial and Biaxial Gemstones.* Nolte C. Ament, C.G.

No. 7. *Gemological Microscopes Adapted for Difficult Synthetic Detection.* Leader: Leopold Kahn, Jr., C.G., assisted by Jerome B. Wiss, R.J., and Myer J. Kassner, J.G.

No. 8. *Pearl Testing Equipment.* John S. Kennard, C.G.

No. 9. *Diamondscopes and Diamond Imperfection Detectors.* Leader: C. I. Josephson, Jr., J.G., assisted by Earl George, R.J. (S. Joseph & Sons), William B. Hawley, R.J. (Davis & Hawley), H. B. McCague, R.J. (Cowell & Hubbard), and William H. Schwanke, R.J. (Schwanke-Kasten Co.).

The gem-testing session began with leaders at Tables No. 6, No. 7, and No. 8 demonstrating advanced technique to Junior Gemologists. (During these hours, Robert M. Shipley reviewed the simpler methods of gem-testing for the attending Registered Jewelers and elementary students.)

Instruments Furnished

For general use of students a large number of refractometers, dichroscopes, polariscopes and 10X loupes were furnished by the G.I.A. and numerous generous students.

Diamondscopes were loaned by Nolte C. Ament, C. I. Josephson, Jr., John S. Kennard, Jerome B. Wiss. Diamond Imperfection Detector by Harold Seburn.

Gemological microscopes were loaned by the following and their use in advanced gemology demonstrated by the first five:

Nolte C. Ament, C.G., Louisville.
Leopold Kahn Jr., C.G., Manila.
Myer J. Kassner, J.G., Laconia, N. H.
John S. Kennard, C.G., Boston.
Jerome B. Wiss, R.J., Newark.
Warren R. Larter, J.G., Newark.
Fred B. Thurber, C.G., Providence.

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(To be continued)

A GEMOLOGICAL ENCYCLOPEDIA

(Continued from last issue)

HENRY E. BRIGGS, Ph.D.

An example of such a gem, whose price is subject only to asking, was the beautiful opal found on the Rainbow Ridge Mining Company's property in Humbolt County, Nevada. This stone weighed 16.95 ounces Troy, and according to reports was sold for a quarter million dollars. It is now in the National Museum (Roebling collection) in Washington. This is one example of a gem where it was impossible to establish any set valuation. The price on such goods must rest with the buyer and seller.

PRECIOUS GEMS

Perhaps the most important of precious gems from a commercial standpoint of view is the diamond. Consequently we will treat that first, and all others in the order of their demand at this time.

DIAMONDS

Diamond is the only gem composed of only one element. It is pure carbon, as shown by the burning of the crystal. The combustion of a perfectly clear crystal produces only carbon dioxide (CO_2). However, the combustion of colored diamonds leaves a very small amount of ash, which proves they are impure. The impurities, no doubt, cause the color.

Diamond crystallizes in the cubic system and is, therefore, isotropic. Anomalous double refraction, however, may be present due to internal stress. Diamond has a perfect octahedral cleavage, and the fracture is conchoidal. It is the hardest known substance and is listed as 10 on Mohs' scale. The specific gravity of fine gem crystals will hold nearly constant at 3.52. However, the other varieties will vary from 3.15 to 3.535. Diamond is one of the most highly refractive of gems, ranking third among those treated in this volume. The index of refraction for an intermediate wave length (green) is 2.427; dispersion between red and violet is .058 which is also very high, being again third in the list of gems treated. The luster is adamantine and of glimmering to shining intensity. Diamond occurs in many shades of the following colors: yellow, pink, red, blue, green, brown and violet, also in colorless and black. The colorless, green, blue and red are the most valuable. I have not mentioned the violet because of its very extreme rareness. The fact that in this color diamond is extremely rare causes the price of such colored stone to rest with the buyer and seller. Diamonds of a greenish tint are more often met with than the blue or red, but the most plentiful of all are the yellows, browns and colorless. Comparatively few of the stones produced are absolutely colorless and of first water. The yellowish stones seem to occur in the best perfection on the average. However, stones of a yellowish or brownish tint are not valued so highly as gems and are often spoken of as "off-color" gems. However, it will be noted that one particular shade of yellow diamond seems to exceed most of the pure white ones in brilliancy. Nevertheless, these yellowish stones do not seem to meet the approval of the exacting connoisseurs. The pure white is preferred to all except the rare colors mentioned. Stones of a brown or even a brownish cast are not valued nearly as high as even the yellow stones. Large brown stones are usually offered at a comparatively nominal figure. Diamond occurs in crystals varying in transparency from the finest water to complete opaqueness. Only the transparent variety are usable as gems, as the diamond depends entirely on the fire caused by refraction and dispersion for its charm. The diamonds sold as blue white are sometimes even tinted yellow, and it is a regrettable fact that our Better Business Bureaus have to repeatedly call someone on this score. A diamond which is designated as "blue white" should be just enough tinged with blue to counteract any trace of yellow which may be present in the stone, much as a tinge of blue is given white linen in a laundry in order to counteract the naturally yellowish cast of the fabric. Stones, however, which show a fair tint are sold as blue gems, steel blue, etc., according to the depth of the tint. It is not definitely known what causes the color of diamonds, but it is believed to be due to metallic oxides, etc.

The nonuniform hardness of diamond has been a matter of more or less discussion in the past. Some mineralogists contend that diamonds are always uniformly hard all through. However, the author is a diamond cutter and has learned very positively from experience that diamonds are not always uniform in hardness throughout the crystal. Occasionally the diamond crystals are abortive and the grain of the stone seems snarled, much as the grain of the root of some trees. Certain spots in these stones are harder than others, as can be unquestionably proven by working in the abortive crystal with a sharp off a crystal of straight grain and consequently uniform hardness. It is indeed true that unless a diamond is applied to the skeif so that the grain is in a direction across that of the rotation of the skeif, cutting will be difficult and little can be done. Of course, this may be used for an argument in the case of abortive crystals. Some say that the apparent varying hardness is due to its being almost impossible to have all the grain in the proper direction at once. This is partly true, but it does not prove the point, for the crystals show some variation even when they are being worked by hand so that each turn of the grain may be taken advantage of. Diamonds from various localities vary in hardness also. The author has found diamond crystals from Australia to be the hardest, and those from Borneo and India to follow closely, then the stones from Brazil (gem quality) follow next in hardness. The diamonds found in Arkansas come after the Brazilian, and last of all, and softest of all, are the South African stones. However, these stones referred to as "soft" are so hard that they cannot be scratched by any substance but diamond, and they will steadfastly resist all attempts to cut them, except those of a skilled artisan. In this matter of hardness of diamonds we have considered only the gem stones. *(To be continued)*