

Gems and Gemology

Jeweled Miniature

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Fundamental Problems of Light

by

DAVID H. HOWELL, C.G.

Probably no single word in our entire language is used with less intelligence and possesses a more nebulous meaning than the word light. This word is used both in a subjective sense and an objective sense. For example, when our eye is subjected to a certain condition we experience a sensation which we call light. Likewise, physical causes are also called light.

Physicists offer a definition based on radiant energy given off by solids in an incandescent state. This energy is distributed throughout certain wave-lengths in definite amounts or quanta. Webster propounds the following: "The essential condition of vision. The opposite of darkness." This is not especially clear as it throws all the responsibility on the word darkness, which is often defined as "The absence of light." Thus we go around and around in a circle and find ourselves precisely nowhere. However, in order to gain a clear conception of what this phenomenon which we call light can do, we must first attempt to obtain an idea of what it is.

The modern scientific frame of mind requires one to think of light as radiations which have relatively high energy radiations, based upon their motion or frequency. In this way, light is separated from other lower or higher frequency

radiations such as heat, radio, and X-rays. The general problems concerning gemstones and their observed attributes are primarily concerned with what we shall call visible light and to certain visible effects caused by ultra-violet light.

HISTORY

Studies in light are not recent and many of our present theories and concepts have been in men's minds for nearly three hundred years. In 1666 Sir Isaac Newton, noting the decomposition of white light in passing through a prism into its spectrum colors, began to theorize upon the mechanics of this observation and also to inquire into the nature of light. He offered the so-called "Corpuscular Theory" for the propagation of light through space; i.e., Light was a flight of material particles by the source of the light and its propagation was due to the mechanical action of these particles upon the retina of the eye.

However, further observations into the behavior of light—especially into the fact that light bent in going around corners—could not be reconciled to this Corpuscular Theory and Huygens 1678 proposed the "Wave Theory." This explained satisfactorily the phenomena of reflection, refraction, and diffraction. Later, in 1800,

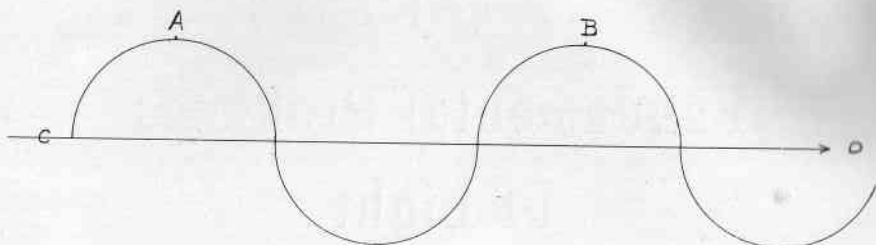


Figure 1

Thomas Young proved the validity of this Huygens Wave Theory by observations and proof of the True Interference of Light.

In 1814 a physicist named Fresnel added to the former concepts the idea of transverse waves and wave motion in order to explain the matter of polarization of light.

Fresnel, however, based his theory upon a very bold hypothesis for it appeared to be necessary to consider space filled with a medium capable of transmitting transverse waves such as are propagated in elastic solids. The idea of the so-called "luminous ether" thus came into existence and the elastic solid theory of light replaced the corpuscular.

This assumed all space filled with a medium having very remarkable properties. To transmit waves having the frequency and velocity of light, it must be millions of times more rigid than steel, while at the same time offering no resistance to the passage of the earth and planets around the sun. It was supposed to be made up of extremely minute particles, far smaller than atoms, held together by forces of attraction, and when one or more was displaced from its normal position, its neighbor was pulled aside, the displacement being handed on from one to another in the form of a wave. The theory had one very marked advantage; it gave a clear picture of the nature of light and practically all of the

optical phenomena known at the time were satisfactorily explained.

On this theory a source of light was considered as a collection of molecules, the atoms of which were in a state of vibration. These communicated their motion to the other particles, and the light wave advanced out into space.

There were many objections to this theory, one of which was the difficulty regarding the longitudinal disturbance which always accompanies the transverse one in the case of wave motion in elastic solid. No evidence of any such longitudinal disturbance in the ether has ever been found.

THE ELECTROMAGNETIC THEORY

In 1850 Clerk Maxwell showed that the propagation of light could be regarded as an electromagnetic phenomenon, the wave consisting of an advance of coupled electric and magnetic forces. Maxwell predicted the speed at which these waves would travel from measurements of the magnetic fields of electric currents. Data obtained turned out to be the velocity of light, that indicated that light was essentially an electromagnetic phenomenon. The waves predicted by Maxwell were discovered in 1892 by Hertz who produced electrical oscillations in a pair of conductors between which he passed a spark. (Father of Wireless Waves—Hertzian Waves.)

This theory—like the elastic solid theory—required an ether, but not a

mechanical one. We were nearly as badly off as previously in the Real explanation of what went on. One physicist remarked in his work on Optics, "So long as the character of the displacement which constitutes the wave remains undefined, we cannot pretend to have established a Theory of Light."

Lorentz in his theory advanced the idea that the atom and molecules contained electrons capable of vibrating under the influence of restoring force if and when they were displaced. This accounted for many of the newly discovered effects of magnetism on light (present day television tubes) as well as problems of refraction, dispersion, etc.

Planck The Quantum Theory—Light is emitted in definite packets or quanta (of energy) and this light quanta traverses space without losing energy or increasing in size.

The present trend seems to be a sort of fusion of the two (corpuscular and wave) theories, an energy quantum directed in its motion by a wave field, for only in this way has it been possible

to reconcile the facts of interference with the laws of the photoemission of electrons.

Having briefly stated what light is, it might be logical to point out next what it can do. The effects of light may be divided into three general classifications.

1. The effects upon the optical nerves of the eye,
2. Chemical changes,
3. Heat changes.

Our principal interest naturally concerns itself with the effects upon the eye. We may class color, transparency, luster, and all observed visual changes under this generic heading.

Chemical changes, however, play an important part in our daily lives. Most of these types of alterations are known as Photo-chemical effects. The fading of certain dyes in sunlight, some flora colors, may likewise be attributed to this cause.

Heat, though more difficult to follow, produces important effects. Growth and development of plants and humans—even

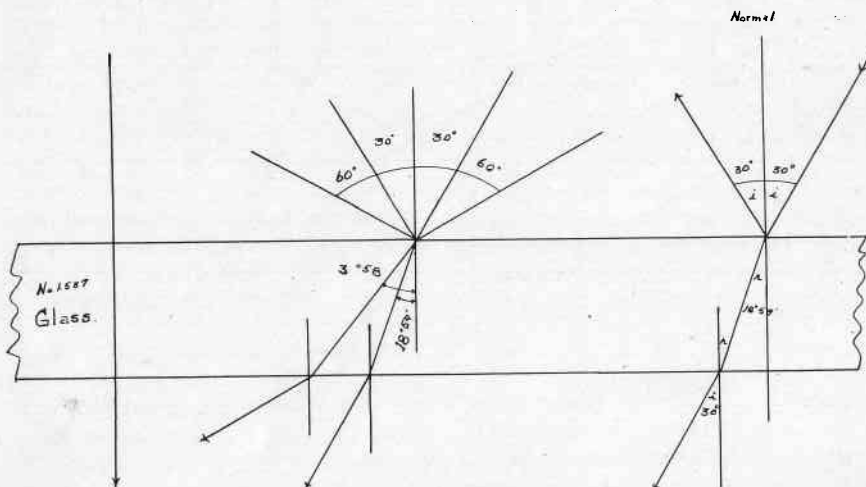


Figure 2

life itself—is directly concerned with light and heat.

So much for what light can do. Let us proceed to a consideration of HOW it does it.

SIMPLE PERIODIC MOTION

Many of the optical problems which we shall consider can be treated from the standpoint of the old elastic solid theory, for the propagation of light in many cases is governed by the same laws which hold in the case of acoustical phenomena and the transverse vibrations in elastic media. The source of light we may consider as a quasi-elastic oscillator, that is, a vibrating particle which is moving back and forth with a force proportional to its displacement.

In **Figure 1** is illustrated a wave in progress in cross section, Pt. A and B being successive crests. The direction CO represents the direction of propagation. The distance AB represents the wave

length. The distance between two points similarly situated upon succeeding crests for a radiation of blue light would measure 4,500 A.U. Were the radiation that of red, however, this distance would be much longer and would measure 6,500 A.U. In a vacuum these two radiations would have comparable velocities and are said to travel at a speed of approximately 186,000 miles per second or 300,000 kilometers per second. The number of these crests and troughs which occur for any given distance of travel determine the frequency of the vibrations. A change in the velocity of any radiation, therefore, results in a change of wave length since the number of oscillations occurring per unit length necessarily follows. This point must be firmly impressed upon one's mind since much of the light phenomenon observed in solid substances is directly attributable to changes in velocities of incident radiations and transmitted radiations.

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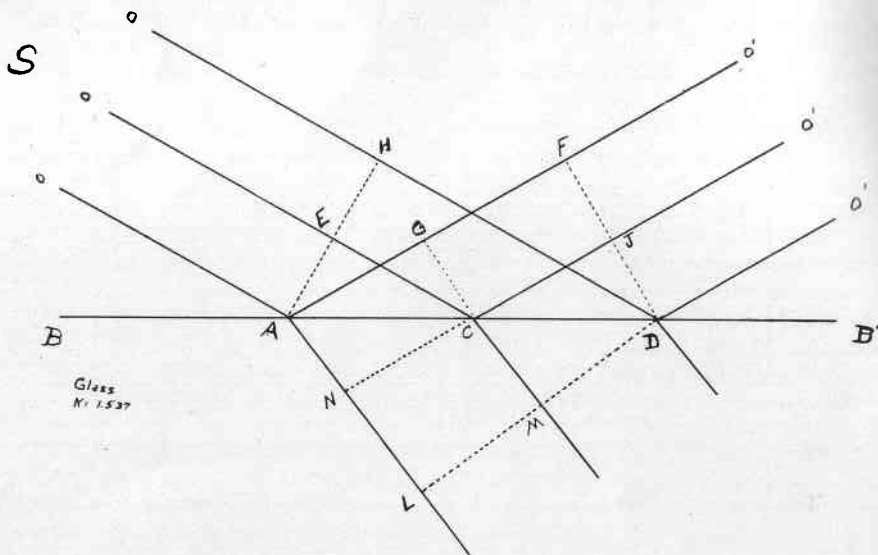


Figure 3

Gem Collection of the U. S. National Museum

by

WILLIAM F. FOSHAG, Ph.D., *Curator*

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The gem collection of the U. S. National Museum had its inception in a modest exhibition of precious stones by the Museum at the New Orleans Exposition in 1884. In 1893 the collection of minerals and gems of the naturalist, Dr. Joseph Leidy of Philadelphia, was acquired and, combined with the gems already in the Museum's collection, formed a part of the exhibit at the World's Columbian Exposition at Chicago in 1894. The collection was very greatly increased by the bequest of Dr. Isaac Lea's extensive collection of precious stones by his daughter, Mrs. Frances Lea Chamberlain. Her husband, Dr. L. T. Chamberlain, who later became honorary curator of the collection, added a number of fine gems, and upon his death bequeathed a modest endowment, the income of which allows the acquisition of new gems from time to time. The gem collection of the U. S. National Museum is known as "The Isaac Lea Collection," although stones from other sources are individually differentiated by label. Specimens of natural uncut gem crystals are exhibited in special cases or find their appropriate place in the systematic exhibit of mineral species.

In 1924 the world famous mineral col-

lection of Colonel Washington A. Roebling was presented to the Smithsonian Institution by his son, John A. Roebling, and deposited in the U. S. National Museum. This fine collection, accumulated over 70 years of persistent endeavor, contained many fine gem minerals in their natural state, and a few magnificent examples of rare cut gems.

For practical reasons, the exhibition of cut stones features the unusual, less common or rarer gemstones, the general policy being to display such kinds and varieties as are not ordinarily to be found at a good jeweler's. Consequently the collection contains few outstanding examples of cut diamond, ruby, or emerald. Natural stones and the remaining gemstones, however, are represented by outstanding or unusually fine examples, both as to size and quality. A large collection of smaller or lesser quality stones are reserved in the laboratories for scientific study.

CUT GEMS

Among the diamonds, mention may be made of a nine carat diamond of velvety blackness, and a series of small stones illustrating the colored varieties.

A series of 22 zircons adequately covers the color range of this variable gem. It includes several fine blue stones from Indo-China, the largest weighing 103 carats, a fine garnet red stone (76 carats), a brilliant golden colored gem (60 carats), and a pale olive green stone (98 carats). Three cut stones of the gamma variety of green color are included, the largest weighing 23 carats.

Large cut gems of spinel appear to be quite rare. A fine ruby spinel weighs 10 carats. Others include an attractive lavender blue (30 carats), amethystine (46 carats), one of clear deep sapphire blue (22 carats) and a deep rubellite pink of 22 carats.

The outstanding topaz gem is a lozenge shaped stone of finest imperial color and quality, weighing 94 carats. This is believed to be one of the finest topaz in existence. A stone of deep rose red color of 18 carats is unusual as an example of a rare natural color. For size a pale aquamarine blue stone of 685 carats is included. A pale blue stone of 44 carats was cut from a crystal mined in Maine.

Among the chrysoberyl gems is an alexandrite from Ceylon weighing 66 carats. This stone is mentioned in Bauer-Schlossmacher "Die Edelsteinkunde" among the famous chrysoberyls. Two other alexandrites weigh 17 and 11 carats, both showing an unusually fine change of color. A large chrysoberyl of 121 carats has the daylight color of the Ceylon alexandrite but does not exhibit the color change in artificial light. Among the Brazilian chrysoberyls is one of clear chartreuse color weighing 46 carats.

Beryl is represented by 41 stones, including American and Brazilian emeralds, aquamarine, morganite, golden beryl, etc. The largest gem in this series is a golden green stone of 133 carats from Madagascar. A number of fine blue Brazilian stones are shown, the largest weighing

125 carats. A good pink Madagascar morganite (56 carats) and a salmon pink California morganite (122 carats) illustrate this color variety of beryl. Fine American stones are from Maine, Massachusetts, Connecticut, North Carolina, South Carolina, and Idaho.

Tourmaline, because of its wide range of color, commands one of the largest series. Outstanding, both for color and locality, is a magnificent green gem from Maine. It weighs 58 carats. Large stones from Brazil and Madagascar run the gamut of the color scale; many of them show interesting dichroic effects. One can gain some idea of the variety of color in tourmaline by noting that of more than 50 examples on exhibition hardly any two are the same.

Seven peridots from the Isle of St. John are topped by a record gem of 310 carats.

Among the unusual stones in outstanding examples are a set of 16 sphenes matched for a necklace, the largest weighing 15 carats. Under the artificial lights of the exhibition halls these sphenes, because of their extreme dispersion, scintillate with the colors of the opal. A benitoite of $7\frac{1}{2}$ carats is one of the first lot of this stone discovered and is also the largest flawless gem of the rare mineral. An azure blue cat's-eye scapolite is one of the two known examples of this rare gem. The new gem brazilianite is represented by two cut stones, the largest weighing 40 carats.

Jade is shown in cabochons or carved pieces of imperial green, apple green, lavender, yellow, brownish red, white, and black colors. A series of jade bead necklaces show a similar color range. Garnets include demantoid, essonite, caruncle, pyrope, rhodolite, and others. Seventy-seven large faceted stones and more than 100 cabochons illustrate the range of the quartz gems.

The lesser gems are represented by

andalusite, apatite, euclase, iolite, phenacite, sphalerite, diopside, willemite, the various feldspar gems, and many others.

Two especially lighted cases supplement the general exhibition series. One is devoted to "phenomena" stone, including the star sapphire "Star of Artaban" of 316 carats. Two star rubies of 34 and 50 carats show the star effect to an unusually fine degree. A small five carat emerald cat's-eye attracts much attention. The second case is devoted to opals. Beside the usual white and black Australian opals, is a series of fine Mexican opals, including the prized "lluvisnandos," so called because they suggest the sunlight shining through a Mexican rain-storm.

Some examples of the use of precious materials in other than gems are also shown. The outstanding example is a huge crystal ball $12\frac{3}{4}$ inches in diameter and weighing 106 pounds. The original crystal is said to have been found in Burma. It is unique, not only for size, but also because it is physically and optically perfect. A masterful sculpture of the head of an Arabian stallion in turquoise on a base of iridescent obsidian, occupies an especial pedestal. It is the work of the well known Swedish-American sculptor, Oscar Hansen.

Unusually fine gem minerals in crystal form are scattered through the mineral collection. Only a few of the more unusual ones will be noted.

Perhaps the best known of these specimens is the so-called "Roebing Opal," the second largest mass of precious opal known. It has the size of about half a brick and weighs 18.4 troy ounces. Its color is pitch black and scintillates with broad flashes of red and green fire. It is from Virgin Valley, Nevada. Another unusual opal is the petrified vertebra of an extinct marine lizard, the plesiosaur. It has the color and quality of good white Australian opal. It is from Australia.

A case of especial interest contains rough American diamond crystals. These include the "Punch Jones" diamond crystal of $34\frac{1}{2}$ carats, the largest alluvial diamond found in North America. It was found in West Virginia. Thirty-two diamond crystals from the kimberlite pipes of Arkansas adequately illustrate the forms from this area. Other crystals are from California, Idaho, Indiana, Kentucky, North Carolina, and Texas.

The collection is unusually rich in fine beryl crystals. A fine hexagonal prism of emerald from North Carolina weighing nine ounces, while not of fine gem quality, is the largest crystal from that locality. There are eight gem beryl crystals, each weighing from one to several pounds. Although of gem quality—some of them are almost entirely flawless—they are selected principally for their fine or unusual crystal development. The collection of topaz crystals, too, is outstanding. It includes a magnificent crystal of 153 pounds from Brazil. A cleavage section of clear topaz weighing 96 pounds is said to have been taken from a crystal seven feet long. A sharp and brilliant crystal of sherry color and weighing $2\frac{1}{4}$ pounds is from the pegmatite mines of Burma. Three long prismatic crystals of imperial Brazilian topaz, while only partially of gem quality, are among the largest of this variety known. A large blue crystal of three pounds is unusual as one of the largest found in North America. It is from Texas.

Many of the lesser gem minerals are represented in outstanding specimens: the largest known crystal of gem wernerite, the finest of the new gem brazilianite, the very rare crystallized turquoise, large flawless kunzite of rich color, a magnificent California tourmaline group, and others.

As one might expect, the exhibition display of gems attracts an extraordinary
(Continued to page 80)

Light . . .

(From page 70)

Radiations are seldom, if ever, encountered or observed as single units or energy or rays but rather as beams composed of many individual rays.

In considering the behavior of light—let us assume that we are dealing with light from a distant source, i.e., the sun. Also, to keep matters simplified, let us neglect for the present the fact that white light (sunlight) is composed of rays of various frequencies, so that we may discuss this light and its elementary problems as a single unit.

Figure 2 tries to illustrate one single ray from such a beam and what occurs when this ray strikes a transparent substance such as glass for example. At the extreme left we have the simplest possible condition, namely: light falling directly upon the surface making an incident angle of 0° with the bounding surface. In other words, it is perpendicular to the plane of the glass. Instantly upon making contact with the solid substance, two things happen to the light ray:

1. Part of the advancing or incident light is reflected back from whence it came.
2. That not reflected actually penetrates the glass but upon so doing its speed or velocity is reduced.

In this particular instance there is no deviation in path direction for either the reflected or transmitted ray. This is unique and should be carefully noted, for at any other angle of contact a ray deviates from its incident path and does not return along its primary path. At the far right the paths of a ray inclined at 30° from the perpendicular is pictured. In the center, this and a larger angled incident ray are shown. It will be noticed that for any one of these the reflected ray assumes a new direction of travel which referred to the Normal (or line drawn perpendicular to the reflecting surface)

makes an angle equal to the angle of approach or, shall we say, the angle of Incidence. This relationship of equality between reflecting and incident angles has been observed to be consistent and so we have arrived at a fundamental optical Law or RULE which says:

"The angle of reflection is ALWAYS EQUAL to the angle of incidence."

Our second basic law may be stated as follows: The Angle of Refraction bears a definite relationship to the angle of incidence which is always equal to the relationship of the velocities of the light rays in each medium. This reads, perhaps, like an extract from a civil or income tax statute, but it really is not so difficult to analyze. Scientific statements of facts which apparently always hold true are often called LAWS. This gives them weight—scares most of us into believing them and accepting blindly, while some of us may even skip reading entirely anything presented as a mathematical truth. Now before a law can become a reality much experimental evidence must have been examined and found to be true. One author suggests that mathematical laws are an obituary notice on a praiseworthy statement.

Let us see what the data regarding refraction really is, and see if we can not find something else to grasp besides a formula which says $v/v' = \sin i / \sin r = n$.

Referring again to the illustration it will be observed that that part of the light which strikes our bounding surface between the air and glass, and is not reflected, changes from its incident path while traversing the substance. This variation in direction was recognized by early experimenters who, though they noted the changes, could not give clear reasons for them. Further, it was seen that with increasing the angle of incidence from the perpendicular or normal, the path change likewise became greater. This relationship of incident and refracted path angles

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Methods of Identification at the U. S. National Museum

by

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U. S. National Museum, Washington, D.C.

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At the U. S. National Museum most gem identification is done with the aid of a single instrument, a polarizing microscope. This type of microscope is widely used in mineralogical laboratories and for purposes of gem identification it may be thought of as a combination dichroscope, polariscope, refractometer, and magnifier. When properly used it is a very versatile and effective instrument. Since this method of gem identification differs somewhat from that employed by most gemologists in this country, it was thought to be worth a description here.

THE INSTRUMENT

The lens system of a polarizing microscope is similar to that of the usual modern compound microscope. The instrument, however, differs from an ordinary microscope in several important respects.

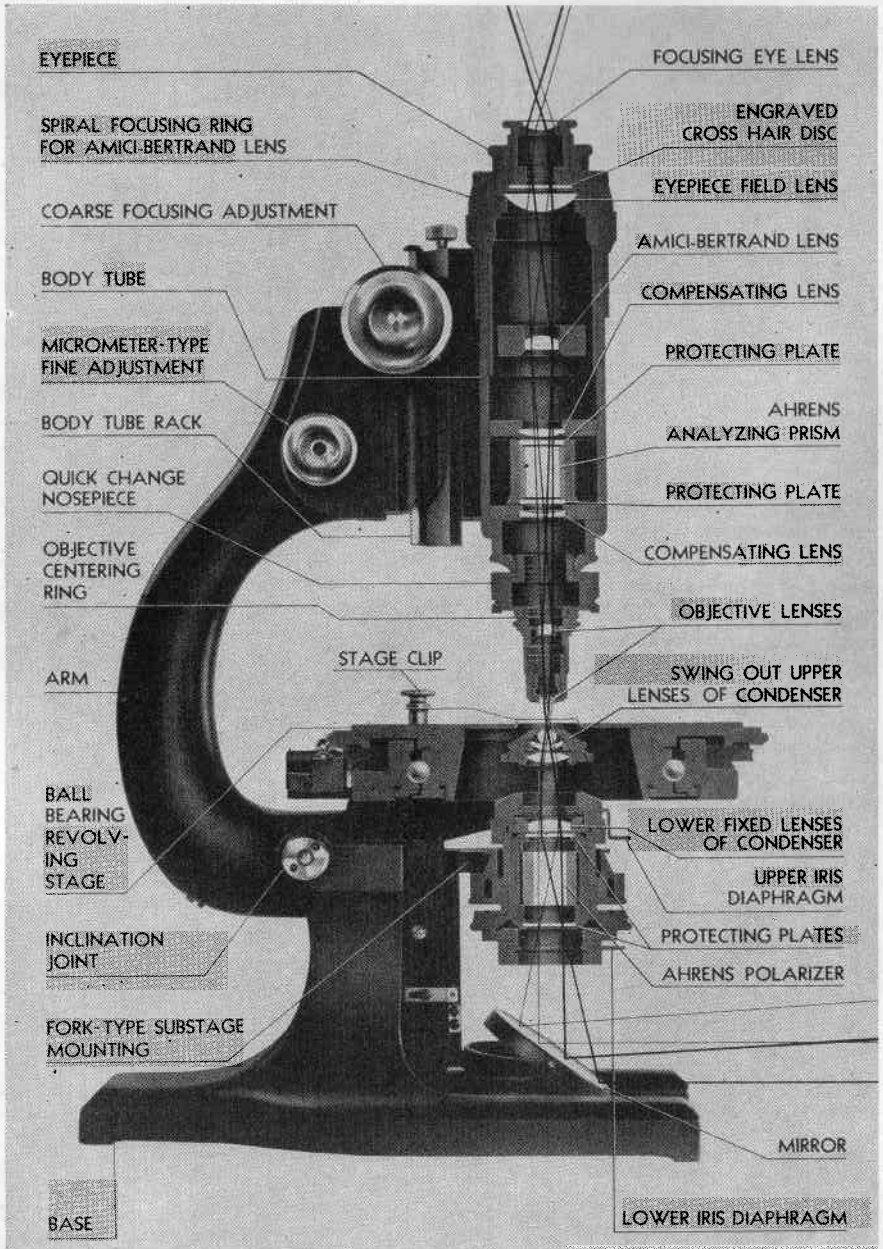
The polarizing microscope is adapted for observation of any substance in plane polarized light, that is, in light which is vibrating in a single plane. This is accomplished by placing in the substage assembly (See figure 1.) of the microscope a calcite prism known as the analyzer. The analyzer is adjusted so that the only light which can pass through it

must be vibrating in a plane at right angles to the plane of the polarizer. The analyzer is mounted on a slide so that it can be inserted into, or removed from, the optical system of the microscope at will. A calcite polarizing prism is often referred to as a "nicol" prism since it was invented by W. Nicol in 1828. Hence, when the analyzer is in position in the body tube of the microscope a condition exists which is usually referred to as "crossed nicols."

The stage of a polarizing microscope is circular and so constructed that it can be rotated about a vertical axis. A series of quickly interchangeable objectives and eyepieces are provided which give magnification ranging from 16x to 460x. An additional feature of a polarizing microscope is a supplementary lens called the Amici-Bertrand lens, which can be inserted or removed from the optical system at will. The function of the Bertrand lens is to enable interference figures to be observed.

EXPERIMENTAL TECHNIQUE

The polarizing microscope can be used most readily for gem identification on unmounted gems, although it is possible to work with some mounted stones. A



Courtesy American Optical Co.

stone is best examined under the microscope by first immersing it in liquid in order to reduce surface reflection.

The stone is placed table down in a small flat bottom glass dish, which can be made by cutting off a flat bottom glass vial of appropriate size. Enough of a suitable liquid is then poured over the stone to completely cover it. This liquid should have a refractive index near that of the stone for best results. It is best to have a series of standard liquids having refractive indices as follows: 1.54, 1.58, 1.62, 1.64, 1.72, and 1.76. These liquids can be purchased already standardized, or can be prepared by following the directions given in most textbooks on optical mineralogy.

The dish containing the unknown gem plus liquid is placed on the stage of the microscope, and without again touching the stone it is possible to determine dichroism, single or double refraction, approximate refractive index, and nature of inclusions, all within one minute or less. In the majority of cases the information thus gained is sufficient to positively identify the gem.

USE AS A DICHROSCOPE

The stone under examination is placed in a dish of liquid and rotated by means of the revolving stage. Examination is made in plane polarized light supplied by the polarizing prism in the substage, the analyzer being pushed to one side in order to remove it from the optical system. If the gem is dichroic it will show its characteristic color change as the stage is rotated.

If a substance is dichroic it is only because it is doubly refractive. Hence, if dichroism is noted it is known at once that the gem is doubly refractive. If dichroism is not seen, however, it may be due to one of two reasons: (1) the gem is singly refractive, or (2) it is doubly refractive but so oriented that an optic axis is perpendicular to the stage of

the microscope.

Normally dichroism is shown only by gems having a fairly strong body color. This is especially true when this effect is observed using an ordinary hand dichroscope. The polarizing microscope, however, due to the fine quality of its optical system, is a very sensitive dichroscope and a color change can be observed in many gems which cannot be detected with an inexpensive hand instrument.

USE AS A POLARISCOPE

The polarizing microscope is converted by the flick of a finger from a dichroscope to a polariscope by inserting the analyzer, or upper polarizing prism, into the optical system of the microscope. In this position of "crossed nicols" the stone is further examined by rotating the microscope stage. If the stone becomes alternately light and dark four times in a complete revolution of the stage it is known to be doubly refractive. If it remains dark as the stage is rotated it is singly refractive, unless the stone happens to be in a position such that an optic axis of a doubly refractive gem is perpendicular to the microscope stage. If the first observation indicates single refraction the gem should be turned over with a pair of tweezers so that it is lying on a pavilion facet, and the test repeated.

The polarizing microscope is a more effective polariscope than an ordinary hand polariscope, not only because of its finer optical system, but because immersion of the stone in liquid eliminates confusing surface reflection. The anomalous double refraction of synthetic spinel is brought out especially well under a polarizing microscope.

MEASUREMENT OF INDEX OF REFRACTION

Index of refraction of a cut gem may be conveniently measured with a polarizing microscope using the immersion method. In this method the gem is tried successively in a series of liquids having

known refractive index until a liquid is found which matches the gem. While this process may sound cumbersome, for routine identification work it may be done very quickly, as explained below.

The set of standard liquids mentioned earlier is used. One of these liquids is poured into the glass dish so as to cover the stone. If the refractive indices of the liquid and gem are the same, or nearly the same, the stone "disappears" in the liquid, and the facet edges, when viewed through the microscope, are practically invisible. An additional test is made by partially shading the stone with a card inserted between the polarizer and mirror. If the index of refraction of the stone is the same or very near to the liquid one edge of the stone will become blue and the other red. If the liquid has a higher index than the gem, the side of the stone away from the card will become dark and the side toward the card light. The opposite effect is observed if the liquid has a lower index than the gem. This test is known as the inclined or oblique illumination test.

If the liquid selected the first time was not the correct one, it is possible by means of the inclined illumination test to immediately tell whether the liquid is too high or too low. A second liquid is then selected and the test repeated. It is possible, with experience, to select the proper liquid on the second attempt unless the stone is something unusual. When changing from one liquid to another, both dish and gem must be carefully cleaned in order to avoid contamination of one liquid with another. This can be easily done by washing with a little acetone and wiping dry.

USE AS A MAGNIFIER

Examination of characteristic inclusions in the gem may be carried out simultaneously with the tests previously described. The inclusions are clearly seen since immersion of the stone in liquid eliminates troublesome surface reflection.

The wide range of magnification available (16 to 460) is advantageous when dealing with fine quality synthetics. Curved stria in synthetic corundum show up well in a stone immersed in liquid, especially if the amount of light being transmitted through the gem is reduced by closing down the size of the iris diaphragm in the substage of the microscope. Other types of inclusions, such as bubbles in synthetics or glass, and crystal inclusions in genuine stones, are brought out very clearly.

Objectives of high power have very short working distances. Therefore, only inclusions near the surface of a gem may be studied under high magnification, the remainder of the gem being out of focus. With objectives giving magnifications of 30x, 60x, 100x, and 230x, however, it is possible to examine the entire stone if it is not unusually large. Care must be exercised not to mistake air bubbles trapped against the surface of the stone for inclusions within the gem. This is true, also, for bubbles that are commonly present in the bottom of the glass dish holding the stone. These sources of error are quickly eliminated with experience.

INTERFERENCE FIGURES

A polarizing microscope may be used to observe interference figures by inserting the Amici-Bertrand lens into the optical system. In general this test is not easy to make since interference figures can only be obtained when a gem has a special orientation, which it is very unlikely to have when lying table down. It is possible to turn the gem about in the liquid so that it lies on various facets and obtain an interference figure. This requires considerable time and patience, but fortunately is seldom necessary.

CONCLUSION

The method of gem identification outlined in the foregoing pages has certain advantages and disadvantages. The ad-

(Continued to next page)

New Color Alteration Fraud Becoming Common in Jewelry Trade

by

LESTER B. BENSON, C.G., F.G.A.

G.I.A. Laboratory Supervisor

A new and particularly effective coating method came to the attention of the Gemological Institute recently. Two zircons of a fine blue color were sent to the G.I.A. laboratory for examination. Examination revealed that they had a coating apparently similar to that used on lenses to reduce surface reflections. While such a coating can improve the color of a gemstone significantly, it reduces the brilliancy of zircon materially because the critical angle between zircon and the film is much larger than the zircon and air critical angle.

The thin film which covers the stone is exceedingly resistant to most solvents. It failed to react to alcohol, acetone, carbon tetrachloride and several acids. However, upon boiling for ten minutes in aqua regia, the film was attacked sufficiently to make it possible to scrape it off with a fingernail. The stone so treated was found to have a very pale color in contrast to the deep beautiful color before the coating was removed. It has not yet been possible to attempt to analyze the coating, which has been called fluoride elsewhere.¹

Such a coating is identifiable by the slight iridescence and dulled luster it imparts to the facets over which it has

¹"Fluoride used to doctor Gemstones" in *National Jeweler*, September, 1948, p. 316.

been spread. On the zircons examined at the G.I.A. laboratory, only the pavilion facets of the stones were so coated.

Identification . . .

(From page 78)

advantages may be summarized as follows: (1) a polarizing microscope is four instruments in one, dichroscope, polariscope, refractometer, and magnifier; (2) the various tests can be performed very quickly without transferring the stone from one instrument to another; (3) inclusions may be examined under very high magnification. Some of the disadvantages are: (1) the high initial cost of a polarizing microscope; (2) immersion of the stone in liquid is troublesome; (3) mounted stones, especially if the mounting is large, are difficult or impossible to handle by this method.

Light . . .

(From page 74)

is shown for various angles of incident light; namely 30° and 60°.

Just what percentage of the incident light energy which falls upon the bounding surface of the glass and is reflected and what percentage is refracted will be discussed later as other matters concerning the behavior of light are advanced.

(Continued to page 81)

The Monoclinic System

The monoclinic crystal system is characterized by a lower degree of symmetry than the four previous described in this publication. This results in the development of crystals whose appearance is unsymmetrical with respect to a horizontal plane. Simplest mathematical relations are obtained when such crystals are described by choosing axes of reference parallel to prominent edges of the crystal. As a result monoclinic crystals are assigned three axes of reference having two right angles of intersection and one angle not a right angle. The relative lengths of the three axes are all different.

The gemstones that crystallize in the monoclinic system are azurite, brazilianite, diopside, euclase, orthoclase (preci-

ous moonstone), gypsum, jadeite, nephrite, lazulite, malachite, serpentine, sphene, spodumene (kunzite and hiddenite) and talc. With few exceptions most of these may be classed as unusual gems.

Orthoclase, jade (nephrite and jadeite) and spodumene are the most common of the monoclinic gem minerals. A rough specimen of kunzite, as well as a cut stone, is shown in the color plate. Cut stones of green and yellow spodumene are also shown. Jadeite and nephrite are never found in large single crystals but are made up of a fine interlocking aggregate of very small crystals, hence the extraordinary toughness of this material.

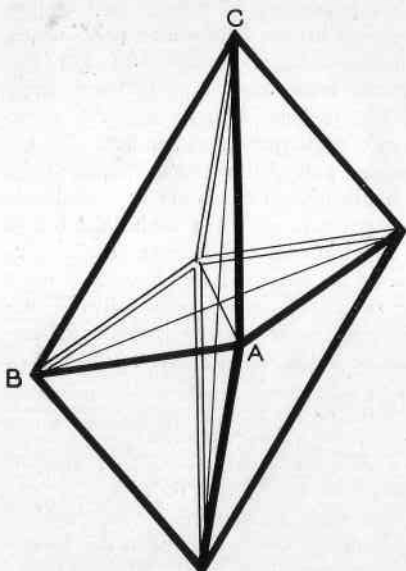
Many of the rare or little used monoclinic gems possess unusual beauty and merit more attention than they receive. Sphene is a good example of this, for here is a gem having a dispersion greater than diamond and a refractive index of slightly less than that of diamond. Hiddenite, the green variety of spodumene, is another very beautiful gem but its rarity makes it a collector's item.

Brazilianite is one of the most interesting of the monoclinic gems for it was first discovered in Brazil in 1945. This mineral has been cut into a number of fine, transparent, greenish yellow stones, one of the largest of which (40 carats) has recently been added to the gem collection of the Smithsonian Institution.

U. S. National Museum . . .

(From page 73)

amount of interest from the visiting public. The scintillating variety of color, luster, and shape makes a deep impression on most visitors and is, no doubt, an important factor in arousing an interest in precious stones.

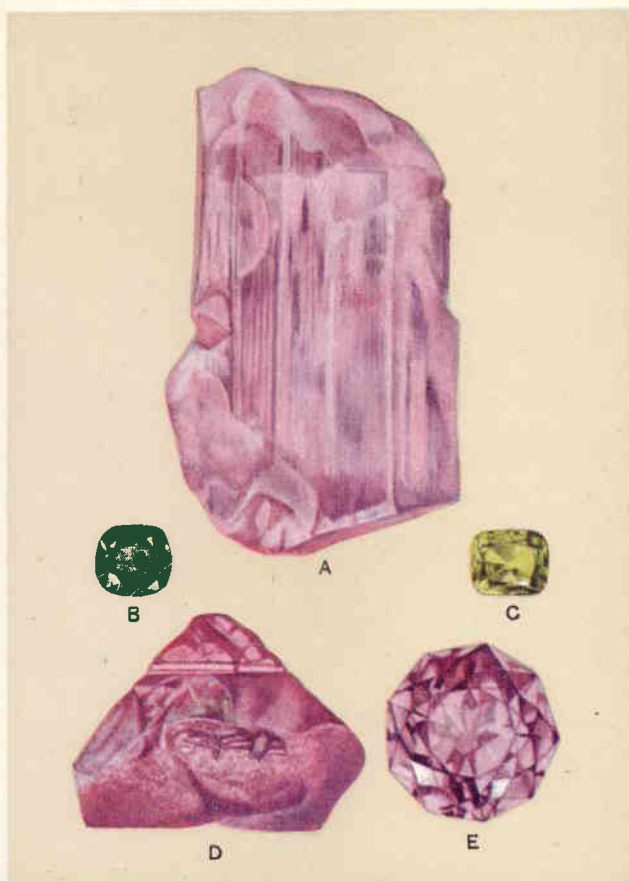


Monoclinic System: A perpendicular to B and C. They are not perpendicular to each other. All unequal.



CRYSTALS: MONOCLINIC SYSTEM

Figure (A) is an illustration of a lazulite crystal. This mineral is rather soft and although not popular as a gem is often cut for collectors. Lincoln County, Georgia. The mineral licroconite from the St. Day United Mines, Cornwall and crocoite from Dundas, Tasmania, although not durable enough for gem purposes are in demand by collectors because of their excellent crystal form and color. Specimens from the collection of British Museum (Natural History), London.



SPODUMENE

Figures (A) and (D) show a Kunzite crystal from two positions with distinct pleochroism easily visible. A fine Hiddenite from Alexander County, North Carolina, is shown at (B), and at (C) a yellow Spodumene from Brazil. The large fashioned Kunzite (E) comes from California. Although fragile, these stones have been popular because of their exceptional color. Specimens from the collection of British Museum (Natural History), London.

Light . . .

(From page 79)

Let us now consider **Figure 3**, and assume the three lines coming from a distant source "S" represent a beam of light whose rays are parallel. B B' is the boundary surface of a piece of glass ($N=1.537$). The incident angle is 60° . The light striking the surface will, as said before, suffer two changes.

1. Due to reflection whereby its direction of travel will be altered.

Now rays OA, OC, and OD are incident upon plane B—B' at pts A, C, and D respectively. Upon striking the bounding surface, part of these rays are reflected toward O' as rays OA', CO', and DO'. Construct line AEH parallel to the incident rays at the point A. This will represent the wave front at the instant ray OA arrives at surface B—B'.

Perhaps it would be well to mention at this point that light rays composing a beam progress uniformly from their origin. Any point upon one ray will have a corresponding point upon another which will be equi-distant from the source and will also have its motion or vibration in absolute harmony with any other. All points across the beam fulfilling this requirement are said to produce a wave-front. This front is perpendicular to the line of propagation. The line AEH represents by construction such a WAVE-FRONT.

Now, part of the ray OA striking at A is reflected instantly towards O'. However, ray OC still will be traveling in its incident direction and will continue to do so until it strikes the surface B—B' at the point of C. During the time required for the ray OC to reach C the reflected ray AO' will have reached the point G. Since no new medium has been encountered or traversed and we are still dealing with light traveling in air, no speed alteration will be observed. The same

development may be applied to the ray OD and its point of reflection at D. A new wave-front may be produced at D perpendicular to the reflected rays and will be shown in the line DJF. The new beam will then continue at its primary velocity having only its direction changed. The angular requirements are equally filled, for angle of incident and reflection are each 60° .

The matter of phase of the incident and reflected beams will be taken up with polarization a little later in our discussion.

The second portion of our change occurring when the beam strikes B—B' and is not reflected will cause refraction. At each point of ray contact with the surface B—B' a new series of vibrations will be instigated. These vibrations will travel with less velocity than those in air. Without too much detailed demonstration—assume that ray OA striking B—B' travels to the point N while E travels to C. Similarly C will advance to M while H arrives at D. Again then ray OA traveled in glass from A to L while H was advancing in air to the point D. Ratios of speed may then be set up.

For example:

$AL/HD=N$ in air/ N_1 in medium
Then by measurement $AL=4.7''$ & $HD=7.0''$

$$4.7/7.0=1/N_1$$

$N_1=7.0/4.7=1.49$ for index of medium

This agrees with 1.53 the published index when the accuracy of the drawing is taken into account.

This Index of Refraction is not an abstract number for it is, when analyzed, a ratio of the velocities of light in air and in glass. This is to say light travels $\frac{2}{3}$ as fast in glass as it does in air. In round numbers this would mean that were light traveling 300,000 kilometers per second in air, it would cover only 200,000 kilometers in the same period of time in glass.

¹ Physical Optics, Robert W. Wood, Macmillan Company, third edition, 1934.



Behind the Scenes in Jade Street

by

CALVIN JOYNER

The center of the jade carving world lies in Peking, where the Tatar and Chinese quarters of the ancient capital meet at the massive Chien gateway.

Inside the gate are the Forbidden City and the Legation Quarters. Outside sprawls, in a tangle of twisting streets and knotted alleys, the most alluring of all shopping districts.

Each lane has its specialty. Lanterns, fans, brassware, books, cloisonne, silk,

On opposite page a nephrite boulder is being sliced with a twisted wire bowstring and carborundum powder. The apprentice, in the center, is applying the wet abrasive. The boulder is being roughed out in preparation for carving it into a large bowl.

silver, ivory, gold and jade, each to its kind, are set out to tempt all China and half the Western world.

Most fabulous of all is the straight and narrow way called "Jade Street." For half a mile it stretches, lined with tiny shops each lined with great fortunes of magnificent jade. Other precious stones are seen in curious carvings, but jade is predominant.

In the windows and on the shelves are vases and bowls, wine jars and jewel cases, flowers and trees, men and gods, thin bangles for earrings and fat rings for the thumbs of aristocratic Manchu archers, ceremonial symbols and altar

Photography by Calvin Joyner

Peking, May 1929

vessels, scepters for emperors and fan handles for their empresses and concubines, things ancient and things modern, all carved from jade.

Jade in every color, brilliant green, gem jadeite from Burma, dull gray nephrite from Sinkiang, and whole catalogues of other shades and colors.

Behind these tiny stores are the work shops where these lapidary miracles are wrought and only the jade workers and a very few of the initiate ever gain admission. Here Mahometan Chinese workmen cut and carve precious jadeite from Burma and tough nephrite from the Kuen Lun mountains of their ancestral Chinese Turkestan (Sinkiang Province).

For centuries before Burmese jadeite was known in China, the nephritic jade of Sinkiang was carved for the Emperors of China by Moslem artisans of that province.

The tradition still holds today. The miners who dig the stone from the Kuen Lun range, the divers who "fish" for water worn pebbles and boulders, the herders who bring jade down the moun-

tain sides loaded on ungainly yaks, the camel drivers, lapidaries and jade merchants were all Moslems in the early days.

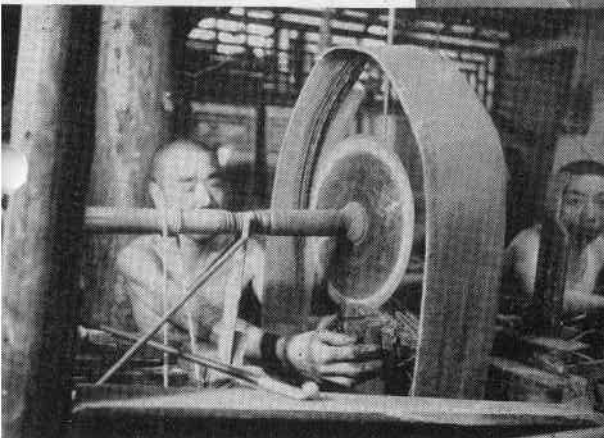
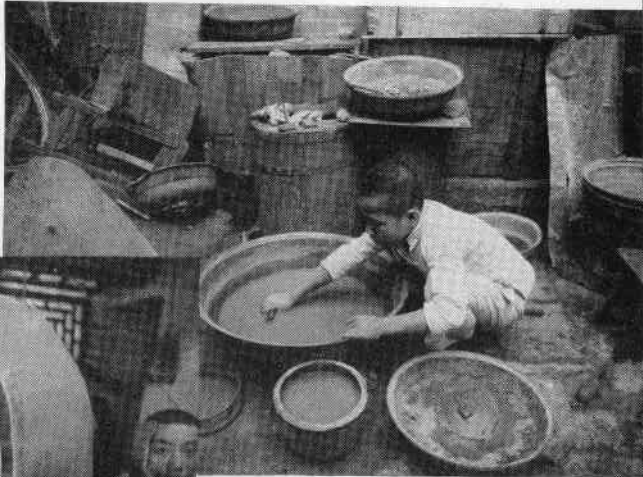
Brought to the Chinese capital by the Emperor Chien Lung, the shop owners and lapidaries of Peking continue to acknowledge Mohammed. They also adhere closely to the methods and tools of their ancestors.

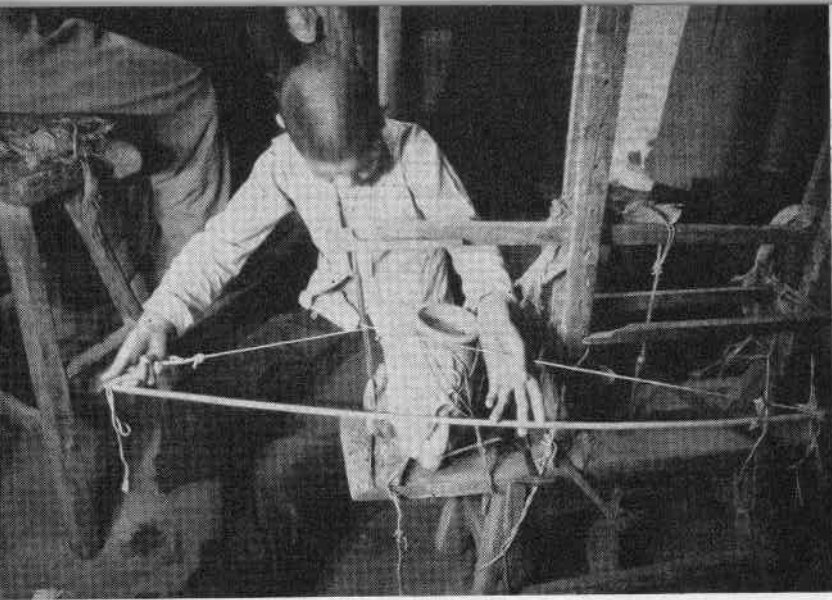
An American lapidary accustomed to electric power, fast cutting wheels of modern abrasives, diamond charged saws, and a variety of polishing compounds, looks with disbelief at the crude foot-driven lathes on which the most intricate and precious carvings are made. In keeping with the elementary lathes are the methods used in slicing large blocks of the tough materials.

A twisted iron wire bow string, strung on a bamboo bow, is dragged back and forth across the jade boulder by two patient workmen while an apprentice applies emery powder and water on the cut. A cut four or five square feet in area requires two men and a boy thirty or forty days to complete.

Carborundum is not unknown but as the owner of a leading shop said to the

At the right the youngest apprentice washes and regrades the abrasive. In the right background two iron bowls rest on a large block of green jade. Below, a base is being shaped for a jade lantern. The weight is carried by a pulley and cord. The pulley and counter-weight do not show in the picture.





The handles for a yellow jade vase are being drilled out by a young apprentice in Peking's Jade Street.

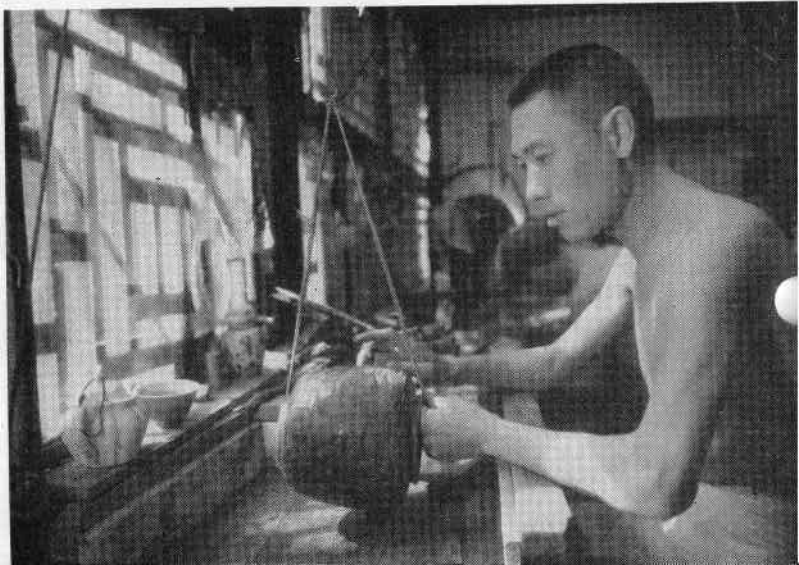
writer, "Yes, they could use carborundum, and finish it in a few days, but what would they do with the time saved? I feed them, house them, and have to keep them busy; if not they will go to some other jade shop. Besides," with a Chinese shrug of the shoulders, "there is just so

much jade to be had, and it takes months and years to get a big boulder down from Sinkiang, so why save time?"

Time is expendable in Peking!

All of the emery, and the occasional carborundum, is saved and apprentices wash it out in iron bowls, regrading it

The shade of a green jade lantern nears completion. Fine details of the carving are being touched in with a small drill head which appears just below the carver's forefinger which is covered with carborundum.





Finishing an elaborate pink coral goddess mounted on a Chinese unicorn or "Ch'i-lin." At the left are a number of spindles with assorted cutting heads.

by settling it out in wash after wash of fresh water.

Smaller cuts are made with soft iron discs driven by the foot-powered lathes.

In a typical jade working shop of a wealthy jade merchant, can be seen as many as twenty-five master workmen

bent over their lathes working by yellow electric light. Their feet drive pedals connected to leather straps which are wrapped in several turns around iron spindles. With each down stroke of the pedals the spindles reverse, back and forward, back and forward.

Hollowing out the stem of the lantern. In the left foreground appears the back bearing-block of the lathe. It is honeycombed with bearing holes.



Jade Street . . .

In front of each workman is a set of spindles of varying weights, with a variety of cutting discs. The leather strap is easily slipped off and on to exchange spindles.

A species of line production is the custom. Heavy slicing is done by ordinary workmen and beginning apprentices, rough carving by more advanced apprentices, fine detail carving by the master carvers, preliminary polishing by apprentices, and finish polishing by experts, but all use the same primitive tools.

The first polishing steps are performed against discs of thick gourd rind cemented to the ends of the removable lathe spindles. The gourd is charged with native iron oxides. Finer polishing for gem quality jadeite is done on composition wheels made of glue, rosin, linseed oil and jeweler's rouge.

In the finer steps of carving and polishing, the cutting or polishing agent is usually applied directly to the jade under treatment by the forefinger of the artisan. After every few strokes of his lathe, he stops, closely examines the work and after making necessary adjustments of lathe, jade, or polish, he proceeds.

Large, or very delicate and fragile pieces of work are normally suspended over the lathe from a line through a pulley and balanced by a counter weight. This lessens danger of breakage and makes the piece more maneuverable for delicate carving.

Pierced work, handles of vases, and other small holes are accomplished by use of a simple bow drill in the skilled hands of a fourteen or fifteen year old apprentice.

The designs are traditional, and are taken from catalogs of soft paper wood prints which hang from strings on the wall near the master designer's table. But they are only raw material: the draftsman thumbs through the pages until

he finds a design suitable for the color and shape of the jade in hand. Then he makes changes to suit the piece of jade and sketches out the barest outlines with a brush dipped in Chinese ink.

After the blocking out cuts are made, the piece is brought back for a few more strokes of the brush, and then the details are left to the carvers. Their free hands make certain that no two pieces of Peking carved jade ever will be exactly alike.

The designer has the most responsible place in the shop. Jade varies remarkably in color and quality, even in small pieces, and he must use his creative imagination to achieve artistic economy in laying out the designs.

He adapts the designs to save material and labor, to make the best use of color, and to arrange the necessary piercing so that it removes inferior material as far as possible and so increases the value of the remainder.

When a large piece of fine material is available the shop owner usually reserves it until he can persuade some wealthy patron to commission a special piece. Then the designer spends days and weeks, with the customer, over endless cups of tea, deciding on the work to be performed.

However, most of his work is done for stock and when finished goes to join the thousands of pieces which decorate the shops of "Jade Street."

Other Contributors . . .

Since Dr. Foshag and Dr. Switzer are old contributors and well known to readers of GEMS AND GEMOLOGY, we have not repeated biographical sketches in this issue. Dr. Foshag is Head Curator of Geology at the Smithsonian Institution, while Dr. Switzer is Associate Curator, Division of Mineralogy and Petrology. Both are on the Editorial Board of this publication, and Dr. Switzer is Secretary of the Examinations Board of the Gemological Institute of America.

Gemological Digests

Since the day the earliest primitive ancestor accidentally stepped upon a bright shining pebble, half concealed in the sands of an ancient stream bed, diamonds have been one of the most wanted material possessions of man. Both as ornaments of beauty, and as durable objects of worth, their desirability has increased with the passing of the centuries.

World War II may be credited with being a contributing factor to the noticeable boom in the diamond market during the past few years. Not only were there more potential customers for the diamond of gem quality, but the diamond became an essential component in the industrial field, with its wide range of duties ever widening.

With the constantly rising standards of living during the current century, with the increased earning power of the average working man, and with the introduction of the diamond as an important industrial tool, there has come a fear in some quarters that the time may come when supply cannot meet demand.

While it is true that the available reserve of diamonds is not inexhaustible, yet their decline on the market is not viewed with alarm in informed circles.

In order to keep our readers informed of the true conditions in the diamond market, reports of current happenings concerning diamond sources, production, and markets will be added to Gemological Digests in this and future issues of GEMS AND GEMOLOGY.

Sir Ernest Oppenheimer Reports on De Beers

LONDON: Reviewing the activities of the De Beers Consolidated Mines, Ltd., for 1947, Sir Ernest Oppenheimer reported the total sales of diamonds as 24,478,000 pounds, including 4,377,000 industrials. Sales for the first half of the current year were given as approaching 22,000,000 pounds, including 7,000,000 pounds industrials.

Sir Ernest expressed the belief that the demand for diamonds is on as firm a basis as at any time, and that it is justifiable for the industry to look at the future with some confidence.

According to the *Financial Times*, plans have been made to increase the output from Consolidated Mines fields during this year, with an extensive scheme of mechanization undertaken.

Developments at The Premier Mine

The work of re-equipping Premier Mine has made good progress, but productive operations are not expected to begin until the end of 1949. Inability to obtain necessary machinery is given as the greatest hindrance to getting into production earlier.

There has been, however, a small experimental "pilot" plant in operation since August, 1947. This has made possible a small monthly production from

Gemological Digests

the mine.

Experimental treatment of the blue ground in the heavy media sink and float concentration plant has proved to be a satisfactory method of extraction and, pending full-scale production, operations at this plant will be increased up to three shifts per day.

Jagersfontein Delay Parallels Premier

Serious delays in the delivery of materials, and inability to acquire needed equipment, is blamed for the delay in re-opening the Jagersfontein Mine by the De Beers Company.

At this mine underground development work is well advanced and it is said mining and hoisting operations could be resumed at short notice. However, it is believed that it will possibly be the end of next year before operation of the mine can be established on a productive basis.

Tanganyika Gets 10% World's Diamond Sales

Contracts signed by Tanganyika producers guarantee exclusive sales to the Diamond Trading Corporation until the expiration of the contract December 31, 1951. In turn, one-tenth of the world's total diamond sales have been guaranteed Tanganyika. Of this total the Williamson mine will get 93% which will amount to approximately 3,000,000 pounds.

Second largest mine in East Africa, the Bohimba, is now also controlled by Dr. Williamson. The territory is being sur-

veyed by highly skilled geologists, not only for diamonds but for other precious stones and minerals.

Needed equipment has been a hindrance to production at the Williamson mines from the beginning but recent government assurance of the fullest support in obtaining requirements should produce results in the output.

Priority has also been given to 100 miles of barbed wire, urgently needed to prevent the continuation of large scale theft of diamonds from the Williamson mines.

Williamson Praised For Overcoming Obstacles

Under Secretary of State for the Colonies, D. R. Rees-Williams, while in London, praised Williamson Diamonds, Ltd., for the advancement made in the development of the mines in East Africa.

"It is astonishing to think," he said, "that Williamson Diamonds, Ltd., reached a production of a million pounds' worth of diamonds a year from their mine at Mwadui, near Shinyanga, Tanganyika Territory, without any modern machinery. Indeed, even at that state the mine was still relying almost entirely on what Dr. Williamson has made with his own hands.

"His is an outstanding case, not only of praiseworthy pertinacity in prospecting until he had discovered the diamond pipe, which his geological training, experience, and deductions convinced him as existing in that area, but of refusal to be beaten by the impossibility of obtaining urgently needed equipment."

(Continued to page 93)

Australian Association Issues Gemological Diplomas

"In the world in which we are now living, the value of expert knowledge will be very highly valued, possibly more than those of the ordinary utility man. By obtaining expert gemological knowledge many men and women will rise from the ranks to trade leadership due solely to knowledge they possess in the gemological fields."

So spoke Dr. D. B. Mellor, President of the Gemmological Association of Australia on July 22 when for the first time in that country diplomas were presented to students of gemology.

The founding of the Gemmological Association of Australia took place in 1945 with Federal Secretary Jack Taylor, Federal Chairman A. E. Toombs, and Arthur A. Wirth largely responsible for its instigation and growth.

In addressing the 15 successful students who received the Fellowship Diplomas, Dr. Mellor explained quite simply that the Gemmological Association of Australia is endeavoring to educate the public in gemstone lore and through such education ultimately achieve protection ethically, culturally, and commercially.

"Very early in the history of the Association it was realized that something would have to be done in the way of supplying professional training to aspiring gemologists," he stated. "Professional training is usually given by some institution: The University grants degrees in medicine, etc.; the Technical College for architecture and chemical engineering. As no institution provided courses in gemology, the Association wisely set about providing its own courses and training. So successful were the New South Wales efforts, and apparently so great was the

need for this kind of training, that branches of the Gemmological Association were soon founded in other states of the Commonwealth—in Victoria, in Queensland, and in South Australia.

"In the beginning of 1947 it was realized that something would have to be done to put matters on a sound federal basis. The association first formed in New South Wales was the Gemmological Association of Australia so that there was no New South Wales branch. The executives of the different state branches and the parent branch duly set about putting this in order and subsequently got everything on a perfectly satisfactory basis. We now have a New South Wales branch of the Gemmological Association of Australia."

Speaking on the value of diplomas, Dr. Mellor said, "First and foremost a diploma is a certificate of professional competence. It will have most meaning to the Fellows and other gemologists because they, rather than the public, will understand the nature of the training that the holders of diplomas have gone through and the standards which they have attained.

"In addition to being a certificate of professional competence a diploma, one hopes, stands for something more. It is important that the Gemmological Association should see to it that nothing but the highest ethical standards are maintained by the diploma holders.

"In this day and age we are all in the hands of experts at some stage or another. No man has either the time or the knowledge to be an expert in more than two fields at the most. If we have

(Continued to next page)

Variations in Opals

by

VIRGINIA V. HINTON, C.G., F.G.A.

Every gemologist will have stones presented for identification, or will acquire stones for his collection, that will prove puzzling and will put one on one's metal. Such stones may often take a lot of careful study. It will be remembered that authorities give opal a specific gravity of 1.95 to 2.3 with a refractive index of 1.40 to 1.46 and a hardness of 5.5 to 6.5.

While in California three years ago I purchased a very bright translucent opal of a honey color that had a brilliant play of color resembling red and green spangles. These spangles were close and made a very pleasing stone. The origin of the stone was in The Last Chance Canyon in the Sierra Nevada range of California. Last Chance Canyon is in Kern County on the easterly side of the range facing part of the Mohave Desert and the Death Valley Country, extremely arid sections with a rainfall of 0" to 10" a year.

While in California, which has a rather dry climate, I got a lot of enjoyment from this stone, but on my return to the Gulf Coast section of southeast Texas, with a rainfall of 50" to 60" a year, and a humidity on clear days often as high as 85% to 95%, imagine my dismay when this stone became a milky white opaque, without any fire. Soaking in olive oil would revive the translucency for a few days but with almost no fire. Southeast Texas has had the driest two years known and the opal has been back to its original beauty during this time. As we know, opal is quite porous and this was proved by the action of this stone and also by the use of a petri cup and

a few grains of calcium chloride which produced artificial dryness. This opal has a s.g. of only 1.89, the r.i. is 1.44 to 1.45, and a hardness of about 5.5. Fluorescence under 2500 AU. light is very strong green, and under 3650 AU. light is dirty white and cloudy. You may not have an opportunity to see such changes in an opal but if you do, don't be surprised.

Oliver Cummings Farrington in his book "Gems and Gem Minerals" speaks of opals losing and regaining their color but does not give any reason.

Generally, the more transparent opals fluoresce more strongly than the black or more opaque stones. Phosphorescence is not unusual. The spectroscope gives a prompt identification as the entire blue end of the spectrum is blotted out.

Some interesting experiments have been made on opals with ultra violet light as shown on the next page.

Australian Association . . .

(From page 89)

a legal question we place ourselves in the hands of a legal advisor, or if we wish to draw plans for a house we go to an architect. Now in so doing we cannot feel satisfied unless we have faith in the expert to whom we commit our affairs. This faith rests not only in a belief that the expert is professionally competent, but also that he is an honorable person. A gemologist must not only know how to distinguish between real and synthetic gems, but he must also be prepared to tell the truth to the person seeking his advise.

(Continued to next page)

Table Showing Variations in Opals

KIND OF OPAL	2500 AU. GERMICIDAL TUBE	3650 AU. 15 WATT BLACK LIGHT TUBE	2500 AU. COLD QUARTZ TUBE
California Opal (mentioned above)	Very Strong Green Spangles Show	Dirty White, Cloudy No Fluorescence	Dirty White, Cloudy
Virginia Valley, Nevada	Light Green	No Fluorescence	No Fluorescence
Australian	Milky Green Light Phosphor. Green	Milky White Moderate Phosphor. Green	Milky Green Light Phosphor. Green
Australian	Very Light Green	Blue-White	Blue-White and Green
Hungarian	Very Light Green	Milky	Milky
Mexican Light Orange Cherry	Medium Green None	None None	None None
Common Opal	Strong Yellow Green	Very Strong Yellow Green	Very Strong Yellow Green
Opalized Wood	Dark Yellow Green	None	None
Imitation Opal (Europe)	Shows a fluorescence but not typically Opal. It seems to show up the material used in the imitation.	None	None

Australian Association . . . (From page 90)

"The good name of the Fellowship of the Gemmological Association will only be built up over long years of straight dealing with the public. The process will be something like building up the goodwill of a business. It is most important

that the good name and high ethical standard and reliability of the holders of the diploma be thoroughly established, for without these the diploma will have little value. *You must have both high ethical standard and high order of professional competence.* Neither is of much use without the other. The two must go together."

Miniature Portraits from the Huntington Art Galleries

One of the really fine collections of jewel mounted English miniature portraits is housed in the Henry E. Huntington Library and Art Gallery, San Marino, California.

Early in the 16th Century, when these portraits were first introduced, they were used on illuminated manuscripts and documents. Later, they appeared as separate portraits in miniature.

Shortly after the middle of the 18th Century, with augmented activity in all the arts, the number of painters of this type of work increased amazingly. At the same time the miniature portrait took on a romantic significance, and became a coveted article of jewelry. The new miniature was enhanced by the opulence of its mounting—gold, enamel, diamonds, and pearls. The Huntington collection is representative of the last brilliant period of miniature painting in England and

numbers more than 100.

Shown on our cover is a likeness of the Hon. Mary Monckton by George Engleheart (1750-1829). This jeweled treasure is painted on ivory, $2\frac{1}{2}'' \times 1\frac{3}{16}''$, with a diamond and enamel mount in crossed ribbon design.

Shown at the bottom of the page are, left to right: The lovely likeness of the Countess of Seafield as painted by George Engleheart. On ivory, $1\frac{15}{16}'' \times 1\frac{9}{16}''$, the floriated mount—topped with a coronet—has a complete circling of rubies with brilliant-studded leaves. The second shows Lady Louisa Manners by Richard Cosway, R. A. (1742-1821). This, too, is painted on ivory, $2\frac{1}{2}'' \times 2\frac{1}{8}''$, and is exquisitely circled with diamonds. The last, by Peter Paillou, is named simply "Portrait of a Lady" and was exhibited in the Royal Academy (1786-1800). Its filigree mount is encrusted with brilliants.



Courtesy Henry E. Huntington Library and Art Gallery

Book Review

DIAMOND TOOL PATENTS II—Diamond Abrasive Wheels. Edited by P. Grodzinski, A.M.I. Mech. E., 55 pp., 2 tables, 1 appendix, name index, Industrial Diamond Information Bureau, Industrial Distributors (Sales) Ltd., 32-34 Holborn Viaduct, London, E. C. 1, August, 1948. Price 10/-.

This book has been published as a companion compilation of a survey released by the Industrial Diamond Information Bureau in 1945. P. Grodzinski, assisted by D. L. C. Jackson and W. Jacobsohn, conducted a survey on diamond abrasive wheels and give their findings in the new edition. Approximately 400 patents, from many countries, having to do with the subject, are listed and classified in numerical order.

GEM STONE LORE, by William Poese, Instructor in Lapidary Arts, published by Mineral Book Company, Colorado Springs, Colorado.

This book deals chiefly with gem cutting and the legend and history of the birthstone gems. In addition it contains reproductions of 31 letters written to the author by celebrities and well known public characters outlining their personal preferences for gemstones.

MINERALOGICAL DICTIONARY, by Chambers, published by Chemical Publishing Company, Inc., Brooklyn, 1948. Price \$4.75.

This mineralogical dictionary, first published in 1945, now available in a second edition is of interest chiefly for 40 color plates, mostly of typical crystals of the most important minerals.

It is odd that a mineralogical dictionary should have only 1,400 entries when

there are more than 1,400 minerals. Optical mineralogy seems to have been entirely neglected. Such terms as optic axis, dispersion, interference figure, etc., that are of primary importance to the mineralogist are not to be found in this work. In addition, although the jacket states that physical and chemical properties are listed, this is not the case. While a word description of the chemical composition is given, hardness, specific gravity, and the optic properties are never listed. However, those interested in having color plates of mineral crystals, including many of the gem minerals, and a rough description of the more important minerals, with a number of other mineralogical terms, will find this book of value. In fact, there are many who would feel that the color plates alone make the book a worthwhile addition to their library.

Gemological Digests . . .

(From page 88)

GIA Educational Boards To Meet in New York

The Educational Advisory Board, Examinations Standards Board, and the Examinations Board of the Gemological Institute of America will meet Saturday, November 13, at the Hotel Pennsylvania in New York City, with Dr. Edward H. Kraus, president of the Institute, acting as chairman.

Robert M. Shipley, Director of the G.I.A., will attend the conference which will convene immediately following the last session of the combined meeting of the Geological and Mineralogical Societies of America at the same hotel.

South Africa Gives Birthstone List

Announcement has just been made by the South African Jewelers Association, Ltd., of an official list of Birthstones of the Month just adopted by its directors. The list as selected after careful consideration is shown below.

These selections conform rather closely to the list of genuine stones established by the American National Retailer Jewelers Association, and clarified by the American Gem Society in this country as

Birthstones of the Month. The list differs slightly in alternates, having added the choice of red tourmaline for January; white sapphire for April; and green tourmaline for August. The American list has a few substitutes which are not accepted by the South African group, namely, bloodstone for March; moonstone for June; tourmaline for October; citrine for November; and lapis lazuli for December.

MONTH	COLOR	OFFICIAL STONE	MEANING
January	Dark Red	Garnet or Tourmaline	Constancy and Fidelity
February	Purple	Amethyst	Sincerity and Devotion
March	Pale Blue	Aquamarine	Courage and Truthfulness
April	White (transparent)	Diamond or White Sapphire	Innocence and Love
May	Bright Green	Emerald	Happiness and Courage
June	Cream	Pearl	Health and Longevity
July	Red	Ruby	Dignity and Luck
August	Pale Green	Peridot or Green Tourmaline	Felicity and Grace
September	Deep Blue	Blue Sapphire	Wisdom and Courage
October	Variegated	Opal	Hope and Good Luck
November	Yellow	Topaz	Friendship and Charity
December	Sky Blue	Turquoise	Prosperity and Success

Contributors in This Issue

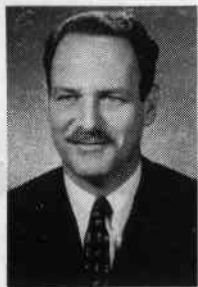


CALVIN N. JOYNER, civil engineer and government executive, has served the American, British, Chinese, and Korean governments. At 24 he was president of an agricultural college in Mexico. He says he was not a great president, but the institution was not a very great college either. During the war years he headed the Civilian Lend-Lease in China and was concurrently attached to the staffs of General Stilwell and Wedemeyer as advisor on Chinese affairs. Until June of this year he was director of the Department of Commerce, U. S. Army Military Government in Korea. It was during the 14 years he served the British Municipal Council, as Municipal Engineer in Tientsin, that the

pictures of "Jade Street," were made by him. Growing out of telescope making, while in China, his interest branched out into gem cutting and jade collecting. The Smithsonian Institute exhibits a collection of hololithic jade rings and a number of specimens of uncut jade donated by him. In defining jade, he is a strong conservative. "Jade," says he, "is only what you can sell to a Chinese as jade. It must come from Burma, Yunan, or Hsinking."

With VIRGINIA V. HINTON curiosity was the forerunner of a fascinating hobby which was to become an exciting career.

Now manager of Foley's Jewel Box in Houston, Texas, her interest in gemstones began 18 years ago when she took a position in a jewelry store in her native Georgia. Marriage to Architect Guerdon S. Hinton interrupted the career for a time but together they started a collection of gemstones. Then she enrolled in the G.I.A. and a whole new world was open to her. To her collection of gemstones she added instruments until today she has one of the finest private gemological laboratories in the country. She became the first woman Certified Gemologist and, in 1944, was awarded a fellowship in the Gemmological Association of Great Britain. The American revision of *Introductory Gemology* was a collaboration of Mrs. Hinton and Robert Webster, the author.



DAVID H. HOWELL, whose article *Fundamental Problems of Light* appears in this issue, was an early graduate of the Gemological Institute of America. By working fourteen hours daily, seven days per week, he completed the entire four-year course in six months time. After receiving his Certified Gemologist title in December 1935, he went to Pomona College where he worked in color research with gemstone material. Later he became Research Associate in Mineralogy in the Claremont College (graduate school) and engaged in correlative work with mineral artifacts and materials to determine origins of certain artifacts. His principal field has been spectroscopy, developing new techniques for investigations of specific problems.