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THE JOURNAL OF GEMMOLOGY

and

PROCEEDINGS OF THE GEMMOLOGICAL ASSOCIATION OF GREAT BRITAIN

GEMMOLOGICAL ASSOCIATION OF GREAT BRITAIN
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LONDON, E.C.2

GEMMOLOGICAL ASSOCIATION OF GREAT BRITAIN

(Originally founded in 1908 as the Education Committee of the National Association of Goldsmiths, reconstituted in 1931 as the Gemmological Association)

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GEMMOLOGICAL NOTES

NEW SYNTHETIC EMERALD

K. Schlossmacher

A new synthetic emerald is making its appearance and is in all probability made in Germany. The microscope discloses an extremely great abundance of small, very much wrinkled and entangled feathers. According to the light-line and shadow-line the refraction of light is lower than benzyl benzolate. These synthetic stones can easily be distinguished from genuine emeralds by the characteristics above mentioned and from synthetic Chatham Emeralds by the shape of the wisps. They resemble most the " Igmerald " but their inclusion of feathers is denser than in the latter. Under long-wave U.V. light the fluorescence is a weak red, as with the " Igmerald," while the synthetic emeralds from America have a strong fluorescence. From these resemblances it is presumed that a fresh trial has been made of the " Igmerald process," but till now the stones are not up to the " Igmerald " in quality, as they are quite cloudy.

In the synthetic emeralds of the latest production from the Chatham Laboratory an improvement can be perceived, but the difference between them and genuine emeralds can still be as easily detected as before.

OPAL IMITATIONS

E. Gübelin

Recently two new types of opal imitation in the form of triplets have appeared on the market. These triplets are composed of a colourless cabochon quartz top backed by a very thin layer of white or black opal which is covered by another layer of opal of inferior quality, black glass or black onyx, joined together by a black cement. The cabochon-shaped upper part gives the refractive index for quartz, while the base shows a different R.I. according to the material used. The density is between 2·48 and 2·65 according to the composition of the triplet.

ARTIFICIALLY COLOURED CULTURED PEARLS

E. Gübelin

Messrs. Herbert A. Peisak Co. of New York are offering cultured pearls artificially coloured black, the beautiful colour of which can rival that of genuine black pearls. They display the same soft iridescence with black, green and purple interference colours. The nature of the colour-dye used has not been made known. On the other hand, the Gem Trade Laboratory has tested the durability of the artificial colouring with various reagents and gives the following report :—

> " We have subjected the five treated black cultured pearls to a variety of reagents which might be encountered by a manufacturer and repairman as well as the customer.
>
> It is our finding that exposure to the following did not affect the colour in any manner :
>
> 1. Ammonia, in the form of concentrated spirits as well as jewellers' cleaning solution.
> 2. Alcohol, denatured grain and Eau de Cologne.
> 3. Acetone, in the form of nail polish.
> 4. Acetic ether and nail polish remover.
> 5. Hot soapy water.
> 6. A detergent solution.
> 7. Boiling water for one half-minute.
> 8. Steam for 20 seconds.
> 9. Carbon tetrachloride.
>
> Further, one pearl measuring 6·49mm. was immersed in concentrated hydrochloric acid until it was reduced to 6·25mm. in diameter (approximately 40 seconds). Although the surface lustre was destroyed as expected, the colour remained. It was found that under a blow-pipe the colour was unaffected up until the point where the nacre was destroyed and began flaking off. Removal of several layers disclosed that the colour remained beneath the destroyed layers. One pearl which was sectioned showed that the colour not only is concentrated through the entire nacreous coating but also appears in the mother-of-pearl nucleus in parallel bands."

The photograph shows that when looking sideways into a drill-hole of a pearl,which is illuminated over the top, the snow-white core contrasts strongly against the black nacreous layer.

KUNZITE

NEVILLE DEANE

The Pala-Chief Mine of San Diego County, California, has recently been re-opened and several pockets of the best faceting grade of kunzite have been found, and also other colours of gem spodumene, which are referred to as violet-blue and cornflower blue and also green. Two pieces of the kunzite colour which have come to hand have been of very good colour and very clear.

The deposit occurs as a decayed pegmatite dyke on a hill top and a mechanical hoe is used to remove unwanted material until a pocket is found, when further work is done by hand. It is said that so far about 4,000 grams have been found, and the price required for good material is high—for example a crystal of 113 grams of unusual blue colour was priced at $335 (£110).

Kunzite and gem-quality spodumene make very bright and lively stones, like the other lithium containing gems, but they are exceptionally difficult to saw, grind or cut, as they are very susceptible to cleaving with the slightest mechanical shock. Once the facets have been cut, polishing is relatively easy. There is, of course, a right way to cut them to show the best colour, but if the crystal is rather thin then they may have to be cut in the " wrong way," but with facets well sloped at the ends to show the colour in the end facets, even if the middle portion is not well coloured.

Although kunzites are obtained elsewhere—Madagascar for example—many of the crystals are very pale, and the re-opening of a mine giving good coloured and clear crystals is to be welcomed even though the cut stones are bound to be rather expensive.

" BLUE-WHITE "

JOHN PROBUS

Of 500 high grade diamonds recently examined by the Gemological Institute of America only one was found to have a trace of blue. Fewer than ten of the stones showed no trace of yellow.

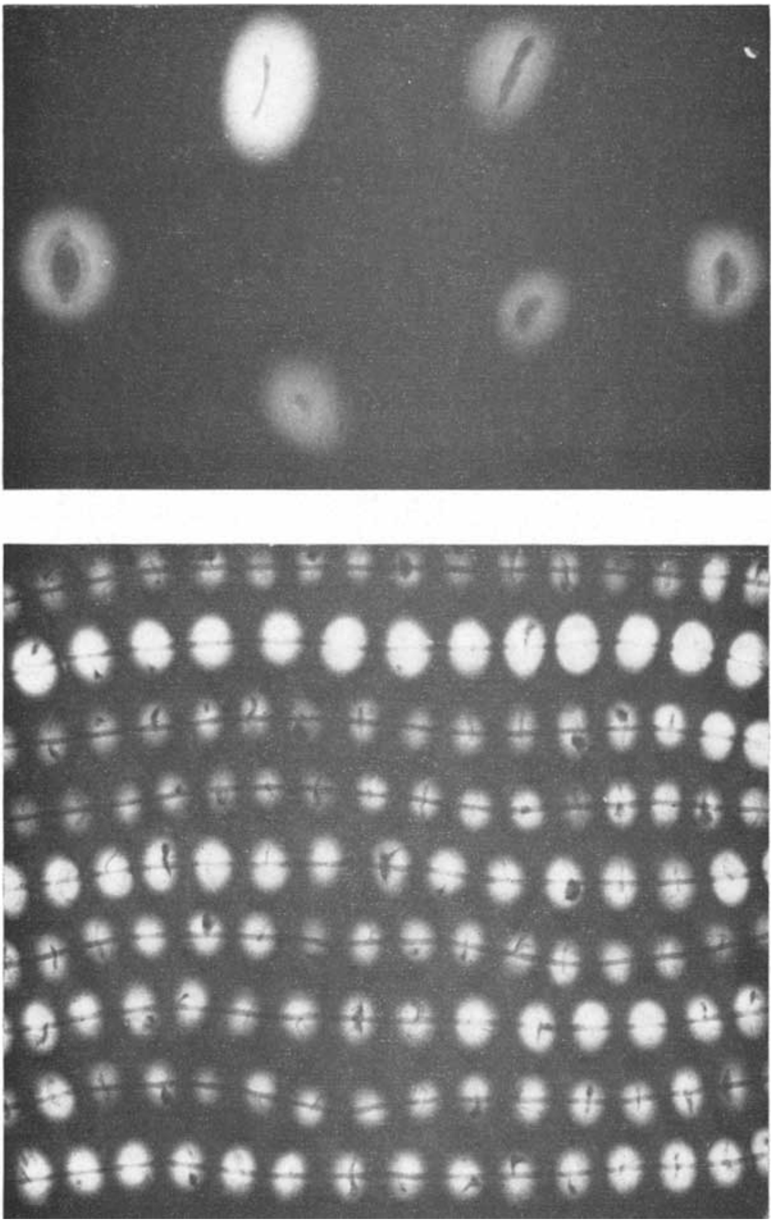
In the United Kingdom there are jewellers who all too frequently use the term " blue-white." Perhaps they do not understand the significance of the term or, what is more likely, have not sufficiently studied the problems of diamond grading by colour.

There is a recommendation in the U.S. that the term " blue-white " should not be used in advertising. It is also not used in advertisement in the U.K. but the term does occur in sales talk. In view of the extreme rarity of a so-called " blue-white " diamond it is obvious that it is a term to be left severely alone by all but the specialists, who themselves are not as numerous as we are sometimes led to believe.

NON-NUCLEATED CULTURED PEARLS

R. WEBSTER

The commercialization of cultured pearls without a bead nucleus has now become of some importance to the jewellery trade all over the world. These non-nucleated cultured pearls are produced by inserting into the pearl-secreting mollusc a small portion of epithelial tissue (the mantle) and this acts as the irritant and the " core." Originally this method of production was confined to the freshwater mussel (*Hyriopsis schlegeli*), which is farmed in the Japanese freshwater



X-ray skiagrams of non-nucleated pearls.

lake Biwa-Ko in Shiga Province of Honshu. A similar method of production has more recently been carried out in Australian waters using the large oyster *Pinctada maxima*.

All these non-nucleated cultured pearls are somewhat baroque or oval in shape. The Japanese freshwater variety seem to have a brighter and more pleasing lustre than the whiter Australian non-nucleated cultured pearls, but the Japanese pearls are much smaller in size.

Both types can be identified by the characteristic structure seen from an X-ray skiagram, in which an irregular gap, sometimes in dumbell form, is seen in the pearls but not necessarily at the centre. This effect is shown in the pictures illustrating this note. X-ray diffraction patterns do not in these cases provide a diagnostic test. Further, it may be mentioned that the freshwater non-nucleated pearls from Japan fluoresce strongly under X-rays, but the sea-water Australian non-nucleated cultured pearls only do so weakly.

" THE EARTH BENEATH US " A. E. FARN

A book published in 1955 entitled " The Earth Beneath Us," by H. H. Swinnerton, caught my eye the other day. I quite expected a treatise on soil condition and hoped for some helpful hints on how to treat a chalk garden or at least how to adapt a calcifuge.

To my intense interest I found a very readable book written round the subject of the earth on which we live. The book deals progressively with the earth's origin, facial features, volcanic activity, climatic patterns of the past, the setting of the stage of evolution and the coming of man. This may not seem truly gemmological but certainly it is an allied subject. Very interesting details of the cause and effect of volcanoes and their build up are given and especially interesting is the occurrence of " parasitic cones."

A fascinating description of the primeval liquid magma of the earth's core and a description of silica as a solid acid, tasteless and used as a constituent for Pyrex dishes, makes unusual reading, as does the account of the formation of quartz family gemstones. A clear picture is given of the formation of gemstones, which is not always so adequately dealt with by gemmologists since they are not themselves usually too well versed in geology. The chapters described as Pluto's Laboratory and Pluto's Treasury are fascinating accounts of gem formations.

Although primarily a geologist's book Professor Swinnerton's has considerable interest for gemmologists. A chapter entitled " Ships of Pearl " has a description of the pearly nautilus and its structure and its method of jet propulsion.

Many more chapters are devoted to various aspects of the earth's creation and evolution of man, but the book, which is simply expressed, has gemmological interest, and after perusing it one feels much more knowledgeable of facts, which previously had rather been slurred.

REVOLUTIONARY EXPERIMENTS IN COLOUR VISION

By B. W. ANDERSON, B.Sc., F.G.A.

COLOUR is of such prime importance to gemmologists that no apology is needed for including in this Journal some account of recent experiments in colour vision which seem to disrupt completely many general ideas on colour, which had appeared to rest on unassailable foundations.

For nearly three centuries our fundamental concepts of colour, at least in its physical aspects, have been based on the classic experiments of Newton, which were carried out for the most part in 1666, when he was a young man of twenty-four and, in his own words " . . . in the prime of my age for Inventions, and minded Mathematics and Philosophy more than at any time since." It will be remembered that by passing a narrow beam of sunlight (which had been allowed to penetrate into his darkened room through a quarter-inch hole in the shutter) through a large glass prism, Newton resolved or analysed the white light from the sun into the colours of the rainbow. These were seen as a 13-inch spectrum on a screen which was suitable placed to receive the rays after they had been variously refracted by the prism. In other experiments Newton proved that the spectrum colours could be re-combined by passing them through a second prism in reversed position to form a spot of white light, and that rays of any pure spectrum colour could not be further analysed into rays of different colour. By adding rays from one part of the spectrum to rays from another part, it was shown that a colour of intermediate hue in the spectral series (red, orange, yellow, green, blue, violet) could be produced. In modern parlance: by blending rays of two different wavelengths, the eye receives the colour-impression produced by rays of wavelength intermediate between the two.

Newton's experiments were logical and irrefutable, so far as they went, and on them were later built, by Young, Helmholtz, and others, theories of colour-vision which, with slight modifications or extensions, have held the field till the present day. According to Young's theory, formulated at the beginning of the nineteenth century, there are three kinds of receptor in the normal human retina: one type specially sensitive to red rays, another sensitive to green rays, and another sensitive to blue rays. Red, green and blue were considered as " primary " colours, since most colours met with in nature can be closely matched by suitable mixing of red, green and blue coloured lights. For exact matching, a fourth colour such as yellow, has been found necessary.

The most promising experimental approach to this type of theory has been that of Professor Granit, of Sweden, who, by placing minute electrodes in contact with nerve fibres in the retina of an anaesthetized animal, was able to amplify the tiny changes in electrical potential which occurred when the nerve fibre was exposed to different kinds of light sufficiently to give audible clicks on a loudspeaker. In these experiments Granit found that there were as many as seven different types of photo-receptor in the retina of most animals, each of which gave a response to different, fairly narrow, regions of the spectrum. He also found receptors which gave a broad response, being stimulated by rays from most parts of the spectrum. Experiments of this kind have not been carried out on human eyes, but it seems reasonable to suppose that very similar effects would be obtained.

In cases of colour-blindness, some form of which is said to affect about eight per cent of the male population, it has been natural to suppose that certain of these colour-receptors are defective, rendering the subject insensitive to red or to green, etc.

Colorimetry, the quantitative measurement of colour, has been built up on the same general background of theory, descriptions of any given colour being given in terms of the proportions of three carefully chosen primary colours needed to reproduce or match the colour in question.

Though too briefly stated to be adequate, the above does, I believe, represent in outline the almost universally accepted ideas on colour and colour-vision at the present time, and, bearing this in mind, one can appreciate the revolution in thinking on the subject that will now be necessary as the result of a series of experiments carried out by Dr. E. H. Land and his associates in the United States. Dr. Land, as the inventor of " Polaroid," has already exercised a tremendous influence on optics and the optical industry: it is possible that the verdict of history will be that his recent discoveries in the field of colour vision are even more important.

Without further preamble, let me describe one of Land's experiments. Two black and white photographs of a group of differently coloured objects were taken through chosen yellow filters, one of which transmitted yellow of rather longer wavelength than the other. From the negatives, two black-and-white transparencies were obtained, identical except in slight differences in the distribution of light and dark portions of the objects pictured. Next, the image of each of these transparencies was projected in such a manner that the two images were superimposed on the screen. If the projection was carried out through the same yellow filters which were used in taking the original black and white photographs, the astonishing fact was that, in place of a yellow picture as commonsense and normal scientific thinking would confidently expect, the image of the picture now appeared *fully coloured!* If the black-and-white slides were removed from the projectors, the two slightly different yellow beams combined to give a yellow spot on the screen as one would confidently expect. By what unexpected process can the two superimposed yellow images of the black and white transparencies yield to the eye the impression of colours, which one would have said could only be produced by rays of wavelengths quite different from those emitted by the twin projectors ?

The startling discrepancy between Land's results and those of innumerable previous workers in the field of colour-vision and colour-matching seems to be due to the fact that all former experiments have dealt with *spots* of light, or with pairs of spots, one being matched with another by varying the amounts of the (usually three) colours used in producing the second " spot." Land and his co-workers have been for the first time in history exploring colour vision under natural conditions in *complete images.* In a vast range of carefully thought-out experiments, carried out over a period of some five years, they have found that, in order to produce colour from black-and-white transparencies of coloured objects, one need only illuminate these transparencies with light of almost any pair of wavelengths (identical with those used in forming the transparencies) and superimpose them on the screen. For the sake of simplicity they have termed one of these the long-wave, or " long " record and the other the short-wave or " short " record. The colours in images so produced appear to depend, not upon the particular shade of the long or short wavelengths used, but from *the interplay of long and short wavelengths over the entire scene.*

In some of these experiments a full range of colours has been produced by using a red filter to provide the " long " record and no filter (i.e. white light) to act as the " short " record. According to classical ideas and experiments one can obtain only different shades of pink by a combination of red and white light, and when two such beams of light from the projectors are combined on the screen pink is indeed produced. But as soon as the black-and-white transparencies are dropped each into its appropriate projector, the image on the screen is flooded with the colours originally present in the objects photographed. If the red filter is removed, the colour disappears and a black and white picture appears.

More stringent experiments were carried out in which different wavelengths of truly monochromatic light were employed in place of the relatively broad bands of wavelengths passed by filters. It was found that any pair of wavelengths that are sufficiently far apart will produce images under the conditions outlined above in which a range of colours is seen extending far beyond what one would expect from classical theory. As we have already noted, the wavelengths chosen can even approach so closely as to be of the same colour description (yellow). There does, however, seem to be a special spectral position at about wavelength 5880 Å on either side of which the " long " and " short " record must predominantly fall if full colour is to be produced. One wonders whether this is in any way linked with the known fact that in this region of the spectrum the human eye can best detect slight differences in hue when the wavelength is varied by small amounts.

The colours produced in these " two wavelengths only " experiments were admittedly not so bright and saturated as when a richer range of wavelengths was available: but that colours should be produced at all under the conditions is the outstanding and amazing fact that calls for entirely new thinking.

Only a few of Dr. Land's experiments have been outlined in this brief article. Many more are described and splendidly illustrated by diagrams and in coloured pictures in a paper entitled " Experiments in Colour Vision " by E. H. Land, which appeared in the " Scientific American " for May, 1959. This is very clearly written, and can be recommended to anyone who wishes to have a greater insight into these astonishing developments. A preliminary paper[1] had already been published by Land at the beginning of the year, but I first became aware of these new discoveries by reading an article " Seeing things in their true colours," which appeared in the " Science to-day " columns of the *Manchester Guardian* for

14th July. Copies of this excellent review of Land's work can probably be obtained by those interested from the offices of *The Guardian* (as the paper is now called) in Fleet Street.

Land seems to have shown remarkable restraint in withholding publication until he and his colleagues had investigated the new phenomena " in depth." These recent discoveries, his work on " Polaroid," and numerous less-known researches and inventions, seem to place him in a category almost as high in the field of physical optics as that occupied by his countryman R. W. Wood, who died about a year ago. Wood's book, " Physical Optics," is one of the most original and exciting of its kind ever written, even to one ill-versed in mathematics. One wishes that Dr. Land would also embody in book form his lifetime's experience in experimental optics. From what one remembers of the entertaining lecture he gave on polarized light at the Royal Institution in 1949, any book by him would be highly readable as well as richly informative.

It will be interesting to see how the new facts revealed by his work on colour vision gradually influence thinking, teaching, and writing on this important and intriguing subject.

1. Edwin H. Land, *Color Vision and the Natural Image, Part I,* National Academy of Sciences (U.S.A.), Vol. 45, p.115, 1959.

THE MEASUREMENT OF REFRACTIVE INDEX BY REFLECTION

By L. C. TRUMPER, B.Sc., F.G.A.

THE upper limit of the standard refractometer is 1·81. Using special liquids, all of which possess serious disadvantages, a slight increase in this upper limit can be obtained, but in general, other techniques need to be used, which either are time-consuming or require laboratory equipment beyond the ordinary gemmologist's means.

Many attempts have been made to devise simpler but effective means of measuring refractive index particularly in the higher ranges, as for example by the measurement of Brewster's angle.

When an unpolarized ray of light impinges on a plane surface, otherwise than at the normal or grazing incidence, the reflected light is partially polarized. Maximum polarization is obtained when the tangent of the angle of incidence is equal to the refractive index of the medium.

A practical method of carrying out this method on gemstones was described by B. W. Anderson in 1941,[1] but its accuracy is very much dependent on the acuteness of the observer.

FRESNEL'S LAW

Alternative methods have been worked out, making use of Fresnel's law

$$\frac{(n-1)^2}{(n+1)^2} \times 100 = \text{the percentage of light reflected at normal incidence.}$$

These methods are based upon the measurement of absolute reflectivity.

Reflectivity can be measured either visually or photoelectrically. The latter method has been effectively used by Orcel (1927, 1928 and 1930), by Ehrenberg and Ramdohr (1934), Moses (1936) and Folinsbee (1949), and a method capable of giving measurements to within 1% has been described by S. H. U. Bowie.[2]

In this, a normal ore microscope is used with a tube iris diaphragm with a " cover-glass " type of reflector unit. The ocular is replaced by a selenium barrier-layer cell in a suitable holder and measurements are provided by a galvanometer of 450 ohms internal resistance. Stabilization of the light source is secured by supplying a partially stabilized current from a constant voltage transformer to a heavy duty accumulator charger, which in turn keeps the battery charged. Comparisons are made against pyrites, which has proved a reliable and convenient standard with a reflectivity of 54·5.

A visual method has been described by A. F. Hallimond,[3] similarly using an ore microscope, in which reflection is first secured of the light source by means of a small mirror at an angle of 48½° and then from the surface of the medium under test contained in a cell at an angle of 7°. In both cases extinction is obtained by a microphotometer employing two fixed and one moving disc of polaroid.

Design of the Trumper Reflectometer

A reflectometer of original design, calibrated to provide a direct reading of refractive index has now been constructed with the special needs of the gemmologist in mind. Unlike the refractometer, it has unlimited range.

The principle upon which the instrument operates is extremely simple. By a system of totally reflecting prisms, an evenly illuminated ground glass screen, forming a circular spot which can be varied in size to suit the size of the table facet of the gemstone under test, is observed by one eye through two different paths simultaneously.

One path observes the full brightness of the spot, the other path observes the spot after reflection at the quasi-normal by the surface under test. The prisms are so orientated that the two spots appear close together side by side.

The brightness of the spot directly observed is reduced to match the lesser brightness of the reflected ray or spot by means of a carefully constructed annular neutral tint wedge. The amount of rotation required is calibrated with the help of a carefully constructed graph using well polished gemstones of known refractive indices, thus enabling the instrument to provide direct readings of refractive index between 1·40 and 3·20.

The observations are carried out in a light-tight box, so arranged that errors cannot arise through stray light. Supplementary neutral tint and colour filters are provided to vary the incident light and diaphragms to adjust the size of the images are incorporated.

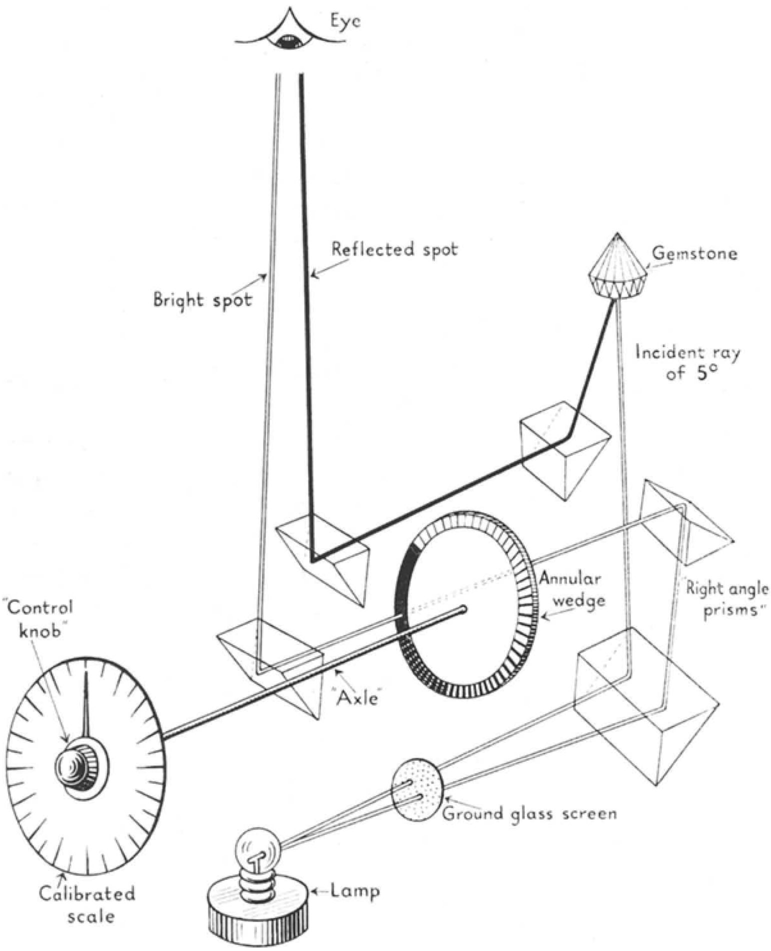


FIG. 1. "*Exploded*" *view of reflectometer showing the two alternative paths of light from the ground glass screen. Any variation in the intensity of the light is common to the two paths.*

An " exploded " view of the reflectometer (Fig. 1) shows the two alternative paths followed by the light from the ground glass screen to be followed.

It will be seen that the same optical principles are observed by both paths, that any variation in the intensity of the light is common to both paths and that the relative intensities of the two remain the same.

This has been proved experimentally, by using different intensities and by varying the neutral tint and other filters. The readings obtained remained the same, provided the observer exercised the same degree of care in making the observations.

Optical Principles Involved

The path followed by the ray of light reflected by the gemstone is longer than the path followed by the main ray.

Since the instrument has been calibrated thus, it makes no difference, but in any event it can be shown that an object (as opposed to a point of light) appears equally bright at all distances.

If S be the area of the small spot of the ground glass screen illuminated by the electric light bulb, d the distance to the eye and a the area of the pupil of the eye, then let Q be the quantity of light emitted per second.

Then the amount of light entering the pupil of the eye per second is $\frac{aQ}{4\pi d^2}$

The solid angle (cone of rays) at the eye is $\frac{S}{d^2}$

and the size of the image on the retina is proportional to this.

The brightness as seen by the eye is therefore proportional to

$$\frac{aQ}{4\pi d^2} \div \frac{S}{d^2} = \frac{aQ}{4\pi S}$$

This result is independent of d — the distance.

From the above it follows that if the areas of the circles of illuminated ground glass screen are different, then the quantity of light emitted to the pupil of the eye will also differ, although any part of the surface will be of the same brightness.

It is for this reason desirable to equalize the two light circles being compared in the instrument by the series of stops provided. Four different diaphragms are needed to accommodate different sizes of table facets with stops to correspond to the path of the main ray.

If a lens or mirror is used to form an image of the circle of illuminated ground glass screen, by the same reasoning as above, the brightness of the image will be $\frac{aQ'}{4\pi S'}$

Q' being the light emitted per second by the image and S' the area of the image.

If O is the object distance, I the image distance and R the radius of the lens, then $\frac{S'}{S} = \frac{I^2}{O^2}$

The solid angle subtended by the object to the lens is proportional to $\frac{R^2}{O^2}$ and by the image proportional to $\frac{R^2}{I^2}$

The light falling on the lens is proportional to $(R/O)^2Q$ and the light falling on the image proportional to $(R/I)^2Q'$

Then $(R/O)^2Q = (R/I)^2Q'$ or $\frac{Q}{O^2} = \frac{Q'}{I^2}$

Thus the brightness of the image $\frac{aQ'}{4\pi S'} = \frac{aQ}{4\pi S}$

which is the same as the brightness of the object.

It can be shown that the above is true also of mirrors and since the table facet of the gemstone is acting as a mirror, it may be argued that slight convexity or concavity of the facet will not affect the brightness of the image observed.

It has been shown experimentally that moderate convexity of the table facet has no effect on the accuracy of readings.

Reflectometer Readings Unaffected by Colour or Transparency

It is believed that reflection of light occurs at the point of change of refractive index, that is at or exceedingly close to the surface of the medium.

It has been experimentally determined that neither the colour of the gemstone nor its transparency has any effect on the readings obtained by the reflectometer. For example, the extreme case of a jet black spinel, which was almost opaque, gave a normal spinel reading of 1·72. A completely opaque silver-grey haematite gave a reading of 3·1 and a translucent synthetic rutile a reading of 2·72.

The Beilby Layer

The results of progressively polishing calcite have been carefully observed and described by Sir George Beilby in a lecture in 1911 to the Institute of Metals.

The cleavage surfaces exhibit a high natural polish. When polished, however, he estimated that a mechanical disturbance penetrated to a depth of about one thousandth of a millimetre, causing furrows which were however healed over by a surface flow. At a depth of about one ten thousandth of a millimetre, these furrows were almost absent. In the surface layer of about one twenty thousandth of a millimetre there was no trace of broken material, the appearance was absolutely homogeneous, like a coating of varnish which is harder than the original surface.

All the evidence points to the fact that this surface flow occurs for a depth of about one thousandth of a millimetre and that the resulting surface is in a vitreous amorphous state. This layer is referred to as the Beilby layer and is probably produced on most gemstones. Diamond is an exception and in the case of corundum recrystallization occurs. Thus, if the gemstone is fully polished, the reflection may be not from the original gemstone surface but from the Beilby layer resulting therefrom, which is amorphous. The Beilby layer is too thin to have any effect on the refractive index readings of the ordinary refractometer. Nor does it appear to have any effect upon the measurements obtained in determining Brewster's angle, but in the case of reflectometer readings it may give a reading differing from the refractive index of the original gemstone material.

Where minerals are known in an amorphous state, the refractive index is usually lower than that for the crystalline material. Thus the refractive index of quartz is 1·547, but for amorphous silica it is 1·460. For high zircon, the mean index is 1·96, but for low or amorphous zircon it is 1·78.

It may well be, therefore, that in polished gemstones a reflectometer reading may result in a lower refractive index than has been established for the gemstone by normal methods, being the refractive index of the Beilby layer of the gemstone.

This may account for the fact that low readings have been obtained for blende. On the other hand, S. H. U. Bowie suggests that the reflectivity of blende depends upon the iron content.

Bireflection, Dispersion, and Dispersion of the Bireflection

The reflectivity of a transparent isotropic medium at normal incidence can be calculated from Fresnel's equation :

$$R = \frac{(n-1)^2}{(n+1)^2} \times 100$$

The reflectivity of diamond for sodium light is 17·2. That is, 17·2% of the incident light is reflected.

It follows that for anisotropic media there is bireflection and that the reflectivity depends upon the orientation of the surface from which the reflection is being obtained and there will be two principal directions which differ in their reflecting power.

An extreme example is provided by the mineral covelline for which variations in reflectivity of from 5 to 20 in orange light are quoted by S. H. U. Bowie.

The reflectivity also varies with the wavelength of the incident light, thus exhibiting dispersion. Diamond varying from 17·1 for green light to 17·3 for red (Bowie) and pyrites from 49 for violet light to 55 for red.

A. F. Hallimond records the following reflectances for pyrites:

Ang°	4700	4900	5200	5500	5800	6100	6500	6700
R ...	49·1	50·9	52·6	52·7	54·3	55·1	56·4	55

Similarly, whilst aluminium is not a good reflector of visible wavelengths, it is well known that it is a highly efficient reflector of short wave ultra violet wavelengths.

The reflectivity of the two principal directions in the surface of an anisotropic mineral also vary independently with the wavelength of the incident light, thus producing " dispersion of the bireflection."

The Lapidary

In cutting a gemstone, the object of the lapidary is to produce an attractive gemstone with the minimum loss of the rough material. He will grind and polish it to produce facets which by a high polish and reflection of light, bring out the inherent qualities of the stone to the best advantage.

Facets examined with a lens in oblique light may disclose :

(*a*) Scratches, roughness, polishing marks and furrows,

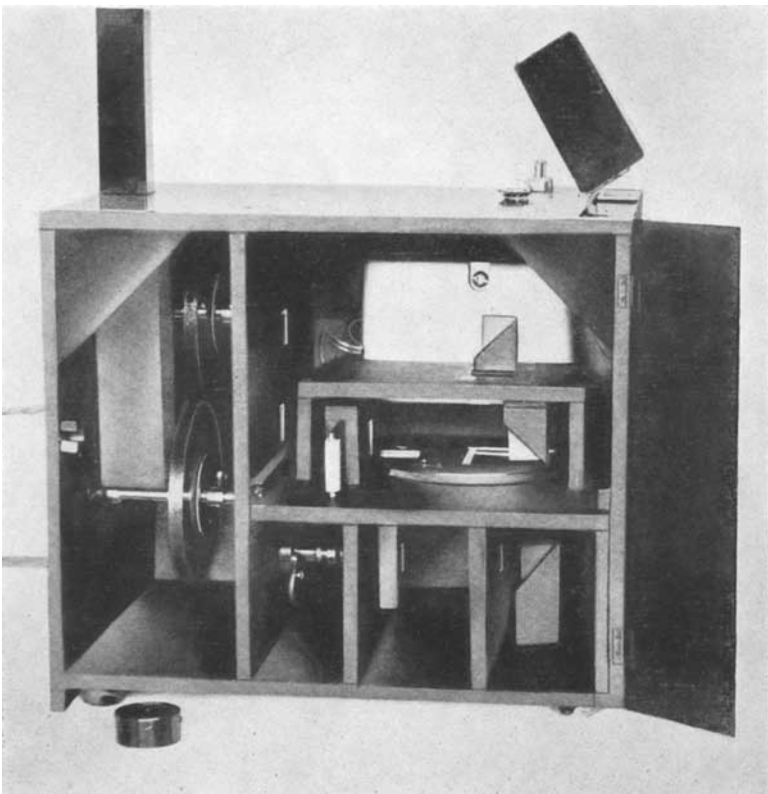
(*b*) A corrugated surface, due to the action of the polishing medium reacting differently to different areas of hardness,

(*c*) Concavity, due to the shape of the lap,

(*d*) Convexity, due to the movement of the stone as the lap rotates,

(*e*) A cylindrical curve due to lack of rotation of the stone or to a side to side movement,

(*f*) A combination of two or more or all of the above.



Interior of reflectometer showing prisms, filter disc, stops and wedges.

Assessment of a Gemstone's Suitability for Reflectometer Readings

The reflectometer depends on Fresnel's law of reflection of light and as a preliminary to any readings with the instrument, the gemstone must be submitted to a searching examination as to the suitability of its table facet.

Considerable research has shown that slight convexity or concavity does not affect the readings, but a high degree of polish and freedom from scratches is essential if accurate readings are to be obtained.

Many complicated instruments exist for the examination of plane surfaces, but a simple test for convexity may be made by observing Newton's rings. Press the table facet against the underside of a microscope slide glass and observe in oblique light. Coloured concentric rings will usually be observed. If few and widely separated, the facet will be almost optically plane. If close together a greater degree of convexity is indicated. Generally if rings are observed the gemstone will be sufficiently plane for a reflectometer test.

Using the facet as a small mirror, observe a distant object such as a blind cord against the light or a distant electric lamp filament. If the polish is poor, it will be blurred or distorted as the facet is gently moved from side to side. If well polished, the distant object will be sharp and the reflection good and free from ripples as the facet is moved too and fro.

If satisfied that the facet is suitable, it should be carefully cleaned and polished with a chamois leather or better still polished up on a felt lap charged with a little rouge or chromium oxide.

Conditions Necessary for Reflectometer Readings

Summing up, the conditions necessary for the examination of gemstones in the reflectometer are :

(1) A reasonably flat or plane table facet,

(2) A highly polished table facet free from scratches,

(3) Correct orientation to obtain maximum reflection and a circle of light in the eyepiece of the instrument,

(4) Equal and similar areas of light visible in the eyepiece for comparison,

(5) Comfortable conditions in which to make the observations and preferably in subdued general lighting,

(6) The observer completely relaxed and the eyes free from fatigue.

Conclusions

The reflectometer was specifically designed for the comparatively rapid examination of gemstones, particularly those with refractive index above 1·81, with the object of providing a direct reading without the use of expensive or complicated apparatus and to provide an instrument which would not get out of adjustment or be dependent on any standard that could deteriorate.

Provided the precautions outlined above are taken, the instrument is capable of providing refractive index readings within 0·02 if several careful readings are averaged.

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Gemmological Abstracts

SEAL (M.). *The abrasion of diamond.* Proc. Roy. Soc. London, Ser. A, Vol. 248, pp. 379-393. November, 1958.

The rates of wear for diamond abraded with diamond powder vary by a factor of >500 for different crystallographic directions. The variation is related to a small directional variation in the coefficient of friction. The difference observed in behaviour at high and low sliding speeds is consistent with wear being due principally to a thermally activated chemical effect.

R.A.H.

WILKS (E. M.). *The cleavage surfaces of type I and type II diamonds.* Phil. Mag., Eighth Series, Vol. 3, pp. 1074-1080. October, 1958.

Microscopy and multiple-beam interferometry have been used to show that, in general, three are more cleavage lines on type I diamonds, and also a greater number of the so-called river systems. The results suggest that impurities within the lattice lead to a more broken substructure in the type I diamonds. Any birefringence does not appear to be related to the cleavage pattern : very few type II diamonds show evidence of a laminated structure.

R.A.H.

BOWDEN (F. P.) and SCOTT (H. G.). *The polishing, surface flow and wear of diamond and glass.* Proc. Roy. Soc. London, Ser. A, Vol. 248, pp. 368-378. November, 1958.

The wear of diamond sliding on glass is due partly to the degradation of diamond to amorphous carbon or graphite. This degradation appears to occur at interface temperatures lower than that required for obvious graphitization of diamond heated without rubbing.

R.A.H.

HALPERIN (A.). *An uncommon growth feature in diamond.* Phil. Mag., Eighth Series, Vol. 3, pp. 1057-1060. October, 1958.

Growth features which extend as terraces from the edges of growth sheets on {111} faces of a diamond are described. One of these features is very flat, probably down to atomic dimensions over its whole area ($\frac{1}{3} \times \frac{1}{2}$ mm.). Its characteristics suggest that in the last stage of growth of a diamond, when trigons are formed on its surface, growth sheets become frozen and growth proceeds only to the fixed edges.

R.A.H.

LEONARDOS (O.H.). *Diamante e carbonado no Estado da Bahia.* Gemologia No. 14, pp. 1-20.

A reprint of a paper formerly published in Mineracao e Metalurgia. Discusses diamond and carbonado as found in the Brazilian State of Bahia. In his classification the author describes a type of industrial diamond between boart and carbonado, known as bala—being the ball-like radial crystalline stones—which he lists as the most valuable of the industrial types of diamond. Values quoted are those obtained by the garimpeiros (miners). The mine values for carbonado are compared with prices asked in London and New York and show a ratio of 1 to 5 or even 1 to 10. The paper describes the geology of the diamond area, methods of recovery, concessions and numbers of garimpeiros working—the latter being based on estimated pre-war figures.

R.K.M.

LEIPER (H.). *Kunzite strike at reopened California mine.* Lapidary Journ., p. 348, June 1959.

Gem-quality kunzite and fancy spodumene have been taken from the Pala Chief Mine since its recent reopening. This mine has produced the largest amount of gem spodumene of any mine in the world. Blue specimens of the gem have been found. Some pale green spodumene has also been obtained, which is not of sufficiently deep colour to merit the name hiddenite.

S.P.

JADE STORY—AMERICAN (2)

By ELSIE RUFF, F.G.A.

THE white man's arrival in America was to change, almost overnight, all that the American Indian knew as a way of life. There was no gradual transition, nor was the European entirely resented, or his culture always imposed by force. Records exist that prove the white man was sometimes welcome, for there was a strong belief in ancestors that were white, with beards, and legends promised their return. Also, the newcomer had merit. He brought iron tools and the wheel. And he brought horses.

Columbus undoubtedly had other ideas than just conquering a new world or linking up with an exotic one. Letters he left, still extant, proclaim him no chance adventurer. Already he had visited many countries, including Britain. Perhaps it is our loss that he was never to peep into the rich land of Mexico. Yet the most imaginative adventurer could hardly have anticipated the racial admixture of this new land, nor the diversity of its languages. J. W. Kraft (*Adventure in Jade*) wrote : " If you examine the Mexican pebbles at the great museum of Mexico City, you will observe a remarkable thing : the faces carved upon them seem to be an international gallery. Some of the faces appear Oriental, some Norse, some Negroid. The artists who worked in this jade must surely have been world travellers."

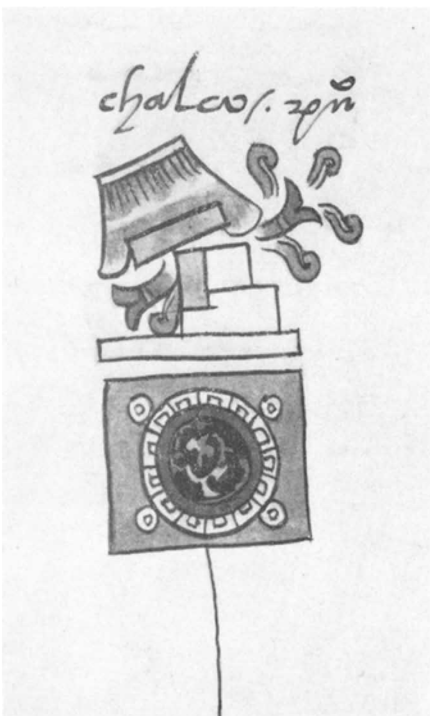
To study American jade is to study this racial admixture. There is little doubt that migrations of people, perhaps over a very long period, entered the New World from north-eastern Asia via the shallow Bering Strait. It is thought that many of them made use of a land bridge or perhaps ice-jams. Certainly the Mongoloid features of many Eskimoes and Indians to-day bear witness. It has been suggested that changes in climatic conditions were responsible for this move at an early stage. Even now Eskimoes on both sides of the strait are practically identical in customs, speech and general physique. N. C. Nelson, a leading authority on early man in America, believes that these people arrived somewhere between 5,000 and 10,000 years ago (others say 15,000), and that they were then enjoying a partially developed neolithic culture. He says too that the trend was to trek south where conditions of life and climate were more hospitable. This Asian immigrant appears to have been somewhat of a wanderer anyway, though many did settle down to agriculture. Only the, then, impenetrable growth farther south imposed a slower pace. Nevertheless, this section of the American population merely accounts for one race. Undoubtedly there were aborigines, and unions between the two must have taken place which, together with the change of conditions and climate, modified the Mongolian characteristics. Yet neither of these races represented the highly developed civilization that the white man discovered. There are races, or at least one race, still to be accounted for.

In studying the Jade Question of America, it is logical to ask: Was jade stimulated by this Mongolian invasion, suggesting that it was part of their neolithic culture ? (And it is all too easy to connect the Mongols with China and jade.) The old theory that wrought jade discovered in America came from the Orient in the rough (a theory once advanced to account for European jade) has long been discarded. Or we may ask : Was jade a part of the life of the aborigines ? Or, was jade a part of the culture or cultures of those races not yet identified ? The answer could be that jade played a part in the life of all three. It is also possible that the study of jade may contribute to an ethnographical answer. A fact emerging from American excavations is, that the deeper the archaeologist digs, the finer the jade he discovers ; in this instance discrediting the evolutionary view as far as jade is concerned. Nor was this jade merely a question of lapidary technique. Pal Kelemen,[1] writing of pre-Columbian jades, said : " It is noticeable that the material used in the earlier centuries is of higher colour and finer quality than later, when during Aztec and Toltec supremacy the scarcity of the better type of jade apparently forced the artisans to reach for darker and coarser materials."

Since the subject of jade in America covers a vast territory, it will be necessary to approach the matter geographically, and to begin where Cortes began is to start with Mexico, essentially a transitional country. Mexico is sometimes described as *A Federal Republic of North America*, and sometimes referred to as part of Central America. Its official language, Spanish, is only one characteristic that has spilled over into California. Perhaps because Mexico is a contiguous neighbour of the U.S.A. we know more of this country than of those to the south. It has, too, a far greater population, Mexico City alone claiming over 4,000,000 souls. Certainly its people, originally *Nahau*-speaking, have been for us the most famous on the American continent.

When the Spaniards landed at Vera Cruz (the Indian name for which was Chalchicuela—cf. Chalchihuitl) the people of Mexico were called Aztecs. This is now so commonly known that we frequently associate the word with Mexico. At the helm of that day was Montezuma. The various descriptions of him suggest an embroidered eastern potentate. Nevertheless, Vaillant (*Aztecs of Mexico*) described him as " simply dressed but for the gold crown and jade earrings of his exalted office." However, he does not appear to have lacked sagacity, benignity, or any of the other distinguishing traits of statesmanship. The gemmologist can do nothing but salute him. For gem-splendour he was, surely, the American version of Henry VIII. Yet the Aztecs as a race were comparatively short-lived. They were preceded in the Valley of Mexico by a people of greater culture, a race that the Aztecs

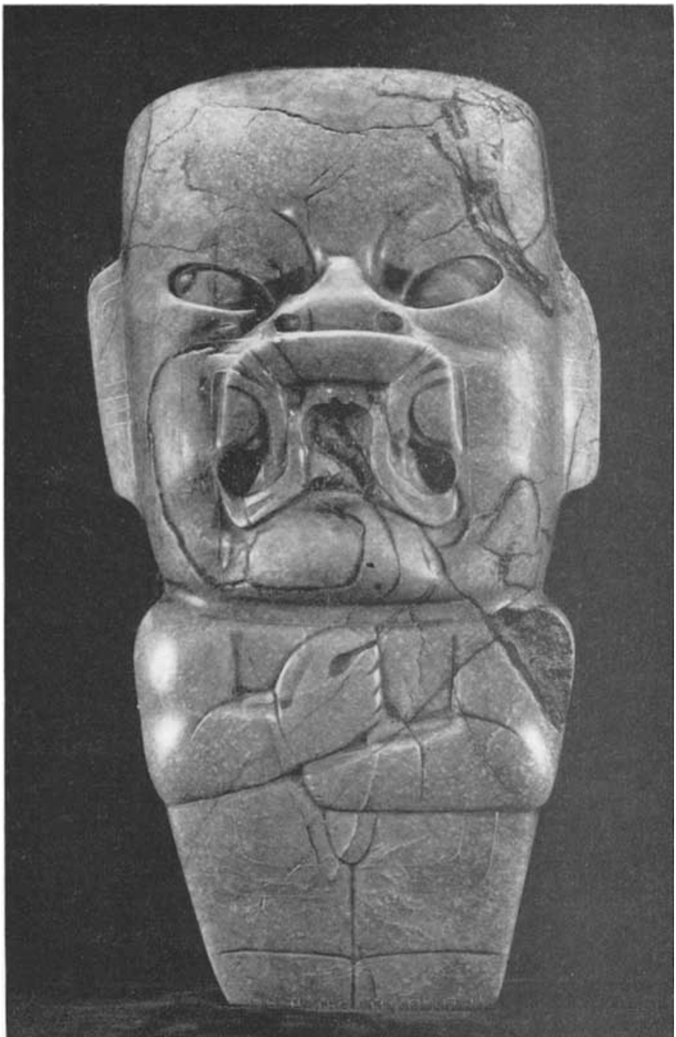
themselves admired. They were called Toltecs, though for awhile this term was unacceptable (and still is in some quarters) to certain authorities who were inclined to assign the Toltec race to legend. It is to the Toltecs that the archaeological remains of ancient Mexico are now attributed, though at the time of the Aztec invasions they were a disintegrating people. Vaillant tells us that the Aztecs arrived from the north, first setting foot on Mexican soil in the eleventh century—about the time of the Norman invasion into this country. " In less than a hundred years," he wrote, " rising on the ruins of the older culture, they developed an extraordinary civilization." Although these Aztecs succeeded in spreading themselves pretty well over Mexico, there were states, Yucatan in particular, where the populace were neither Aztec nor Toltec. Seemingly they were older than both. They were called Mayas (pronounced My-ers), and although at some time during their



Symbol for chalchihuitl. " Most precious heavenly jewel confined at the four directions." Chalco is S.W. of Mexico City. Top part of the illustration represents capture of Chalco in reign of Aztec King Chimalpopocha 1400-1428.

Dark centre is green jade. set in red surrounded by white.

(FROM THE J. COOPER CLARK'S CODEX MENDOZA, BODLEIAN LIBRARY).



Mexican Kunz collection. Votive Adze of jadeite.

(Courtesy of American Museum of Natural History.)

history they must have been contemporary with the Toltecs, it is generally agred that they were a more ancient race.

For convenience of study the Maya history has been divided into two parts. The Maya Old Empire is roughly dated from the third to the seventh centuries A.D. The second Empire flourished from the eleventh to the fifteenth centuries A.D. These dates have been taken from inscriptions on important sites. S. K. Lothrop, of the American Indian Museum (Heye Foundation), writes : "At the close of the sixth century A.D. the Mayas abandoned their southern cities and embarked on a period of wandering, interrupted by temporary settlements. Finally, about the year A.D. 1000, the foundations of the great cities were laid and the Maya entered on a period usually called the Renaissance. All the Maya, however, did not move to Yucatan ; a large number settled in the highlands of Guatemala."

Of recent years the term pre-Maya has come into existence, and this race was certainly neither Mongoloid nor aboriginal. Legends say they were white, bearded and tall.

From his own studies Kraft (see above) believes that the order of values in the Aztec empire, as material for jewel and votive pieces, was first jade, then turquoise and finally gold. Edward Seler, of the University of Berlin, visited America in 1902 and later referred to the extraordinary value that jade possessed both to the Aztecs and the Mayas. He spoke of an ancient commercial road leading from the Highlands of Mexico to Tabasco and Yucatan, and to the Rio Montagua in Guatemala. " Along this road," he wrote, " there had grown up trading stations where the Mexicans met the Mayas and jade was an important article of traffic at these points." G. F. Kunz, quoting Seler, said : " . . . It is surprising how the Chinese, the Swiss lake-dwellers, and the ancient Mexicans, recognized correctly the water-worn iron-stained and apparently unrecognizable pebbles, as jade or jadeite, whether they were selected for an art object, a celt or tool, or for an ornament."

So important was jade to the Mexicans and their forbears that no book on the country itself or its history can ignore it. In 1947 a volume appeared entitled *Mexico South.* The author (M. Covarrubias) wrote: " While the Mexicans often placed jade beads in the mouths of corpses, the Chinese 2,400 years ago placed a cicada of jade in theirs. Although these parallels are most likely coincidental, it is hard to explain why both Chinese and Mexicans painted their funeral jades with a coat of bright red cinnabar. Furthermore, the style of ornamentation of some of these jades is often strikingly similar, variations of the squared spiral motive . . . Jade was to the Mexicans, as well as to the Chinese, more than just a precious stone : it was worshipped as a symbol of everything that was divine and valuable. In Mexico the name chalchihuitl and the glyphs for jade were synonyms of ' jewel ' or ' precious '. (See sketch.) Jade was linked to rain, vegetation, life, and godliness. . . . Because of its rarity and great intrinsic value, it was reserved for the great. . . . The famous culture-hero of ancient Mexico was Topilzin Ce Acatl, in turn an incarnation of Quetzalcoatl* (a fair-faced, bearded god). He was the semi-divine sage, priest, and ruler responsible for all art and science of the Toltec nation, the Huang-Ti of America. Even his birth was miraculously achieved ; he was conceived years after his father's death, by means of a green jewel, a piece of jade that his mother had swallowed."

One of the earliest contributors to our knowledge of American jade was E. G. Squier. His famous paper, " Observations on a collection of chalchihuitls from Central America," was read in 1869, and, although nearly a hundred years old, is still quoted. Like everyone else who has handled these old documents he was endeavouring to sort out the various species included under a general heading. " The Mexicans," he wrote " nevertheless had true emeralds, of which we have left to us the most glowing descriptions. Gomara, a Spanish historian of the sixteenth century, describes particularly five large ones which Cortés took with him from Mexico to Spain at the time of his first visit, and which were regarded as among the finest in the world. They were valued at 100,000 ducats (approximately £45,000) and for one of them the Genoese merchants offered 40,000 ducats (approximately £18,000), with a view to selling it to the Grand Turk. Cortés had also the emerald vases, which the padre Mariana assures us, in the supplement of his *History of Spain,* were worth 300,000 ducats. They were reported to have been lost at sea. All these emeralds were cut in Mexico by Indian lapidaries under the orders of Cortés, and were most elaborately worked. One was wrought in the form of a little bell, with a fine pearl for a clapper, and had on its lip this inscription in Spanish . . . ' Blessed he who made thee ! ' The one valued most highly was in the shape of a cup, with a foot of gold. . . . Remarkable

* Quetzalcoatl — pronounced KAYT-ZAL-CO-AL.

as were these emeralds, Peter Martyr[2] mentions one, of which Cortés was robbed by the French pirates, that must have surpassed any of them in size and value. ' But what shall we speak of Iewelles and precious stones ? Omitting the rest, there was an Emerode like a Pyramis, the lowest part or the bottom thereof was almost as broad as the palm of a man's hand, such a one (as was reported to Caesar, and to us in the Kinges Senate) as never any human Eye behelde. The French Admirall is said to have gotten it of the Pyrattes at an incredible price.' (Decade VIII, c. 4) "

G. F. Kunz in *Gems and Precious Stones of Mexico* had something to say of these treasures sent to the King of Spain (also commented upon by a more modern authority).[3] " Many specimens of carved jade," he wrote, " were brought over early to Spain, but it is probable that the most remarkable were lost. Wonderful tales were told of the sacred articles of ' emerald ' belonging to Montezuma, including a goblet and a ' rose ' that were shipped by Cortés to the King of Spain ; among the choicest treasures of the conquest. Unfortunately the vessel that bore them foundered at sea, and these unique works were forever lost. It is impossible that they could really have been emerald, as that gem scarcely occurs in Mexico at all. They were probably chalchihuitls of peculiar richness of colour, and constituting doubtless both in workmanship and material the finest products of Aztec art. The most remarkable specimens now known of jadeite from Mexico are chiefly carved masks and pendants or celts and adzes, these latter often being carved and elaborately ornamented, showing that they are insignia of rank and not implements for use. Many of them retain on the back or sides portions of original rounded surfaces, proving that they were made from boulders. In several instances large pieces have been reduced by cutting out smaller portions from the back, leaving the carved surface uninjured—thus indicating increasing scarcity of high-priced material, which induced their removal of superfluous portions to make new objects, or perhaps some peculiar tradition or superstition, attributing special sacredness to pieces once belonging to some deceased chieftain, which might perpetuate to his successors by bestowing on them parts thereof, while the main original was buried with its possessor. . . . One of the most important recent discoveries of jadeite objects was made in the excavations at the Escallerillas in the City of Mexico, immediately at the back of the cathedral, which stands near or upon the site of the great ancient temple. This excavation was carried on during the years 1900 and 1901, and brought to light at least 2,000 beads of jadeite, also jadeite tablets, many hundred copper objects, and a large and beautiful knife measuring 32″ in length. . . ."

Perhaps the most outstanding excavation of recent years was that made by Alberto Ruz, Director of Research at Palenque, in Chiapas, one of the states of Mexico. There he unearthed a tomb that could vie with the most lavish of Egyptian tombs and where the majority of the gems were jades. Jade idols ; jade ear plugs (a popular ornament in that part of the world) ; a diadem made of tiny discs of jade ; a mosaic mask of jade that covered the face of the deceased and is thought to represent his features ; jade tubes ; jade beads ; jade cut into spheres, cylinders, flowers, fruit ; a bracelet of 200 jade beads on each wrist ; and rings of jade on the fingers. There were, too, symbols of rank in jade, and a dark jade bead in the mouth of the corpse as part of the funeral rites of the Mayans. It was noticed also that this Mayan potentate or ruler or king was taller than the Mayans of to-day, supporting early traditions on this subject of ancestors. He may not, of course, have been a Mayan. A king he certainly was. His date, worked out from Mayan reckoning, is believed to be around the seventh century A.D. This pyramid tomb of a prince of Palenque has been named the Temple of Inscriptions.

Writing of the treasures of this temple in *Gems and Gemology* (Summer, 1953), Ruz says : " . . . As for the jewels which we discovered in the tomb of the Temple of Inscriptions, we can state to-day that in their work of precious stones, the Palenquans were, likewise, great and refined artists. We have the impression that there did not exist for them anything impossible to accomplish in architecture, sculpture, and lapidary art, since their ingeniousness and artistic feeling permitted them to overcome any difficulty. This is evidenced by the complex shape of the beads, produced from irregular fragments of jade, whose original conformation was made use of to transform into flowers, full blown or partly open or closed, and in lengthened or spherical beads. Other evidences were the beads with lengthwise perforations through which the threads of a necklace passed transversely. Another is the perfect adaptation of fragments for mosaic, for which they used bits of broken jewels. A large bead has been scooped out and provided with two plaques for fastening it ; ear hoops were made of various constituents and skilfully fitted."

In the same journal Ruz writes of other important excavations, including that of Alfonso Caso in Monte Albán, State of Oaxaca, during 1932. Here the tomb rendered no less than 500 objects, many of gold, jade, turquoise and pearls. One extraordinary object was that of a rock-crystal goblet, and in this connexion Dr Ruz brings to notice, because of the rarity of such objects, that of the rock-crystal skull in the British Museum. Among the jade pieces, he tells us, were the handle of a fan in the shape of a serpent, the head of an eagle with eyes inlaid with gold, finger-rings, ear-rings, ear-hoops, and beads that once made up necklaces. Another important excavation mentioned was made in 1941 by Matthew Stirling in Cerro de las Mesa, on the coast of Vera Cruz. Here 782 pieces of jade were found in a variety of colours from milky-white to black, and also pale bluish. Writing in the National Geographic Magazine for 3rd September, 1941, Stirling says that " many of the figurines and objects of jade were as bright and shiny as on the day on which they were buried."

Stirling's words best portray his own finds : " There were two beautiful statuettes of blue translucent jade, four and five inches long, one realistic and in the round, the other flat and stylized. There was a splendid three-inch figure of a nude man, seated, with an extreme head deformation, carved out of green jade, a masterpiece of solid monumental sculpture. There was still another figurine in grey jade, covered with a coat of red cinnabar, and with a glimmering little disc of crystalline hematite stuck on its chest. It represents a plump girl wearing a skirt, with her hair hanging loose at the back and with bangs in front. Her face resembles those of the colossal heads and bears the same wistful smile that distinguished two of them. Also of the finest jade was a pair of green square ear-plugs engraved with eagles' heads, and a realistic replica in jade of a large clam shell, as well as a bulb-shaped object with a stem, a delicate copy of a stingaree's tail in clear blue jade, a paper-thin little mask of a duck's head, and a number of emerald green jade beads shaped like sections of bamboo. . . . Hundreds of jade axes, generally in groups of thirty-seven, were found buried at various places, undoubtedly offerings, carefully arranged in rows and in groups, apparently with a magic purpose in mind. . . ."

In his 1943 season of excavation, Stirling found Olmec figurines (Olmec culture approx. 500-100 B.C.) this time with eyes inlaid with hematite, more axes, and endless objects of jade, many made out of the precious emerald-green clear variety called in China (and in North America to-day) "jewel jade," and known previously to come only from Burma—now found in America for the first time. "Nothing like the discoveries of La Venta[4] have ever been made before, and the identity and cultural connexions of its inhabitants remain shrouded in mystery."

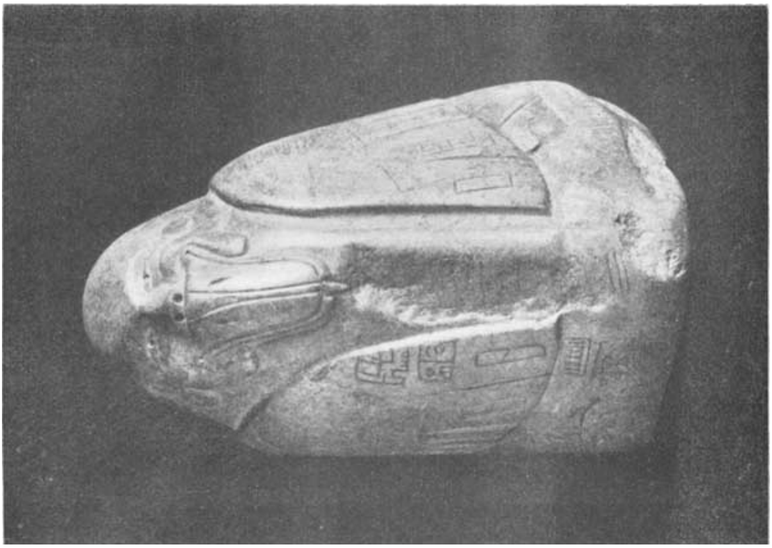
Squier describes one piece among the collection he examined as bearing a resemblance to the engraved Assyrian seals "or, as they are sometimes called, 'Chaldean' cylinders. It is a perforated cylindrical piece of heavy, opaque stone, of a dark sea-green colour (nephrite ?), two inches long by an inch and one-tenth in diameter. In a kind of oval, or what Egyptian scholars would call a *cartouche*, is presented the profile of some divinity (the Maya god of death ?), with the eye closed and the tongue depending from the corner of the mouth. Something like claws, engraved on the projection of the cylinder, start out from the cartouche, on the left side. The whole is boldly and sharply cut, and highly polished. This relic was obtained from the island of Flores, the ancient Tayasal, in the lake of Itza or Peten, in Yucatan. Among the things found by the conqueror of the Itzaes, Ursua, in the temples which he destroyed on the island in 1697, he mentioned 'an idol of emerald a span long, which' said the chronicler 'he appropriated to himself.'"

Dated 1901 is an account, of an exploratory nature, written in German by Teobart Maler and later translated. The author's own words (again) best tell the story : "We reached El Caso on 20th May. (1897.) Here too the river afforded a magnificent panorama. . . . Here the mineralogist can gather an interesting collection containing specimens of all that are buried in the heart of the most distant mountains of Chiapas and Guatemala. . . . Many species of stone are found here. I thought I recognized carnelian, syenite, jadeite, ophite, hematite, pure white marble of the finest grain, very pretty pieces of petrified wood, etc. These stones, the most of which are extremely hard, are of all colours, many are striped with several colours. . . . On the following day we undertook an exploration of the ruins of the Budsilhá, which according to our estimate must be six kilometres below La Mar. . . . On the summit of the rock standing alone not far from the waterfall, some monteros,

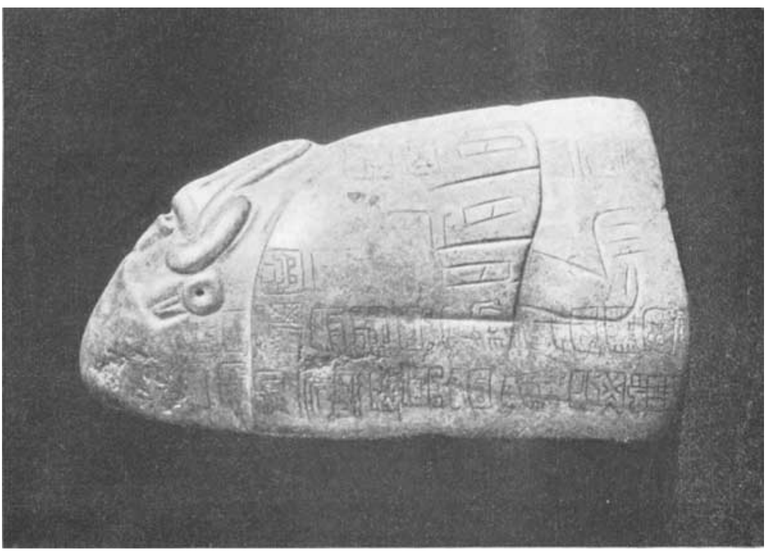
Tuxtla statuette,
Tuxtla, Vera Cruz,
Mexico.
Height 6";
base $3\frac{7}{16}$" by $3\frac{15}{16}$".
Jadeite-diopside.

(Courtesy of the Smithsonian Institution).

roaming about some years ago, found a small figure of hard green stone (jadeite), which subsequently through the instrumentality of Sr. Mejenes came into my possession at Tenosique. In ancient Mexico the manufacture of objects from hard stone was the work of skilled stone-cutters, and the profession descended from father to son. Certain villages were especially famed for such works in stone, which as articles of trade were carried far and wide. As such objects are indestructible they may belong to the most remote period and place—wherever they are found—and their origin can



Further views of jadeite-diopside statuette, Tuxtla, Vera Cruz.



(Photographs by courtesy of the Smithsonian Institution).

be determined only by comparison. At first I was only able to recognize that the little figure from Budsilhá originated among a people having a head of pronounced oblong shape ; later it proved that the shape of the face, especially the mouth, is similar to that of the god from what was once the principal temple of San Lorenzo on the lower Lacuntun. The little jadeite figure is 14cm. long and represents a man standing erect with his left arm against his waist and his right arm across his abdomen. He wears a girdle (maxtli, mastli), the loop of which falls down in front. Small ornaments are delicately worked on the knees and breast. He has no head covering, and there are no discs attached to his ears. The small hole through the centre suggests that the figure may have been worn on a necklace or attached to some object." A little further on the author is describing the figure of Ketsalkoatl (Quetzalcoatl) " placed upon the step in a niche, sitting cross-legged in Asiatic fashion . . . the god had oblique eyes (that is, Chinese or Mongolian eyes). . . . It is undeniable that these images of gods in Zaxchilan and Piedras Negras, sitting cross-legged in their niches, and wearing serpent headdresses or turbans, are strongly suggestive of the Indo-Turanian representations of Buddha. At all events the oblique eyes indicate Turanian[5] origin, even if the historical reason why the principal god of the Maya-Toltec (Ketsalkoatl ?) displays Turanian type may not be clear to us. But where history is mute monuments are eloquent."

The ancient city of Teotihuacan about 30 miles north-east of Mexico City was an early Toltec capital, which the later Aztecs never apparently restored or used. Although Aztec influence extended from sea to sea, certain areas held their independence. Teotihuacan was conquered in 1429, yet appears to have held no importance in Aztec eyes. Research was carried on there recently by S. Linné of the Ethnographical Museum of Sweden and here he found the datable finds of the Aztec era scanty when compared with those of the older culture. A jade plaque discovered there, and now in Mexico, was studied exhaustively by Thomas Gann.[6] This plaque he described as consisting of two distinct laminae, " the curved surface being of bright apple green, the back of dull translucent blue with intrusive veins of green penetrating it obliquely. It is 14 cm. in length, 14 cm. in breadth at the widest part, weighs 1 lb. 4 oz. and is bored completely through its upper margin, probably for suspension. Apart from the fact that it is, both in workmanship and quality of material," Gann wrote, " one of the most beautiful examples of jade ever found in America, this plaque is of extraordinary interest, as it proves conclusively the existence of intercommunication between Teotihuacan, the Toltec capital, and some Maya city of the Old Empire." Gann adds : " The design is typically and unmistakably Maya. . . . How this remarkable ornament, which among the Maya must have been regarded as the Koh-i-noor diamond is in the modern world, can have found its way across the long distance and through many hostile tribes separating the Toltec capital from the nearest Maya city, is one of the mysteries for which no solution is ever likely to be forthcoming."

Says another writer:[7] " Finely carved jades were undoubtedly regarded by the Mayas as objects of great value. They could be passed from generation to generation and could be traded in different parts. In most cases one cannot rely on the circumstances of their discovery to evince their origin and often the only clue is the style of the carving itself, at best an uncertain criterion, especially as conclusions must be based largely on analogy with arts of different technique. Fortunately a few jades were inscribed with dates, and when these dates can be related to inscriptions on monuments they sometimes furnish more reliable evidence than does either style or stratigraphy."

Undoubtedly the most famous jade piece thus far discovered in the Americas is the so-called Tuxtla statuette, reproduced here, and now in the U.S. National Museum in Washington, D.C. Most authorities agree that this masterpiece was the work of a pre-Maya race, suggesting that the date on the object had been added later, perhaps by the Mayas when the statuette was first discovered. Some have associated it with the enormous stone statues freely discussed in recent years. The Tuxtla statuette (pronounced Tushtla) is 6 inches high and $3\frac{7}{16}$ inches wide at the base It acquired its name from the place of its discovery around 1907, at San Andres Tuxtla, in the State of Vera Cruz, Mexico. It is the earliest dated Maya jade object found *outside* the region where Maya civilization was known to have flourished, which may be one reason for suspecting it to be pre-Maya, and contributes to the theory that, whatever this unknown race, it had spread itself over a wide territory. According to Gann (*An Unknown Land*, 1924) this statue bears a date in the early part of cycle 8 in Maya chronology, or about 100 B.C. He writes : " If that statuette was made where it was found it would indicate that we must look for the birthplace of the Maya civilization in this region, rather than 200 miles to the south where it attained its highest development." If, therefore, this date is correct, it antedates the coming of Columbus by something like 1,600 years. We are told that the statuette represents a priest dressed in ceremonial bird costume, the whole a pale-green variety of jadeite. " In carving this figure," Gann continues, " the Maya artist—one with great ability and a feeling for realism rare in Maya art—has evidently been constrained to adapt his design to the shape of the boulder. Remains of the original water-worn surfaces are clearly visible on the front, on the left side, and on the back. . . . It is impossible as yet to read the Maya hieroglyphs that run vertically down the sides and back, but students of American archaeology now know very well the characters used by the Mayas to express numbers and dates, so that we can interpret the hieroglyphs that appear on the front of the image."

Henry S. Washington, a geophysicist, writing in 1926[8] said: " The material of the statuette is composed, obviously, of jade and the present study by optical and chemical methods shows that the material is not nephrite, as once thought, but a variety of jadeite. . . . Through the kindness and courtesy of Dr. W. H. Holmes, to whom I would express my sincere thanks, I was privileged to examine the figure in the geophysical laboratory and to remove enough material for chemical and optical studies. . . . The rounded conical image (flattened at the back) represents an oldish man, bald headed, with the beak of a duck-like bird masking the lower part of the face, and moustache-like features connecting the nostrils and folding down over the cheeks. If the carving represents a god, he must have been a beneficent one for there is a merry twinkle in his eyes and a suspicion of a smile behind the beak that are facial characteristics, widely different from the usually repellant features of gods as they are frequently depicted on the Mayan monument."

Among the earliest dated objects, after the Tuxtla statuette, is that known as the Leyden Plate, " one side of it inscribed in shallow lines, now much worn, the figure of a king or warrior, and upon the reverse a Maya inscription." It was found during the construction of a canal connecting the Rio San Francisco del Mar with the Rio Gracioza on the frontier of British Honduras and Guatemala in 1864. This also is of jadeite and etched upon it is an ancient date of Maya history—one interpretation is that of 320 of our times, another as A.D. 61. Found at a very great depth, by a Dutch civil engineer named S. A. von Braam, it was given by him to the Ryks Museum in Leyden, Holland, and so acquired its name. About 8″ high, this celt-shaped plaque has been described as "very pale jade of fine quality."

Closely linked with the Leyden Plate is the Humboldt Celt, a votive adze presented to Humboldt by Del Rio in 1803 when he was making a tour of Mexico. Humboldt deposited this celt in the Royal Museum at Berlin without commenting upon it. Lord Kingsborough[9] gave it its first illustration in Vol. V of his collection. But not until 1875, when Professor Fischer of Freiberg, to quote his own words "succeeded in rediscovering the precious and forgotten relic on the dusty shelves of the Berlin Museum", was any particular notice taken of it. This piece is also of jadeite and is 16·5cm. in height. The connection between the Leyden Plate and the Humboldt Celt is that both stones are almost the same shade of green, the unity of colour being interrupted here and there by flakes of a bluish hue. Both stones show the outlines of what is known in archaeology as the celt, and exhibit on their surface carvings of beautiful execution. They appear equal in size, 222mm. in length and 80mm. in width, though the top of the Humboldt celt is broken off. If restored it is reckoned that the length of the celt would be probably 275mm. Philip J. J. Valentino[10] writes : "There are essential points of difference between the two specimens. The Humboldt jade has the full form of a celt, namely that of a wedge. It is bi-convex, with a thickness approximating to 34mm. The edge approaches the crescent form. The Leyden specimen, on the contrary, is almost flat and only shows the well-known celt form in its outlines, with an average thickness of 5mm. On closer examination a slight bevel will be noticed from the edges towards the axis, on both surfaces of the plate, exhibiting therefore rather a tendency to bi-concavity. . . . Let me at this time state the fact that by far the greatest number of *chalchihuites* gathered from the hands of natives at the time of the conquest, and in the course of the following centuries, have turned out to be falso-nephrites. Genuine nephrites must have been employed by the earliest generations for they are distributed only in ancient graves, or in the soil at a considerable depth, or at the foot of ruined buildings, of which the natives themselves attest that they did not know what kind of people built them. However, their cult, calendar, ceremonies, and usages so acknowledged were derived from ancient times. Among their ceremonies, as we learn, the entombing of the deceased with a green stone on his tongue was considered a religious duty. A considerable number of *chalchihuites* must have therefore been annually consumed."

G. F. Kunz writes (*Gems and Precious Stones of North America*) that the Humboldt Celt has a thickness of $1\frac{2}{5}''$ and the Leyden Plate $1\frac{1}{5}''$. From the fact that the two, if placed together face to face, have exactly the same outline, it is highly probable that they were originally part of one and the same celt and it is quite possible that remaining parts may be found."

During 1862, one, Daniel Wilson, was writing of another axe that had an interest for Humboldt. He says : " Humboldt figures in his ' Vues des Cordilleres ' a hatchet made of compact feldspar passing into true jade, obtained by him from the professor of mineralogy in the School of Mines at Mexico, with its surfaces covered with graven figures or characters. In commenting on this interesting relic, M. Humboldt adds : ' Notwithstanding our long and frequent journeys in the Cordilleras of the two Americas we were not able to discover the jade *in situ* and this rock being so rare we are the more astonished at the great quantity of hatchets of jade which are found in turning up the soil in the localities formerly inhabited, extending from the Ohio to the mountains of Chili. Here also we have a glimpse of widespread ancient trade and barter carried on throughout the American continent in ancient times and of a wide intercourse embracing North and South America, that the investigators of the traces of a former civilization have been willing to recognize '."

Kunz described what he believed to be the largest jadeite adze yet to be found. It is now known as the Kunz adze and illustrated here. " On its face is figured a grotesque human figure, and for a hard material the workmanship is excellent. It is believed to have been found in Oaxaca, Mexico, and measures $10\frac{13}{16}$ inches in length, 6 inches in width, $4\frac{5}{8}$ inches in thickness, and weighs 229·3 Troy ounces. . . . The colour is light green with a tinge of blue, and streaks of an almost emerald green on the back. In style and ornamentation it very closely resembles a gigantic adze of granite . . . it has almost a counterpart in the green adventurine quartz adze now forming part of the Christy collection in the British Museum. . . . From all appearances this adze was shaped from a boulder, since weathered surfaces, such as appear on all sides of it would be found only on an exposed fragment. . . . The lapidarian work on this piece is probably equal to anything that has been found, and the polishing is as fine as that of modern times." Kunz goes on : " The next most important specimen is a large jadeite celt described by A. B. Meyer[11] as belonging to the Royal Ethnological Museum at Dresden. This, however, weighs only 7 pounds and is wholly devoid of ornamentation."

Of Mayan Jades, Gann wrote: " From the earliest days of the Old Empire, a period going back at least fifteen centuries before the arrival of the Spaniards, green jade was regarded by the Maya of Central America as the most valuable of all the precious stones known to them. Both among the later Maya and the *Nahuatl* tribes, skilled lapidaries, whose occupation was hereditary, devoted their lives to fashioning it into such objects as ear plugs, gorgets, labrets, wristlets, anklets, and beads, many of them exquisitely engraved with human and animal figures, and far, to us naturally, the most interesting with hieroglyphic inscriptions, recording the contemporaneous dates of the objects upon which they were engraved." He observes : " The Leyden Plate was found in making an excavation for engineering purposes, and was not associated with any grave or ruin. How is such an extremely valuable object, as this must have been, come to have been lost by its owner nearly 2,000 years ago is difficult to imagine. Small and very valuable objects such as jade ornaments were probably carried for long distances in ancient times, either in the course of trade or as gifts from one ruler to another, and the probabilities are that places in which they are found are not usually their place of origin, and may not be within many hundred miles of the latter. The fact that two of the earliest known Maya dates are inscribed upon small objects, and not, as are the majority of the later ones, upon great monoliths, would tend to show that the invention of the Maya calendar and hieroglyphic systems antedated the custom of erecting stone monoliths at regular intervals, by a considerable period, though by how long our knowledge of the early history of the Maya is not at present sufficiently advanced to enable us to hazard a guess."

Gann goes on : " Carved Maya jade affords an extremely fascinating study for the archaeologist, as next to the great sculptured monoliths and the painted stucco walls, it formed probably the chief channel through which the Maya artist found expression for his artistic conceptions. Bound down as the Maya were by religious conventions in painting, wood carving, and sculpture in stone, some of these jades compare favourably with the best Chinese and Japanese work, both in technical skill and in the beauty of the material used."

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6. Thomas Gann. *Maya Jades.*
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8. *Scientific American.* August, 1926.
9. *Journ. Gemmology*, Jan., 1959, p. 26.
10. P. P. J. Valentino. *Two Mexican Chalchihuites*, Proc. of the American Antiquarian Soc., Oct., 1880-Oct., 1881, Vol. 1, p. 283-303.
11. *Journ. Gemmology*, July, 1955, pp. 142 and 143.

ASSOCIATION NOTICES

A book-plate has recently been designed for the Sir James Walton Memorial Library, which is administered by the Gemmological Association and the National Association of Goldsmiths.

The interest in this comprehensive trade library is quite remarkable and both organizations are grateful for various contributions that have been made of books, gems, minerals and donations. The book-plate was designed by Mr. C. Cullen.

TALKS BY MEMBERS

Atkinson, J. C. : " Gemstones, synthetics and imitations," Newcastle West Rotary Club, 31st August, 1959.

Bowden, A. : " Gemstones," Cawsand, R.A.M.E. Women's Institute, Cornwall, 18th September.

Warren, F. : " The story of diamond," Bedminster Rotary Club, August, 1959.

MEMBERS' REQUIREMENTS

Tourmaline tongs and quartz wedge. Ref. : 591.

GIFTS TO THE ASSOCIATION

The Council of the Association records with appreciation the following gifts :—

A collection of about 150 rough minerals, for teaching purposes, from John R. Fuhrbach, B.Sc., F.G.A., C.G. Texas.

A zircon crystal from C. V. Powell, Ltd., Cheltenham.

A number of books for the Sir James Walton Memorial Library from Professor W. F. Eppler including " The book of the pearl " by Kunz and Stevenson; " The production of precious stones in 1902, 1903, 1906-10, 1929, by various authors; " Queensland gems " by J. R. Sankey; " Gems and ornamental stones of California " by L. E. Aubury; History of the gems of N. Carolina " ; " Gems and precious stones of N. America " by G. King; " The diamond mines of S. Africa " by G. F. Williams," and various other texts.

EXAMINATIONS, 1959

The 1959 examinations attracted a large number of candidates and 183 sat for the preliminary and 60 for the diploma. Centres for the examinations were established in Australia, Canada, Ceylon, Finland, Germany, Holland, Kenya, New Zealand, Nigeria, Norway, South Africa, Southern Rhodesia, Switzerland, Thailand and the United States of America, apart from the United Kingdom.

Upon the recommendation of the examiners the Tully Memorial Medal has not been awarded. The Rayner prize has been awarded to Mr. P. W. T. Riley of Chester.

The following is a list of successful candidates, arranged alphabetically :—

DIPLOMA

Qualified with Distinction

Blignaut, Adi, Johannesburg
Davis, George, Glasgow
Mendelsohn, Michael, Cape Town
Phillips, Alan L., Bardsey, Nr. Leeds
Shane, Leon, Toronto
Stocker, Philip L., London
van der Vlerk, Hendrik T., Schiedam, Holland

Qualified

Allden, Arthur G., London
Battersby, Keith W., London
Bergan, Kjartan E., Oslo
Betts, Geoffrey N., Birmingham
Britchfield, Charles F. J., Gravesend
Brousseau, Murray P., Toronto
Buckler, Albert N., London
Buitenen, A. Th. Chr. v., Jr., Holland
Bykersma, Barbara T., Toowoomba, Australia
Durrant, Anthony W., Ipswich
Engstrom, Hans W. E., London
Etienne, Lorette, Bangkok
Feer, Beatrice D., Geneva
Fitzpatrick, Noram R., Glasgow
Gaudernack, Lilly, Sandvika, Norway
Griffiths, William H., Birmingham
Gryska, Stephen, Worksop
Hall, Edwin F., Smethwick
Hope, Kenneth, London
Kay, Jonathan G. D., Liverpool
Kelley, William E., Lakewood, U.S.A.
Langton, Edward G., London
Marshall, Michael, Hull
Maund, Ann, London
Meadows, Everard C., Purley
Neil, Peter, Glasgow
Patience, Kenneth, Louth
Pilot, Lawrence M., London
Pragnell, John W., Bournemouth
Raven, Robert H., Chelmsford
Sack, Karl A., San Diego, U.S.A.
Schaffner-Allemann, Susanne, Basle
Schoien, Magnus, Skien, Norway
Seneviratne, Seetha, London
Shapland, Roger S. C., Cookham Dean
Sidoli, Jules, London
Smith, James S. A., Glasgow
Wall, John S., London
Whitehead, Henry J., Edinburgh
Weatherhead, Albert V., Wellington, N.Z.
Yates, Roy F., Manchester

Preliminary Qualified

Asmodt, Knut, Oslo
Abhyankar, Jagannath S., Bombay
Arend, Robert, Toronto
Beach, Michael L., Twickenham
Bearman, Janette O., Barking
Bills, Raymond F., Streetly
Burton, John R., London
Burwood, James R., Coventry
Bykersma, Barbara T., Toowoomba, Australia
Calderwood, Barbara J. R., Dalrn
Chalcroft, Pamela, Edinburgh

Charles, Russell J., Camp Hill, U.S.A.
Charles-Jones, Julia, London
Childs, Alan J., Hornchurch
Christophersen, Einar, Sandnes
Church, Bruce A., Wakefield
Collins, Christine D., Wolverhampton
Edge, William S., Glenelg
Elout, Helen, Holland
Erichsen, Bjørn T. N., Horten
Fernandez, Cyril W. A., Bombay
Finucane, Alfred D., London
Fisher, Leonard G., London
Fisher, Peter J., Cookstown, Co. Tyrone
Frith, Kathleen C., London
Gunnari, Tuula-Pia I., Helsinki
Gustafsson, Ethel K., Helsinki
Goward, David E., Matlock
Havem, Unni, Oslo
Heesom, Thomas H., Altrincham
Heikkila, Heikki S., Helsinki
Hinks, Peter J., London
Hool, Rene H., Rotterdam
Horrox, Conrad, Manchester
Hunter, John W., Glasgow
Hyman, Geoffrey M., St. Annes
Jackson, Jane K., Glasgow
Johnston, Suzanne S., Edinburgh
Johnstone, John M., Wirral
Juste, Robin L., South Brent
Kaksonen, Yrjo E., Helsinki
Kaskimies, Keijo L., Helsinki
Kelley, William E., Lakewood, Ohio
Kenworthy, Margaret, Bramhall
Kociumbas, Joseph, Toronto
Kothari, Udai C., Jaipur City
Kutner, Madeleine C., Coventry
Lee, Kenneth A., London
Lusty, Kenneth C., Chester
Mackay, George A., Glasgow
Mackenzie, Duncan, Greenock
McTurk, George L. C., Edinburgh
McCartan, Charles A., Edinburgh
McMillan, Archibald, Edinburgh
Mahbubani, Lal B., Calcutta
Masters, Christopher R., Blackpool
Meadows, Everard C., Purley
Mikkola, Toini, Helsinki
Mortimer, Frederick, Loughton
Muggli, Berta, Meggan
Nimalasuria, Nanda, Colombo
Norman, Michael S. J., Bath
Nyman, Yrjo I., Helsinki
Øiesvold, Arild, Arnes, Norway
Øiesvold, Odd, Jessheim, Norway
Orkomies, Lotta, Helsinki
Palmer, John R., Southend-on-Sea
Parsons, Elizabeth M., Leicester
Patni, Chandulal G., Nairobi
Piper, Robert W., Guernsey
Powell, Roy, Wanganui
Pyke, John S., Wirral
Riddell, Eileen R., Armagh
Rowley, Clement J., Stoke-on-Trent
Sack, Karl A., California
Saller, Xaver, Munich
Sarin, Baldev K., London
Schidlowski, Dietrich, Pretoria
Schofield, John, Stalybridge
Scorer, Brian, London
Shane, Leon, Toronto
Sidoli, Jules, London
Slack, Ernest H., Manchester
Snaddon, James, Sale
Springall, John E., London
Stuart, Donald R., Scarborough, Canada
Sundqvist, J. A. M., Helsinki
Stoodley, Simon A., Eastbourne
Tannum, Brit, Fredrikstad, Norway
Tarkkanen, Unto O. R., Helsinki
Taylor, Peter G., Hounslow
Tiley, Derek T., London
Truman, Peter W., Haslemere
Turton, George G., Bromsgrove
Waddington, Alfred M., Scarborough, Canada
Walker, George E., Toronto
Weatherhead, Albert V., Wellington
Webb, Herbert H., London
Wibbens, Jurjen, Schoonhoven
Wilding, Peter, Liverpool
Winchester, James H., Glasgow
Whitehead, Bernard, Birmingham

CANADIAN GEMMOLOGICAL ASSOCIATION

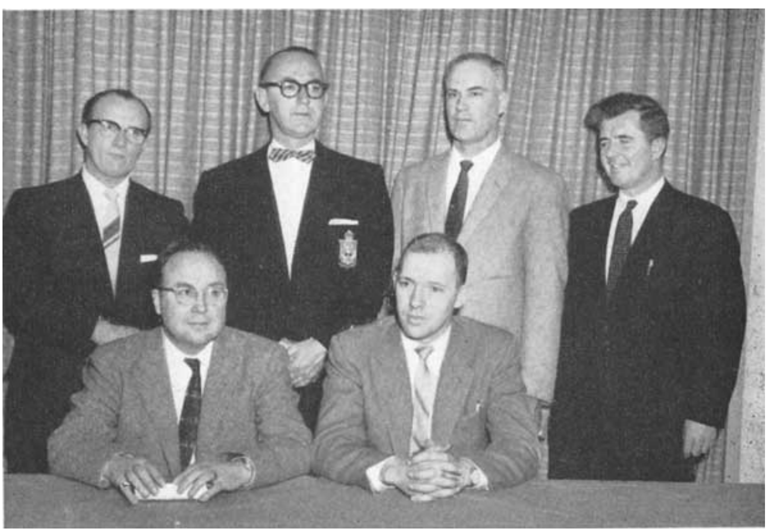
The Canadian Gemmological Association was incorporated by Letters Patent, December 1958, with headquarters at Toronto, Canada. Meetings are held, bi-monthly, at the Westbury Hotel, Toronto, with members and their friends being notified about a week in advance of such meetings. The following is a list of the executive officers :

President : D. S. M. Field, F.G.A.
1st Vice-President : J. W. Gunning, F.G.A.
2nd Vice-President : A. J. Ritchie, F.G.A.
Secretary : Dr. R. T. F. Boyd, F.G.A.
Treasurer : R. J. Wille, F.G.A.
Membership Secretary : J. Stitt, F.G.A.

The Advisory Board of the Canadian Gemmological Association comprises the following officers :

Dr. V. B. Meen, M.A., Ph.D., Royal Ontario Museum
Dr. W. M. Tovell, B.A., M.S., Ph.D., Royal Ontario Museum
Dr. D. H. Gorman, B.Sc., Ph.D., University of Toronto
H. M. Forth, Esq., G.G. (G.I.A.)
A. Lerman, Esq., F.G.A.
H. A. Creates, Esq., R.J. (A.G.S.)

The objects of the Canadian Gemmological Association parallel those of the Gemmological Association of Great Britain, and the rules and regulations governing procedure are also patterned after the British Association. The chief



R. T. F. Boyd, D. S. M. Field, A. Ritchie, J. Stitt, J. Gunning, R. Wille.

function of the Canadian Gemmological Association is to maintain in Canada the high standards set by the accredited gemmological bodies in other countries.

No attempt is being made to set up Canadian courses of study in gemmology. Membership is open to all students and gemmologists who have achieved standing in organized courses offered by accredited gemmological bodies in Great Britain, the United States, Australia and Continental Europe.

MEMBERS' MEETINGS 1959-1960

October	22	Medical Society of London Hall, 7 p.m. Questions and discussion evening.
„	22	West of Scotland Branch—visit to Glasgow Police Museum.
November	17	Reunion of members (6 p.m.—7 p.m.) and presentation of awards (7.15 p.m.), Goldsmiths' Hall, London, E.C.2. Lady Walton has kindly consented to present the awards.
January	21	West of Scotland Branch—Mr. R. Webster on " Gemmological problems."
„	22	Midlands Branch Meeting.
February		New diamond film " Stars that shine for ever," British Council Cinema. Date to be arranged.
March	4	Midlands Branch Meeting.
April	12	Herbert Smith Memorial Lecture. Dr. A. F. Hallimond on " Polarization." Goldsmiths' Hall, London, E.C.2., 7 p.m.
„	21	West of Scotland Branch Annual Meeting.
„	29	Midlands Branch Meeting.
May	5	30th Annual General Meeting, Saint Dunstan's House, London, E.C.2, 6.45 p.m.
June	4	West of Scotland Branch summer outing.

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