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ASSOCIATION
OF GREAT BRITAIN



GEMMOLOGICAL ASSOCIATION
OF GREAT BRITAIN

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THE DIAGNOSTIC RADIOGRAPHIC STRUCTURE OF PEARLS

By G. BROWN, Dip.D.T., F.G.A., F.G.A.A.

University of Queensland Dental School

Direct radiography of pearls has been used as a diagnostic technique since the early 1930s. It would appear that the Phillips Metalix Pearl Testing X-ray Unit was a pioneer design specifically produced for jewellers. This unit produced direct radiographs, x-ray diffraction radiographs, and x-ray fluorescence of unknown pearls.

For those gemmologists interested in the historical development of the use of x-rays for pearl testing, Webster ^(1,2) has published two fine reviews. Most gemmological text books ^(2,3,4,5) devote some space to a general discussion of the use of x-rays in pearl testing; however, this discussion is seldom given in depth. The neophyte pearl tester frequently finds his literature searches yield few useful details of radiographic technique. This apparent lack of technical information is readily explained, as no universally applicable technique exists which will reproducibly produce direct radiographs of pearls of diagnostic quality.

Pearl radiography must be conducted in a sequential manner, utilizing a range of exposure times, target-film distances, kilovoltages, shields, film types and development times, until a radiograph of diagnostic quality is produced. General guidelines do exist; these are well documented by Webster.^(1,2) If detailed guidance is required by the beginner, the gemmologist could do no better than to seek advice from a major pearl-testing laboratory.

Certainly, the average gemmologist does not possess the training, equipment, or legal authority to involve himself or herself in the radiography of pearls; however, it is important that a competent gemmologist does develop the necessary observational skills that will enable him or her to interpret a well prepared radiograph.

The radiographs and their accompanying diagnostic criteria, which are appended to this paper, aim to assist the interested gemmologist understand the potential diagnostic usefulness that direct radiography possesses for assisting the identification of pearls.

DIAGNOSTIC CRITERIA FOR PEARL RADIOGRAPHS

Type	Figure No.	Radiographic Characteristics
1. NATURAL PEARLS		
(1) WHOLE PEARLS		
(A) Salt Water Pearls		
(i) Oyster Pearl (<i>Genus Pinctada</i>)	Figure 1 (undrilled)	Central radiolucent cavity. Irregularly distributed radiolucent arcs and circumferential lamellae of conchyolin.
	Figure 2 (drilled)	Radiolucent drill-holes.
(ii) Abalone Pearl (<i>Genus Haliotis</i>)	Figure 3 (undrilled)	Irregular external form. Large irregular radiolucent central cavity. Radiolucent arcs of conchyolin.
(iii) Conch Pearl (<i>Genus Strombus</i>)	Figure 4 (undrilled)	Spherical radiopaque mass with no discernible structural characteristics.
(B) Fresh Water Pearls		
(i) Mussel Pearl (<i>Genus Unio</i>)	Figure 5 (undrilled)	Predominantly baroque shape. Fine circumferential arcs of radiolucent conchyolin.
(2) BLISTER PEARLS		
(A) Salt Water Pearls		
(i) Oyster Pearl (<i>Genus Pinctada</i>)	Figure 6 (undrilled)	Partial radiopaque external form. Regular radiolucent central cavity.

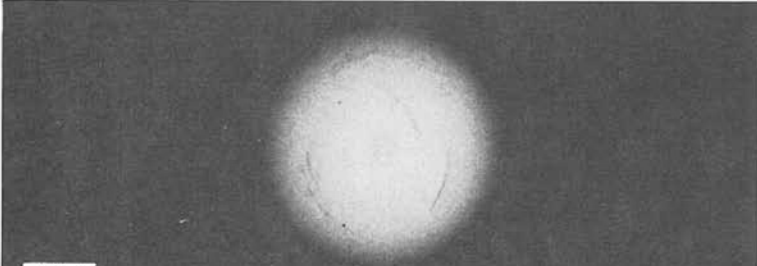


FIG. 1

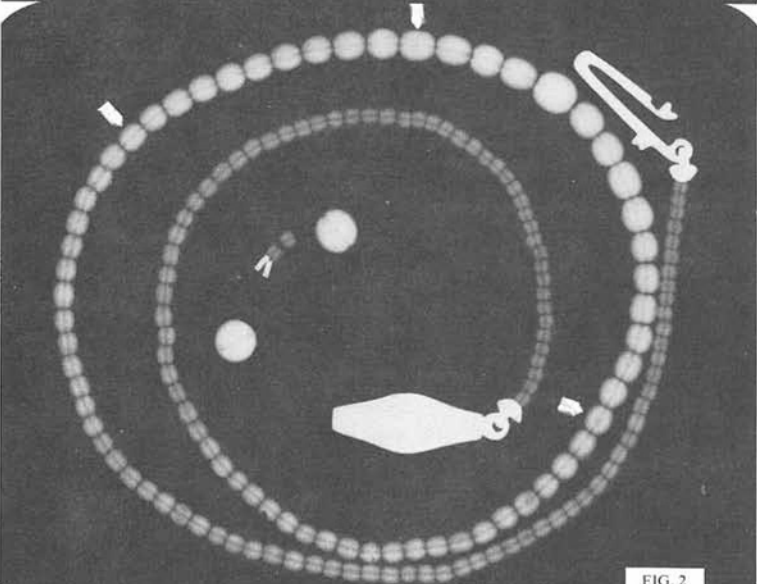


FIG. 2

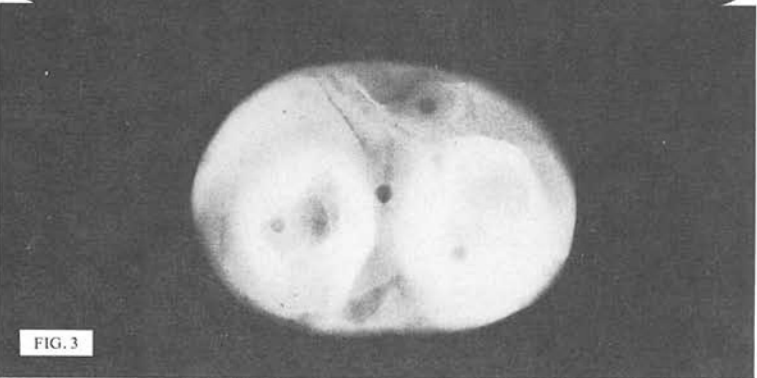


FIG. 3

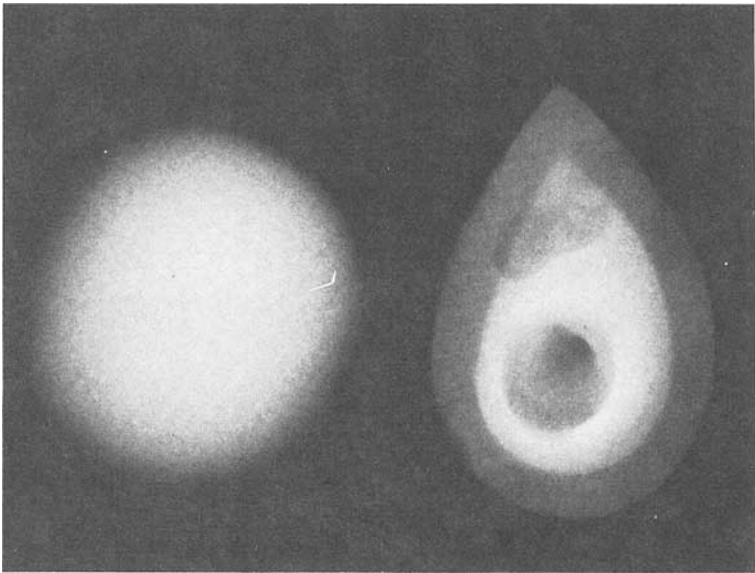


FIG. 4

FIG. 6

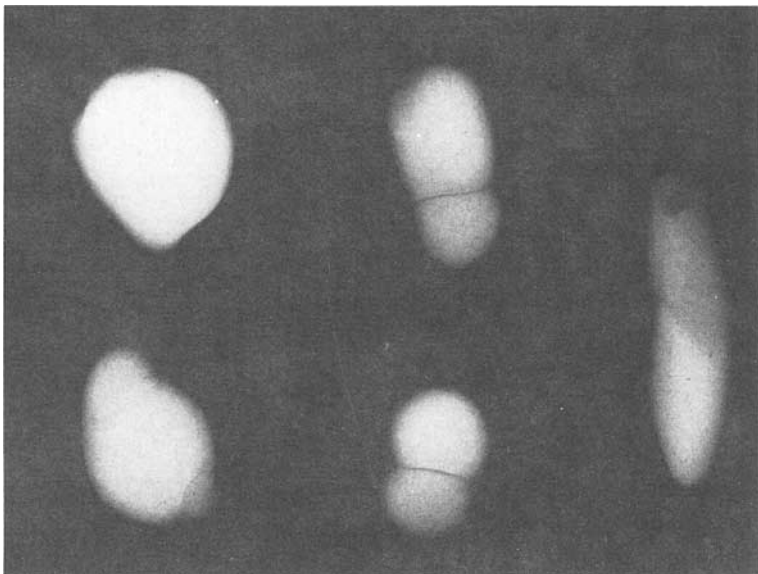


FIG. 5

2. CULTURED PEARLS

(1) WHOLE PEARLS

(A) *Salt Water Pearls*

(i) Bead Nucleated Pearls

- | | | |
|---|--------------------------|--|
| (a) Australian, Silver
<i>(Pinctada maxima)</i> | Figure 7
(undrilled) | Thin external radiopaque layer of nacre.
Thin continuous radiolucent layer of conchyolin (thick if baroque).
Large central radiopaque bead of mother of pearl. |
| (b) Australian, Pale Yellow
<i>(Pinctada maxima)</i> | Figure 8
(drilled) | Accessory radiolucent drill-holes to facilitate bleaching and dyeing. |
| (c) Japanese, Rosé
<i>(Pinctada martensi)</i> | Figure 9
(drilled) | Thin external radiopaque layer of nacre.
Thin continuous radiolucent layer of conchyolin.
Large central radiopaque bead of mother of pearl. |
| (d) Cook Is., Black
<i>(Pinctada margaritifera)</i> | Figure 10
(undrilled) | Mostly baroque shapes.
Thick irregular radiopaque external layer of nacre.
Thick/thin continuous radiolucent layer of conchyolin.
Large central radiopaque bead of mother of pearl. |

(B) *Fresh Water Pearls*

(i) Flesh Nucleated Pearls

- | | | |
|--|---------------------------------|--|
| (a) Japanese (Lake Biwa)
<i>(Hyriopsis schlegeli)</i> | Figure 11
(baroque, drilled) | Small baroque shape.
Irregular central radiolucent cavity. |
| | Figure 12
(oval, drilled) | Round/oval shape.
Small central radiolucent cavities often removed by the drill hole.
Note: fine circumferential lamellae of radiolucent conchyolin could not be detected. |
| | Figure 13
(undrilled) | Semi-baroque shape.
Irregular central radiolucent cavity.
Note: fine circumferential lamellae of radiolucent conchyolin could not be detected. |

(2) MABE PEARLS

(A) *Salt Water Pearls*

- | | | |
|--|------------------------------------|---|
| (i) Australian
<i>(Pinctada maxima)</i> | Figure 14
(side view, top view) | Thin hemispherical radiopaque layer of nacre.
Central radiopaque bead.
Radiolucent cement-filled space. |
|--|------------------------------------|---|

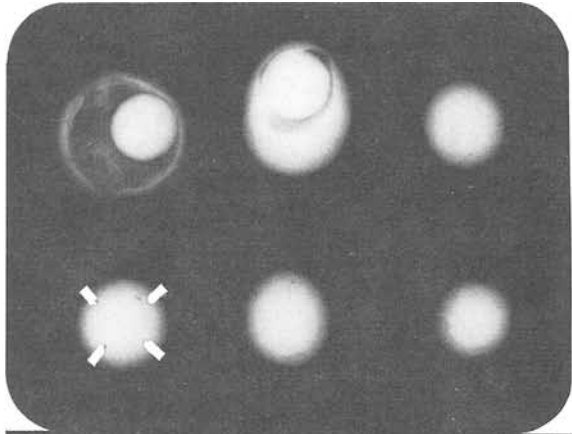


FIG. 7

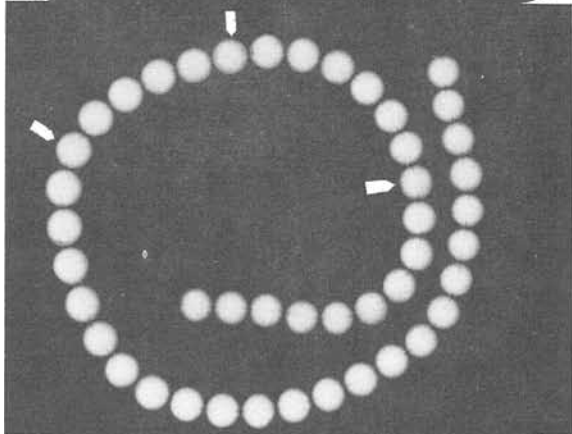


FIG. 8

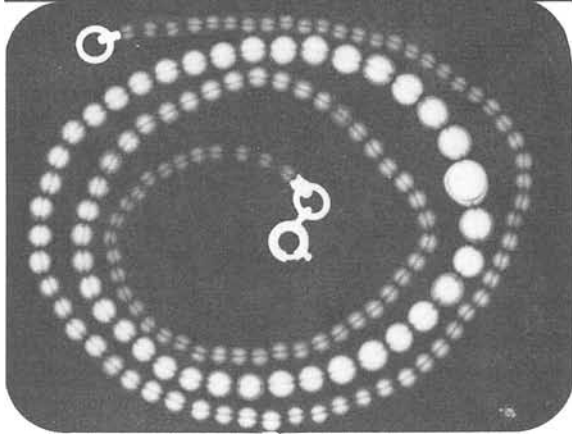


FIG. 9

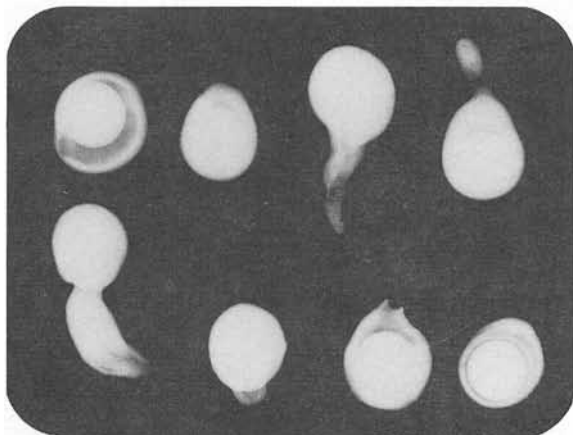


FIG. 10



FIG. 11

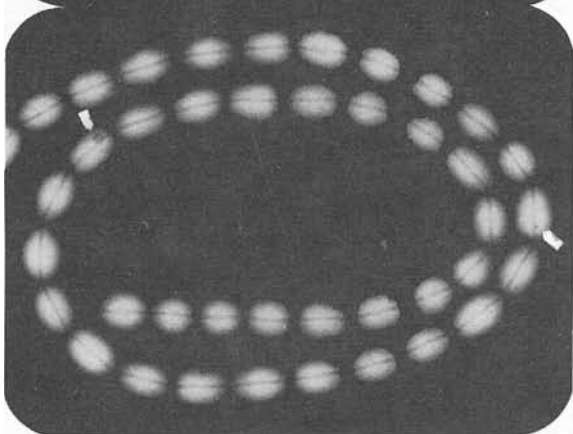


FIG. 12

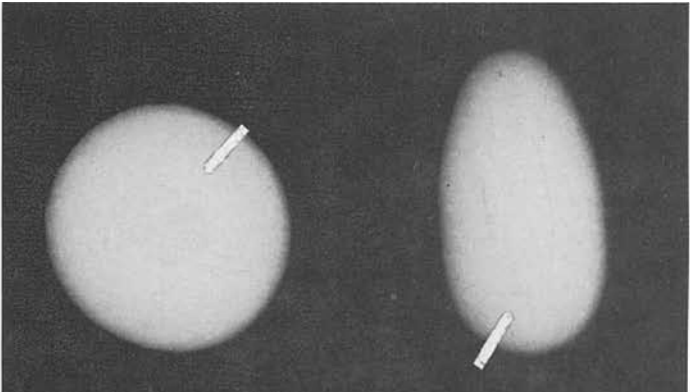


FIG. 13

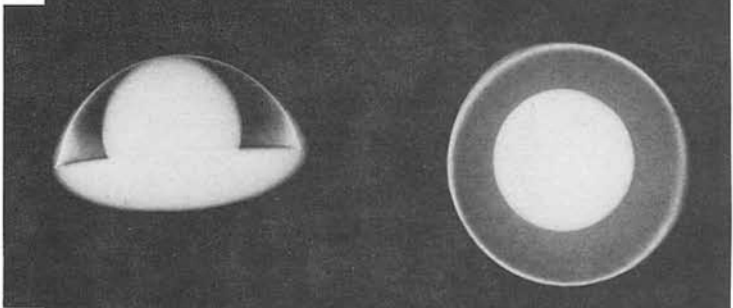


FIG. 14

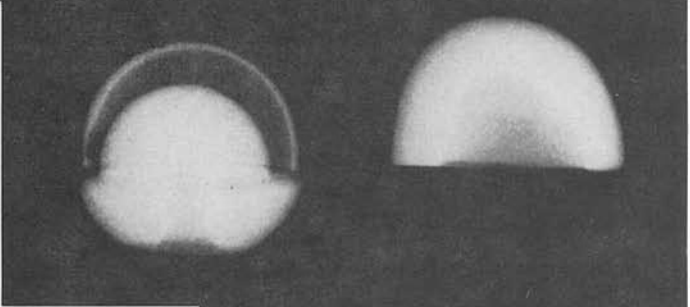


FIG. 15

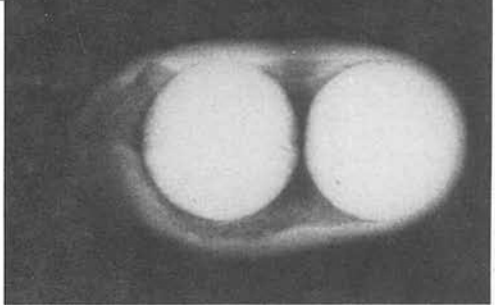


FIG. 16

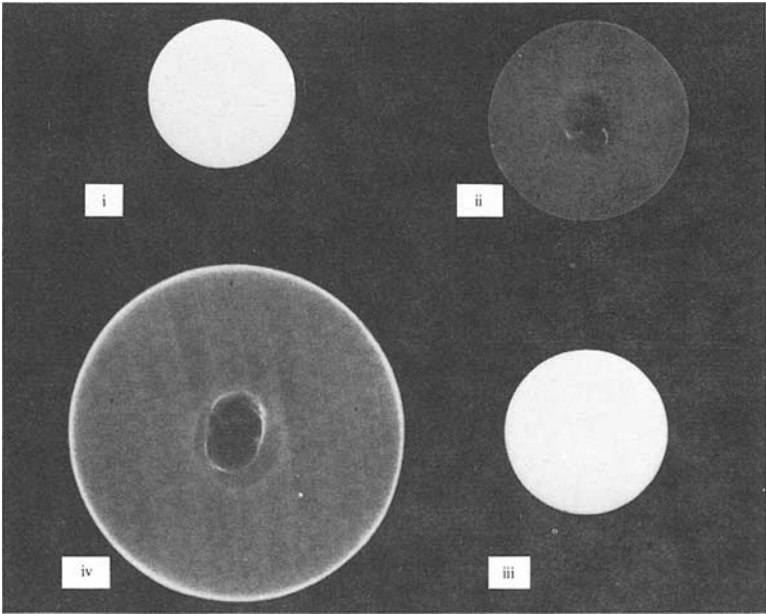


FIG. 17

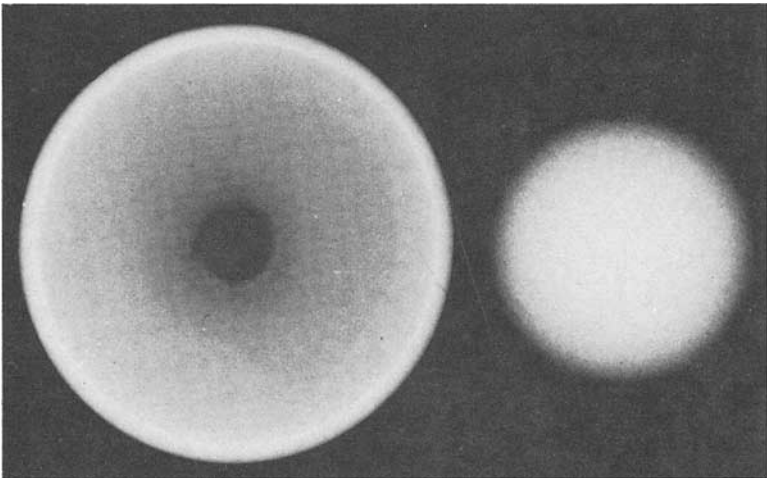


FIG. 18

FIG. 19

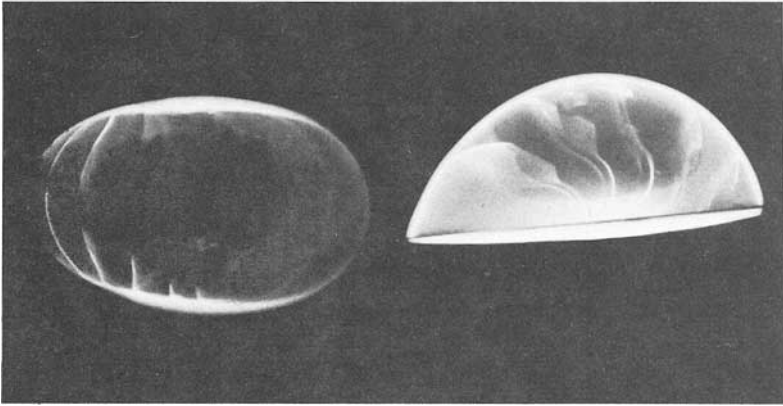


FIG. 20

- | | | |
|---|--------------------------|--|
| (ii) Japanese
(<i>Pinctada martensi</i>) | Figure 15 | Thin hemispherical radiopaque layer of nacre.
Fitted radiopaque backing of mother of pearl.
Thin radiolucent cement-filled space. |
| (3) CULTURING ACCIDENT | Figure 16
(undrilled) | Two radiopaque beads! |
| 3. IMITATION PEARLS | | |
| (1) ESSENCE D'ORIENT
COATED BEADS | | |
| (A) <i>Solid Glass</i> | Figure 17 (i) | Spherical radiopaque mass. |
| (B) <i>Solid Plastic</i> | Figure 17 (ii) | Spherical nearly radiolucent mass.
Thin continuous external radiopaque layer of essence. |
| (C) <i>Mother of Pearl</i> | Figure 17 (iii) | Spherical radiopaque mass with no discernible structural characteristics. |
| (D) <i>Solid Wood</i> | Figure 17 (iv) | Spherical nearly radiolucent mass showing the linear pattern of the wood grain.
Thin continuous external radiopaque layer of essence. |
| (E) <i>Wax-filled Glass</i> | Figure 18 | Spherical mass with a densely radiopaque exterior and a much less radiopaque interior. |
| (2) ANTILLES PEARL
(TURNED M.O.P.)
(<i>Conch Shell</i>) | Figure 19 | Radiopaque mass with no discernible structural characteristics. |

- (3) COQUE DE PERLE Figure 20 Internal radiopaque spiral whorls.
(*composite imitation made* (top view,
from the first coil of the side view)
internal spiral of the
Nautilus shell)

ACKNOWLEDGEMENTS

I wish to express my appreciation to the following people who have assisted me with this project: for provision of specimens—N. Barnes (Pacific Pearls), H. Mendis (Mendis Gems), R. O’Neil; for radiographic services—L. Street; for photographic services—D. Lund.

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[*Manuscript received 27th July, 1978.*]

BLUISH-GREEN ZOISITE FROM MERELANI, TANZANIA

By Dr K. SCHMETZER and Prof. Dr H. BANK

Since the first publication on the blue variety of zoisite, called tanzanite, from Merelani, Tanzania (Bank *et al.* 1967), this mineral has become an important gemstone. The colour is caused by traces of vanadium, replacing Al^{3+} in the crystal structure of zoisite (Hurlbut 1969). The absorption spectra of this blue zoisite have led various working teams to different interpretations of the absorption bands (Faye & Nickel 1971, Tsang & Ghose 1971). Most probably, the Al^{3+} -positions are occupied by tri- and tetra-valent vanadium ions (Schmetzer 1978). The colour change of the zoisite crystals from Merelani through heat treatment to approximately $500^{\circ}C$ is caused by the disappearance of an absorption band in the blue part of the visible spectrum (at $22\ 000\ cm^{-1}$). Pleochroism before and after heat treatment is as follows:

	crystals before heating	crystals after heating
X a	reddish-purple	reddish-purple
Y b	blue	blue
Z c	yellowish-brown	blue

Green zoisite from Longido in Tanzania, which is coloured by Cr^{3+} , was first reported by Game (1954). The absorption bands in its spectrum are attributed to Cr^{3+} -ions, which having been already described for vanadium, are located on Al^{3+} -positions in the zoisite lattice (Schmetzer & Berdesinski 1978). Some time ago one of the authors discovered among rough zoisite crystals from Merelani numerous bluish-green stones, showing a pleochroism differing from that of pure blue zoisite. When heated up to $500^{\circ}C$, these stones too changed their colour. The pleochroism of heat-treated and not heat-treated stones of this bluish-green type is as follows:

	crystals before heating	crystals after heating
X a	reddish-purple	reddish-purple
Y b	bluish-green	blue
Z c	greenish-yellow	bluish-green

The optical and crystallographical values of the bluish-green zoisites do not differ from the respective parameters of the blue zoisites. The absorption spectra of the bluish-green varieties show all bands of the vanadium bearing blue crystals from Merelani and those of the chromium bearing zoisites from Longido. Microprobe analysis confirms the spectroscopic investigation: the bluish-green crystals contain nearly equal contents of vanadium and chromium (0.06% V, 0.07% Cr), whereas the iron contents of bluish-green and blue zoisites from Merelani remain very low (0.001% Fe).

The bluish-green zoisite from Merelani must be regarded as coloured by both vanadium and chromium. We regret that we could not find out in which part of Merelani deposit these bluish-green crystals occur. Therefore there is no possibility to discuss the genesis.

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[Manuscript received 23rd March, 1979]

SOGDIANITE

By *ROLF DILLMANN, F.G.A.*

Gübelin A. G., Berne, Switzerland

In the journal of the German Gemmological Association, 2nd June 1978, I read an article by H. Bank *et al.*⁽¹⁾ about sogdianite as a possible gemstone which I found interesting. As good luck would have it, such a sogdianite was sent to me by a gem-supplier: this was a cabochon-cut stone weighing 6.27 ct and measuring 13.2 mm long by 10.2 mm wide (see Figure 1). Though I cannot be certain of my specimen's provenance, the stone examined by H. Bank *et al.* was said to have originated in the Wessel mine near Hotazel by Karuman, N. Cape Province, S. Africa, and to have been supplied by the firm Weinz-Nebert, of Kirschweiler, and as my stone was supplied by the same firm it may well derive from the same occurrence. As I had never seen such a gemstone before and as I did not find any mention of it in my gemmological library, I decided to investigate it with the gemmological means at my disposal. Here are the data as (apart from chemical composition) I determined them.

Sogdianite

chemical composition: $(K,Na)_2(Zr,Ti,Fe)_2(Li,Al)_3[Si_{12}O_{30}]$
 (after H. Strunz, 1970,⁽²⁾
 following W. D. Dusmatov
et al., 1968⁽³⁾)

colour:	lively violet
lustre:	waxy
transparency:	translucent
specific gravity: (by hydrostatic weighing, using distilled water with two or three drops of wash- ing-up liquid, at room temperature)	2.765



Fig. 1. Cabochon-cut sodgianite weighing 6.27 ct.

<p>hardness: (using a hardness plate and checked with Rayners' hardness pencils)</p> <p>microscope:</p> <p>refractive index:* (Dialdex refractometer checked by Topcon refractometer)</p> <p>luminescence:</p> <p>absorption spectrum: (by Cool-light Spectroscope with a Zeiss optic, having a wavelength scale: using a blue filter for clear view of lines in the blue)</p>	<p>5-6 (Mohs)</p> <p>bright veins visible (quartz?) white flakes (accumulation of bright veins)</p> <p>anisotropic ω 1.606 positive ϵ 1.608</p> <p>UV short very weak dark red UV long weak violet</p> <p>411 nm } 419 nm } sharp lines (diagnostic) 437 nm } 488—493 nm } 630—645 nm } weak bands</p>
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Personally, I should be pleased if these data found confirmation.

*The RI was measured on a thin slice taken from one end of my stone and polished. Repeated attempts to obtain the RI from the curved surface of the cabochon by the 'spot method' invariably resulted in a figure of 1.54: I cannot explain this discrepancy.

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[*Manuscript received 18th November, 1978.*]

REPORT FROM THAILAND, 1978

By K. W. FINDLAY, B.Sc.(Eng.), C.Eng., F.I.Chem.E., F.I.Mech.E., F.G.A.

On our second visit to Thailand*, in March, 1978, we wandered through Chantaburi looking for gem dealers—there must be several score but they all had faceted synthetics on offer. A few had garnets and green sapphires. The market in Chantaburi is a high-light tourist attraction; they sell all kinds of tropical vegetables and fruit, also fish, live crabs, eels, frogs and shellfish.

Just opposite the market square we came upon a Lapidary Supply Shop. The counter is shown in Figure 1. They had lap-wheels made in Red China, tongs, lubricants in bottles, hard grindstones. The varieties of colour of boules and half-boules from Idar-Oberstein show up very well.

It seems as if the Chantaburi gem areas have dried up as there is very little mining activity and practically nothing coming through from Pailin, Cambodia. Khau Ploy Waen (Figures 2-5) is now a sacred hill; Bo Rai, 48km due East of Chantaburi is a present source of rubies: it is only 7km from the Cambodian border, 12°36'N. 102°30'E. Nong Bar, Bo Waen and Na Wong are stated to be producing rubies in the Chantaburi area but are not shown on the Highway Map 1:10⁶.

*For the first, see *J.Gemm.*, 1978, XVI, 3, 194-5.—Ed.



Fig. 1. The counter of a Lapidary Supply Shop on Market Square in Chania, Crete. Faceted synthetics are in the saucers, and boules and half-boules on the lower shelf.

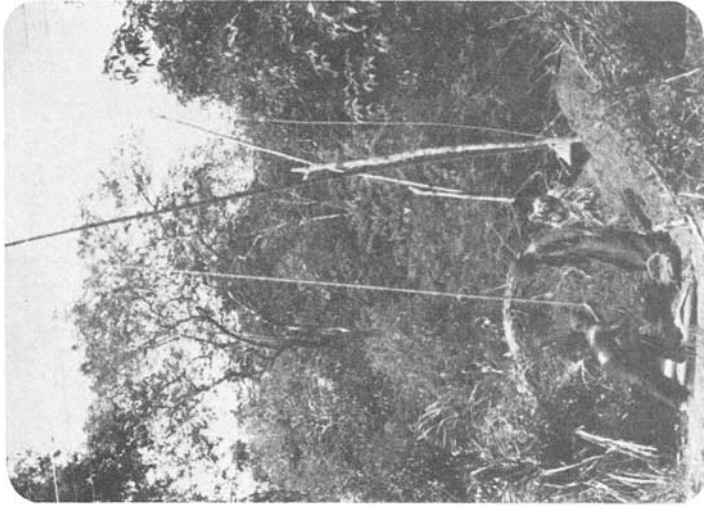


Fig. 3. The bamboo boom and draw-rod for hoisting the gem gravel from the pit. The length of the draw-rod gives some idea of the depth of the pit.

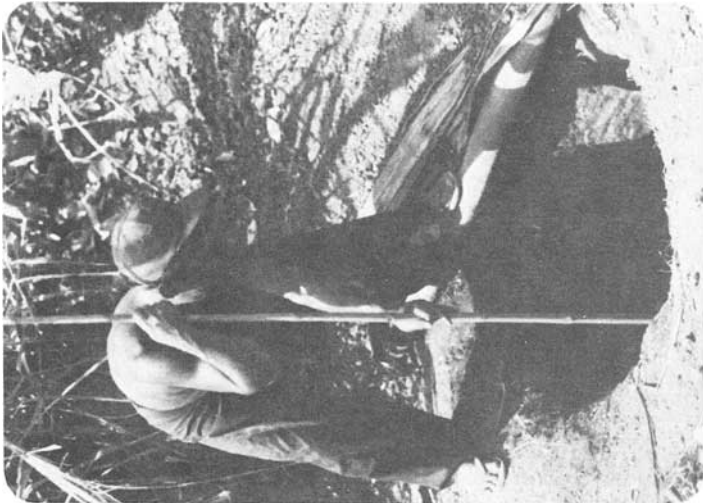


Fig. 2. Fox-hole entrance to the gem-pit—at Khau Ploy Waen, near Chantaburi.

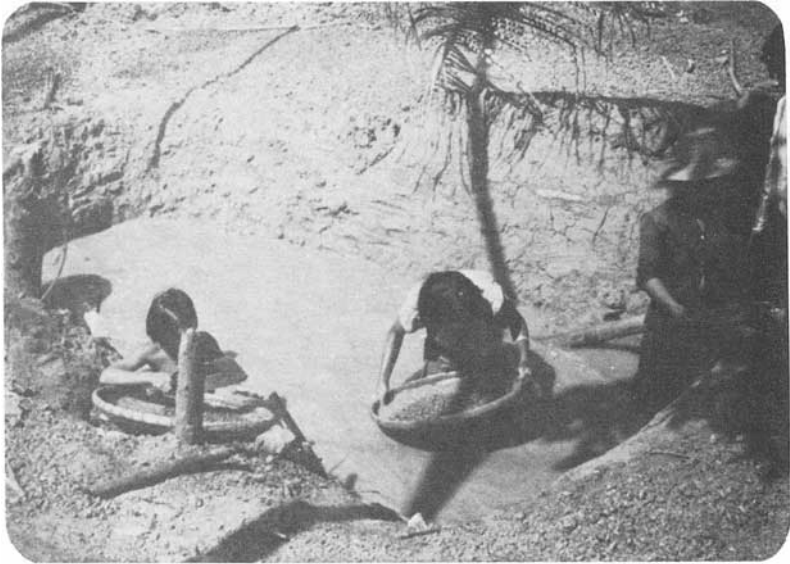


Fig. 4. Young and old female members of the mining family washing the gravel.



Fig. 5. A group of gem (?) vendors at Khau Ploy Waen, near Chantaburi. They have genuine green sapphires, Linde star sapphire and ruby, doublets (sapphire and ruby), also dark red star rubies—synthetic with thin black star backing.

Irrem, Tap Rom and Bang Kaja are sources of sapphire near Chantaburi. I understand Bang Kaja (Ban Cha Cha) is 15km from Chantaburi.

The gem area near Kanchanaburi is Bo Ploy some 40km N. by road, where they recover blue and green sapphires, also in smaller quantities yellow sapphires and chrysoberyl cat's-eye.

There is a local air-conditioned coach service from Bangkok, costing 60 Baht (equal to \$(US)3) for the 260km round trip.

Kanchanaburi 14°02'N. 99°30'E.

Bo Ploy 14°20'N. 99°27'E.

Phrae, 744km North by road from Bangkok, 18°10'N. 100°10'E., is stated to be the centre of a new sapphire area where they are finding good royal blue stones. Den Chai, 18°0'N. 100°03'E., is near the railway line to Chiang Mai. The actual mining areas are: Wang Chin, 50km from Den Chai at 17°54'N. 99°33'E., accessible only in dry weather, and Bar Gow, 20km from Den Chai (not on map), and Now Soon near Den Chai (not on map).

Another gem area is said to be near Si Sa Ket (Srisaket) (Srisrkes), 580km from Bangkok East at 15°12'N. 104°20'E.

62km South is the town of Kantaralak, 14°40'N. 104°40'E. The mining area is at Kor Sa Ad nearby.

We were also told by a reputable dealer in Bangkok that zircons were being recovered from Cheom Ksan (Chomkasan), 14°15'N. 104°55'E., in Cambodia.

I understand that no gem material is coming out of Burma because the government has closed the mines and the small miners dare not sell any rough they have, for they would not be able to use the money to buy goods, so they are biding their time.

With 200,000 gem cutters in Thailand, they are faceting stones from all over the world. I saw much from Sri Lanka, Australia and Colombia and Brazil, but what impressed me most was the extent of the synthetic gem industry; it may be for the cheaper oriental jewellery as well as the ignorant tourist who thinks he is getting a bargain.

[*Manuscript received 24th May, 1978.*]

THE AIR-BOUNDARY REFRACTOMETER*

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§1 INTRODUCTION

Of all the gemmological instruments, the refractometer is undoubtedly the most useful tool for the identification of gemstones. Unfortunately the common Rayner refractometer measures refractive indices up to 1.81 only, the limitation imposed by the refractive index of the prism material. This makes it useless for a number of natural and synthetic gems having refractive indices above 1.81 (see Table 1[†]). An ever increasing number of synthetic materials such as YAG, GGG, cubic zirconia and strontium titanate are being placed on the market as diamond simulants. To differentiate these high refractive index synthetics new refractometers have been developed to meet the demand. Some of these new refractometers use infrared light sources, while others measure the relative reflectivity of the gemstones. Dr W. W. Hanneman has pointed out the shortcomings of these new instruments in a most comprehensive review on this subject (Hanneman 1978).

The most fundamental approach to measuring refractive indices is of course to base the method on the very definition of refractive index. Using a monochromatic sodium light source and a precision spectrometer this is a simple and accurate process, if the gem is cut as an equilateral prism. Having measured the apex angle A and the angle of minimum deviation D on the spectrometer, the refractive index of the prism material can be calculated from

$$n = \frac{\sin\left(\frac{A+D}{2}\right)}{\sin\left(\frac{A}{2}\right)} \quad (1)$$

In practice the gems are usually faceted into round brilliants or trap cuts, so that measuring refractive index by this method is an extremely laborious and painstaking process. To overcome this

*Patent pending.

†see page 535 below.

difficulty we have devised a new type of refractometer, which is based on the fundamental definition of refractive index and yet is relatively easy to use. Refractive indices up to 2.6 may be measured without the use of any refractive index liquid. With water as a refractive index liquid the upper limit may be extended to 3.4. In the present stage of development it is not as accurate as the Rayner refractometer, being able to measure refractive indices to within ± 0.02 only. The instrument's main advantage is its ability to measure refractive indices above 1.81. We feel that the device could become a useful additional piece of equipment in the gemmologists' laboratory, rather than a replacement for the Rayner refractometer.

§2 PRINCIPLE OF THE AIR-BOUNDARY REFRACTOMETER

This new refractometer utilizes the phenomenon of total internal reflection when light travels from an optically denser medium, i.e. the gemstone, into the surrounding air. Total internal reflection occurs at the table facet of a gem when the angle of incidence $\angle ABC$ is greater than or equal to the critical angle θ_c (Figure 1). The critical angle for a gem of refractive index n is given by

$$\theta_c = \sin^{-1} \frac{1}{n} \quad (2)$$

As a result of total internal reflection the angle of reflection $\angle CBD$ is equal to $\angle ABC$. The totally reflected ray BD is then refracted at a pavilion facet CDE and viewed by the observer. We shall show that the angle θ_1 between the emergent ray DK and the vertical direction DJ gives a measure of the refractive index of the gem.

According to Snell's law of refraction, the angles of incidence and refraction at the boundary CDE are related by

$$\frac{\sin i}{\sin r} = \frac{1}{n} \quad (3)$$

From simple geometry:

$$i = \theta_p - \theta_c \quad (4)$$

where θ_p is the angle subtended by the pavilion facet CDE and the table facet.

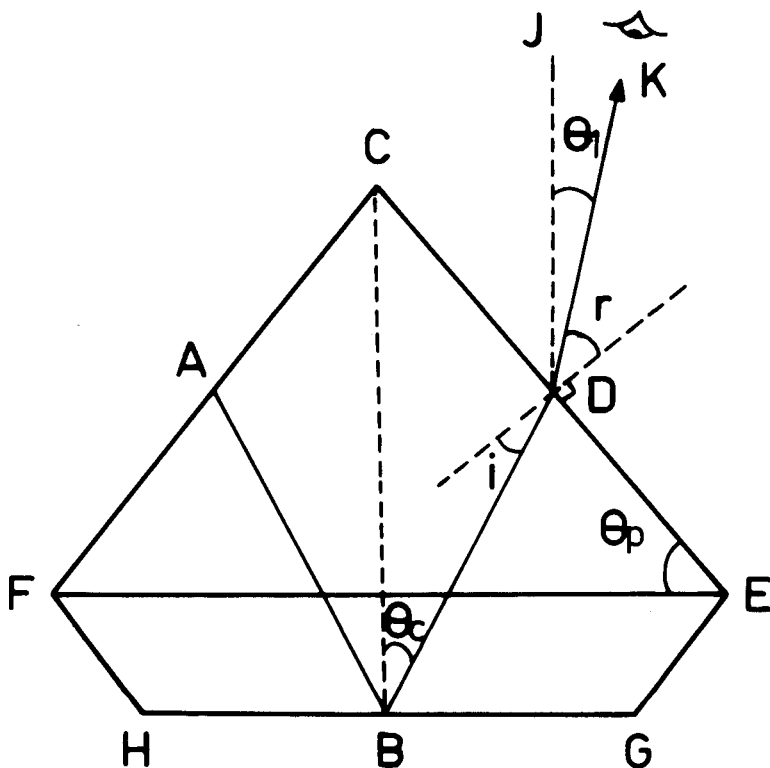


Fig. 1 Total internal reflection at the table facet of a gem.

Also from geometry:

$$r = \theta_p - \theta_1 \tag{5}$$

Therefore

$$\frac{\sin(\theta_p - \theta_c)}{\sin(\theta_p - \theta_1)} = \frac{1}{n} \tag{6}$$

Thus the unknown refractive index n of a gem can be calculated from Eq. (6) if the angles θ_p and θ_1 are measured.

For angle of incidence $\angle ABC$ larger than the critical angle θ_c , the light will always be total internally reflected at the table facet HBG, refracted at the pavilion facet CDE and seen by the observer at an angle $\angle JDK$ smaller than θ_1 . For angle of incidence $\angle ABC$

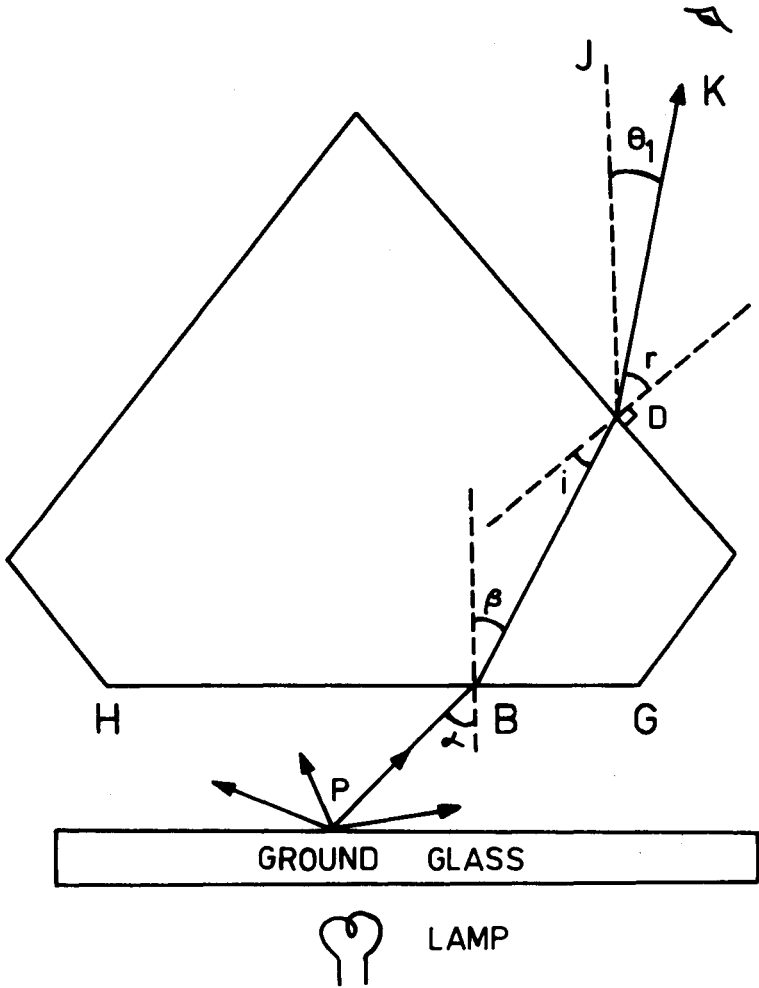


Fig. 1(a) Gem illuminated through a piece of ground glass.

smaller than the critical angle θ_c , the light is not total internally reflected at the table facet HBG and hence never seen by the observer.

As the observer looks down at the gem along the vertical direction JD he sees a brightly lit gem because of the total internally reflected light. As he moves his head away from the vertical direction the gem will remain bright until the angle LJDK is equal to θ_1 .

For LJDK larger than θ_1 the pavilion facet will appear dark because no light comes out of the gem at an angle larger than θ_1 . Thus θ_1 can be found by moving the observer's head slowly from the vertical (i.e. varying LJDK) until the pavilion facet just turns from bright to dark. This condition corresponds to LJDK = θ_1 , the angle θ_1 is measured and the refractive index n of the gem can be calculated from Eq. (6).

In the discussion above we have assumed that the light ray enters the gem from above as indicated by ray AB in Figure 1. In practice we find the effect is more pronounced if the gem is illuminated through a piece of ground glass placed underneath the table facet HBG as shown in Figure 1(a). The ground glass scatters light in all directions. Consider a light ray PB incident on the table facet on an angle α . The angle of refraction β is given by Snell's law of refraction:

$$\frac{\sin \alpha}{\sin \beta} = n \quad (6a)$$

Since the largest possible value of α is 90° , the largest possible value of β is $\arcsin(1/n) = \theta_c$. Thus the gem will appear dark when the observer moves his head so that LJDK is larger than θ_1 .

To measure the pavilion angle θ_p , a horizontal beam of light AB is shone on the pavilion facet (Figure 2). The observer moves his head until he sees a mirror image of the light source in the pavilion facet closest to the light source. From the law of reflection and simple geometry we find that θ_p is related to the angle θ_2 between the line of sight BC and the vertical direction BD by

$$\theta_2 = 90^\circ - 2\theta_p \quad (7)$$

Thus θ_p can be calculated from measured value of θ_2 .

A simple technique sometimes used by diamond dealers to distinguish round brilliant cut diamonds from lower refractive

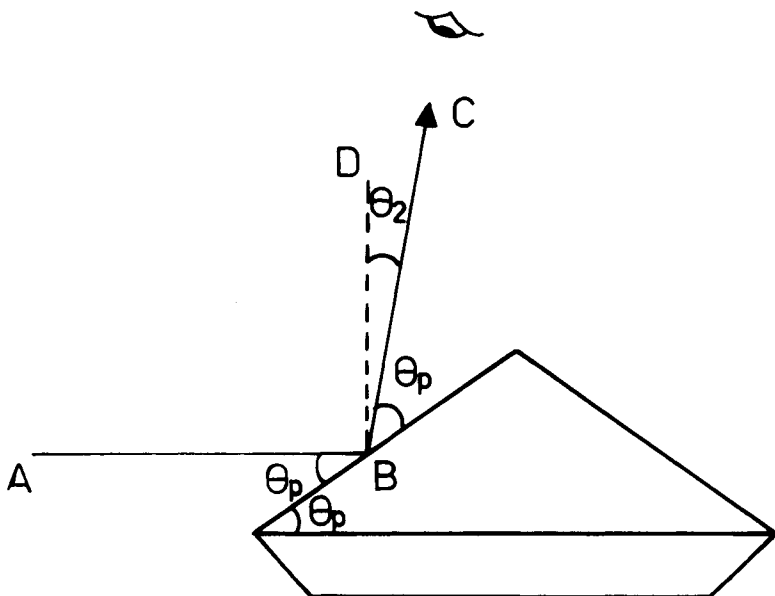


Fig. 2 Specular reflection at a pavilion facet.

index simulants quickly is to place the stones table facet downward and rock the stones back and forth. When observed from above the diamonds look silvery because no light gets out of the pavilion in a vertical direction while the lower refractive index stones look glassy because light can get out of the stones even at large angles away from the vertical. It can be seen that the air-boundary refractometer essentially measures how far away from the vertical one has to look before no light can be observed coming out of the stone.

§3 CONSTRUCTION OF THE AIR-BOUNDARY REFRACTOMETER

As explained in §2 the refractive index of a gem can be calculated from Eq. (6) if the two angles θ_p and θ_1 are known. To measure these two angles we have constructed an inexpensive prototype refractometer. The refractometer consists of a black plastic box of inside dimensions shown in Figure 3. ABCD is a sliding door which may be moved sideways to allow the gem to be placed table facet downward on a one centimetre square ground glass stage S. The sliding door is closed to shut off roomlight while

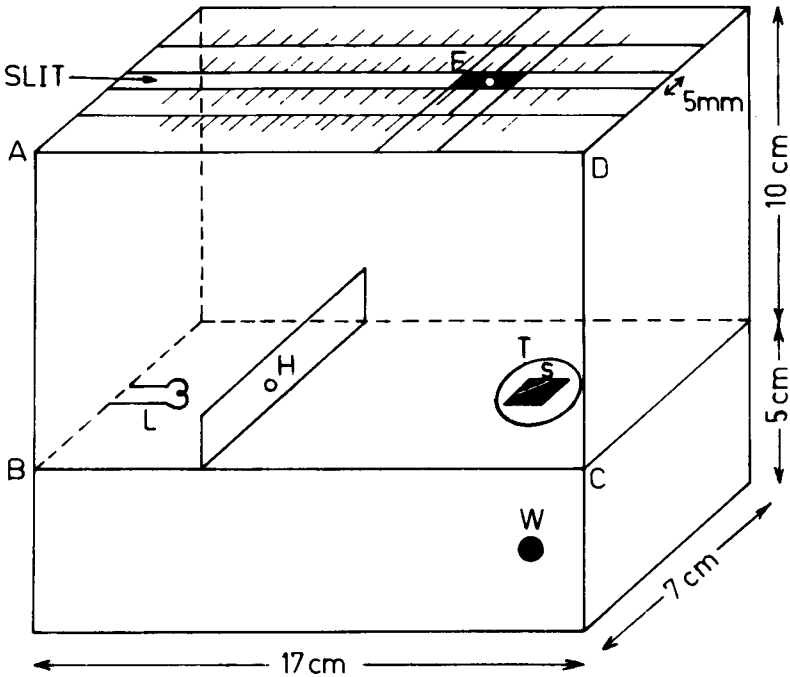


Fig. 3 Sketch of the air-boundary refractometer.

making measurements. To measure θ_p and θ_i the gem is illuminated with small light bulbs L and M respectively. A metal sheet with a 1 mm diameter hole H at a height 2.5 mm above the base defines the light beam illuminating the pavilion facets of the gem. The height of the illuminated hole H is adjustable by a screw mechanism not shown in Figure 3. Light bulb M is directly underneath the ground glass stage S. Both light bulbs are powered by two UM-1 dry cells and controlled by a 3-way switch W.

The gem is observed through an eyepiece E which consists of a perspex sheet with a 2 mm diameter hole in the centre. The eyepiece slides along a narrow slit 5 mm wide and 17 cm long at the top of the refractometer. Figure 4 shows a cross-sectional view of the refractometer. The angles θ_1 and θ_2 are related to the displacements X_1 and X_2 of the eyepiece by

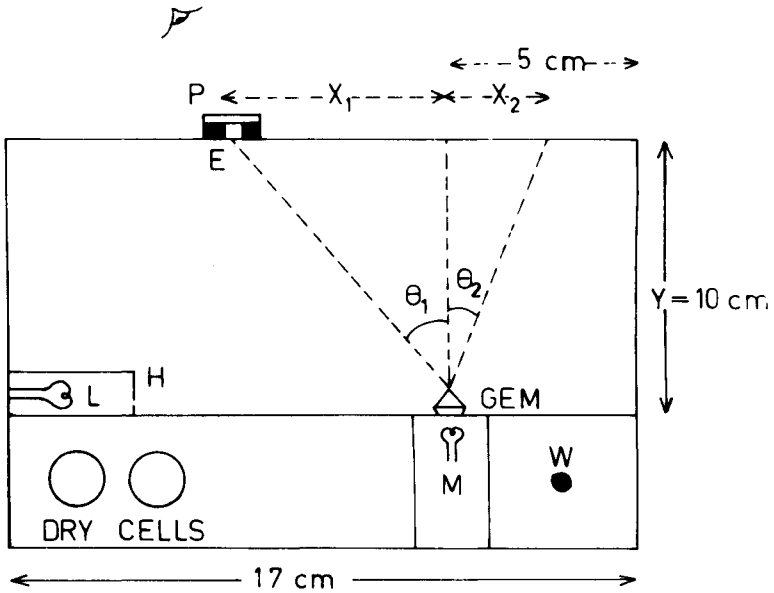


Fig. 4 Cross-sectional view of the air-boundary refractometer.

$$\tan \theta_1 = \frac{X_1}{Y} \tag{8}$$

$$\tan \theta_2 = \frac{X_2}{Y} \tag{9}$$

where the height Y is chosen to be 10 cm for the prototype model.

Using Eq. (9) and Eq. (7) the values of X_2 for various pavilion angles θ_p can be calculated. Thus a scale of θ_p can be marked alongside the viewing slit and θ_p for a particular gem can be read directly from the scale (bottom scale in Figure 5).

Similarly X_1 for various values of θ_p and refractive indices are calculated from Eqs (2), (6) and (8). It should be noted that X_1 depends on θ_p as well as on the refractive index n . Figure 6 plots X_1 as a function of the refractive index for pavilion angle $\theta_p = 37^\circ, 39^\circ, 41^\circ, 43^\circ$ and 45° respectively. The refractive index scales for $\theta_p = 39^\circ, 40^\circ, 41^\circ, 42^\circ, 43^\circ, 44^\circ$ and 45° are marked alongside the eyepiece slit in Figure 5. The refractive index of a gem with a pavilion angle θ_p in between the integral values can be found by extrapolation. Thus the refractive index for $\theta_p = 40.5^\circ$ is the average of the refractive indices for $\theta_p = 40^\circ$ and 41° respectively.

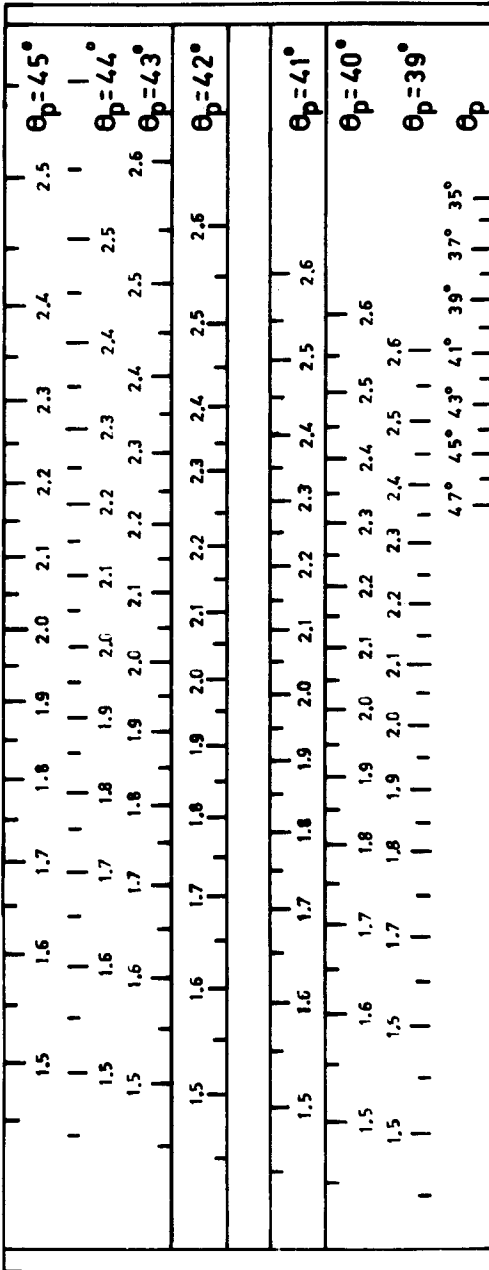


Fig. 5 Scales of refractive index and pavilion facet angle.

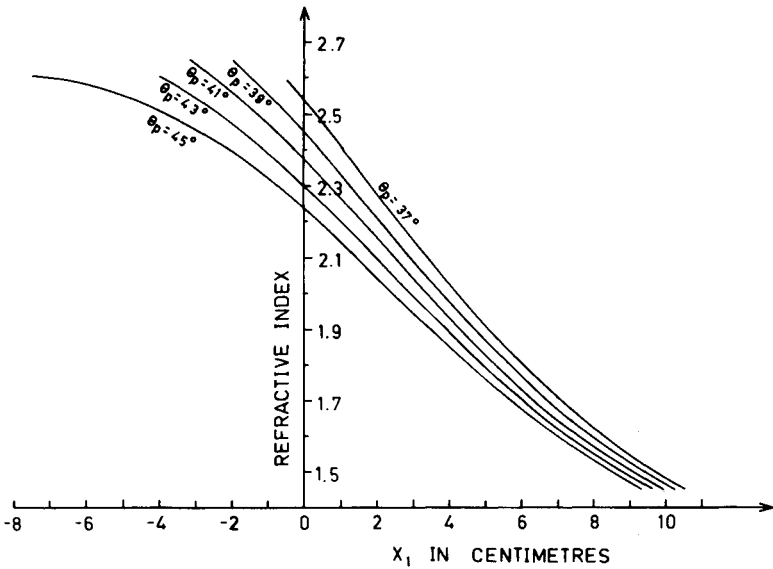


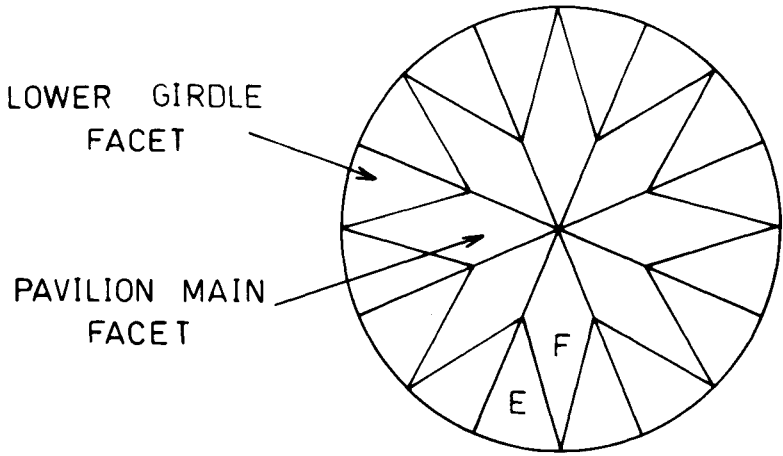
Fig. 6 Variations of X_1 with refractive index and pavilion facet angle

§4 OPERATION PROCEDURES

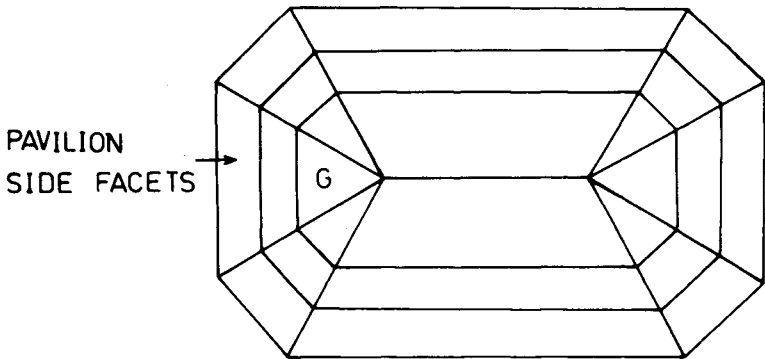
(1) Move the sliding door sideways to place the gem table facet downward on the ground glass stage S. No refractive index liquid is required, but the gem should be wiped clean of grease or fingerprints. Move the gem so that the girdle falls on the black line marked on the ground glass stage. This is important, as the value of θ_p measured depends on the position of the gem on the stage S.

(2) Switch on the light bulb L by pressing down the 3-way switch. Look through the viewing slit on top of the refractometer for a reflected image of the illuminated hole H in one of the pavilion facets of the gem. It may be necessary to rotate the gem by a few degrees so that the reflected image of H is seen through the lower girdle facet E or the pavilion main facet F in Figure 7a. To facilitate this operation the stage S is made rotatable by fixing it at the centre of a brass cylindrical table T (Figure 8). The cylindrical table T fits into a cylindrical shell Q and can be rotated through a few degrees by moving the rod R.

(3) After θ_p is measured the 3-way switch is pushed to its



(a)



(b)

Fig. 7 Pavilion facets of round brilliant and trap cut stones.

upward position to switch on light bulb M underneath the ground glass stage. The eyepiece is first moved so that it is directly above the gem ($\theta_p = 45^\circ$ on the θ_p scale). If the RI of the gem is lower than 2.37 it will appear bright, otherwise it will appear dark. For the sake of argument assume the RI of the gem is less than 2.37; move the eyepiece to the left until the lower girdle facet E (Figure 7a) just turns dark. The RI of the gem is read from the position of the eyepiece along the appropriate refractive index scale for θ_p . If θ_p had been measured to be 41° , then the RI is read from the $\theta_p = 41^\circ$ scale. It should be noted that as the eyepiece is moved further to the left, the pavilion facet E becomes darker and darker until it becomes quite black. The refractive index of the gem is determined by the eyepiece position when the facet E first darkens.

(4) For argument's sake consider a gem of pavilion angle $\theta_p = 41^\circ$, say. If the refractive index is higher than 2.37 the gem will appear dark when the eyepiece is directly above the ground stage. In this case the eyepiece should be moved to the right until the lower girdle facet E just turns slightly bright. The refractive index of the gem is then read from the $\theta_p = 41^\circ$ scale. If the refractive index is higher than 2.86, then total internal reflection occurs also at the pavilion facet CDE (Figure 1) so that the gem looks dark in all directions. In such a rare case the refractive index can be found by placing a drop of water between the gem table facet and the ground glass stage S. Total internal reflection then occurs at the gem-water boundary instead of the gem-air boundary. Hence the refractive index is obtained by multiplying the scale reading by the refractive index of water (1.33). There are few gems of such high refractive indices, the only noteworthy one being rutile (2.616-2.903).

(5) After the measurements the 3-way switch should be returned to its neutral position to conserve battery power.

§5 REFINEMENTS IN THE AIR-BOUNDARY REFRACTOMETER

(1) For measuring refractive indices of strongly birefringent gems, a rotatable polarizer is attached to the eyepiece (P in Figure 4).

(2) The refractive indices can be measured more accurately by placing an interference filter or coloured glass filter over the light bulb M, so that only yellow light (589 nm) illuminates the ground glass stage S.

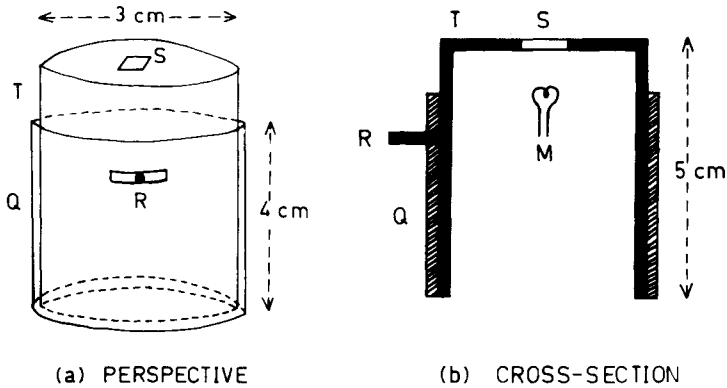


Fig. 8 Perspective and cross-sectional views of the rotatable table.

(3) The θ_p scale and refractive index scales have been calculated assuming the pavilion facets to be 2.5 mm above the ground glass stage S. This assumption is valid for a round brilliant cut stone weighing about 1 carat. For larger stones the pavilion facets will be higher. This increase in height is measured by a scale attached to the refractometer and the height of the illuminated hole H correspondingly increased. This operation maintains the accuracy of the θ_p scale; the errors introduced into the refractive index scales due to the larger size of gems are negligible.

(4) To calibrate the refractometer we place a small right-angle glass prism to simulate a gem. The 45° angle of the prism is measured by the refractometer and the θ_p scale of the refractometer set accordingly. The vertical direction corresponds to $\theta_p = 45^\circ$, hence the refractive index scales are also set. The refractive index of the prism is then measured on the air-boundary refractometer. Since the refractive index of the prism is known from previous measurement on a spectrometer or Rayner refractometer, this process demonstrates to a novice what we mean by "the refractive index of the gem is determined by the eyepiece position when the facet E first darkens" (last sentence in paragraph (3) of §4).

§6 RESULTS AND DISCUSSIONS

The air-boundary refractometer has been used to measure the refractive index of a variety of gems and the results compared with those obtained with the Rayner refractometer or literature values

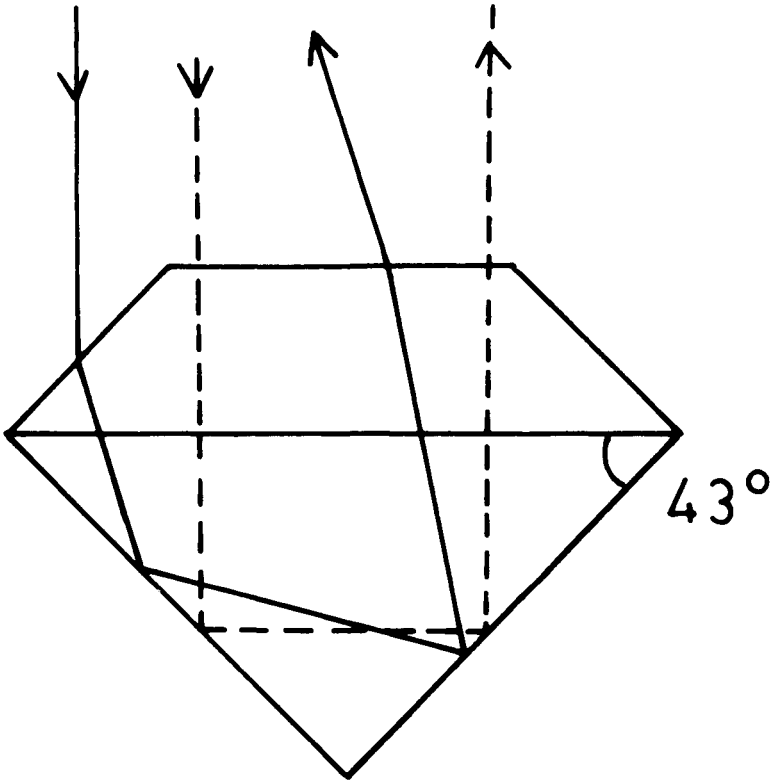


Fig. 9 Total internal reflection in a cut stone.

(Table 2). At the present stage of development we are aware of its shortcomings:-

(1) It is less accurate than the Rayner refractometer. Its accuracy is affected by the measured value of the pavilion facet angle θ_p . In general the refractive index can be measured to ± 0.02 by this device as compared to ± 0.001 for the Rayner refractometer.

(2) It cannot be used on cabochons or fancy cut stones with pavilion facet angles outside the range 37° to 45° . It can only be used on set stones the pavilion facets of which are left exposed by the setting.

Nevertheless it has the following advantages:-

(1) Most important of all, the air-boundary refractometer can measure refractive indices higher than 1.81. It can measure the refractive index of YAG (1.83), GGG (2.03), cubic zirconia (2.15) and thus distinguish them from diamond (2.418). The refractive index of strontium titanate (2.41) is too close to that of diamond to be differentiated by this method. However it can be easily recognized by its dazzling fire due to the high dispersion.

(2) It is simple and robust in construction. Although the prototype model is made of plastic, it can very well be made of wood, brass or aluminium.

(3) It costs only about £20. No expensive prism is required as in the Rayner refractometer.

(4) It does not require a refractive index liquid.

(5) The angles of the lower girdle facets and the pavilion main facets are measured by this method. This allows us to determine whether the gem is correctly cut or not, a factor which affects the beauty and price of a gem. In a correctly cut gem the pavilion angles are chosen so that light entering from the table facet is total internally reflected inside the pavilion and comes out at the crown to give brilliance and fire to the gem (Figure 9). Table 3 gives the pavilion main facet angle for gems of various refractive index range (Sinkankas 1962). The lower girdle facet angles are usually larger than the pavilion main facet angles by two or three degrees.

In conclusion we feel this new refractometer may prove to be useful for gemmologists interested in high refractive index stones such as diamond and its more recent simulants.

TABLE 1

Gems with Refractive Indices Higher than 1.81

YAG	1.83
Demantoid Garnet	1.89
Zircon (High)	1.93-1.99
Sphene	1.90-2.02
GGG	2.03
Cubic Zirconia	2.15
Strontium Titanate	2.41
Diamond	2.418
Rutile	2.62-2.90

TABLE 2

RI measured by the Air-Boundary Refractometer

Gems	Air-boundary refractometer	Other sources
Amethyst	1.56	1.553-1.544
Topaz	1.61	1.613-1.622
Chrysoberyl	1.75	1.749-1.756
Synthetic ruby	1.77	1.760-1.769
YAG	1.85	1.83
Zircon	1.97-2.03	1.93-1.99
Cubic zirconia	2.16	2.15-2.18
Diamond	2.41	2.418
Strontium titanate	2.42	2.41

TABLE 3

Pavilion Main Facet Angles by RI Range

Refractive Index	Pavilion Main Facet Angles
1.40-1.60	43°
1.60-2.00	40°
2.00-2.50	37° to 40°

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AN EXPERIMENTAL BREWSTER-ANGLE REFRACTOMETER

By *PETER G. READ, C.Eng., F.G.A.*

Over the last ten years, the introduction of convincing man-made diamond simulants having refractive indices above the range of the critical-angle refractometer has emphasized the need for a simple and reliable quantitative method of identifying both diamond and its imitations, particularly when mounted.

The development of the blende and diamond versions of the standard Rayner refractometer^(1,2) provided a useful extension to that instrument's range, but even here, the limiting factor was the contact liquid (West's solution, with an RI of 2.05). There are, of course, several alternative ways in which high refractive indices can be measured, and these range from the 'Direct' method which uses a microscope⁽³⁾ (or a modified vernier caliper gauge⁽⁴⁾), to the derivation of RI via the measurement of facet and minimum deviation angles on a goniometer or table spectrometer.

None of these alternatives, however, has the convenience of a direct-reading instrument, and it was not until the introduction of the first commercial electronic reflectivity meter in 1974^(5,6) that an easy method of identifying high RI gems was provided by the measurement of their relative reflectivities.

While the use of this type of instrument enables a rapid check to be made on a gemstone's identity, the accuracy of the result depends on the cleanliness and perfection of polish of the gemstone's surface. In inexperienced hands, the reflectivity meter can provide misleading readings, particularly if the surface condition criteria are disregarded.

During a search through one of the more recent reference works⁽⁷⁾ on optics for an alternative technique for the measurement of high refractive indices, the writer came upon a description of the plane polarization of light by reflection. In this connexion, Brewster's law states that complete polarization of a ray reflected from the surface of a denser medium occurs when it is normal (i.e. at right-angles) to its associated refracted ray in that medium (Figure 1.) The Brewster angle of polarization can be related to the medium's refractive index as follows:

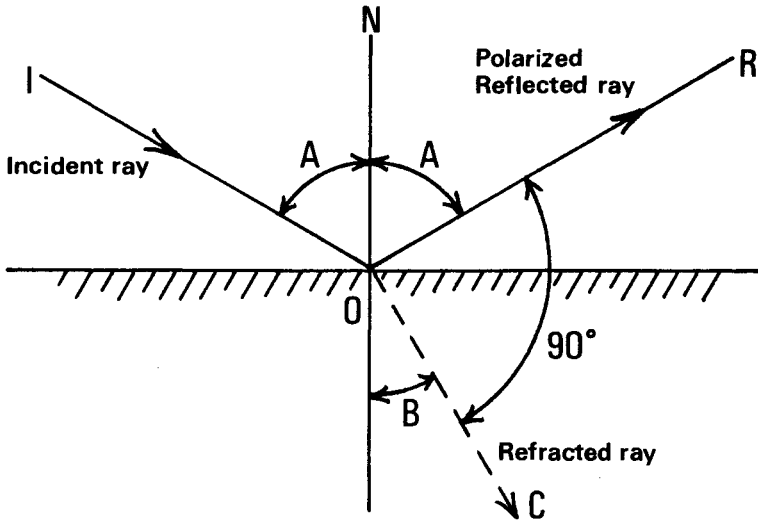


FIG. 1. Showing the 90° relationship between the reflected and refracted rays at the polarization angle A for the denser medium.

If A in Figure 1 = the Brewster angle of polarization (i.e. $ROC = 90^\circ$)

$$\text{then } A + B = 90^\circ$$

$$\text{As the RI of the denser medium} = \frac{\sin A}{\sin B},$$

$$\text{and } A + B = 90^\circ, \text{ then } \text{RI} = \frac{\sin A}{\cos A} = \tan A$$

and Brewster angle of polarization $A = \text{arc.tan}$ of the medium's RI.

Taking the extremes of flourspar and rutile:

$$\text{Brewster angle for flourspar} = \text{arc.tan } 1.43 = 55^\circ$$

$$\text{Brewster angle for rutile} = \text{arc.tan } 2.75 = 70^\circ$$

Although further investigation showed there had been previous attempts to use the angle of polarization to measure RI, these do not appear to have been pursued seriously because of the mechanical difficulty in rotating a beam of incident light about the surface of a gemstone, and simultaneously following the movement of the reflected ray with a suitable polarization detector⁽⁸⁾.

To test the practicality of using the Brewster angle phenomenon as a means of measuring a gemstone's refractive

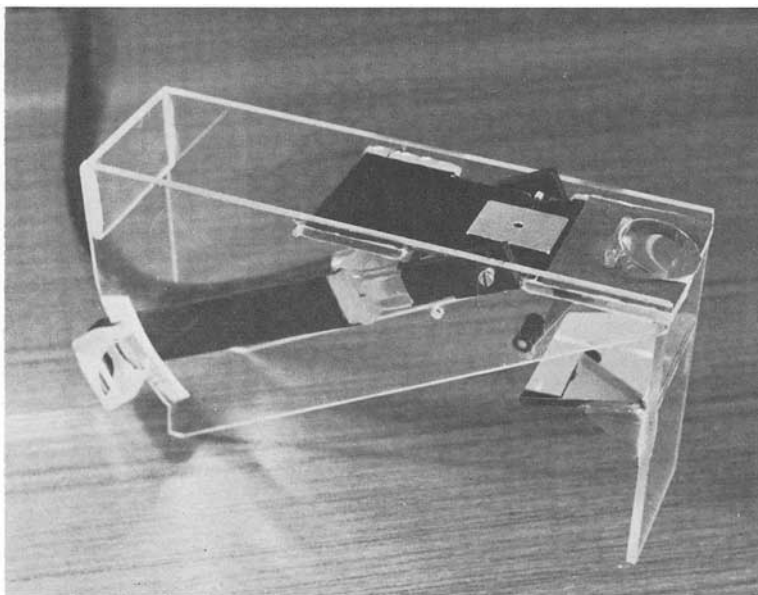


FIG. 2. Experimental Brewster-angle refractometer.

index, the writer constructed a simple optical model (Figure 2) which dispenses with a moving detector and passes the reflected ray through a suitably orientated polarizing filter, imaging the result on a translucent screen (Figure 3). With a gemstone positioned over the test aperture, the angle of the incident light is then adjusted for extinction of the reflected light spot, the extinction or Brewster angle being used as a direct measure of RI.

The experimental model proved the feasibility of the technique. It also showed that a strong source of light was necessary to compensate for the light lost both through the polarizing filter and by the low reflectivity of the gemstone (for a normal incident ray, this light loss is as high as 83% for diamond, and 95% for quartz).

Although a high-intensity white light source was used for the experimental model, ideally a monochromatic source should be used to achieve total extinction of the reflected ray at the Brewster angle.

While not capable of detecting double refraction, the experimental model was (in contrast to the reflectivity meter) relatively insensitive to scratches or dirt on the gemstone's surface,

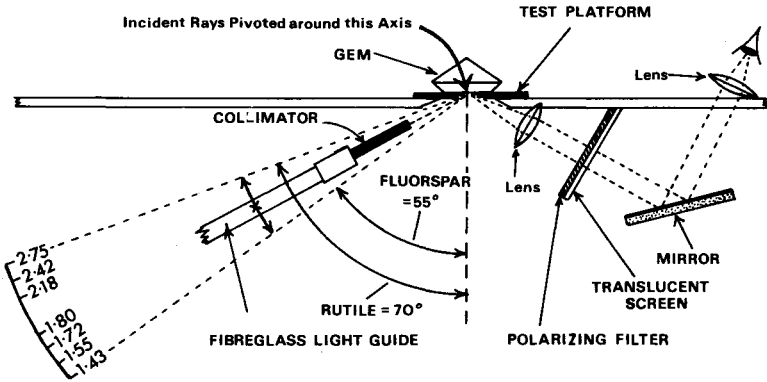


FIG. 3. Sketch showing the construction of an experimental Brewster-angle refractometer. To prevent unwanted light reflections from reaching the screen, a vertical light baffle was fitted beneath the test platform aperture.

which simply reduced the degree of attenuation of the filtered light spot at the polarization angle. Measurement of RI was limited in the model to two significant figures, although this could no doubt be improved by the more efficient use of the light source and by providing a fine adjustment of the incident light angle. However, satisfactory readings were obtained with a range of opaque as well as translucent and transparent gems.

Readings taken on the semi-polished flat bases of cabochons (jasper, tiger's eye, rose quartz, moonstone, sodalite) were more positive than on the standard critical angle refractometer. As with the reflectivity meter, correct registration of the surface of the gem over the test aperture is most important. In the experimental model, this is ensured by first setting the incident beam at an angle which produces a visible light spot on the translucent screen, and then adjusting the position of the gem until this spot is symmetrical and centred on a guide line drawn vertically down the screen. Finally, the angle of the incident light is adjusted until the light spot is either extinguished, or at its weakest, and the RI value of the gemstone then read from a calibrated scale.

In conclusion, the writer hopes that this initial development work will encourage further experiments in the use of polarization by reflection (a phenomenon which is the main source of naturally

occurring polarized light), and that this may eventually lead to the production of a commercial Brewster-angle refractometer.

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GEMMOLOGICAL ABSTRACTS

ALEXANDER (A.E.). *Before the gems came the crystals*. Australian Gemmologist, **13**, 8, 247-50, 6 figs, 1978.

A rambling reminiscence of a specific find of gem crystals in Minas Gerais in 1947 and their subsequent use in part by sculptor Oskar Hansen. Most were unused and found their way to the author for advice and marketing. Other examples of Hansen's work are illustrated. R.K.M.

ALEXANDER (A.E.). *The Far Eastern gem deposits and Dr Edward Gübelin, the Marco Polo of the gemmological profession*. Australian Gemmologist, **13**, 8, 280-4, 4 figs, 1978.

A rather disjointed dip into correspondence from Dr Gübelin on journeys which took him to gem mines in a great many places. Author brings Chas. Murray into the account and finally includes lists of gems found in 'Far East' countries. (It is disconcerting to find Tanzania and Kenya included, but to an American they are eastern lands). R.K.M.

ALEXANDER (A.E.). *Two new mineral specimens enter the New York market*. Australian Gemmologist, **13**, 8, 250, 2 figs, 1978.

Brief mention and photographs of 'angel-skin opal' (pink, from Mexico, carved/cabochoned in Idar-Oberstein), Australian yellow-brown jasper (carved in China) and 'a mixture of quartz and tiger-eye' cut in Idar-Oberstein. J.R.H.C.

ALTHAUS (E.). *Wassermelonen und Mohrenköpfe*. (Watermelons and niggerheads.) Lapis, **4**, 1, 8-11, 12 figs (7 in colour), 1979.

Explains the various theories of the cause of colour in tourmaline with illustrations of absorption spectra and notes on charge transfer. M.O'D.

ANDERSON (H.). *How to feel the difference between a diamond and a cubic zirconia*. Australian Gemmologist, **13**, 8, 285-7, 1978.

This is the 'slippery topaz' of Church brought up to date. Diamond is said to feel sticky due to affinity for natural grease of the skin. Drop test (heft) is also suggested. R.K.M.

BALAKIREV (V.G.), TSINOBER (L.I.), KOVALENKO (V.S.), SVIRIDENKO (A.F.), AYEROV (G.D.). *Electron microscopy of cristobalite-tridymite opal*. Doklady Akademii Nauk SSSR, **233**, 4, 672-4, 1 fig, 1977). (In English.)

Cristobalite-tridymite opals coloured green, reddish-brown and yellow were studied by means of electron microscopy using replicas, diffraction contrast and microdiffraction. Reflections of 4.30Å which are characteristic of tridymite but not of cristobalite showed that all types of particles studied were low-temperature tridymite. M.O'D.

BANK (H.). *Edelsteine aus Kenya*. (Gemstones from Kenya.) Z.Dt.Gemmol.Ges., 27, 4, 185-95, 1 map, bibl., 1978.

Because of its geology and petrology, Kenya is rich in minerals and gemstones. The author lists alphabetically the various occurrences, adding a few notes to some. Green, as well as blue-green, apatites are found. The beryls are mostly of industrial quality, but aquamarines are found in the Baragoi region; there are some green and blue beryls (but not emeralds) and a few morganites. Kyanite is mentioned, as is also diopside, epidote and various feldspars, mainly amazonite and oligoclase, also gaylussite. The garnet group is represented by almandines, which are found in good crystals, and green garnets, which are transparent vanadium-chromium grossularites. Rarer are the green kornerupines, and even rarer the green kornerupine cat's-eyes. The most valuable gem found in Kenya is undoubtedly corundum, which occurs as ruby, sapphire and in other varieties. Meerschäum of good quality was found in the year 1953; obsidian can be seen in the rift valley near Magadi. Some olivine is present; there is some opal but not of cuttable quality with the exception of some yellow-greenish material. Quartz is represented by amethyst, rock crystal, rose quartz, agate and a variety of green quartz. Sillimanite in gem quality is rare; there is some spinel, sphene and titanite, but not much. Topaz is found in its colourless and yellow variety. Tremolite and tourmaline are mentioned. The vesuvianite from Kenya is yellow-green. There is some zircon. The other gems mentioned are amblygonite, anglesite, augite, azurite, barite, cassiterite, cerussite, magnesite, scheelite, smithsonite and sphalerite. E.S.

BANK (H.). *Rubine aus Alipur, Mysore (India)*. (Rubies from Alipur in Mysore, India.) Z.Dt.Gemmol.Ges., 27, 4, 211, 1978.

Although most rubies are not as good as the Kenyan material, some good quality stones have reached the market. E.S.

BANK (H.), BERDESINSKI (W.), SCHMETZER (K.). *Durchsichtiger rosafarbiger Bustamit aus Australien*. (Transparent pink bustamite from Australia.) Z.Dt.Gemmol.Ges., 27, 4, 208-10, bibl., 1978.

Data are given of a transparent, pink stone, bustamite, presumed to come from Australia. A table compares the optical data with those of other chain silicates such as wollastonite, rhodonite and pyroxmangite. E.S.

BANK (H.), MAES (J.), DOS SANTOS (A.). *Sillimanit-Cabochons in gemischter Ceylon Partie*. (Sillimanite cabochons in mixed parcel from Ceylon.) Z.Dt.Gemmol.Ges., 27, 4, 212-13, bibl., 1978.

Sillimanite is very difficult to cut because it is very fibrous; up to the present some examples have been found from Burma, Ceylon and Kenya. Two further stones were diagnosed in a mixed parcel from Ceylon. E.S.

BARIAND (P.), POULLEN (J.F.). *Nicht nur Lapis*. (Not only lapis.) Lapis, 4, 1, 20-3, 6 figs (4 in colour), 1979.

The areas of Nilaw, Mawi and Korgal in Afghanistan produce a number of important gemstones. Nilaw is a pegmatite with beryl, various feldspars, tourmaline, spodumene and pollucite; Mawi pegmatites give very large kunzite crystals, including green, blue, rose-coloured and colourless, morganite and aquamarine and

multi-coloured tourmaline. At Korgal the pegmatite produces fine elbaite with beryl, muscovite and microcline. Crystals of tourmaline are large and fine-coloured from all three areas. M.O'D.

BERGER (J.). *Kostbare Klippen*. (Rich cliffs.) *Lapis*, 4, 1, 28-30, 7 figs (3 in colour), 1979.

Describes the area near Windhoek in South-West Africa where tourmalines and other minerals are found. The individual mines include the Neuschwaben (green tourmalines), the Usakos Tourmaline mine (yellow-green, rose-red, yellow and colourless tourmaline), the Otjimbingwe mine (red and olive-green tourmaline), the Kubas mine (fine quality yellowish-green, red and rose-colour), the Albrechtshöhe mine (emerald-green), the Brandberg Tourmaline mine (dark red, colourless, dark- and yellowish-green). M.O'D.

BEYER (H.). *Ausgesuchte Objekte zum Thema 'Kieselsäure'*. (Choice pieces on the theme of 'silicic acid'.) *Aufschluss*, 30, 120-38, 21 figs (2 in colour), 1979.

A survey of the types of quartz with reference to crystal formation and twinning. M.O'D.

BEYER (H.). *Über einflussfaktoren auf Tracht, Habitus, Skelettformen, Verzerrungen, Zwillings und Aggregatbildungen an Kristallen*. (On the influence of inclusions on the form, habit, structure, twinning and aggregate-forming properties of crystals.) *Aufschluss*, 30, 33-50, 12 figs, 1979.

An introduction to the ways in which crystal growth can be hindered, altered and re-started due to the presence of impurity inclusions. Diagrams show characteristic modes of growth of apatite and zircon. M.O'D.

BIBBY (D.M.). *Zonal distribution of impurities in diamond*. *Geochimica et Cosmochimica Acta*, 43, 415-23, 2 figs, 1979.

Zonal distribution of impurities in several diamonds were studied by neutron activation followed by dissolution of the stones into fractions. All stones were found to contain submicroscopic inclusions, either silicates, carbonates or immiscible sulphides derived from the parent magma. Variations in impurity concentration are thought to reflect changes in growth rate or environment. M.O'D.

BIRCH (W.D.). *Kein Land für Turmaline?* (No country for tourmaline?) *Lapis*, 4, 1, 32, 2 figs, 1979.

Describes the dravite from Western Australia. M.O'D.

BROWN (G.). *Gemmological study group report on a new opal imitation*. *Australian Gemmologist*, 13, 8, 273, 2 figs, 1978.

Slocum Stone cemented to opal-veined ironstone base. Deception easily detected by preferred direction of play of colour seen in the imitation top (no play of colour from side) and by ironstone characteristics visible through the top of the stone. R.K.M.

DE GROOT (G.E.). *Rijksmuseum van Geologie en Mineralogie, 1878-1978; a retrospect*. Scripta Geologica, **48**, 1-96, illus. in black-and-white and in colour, 1978.

The Museum contains a collection of gemstones which are mentioned in this account of Museum history and reconstruction. M.O'D.

DILLMANN (R.). *Sogdianit*. (Sogdianite.) Z.Dt.Gemmol.Ges., **27**, 4, 214, 1978.

Physical properties are given. E.S.

DUNN (P.J.), WOLFE (C.W.), LEAVENS (P.B.), WILSON (W.E.). *Hydroxyl-herderite from Brazil and a guide to species nomenclature for the herderite/hydroxyl-herderite series*. Mineral. Record, **10**, 1, 5-11, 10 figs, 1979.

Almost all specimens described as herderite are in fact hydroxyl-herderite. These form the end-members of an isomorphous series; fine crystals have recently appeared from Virgem do Lapa and the Golconda mine, both in Brazil. M.O'D.

FISCHER (K.). *Knallerbsen und Katzenaugen*. ('Torpedos' and cat's-eyes.) Lapis, **4**, 1, 43-4, 2 figs, 1979.

Gives instructions for the cutting of tourmalines with particular reference to cat's-eye stones. M.O'D.

FORD (T.D.). *Blue John—Derbyshire's unique gem*. Gems, **11**, 2, 13-23, 9 figs (4 in colour), 1979.

An account of the occurrence and working of the Blue John variety of fluorite in the Peak District of Derbyshire. Historical notes are included and the author states that the material is still available, though not now found on outcrops. The colour is here attributed to hydrocarbons with associated uranium, the radioactive emanations of which give rise to dislocations and colour centres. M.O'D.

FUMEY (P.). *L'apatite*. (Apatite.) Revue de Gemmologie, **58**, 16-17, 3 figs, 1979.

Apatite from various localities is discussed with particular reference to examples found in France. M.O'D.

GRAZIANI (G.). *Rote Bänder in Willemite von Franklin Furnace, N.J., U.S.A.* (Red striations in Willemite from Franklin Furnace, New Jersey, U.S.A.) Z.Dt.Gemmol.Ges., **27**, 4, 201-4, illus., bibl., 1978.

The willemite is of pale green-yellow colour with red striations, which were examined and found to be hematite. E.S.

GRAZIANI (G.), GUIDI (G.). *Mineralogical study of a star-beryl and its inclusions*. Neues Jahrbuch für Mineralogie Monatshefte, **2**, 86-92, 5 figs, 1979.

The beryl was in the form of a thin sheet about 12×6×3mm, green and transparent. Quartz, corundum, pyrrhotite were found as inclusions with less prominent examples of epidote, apatite and pyrite. It is unusual to find quartz and corundum in beryl. The specimen is Brazilian. M.O'D.

GRICE (J.D.), WILLIAMS (R.). *The Jeffrey Mine, Asbestos, Quebec*. Mineral. Record, **10**, 2, 69-80, 20 figs (3 in colour), 1979.

The Jeffrey mine is celebrated for the superb crystals of grossular garnet, some

of which are green with chrome-rich cores, others being the orange hessonite variety. Green stones once reported as uvarovite are now known to be grossular; TiO_2 is also thought to play a part in the green coloration of some of the stones. M.O'D.

GÜBELIN (E.J.). *Einschlüsse im Turmalin*. (Inclusions in tourmaline.) *Lapis*, 4, 1, 38-9, 14 figs in colour, 1979.

Coloured illustrations of characteristic inclusions in tourmaline are shown together with a faceted 'water-melon' stone. M.O'D.

GÜBELIN (E.J.). *Fiskenässet: Rubinvorkommen auf Grönland*. (Fiskenässet: ruby location in Greenland.) *Lapis*, 4, 3, 19-26, 11 figs (10 in colour), 1979.

Ruby and kornerupine are found at Fiskenässet in the south-west of Greenland. Ruby occurs in mother rock of plagioclase and is accompanied by pargasite. Kornerupine is dark green and transparent with RI 1.662-1.665, 1.673-1.677 and 1.675-1.679, and DR 0.013-0.014. M.O'D.

GÜBELIN (E.J.). *Il punto sulla ricerca in gemmologia*. (The point of research in gemmology.) *La Gemmologia*, 4, 2, 5-21, 1978.

Differences in the properties of natural stones and a number of synthetic materials are discussed. There is a short bibliography of up-to-date items. M.O'D.

GÜBELIN (E.J.). *Zwei neue Schmucksteine aus den Vereinigten Staaten*. (Two new gemstones from the United States.) *Z.Dt.Gemmol.Ges.*, 27, 4, 196-200, 5 figs, 1978.

The two new gem materials described from the States are stellarite and parrot wing, both commercial names. Stellarite is most attractive and consists of blue and dark materials which can be blue to green with metal grey to black veins. The blue component is quartz; the blue colour is produced by the copper matrix. The blue-green component is chrysocolla; the grey to black veins consist of hematite; interference colour can be traced to plancheite, a hydrous copper silicate. Parrot wing consists mainly of cryptocrystalline quartz, similar to agate or jasper. The brown, red and yellow colours are quartz, the second component is chrysocolla, which adds a green-blue hue. The chrysocolla is mixed with limonite, adding brown to the mixture. E.S.

HINTZE (J.). *Die Smaragdlagerstätten Kolumbiens*. (The emerald localities of Colombia.) *Aufschluss*, 30, 83-92, 3 figs, 1979.

The mines from which emeralds have been recovered are indicated on maps, two of which illustrate the immediate areas around Muzo and Gachalá respectively. A useful bibliography is included. M.O'D.

HOCHLEITNER (R.). *Dravit von der Drau*. (Dravite from the Drava.) *Lapis*, 4, 1, 31, 1 fig in colour, 1979.

Dravite from the classic locality of the Drava in Carinthia is described and illustrated. This brown variety was discovered in 1883; von Kunitz gave the name dravite to the sodium magnesium tourmaline. M.O'D.

HORIUCHI (N.). (New synthetic opal made of plastics.) J. Gemm. Soc. Japan, 5, 2, 61-65, 9 figs, 1978. (In Japanese.)

The white opal is made from plastic spheres of about 220nm in diameter, bonded by plastic and gives a fine play of colour. M.O'D.

HUDSON(P. R. W.). *Crystal imperfections in natural gem diamond*. Australian Gemmologist, 13, 8, 253-7, 1978.

An erudite discussion of experimental evidence of the presence or otherwise of nitrogen platelets, and/or discrete or paired N atoms in the diamond lattice. (At such submicroscopic levels their existence appears of little gemmological consequence. They are not defects affecting value except in so far as N can cause colour). R.K.M.

JAMIESON (N. P.). *Recognition of synthetic opal*. Australian Gemmologist, 13, 8, 259-60, 3 figs, 1978.

A brief account of a talk by Dr J. V. Sanders in 1977. Summarizes probable methods of manufacture and differences between natural and synthetic opal. 'Glueing' of silica spherules either by heat sinter or by organic cement is suggested, also blacks obtained by glucose and acid method mooted. (Author gives a 'synthetic' label to Slocum Stone—which is really a glass imitation). R.K.M.

KOSE (A.). (Artificial opal.) J. Gemm. Soc. Japan, 5, 2, 66-74, 5 figs, 1978. (In Japanese.)

An iridescent polymeric material simulates precious opal and displays colour in the same manner. Microspheres are obtained from synthetic polymeric mono-disperse latex. M.O'D.

LAREIDA (S.). *Man mietet sich einen Esel . . .* (One hires an ass . . .) Lapis, 4, 1, 14-19, 14 figs (7 in colour), 1979.

An account of the occurrence of tourmaline on the island of Elba with particular reference to 'niggerheads' (crystals with black tops). Notes are also given on other minerals found in the area; these include spessartine, topaz, quartz, cassiterite, beryl (aquamarine and morganite) and orthoclase. M.O'D.

LIEBER (W.). *Diamanten: Bruchstücke der Ewigkeit*. (Diamonds: fragments of eternity.) Lapis, 4, 3, 4-10, 13 figs (4 in colour), 1979.

A short account of the history of the workings for diamond with especial reference to South Africa. M.O'D.

MUMME (I. A.), SEIBRIGHT (L.). *The colouration Mt Surprise topaz by gamma irradiation*. Australian Gemmologist, 13, 8, 274-7, 1978.

An account of experiments in colouring topaz from one locality, using cobalt 60 source of gamma rays. (Unfortunately this intelligent report is spoiled by the omission of an unknown length of text between pages 275 and 276. Printing errors frequently mar this ambitious little journal, e.g. elsewhere in this issue, 'chariote' for 'charoite', 'rastite for 'bastite', 'scarolite' for 'scapolite', and once again Monsieur Gilson has been called 'L. Gibson'. Surely something can be done about these unnecessary errors?) R.K.M.

NASSAU (K.). *Distinguishing diamond from cubic zirconia*. Lapidary Journal, **32**, 10, 2136-50, 5 figs (1 in colour), 1979.

Cubic zirconia can be distinguished from diamond by the use of a reflectivity meter, by the use of a recently-devised test of surface wetting and by a thermal conductivity probe. Using a felt-tipped pen a sharp blob will be formed on a cleaned diamond surface while with zirconia the ink forms beads. Room temperature thermal conductivity can be used to give a signal when a particular stone is tested. M.O'D.

NIEDERMAYR (G.). *Phenakit in Edelsteinqualität aus dem Habachtal, Salzburg (Österreich)*. (Phenakites in gem quality from the Habach Valley, Salzburg, Austria.) Z.Dt.Gemmol.Ges., **27**, 4, 205-7, 2 figs, bibl., 1978.

Phenakites are found in the well-known emerald deposits in the Habach Valley in Austria. They are generally colourless, transparent to translucent, but can be found with orange-yellow to beige clouds. The material is often free from inclusions and is now used for gemstones. The author mentions stones up to 12 ct. The two illustrations show parallel very fine liquid inclusions as growth lines and irregular two-phase inclusions. E.S.

OBENAUER (K.). *Über den Aufbau des Buntsandstein-Carneols und seiner Achatdrusen*. (On the formation of cornelian in coloured sandstones and their druses.) Aufschluss, **30**, 113-19, 3 figs (2 in colour), 1979.

Discusses three German locations for cornelian with illustrations of thin sections. M.O'D.

O'DONOGHUE (M.J.). *New facets of gems*. New Scientist, **82**, 1153, 373, 1 fig, 1979.

Gives a short review of progress in manufacturing gem materials; written in connexion with an exhibition held at Goldsmiths' Hall, London.

(Author's abstract). M.O'D.

OTTEMANN (J.), SCHMETZER (K.), BANK (H.). *Neue Daten zur Anreicherung des Elements Gallium in Alexandriten*. (New data on the enrichment of gallium in alexandrite.) Neue Jahrbuch für Mineralogie Monatshefte, **4**, 172-5, 1978.

Ga³ replaces Al³ in the crystal lattice of alexandrite chrysoberyl; in some stones from Brazil up to 1200 ppm of Ga were found. M.O'D.

ROST (F.), FUCHS (B.), SADDREDINI (H.). *Über Demantoid aus dem Ural und seine Farbe*. (On demantoid from the Urals and its colour.) Aufschluss, **30**, 51-6, 2 figs, 1979.

Chromium and titanium in demantoid from the Urals are measured and their absorption spectra shown. M.O'D.

RUSKONÉ-PONCET (E.). *Le travail des gemmes jusqu'au début du XXe siècle*. (Fashioning of gemstones up to the beginning of the 20th century.) Revue de Gemnologie, **58**, 13-15, 4 figs (1 in colour), 1979.

Discusses the role and methods of the lapidary with particular reference to those operating in the Jura during the 19th century. M.O'D.

SCHMITZ (H.-H.). *Mineralogie der Kieselsäure*. (Mineralogy of silicic acid.) *Aufschluss*, **30**, 103-12, 7 figs, 1979.

The mineralogy of silica is discussed with particular reference to and illustration of crystal form. M.O'D.

SCHRADER (E.L.), FURBISH (W.J.). *Hyalite from the Spruce Pine district, North Carolina*. *Mineral. Record*, **10**, 1, 29-30, 4 figs, 1979.

Hyalite coloured light green, light blue, yellow or translucent white, is found in the Spruce Pine area of North Carolina. RI is 1.445-1.455 and some specimens fluoresce under short-wave ultraviolet light. M.O'D.

SCHUBNEL (H.-J.). *La gemmologie au 11e congrès de l'association internationale de minéralogie*. (Gemmology at the 11th International Mineralogical Conference.) *Revue de Gemmologie*, **58**, 5-7, 1979.

Summaries of papers dealing with Soviet lazurite, nephrite, charoite, and synthetic emerald and diamond in general are given. M.O'D.

SINKANKAS (J.). *Tourmalinreiches Südkalifornien*. (The tourmaline country of southern California.) *Lapis*, **4**, 1, 33-7, 8 figs (3 in colour), 1979.

Tourmalines are found in five main areas of Southern California; Pala, Mes Grande, Ramond, Palomar Mountain and Rincon. The various occurrences and mines are described. M.O'D.

STRUNZ (H.). *Anjanabonoina, Fundort schönster Turmaline*. (Anjanabonoina, home of the finest tourmaline.) *Lapis*, **4**, 1, 24-27, 11 figs (9 in colour), 1979.

Anjanabonoina in the Malagasy Republic is celebrated for the high quality of the tourmaline produced there. Especially noteworthy are the zoned sections. Many crystals show complex terminations. Danburite of an orange-yellow colour is also found. M.O'D.

TAN (L.-P.), LEE (C.W.), CHEN (C.-C.), TIEN (P.-L.), TSUI (P.-C.), YUI (T.-F.). *A mineralogical study of the Fengtien nephrite deposits of Hualien, Taiwan*. National Science Council of the Republic of China, NSC Special publication No. 1, pp. v, 81, 77 figs (64 in colour), 1978.

Nephrite from Taiwan is classified into common, cat's-eye and waxy material and occurs in hanging walls and footwalls of serpentinite. Inclusions of serpentine and chromite are found in the nephrite and appear to indicate that the nephrite is a metasomatic product of serpentinite derived from ultramafic rock. Surface textures, thin sections, rough boulders and faceted stones as well as cabochons are illustrated. The value of nephrite sold on the retail market in Taiwan annually is estimated at 10 billion NT dollars. M.O'D.

TENNYSON (C.). *Der Feinbau des Turmalins*. (The elegant structure of tourmaline.) *Lapis*, **4**, 1, 6-7, 7 figs, 1979.

Diagrams illustrate the chemical composition and the structure of tourmaline and are amplified by brief notes. M.O'D.

WILKS (E.M.). *Remarks on the classification of natural polycrystalline diamond.* Industrial Diamond Review, 156-61, 15 figs, May 1979.

The limitations of descriptive names such as 'carbonado', 'ballas', 'framesite' and 'boart' for natural polycrystalline diamond are explored, and examples of conflicting definitions in existing reference works are quoted. Specimens of carbonado, ballas and framesite were obtained, and their surfaces inspected for coherence and compactness by polishing a facet on each one and viewing it at low magnification on an optical microscope (using Nomarski interference contrast). The specimens were then checked for abrasion resistance using a V-shaped diamond wheel, and for density using hydrostatic weighing. From the results of these tests, a proposal is made (backed up by a series of microphotographs) that future reports on polycrystalline diamonds should include an indication of such essential identification parameters as density, porosity and degree of coherence. P.G.R.

Diamond probes secrets of Venus. Industrial Diamond Review, 115-18, 10 figs, May 1979.

A 205.4 carat Type IIa diamond from the Premier mine at Cullinan was used to produce an 18.2mm diameter by 2.8mm thick window for the NASA Pioneer Venus Multiprobe. The diamond window was used to protect the infrared radiometer sensor fitted to the largest of the probes whose function was to determine how temperatures on Venus varied with altitude and location. Diamond was chosen for the window as it was the only material which could meet the stringent requirements of strength and corrosion resistance and also have good optical transparency in the infrared (hence the use of nitrogen-free Type IIa diamond).

The diamond window was cut and polished from the rough by D. Drukker of Amsterdam. Sawing of the window blank took more than two months, and when completed, the window weighed just under 13 carats. Two windows were produced, one for the flight and one as a spare. The Pioneer Venus Multiprobe was launched on 8th August, 1978, and after a 220 million mile journey, the large probe carrying the diamond window landed on Venus on 9th December, 1978. Although initial data have given more precise details than hitherto on the composition of the Venusian atmosphere, it is said that most of the data from the probes will take at least four years to assess and correlate. P.G.R.

Gemstones and abrasives. Mining Annual Rev., 125 & 127-8, 1978.

A review of the world production of diamonds is presented, including a table of the output of individual countries over the past three years. A brief review is also given of industrial diamond consumption (both natural and synthetic). R.A.H.

Recent prices on coloured stones. Canadian Gemmologist, 2, 4, 31-2, 1979.

A list gives the retail price per carat (including wholesale price with 30% plus tax plus keystone) of most of the commoner gemstones. Examples given include a medium coloured tanzanite of 3ct at (Canadian) \$500 per ct, golden beryl of under 2ct at \$200 per ct and pink tourmaline of about 7 ct at \$300 per ct. M.O'D.

BOOK REVIEWS

CANNON (B.). *Minerals of Washington*. Cordilleran, Mercer Island, Washington, U.S.A., 1975. pp.iii, 184. Illus. in black-and-white. \$4.95.

A well-written and attractively produced guide to minerals found in the state of Washington, this book consists largely of an alphabetical arrangement of the minerals found with their descriptions and in many cases with sketches. Maps are provided with the preliminary material, which also includes descriptions of rocks in general and of the various geologic provinces of the state. M.O'D.

RAMDOHR (P.), STRUNZ (H.). *Klockmann's Lehrbuch der Mineralogie*. (Klockmann's Mineralogy). 16th edn. Enke Verlag, Stuttgart, 1978. pp.xi, 876. Illus. in black-and-white. DM168.

This reviewer has waited a long time for this standard work to be issued once more; since there is no comparable English work at present on the market English-speaking readers have to discover details of many new minerals in a number of works, many of which, though very useful and accurate, have not the convenience of including new data together with notes on occurrence, tests, etc. A quick check shows that material has been added up to 1977 (from items listed in the bibliography) and that such new reports as liddicoatite are included, though the transparent variety of vayrynenite from Pakistan is not listed. However since such out-of-the-way items have to be checked readers can be sure that the rest of the book is of a more than satisfactory completeness.

Early chapters deal with the formation and classification of crystals, with the occurrence of minerals, with geochemistry and with methods of testing. This takes us approximately half-way through the book. The rest of it is devoted to systematic mineralogy in which all details are given for the minerals concerned. Important species have more details given of their occurrence, easily seen since this is printed in italic. Diagrams are beautifully drawn as one expects in a German textbook. Bibliographies are appended to each section; there are subject and species indices and a list, arranged alphabetically, of some of the most important of the world's mineral sites.

'Klockmann' is the standard textbook on the Continent and those who are seriously interested in minerals should not let the language stand in their way of obtaining and using this excellent book. M.O'D.

REAM (L. S.). *Gems and minerals of Washington; a collector's reference*. Jax Products, Renton, Va, 1977. pp.202. 110 Figs. \$5.95.

This pocket-sized guide has a pleasing precision of style and is arranged in two sections, gems and minerals, in each of which the species are listed alphabetically. Agates and nephrite are the most important of the ornamental materials found in the State. There is a short bibliography. M.O'D.

ASSOCIATION NOTICES

GIFTS TO THE ASSOCIATION

The Council of the Association is indebted to the following for their gifts:

The Gemmological Association of All Japan for a collection of 28 cabochon and faceted stones produced by Dr S. Iimori, of Tokyo, Japan. They imitate jadeite, sapphire, emerald, amethyst, turquoise and cat's-eyes. These are made of lead glass, but minute pieces of mineral are added to the melt to improve the appearance.

Mr E. A. Thomson, London, for a cut specimen of trilliumite, 2.76ct, from Wilberforce, Ontario, Canada.

NEWS OF FELLOWS

Mr Louis Lo, F.G.A., has been appointed Secretary of a newly-formed organization—The Gemmological Association of Hong Kong. He would be pleased to hear from any members of the Gemmological Association of Great Britain who are interested in joining the local Association. Letters should be sent to Mr Lo c/o G.P.O. Box 2664, Hong Kong.

On the 8th June, 1979, Mr M. J. O'Donoghue, M.A., F.G.S., F.G.A., gave a talk to a general audience at Ightham, Kent, entitled 'An introduction to gemstones'. On the 12th June, Mr O'Donoghue gave a talk to the Essex and London Rock and Mineral Society on the subject of 'Developments in the gem world since 1970' and a number of specimens were shown. On 3rd July Mr O'Donoghue spoke to the Amateur Geological Society, London, on 'The minerals of Scandinavia'.

On 31st July, 1979, at a special dinner at the United Nations Buildings, New York City, Mr John F. Croydon, F.G.A., (this year's President of the National Association of Goldsmiths) and Professor Dr E. Gübelin, F.G.A., received the Retail Jewellers of America International Jewellery Leadership Award.

MEMBERS' MEETINGS

Midlands Branch

A field trip to Derbyshire Peak District was held on the 22nd July, 1979.

North-West Branch

On 15th July, 1979, a field trip was arranged to Crich Quarry, near Matlock, where fluorite and pink and cream banded barite are among the minerals to be found.

On 13th September, 1979, Mr P. G. Read, C.Eng., M.I.E.E., M.I.E.R.E., F.G.A., gave a talk on new gemmological instruments and techniques.

ANNUAL GENERAL MEETING

The 49th Annual General Meeting was held at Saint Dunstan's House, Carey Lane, London EC2V 8AB on the 16th May, 1979.

The Chair was taken by Mr David Callaghan, the Vice-Chairman, who explained that the Chairman, Mr Douglas King, was unfortunately prevented by illness from being present. He also referred to the untimely deaths of the former Secretary, Mr Gordon Andrews (the 1931 Tully Medallist), and of Mr Douglas Ewing, a member of Council who had done a great deal to promote gemmology in Scotland and had been a good ambassador for the Association in his travels around the United Kingdom and to many places abroad.

Special thanks were extended to the Chairmen and Secretaries of Branches as well as to members of Council, Examiners and Instructors, who willingly gave so generously of their time to attend Council Meetings and do other work for the Association. The Examinations Review Committee had met during the year and thanks were due to the President, Sir Frank Claringbull, for acting as its Chairman and to Mr Jonathan Brown as its Secretary. Mr Callaghan then referred to the excellence of the *Journal of Gemmology*, which had such a high standing in the gemmological world, and expressed sincere thanks to the Editor, Mr John Chisholm, for all his work. The Association's thanks were also recorded to the Treasurer, Mr Lawson Clarke, for keeping the accounts in good order and ensuring that there was a satisfactory balance at the end of the year, to the Rayner Optical Company for its continued interest in the Association and for its efforts in improving instrument production (which enabled Gemmological Instruments Ltd to meet the needs of gemmologists throughout the world) and, last but not least to Mr Harry Wheeler, the Secretary, and all his headquarters' staff, who worked so diligently to ensure the smooth running of the gemmology courses, examinations and other activities.

In the absence of the Treasurer, the Secretary reported on the accounts for the year, and the Assistant Secretary, Mr Douglas Wheeler, was thanked for the way in which he had used every opportunity to obtain bank interest on available funds.

The adoption of the Annual Report and Accounts was then proposed from the Chair, seconded by Mr David Larcher and duly passed.

Sir Frank Claringbull was re-elected as President: Messrs Douglas N. King, David J. Callaghan and F. E. Lawson Clarke were re-elected Chairman, Vice-Chairman and Treasurer respectively: Messrs D. Frampton, P. Riley and C. Winter were re-elected and Messrs L. Cole, A. E. Farn, A. Hodgkinson, B. Jones and A. Round were elected members of Council.

It was announced from the Chair that Messrs Hard Dowdy, Watson Collin & Co., Chartered Accountants, had signified their willingness to continue as auditors, and, in closing the meeting Mr Callaghan expressed his thanks to the British Jewellery and Giftware Federation for the use of their Boardroom and to the

Worshipful Company of Goldsmiths for generously continuing to allow the Association to use rooms in Goldsmiths' Hall when convenient.

TSAVOLITE

At a recent meeting of the Coloured Stones Commission of C.I.B.J.O. (International Organization for the Jewellery Trade) it was decided that the green grossular garnet should be known as 'Tsavolite' and not 'Tsaveorite' as it was originally called. The original name had no proper etymological basis, whereas the new agreed name, in common with many other minerals, has the termination '-lite', derived from the Greek *λίθος* (lithos = stone) and so means 'a stone of the Tsavo region'.

'SYNTHETIC JEWELLERY AND GEMS'

An exhibition of 'Synthetic Jewellery and Gems' was held at Goldsmiths' Hall, London, from 1st May to 25th May, 1979. In addition to a display of synthetic and imitation material and cut specimens, there were exhibits of jewellery dated from 1400 BC to 1979 AD and a collection of plastic jewellery. The exhibits were divided into six sections covering ceramics (from Wedgwood's jasper and sandblasted bone china); glass (including paste jewellery and gems); enamels from all over the world; vulcanite (the Victorian substitute for jet); plastics (from before 1939 to modern resins by Susanna Heron and acrylics by David Watkins); and finally a small section on synthetic stones.

REUNION OF MEMBERS AND PRESENTATION OF AWARDS

The Reunion of Members is to be held at Goldsmiths' Hall, Foster Lane, London E.C.2. on Monday, 19th November, 1979, between 6.00 and 7.00 p.m.

Following the Reunion the awards gained in this year's examinations will be presented by Prof. Dr Pieter C. Zwaan, F.G.A., Director of the National Museum of Geology and Mineralogy, Leiden, Holland, at 7.00 p.m.

'THE CRYSTALLINE WORLD OF GEOLOGY'

A course of 12 meetings has been arranged by the Geological Museum and the Department of Extra Mural Studies of the University of London, to be held at the Museum every Monday evening from 7th January to 24th March, 1980, at 6.30-8.30 p.m.

It will be an introductory course for those who wish to know more about the crystalline state and will consist of a series of informal talks, demonstrations and practical sessions. Museum exhibits, films and colour slides, microscopes and optical instruments will be used to investigate rocks, minerals, gem and man-made crystals. The lecturer will be Mr Ian F. Mercer, B.Sc., F.G.A.

For further information and enrolment please contact Mrs Julie Robins, Department of Extra Mural Studies, University of London, 26 Russell Square, London WC1B 5DQ.

FRIENDS OF JADE

A press release has been received regarding the formation of a new non-profit society named 'Friends of Jade', primarily concerned with circulating information about jade for people interested in the subject. For further particulars, write to Friends of Jade, P.O. Box 135, Wallington, Surrey, England.

LETTER TO THE EDITOR

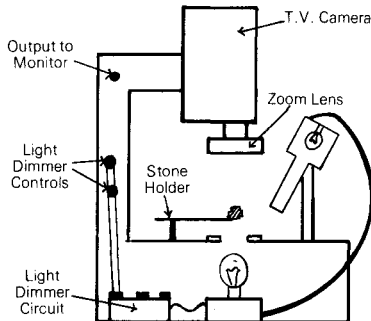
From Mr D. Minster

Dear Sir,

A new concept in the use of closed circuit T.V. for the gemmologist or diamond merchant.

One of the main problems facing the consulting gemmologist today, after a customer has been told that his diamond is not flawless, is showing the customer the flaw under the microscope. The main problems are that (a) people's eyes differ, and, if the flaw is relatively small or insignificant, it will (or can) be out of focus for the customer, so that he does not see the flaw (we are now dealing with the higher magnifications); and (b) even when the flaw is visible and described, most customers are still 'not sure' about what they are looking for or at. Another problem is that when people are allowed into the laboratory, they start fiddling with the equipment and stones while the gemmologist is busy studying the stone in question under the microscope, and for various security reasons this is not desirable.

After much deliberation on the subject, I came up with a solution to these problems with the aid of a closed-circuit television system. Instead of buying expensive attachments for incorporating the T.V. system into the microscope or buying a special microscope, I decided to use the actual T.V. camera in place of the microscope (*see sketch*).



As can be seen in the sketch, the layout is fairly simple and very easy to operate. The stone to be viewed is placed in the holder: it is then manipulated up or down to bring it into the focus of the fixed objective zoom lens. This is easily done by observing the image on the T.V. monitor. The zoom lens is then adjusted to give the desired magnification. It will be noted that the viewer has the choice of variable intensity transmitted or incident light or both. By observing the image on the screen the flaws can be pinpointed and pointed out to the customer. They can then be discussed by the gemmologist with the added advantage of knowing that the customer has seen the same flaws and now knows what he is looking at. The beauty of this system is that a microphone can be placed near the camera and two monitors can be used, thereby allowing the gemmologist in the laboratory to see what he wants to see and the customer, who is situated elsewhere in the shop, to 'examine' the stone with the gemmologist on his monitor. The gemmologist can then describe his progress over the microphone via an intercom and the customer can ask questions as well. One drawback that seems apparent is that the T.V. system used is black-and-white; this is no drawback if the system is used exclusively for diamonds, as they are essentially black-and-white. The cost of the system is a lot less than a high quality microscope and a much higher magnification (approx. $400\times$) and resolution are obtained than from a standard gemmological microscope.

Other plus factors are that the customer is more impressed and gains something from the experience, and now knows what he or she is buying, and also that the customer is kept out of the laboratory, thus alleviating the problems of security and damage to equipment. This system is also a great educational aid.

Yours etc.,
D. Minster

5th July, 1979. c/o Minster Jewellers, Pretoria, South Africa.

CORRIGENDA

On page 217 above, in line 17, for '45th Annual General Meeting' read '48th Annual General Meeting'.

At foot of page 465 above, the Coded Bibliographic Strip should read 'ISSN:0022-1252 XVI(7) 465 (1979)'.

On page 486 above, at the end of line 1, for 'fin' read 'fine'.

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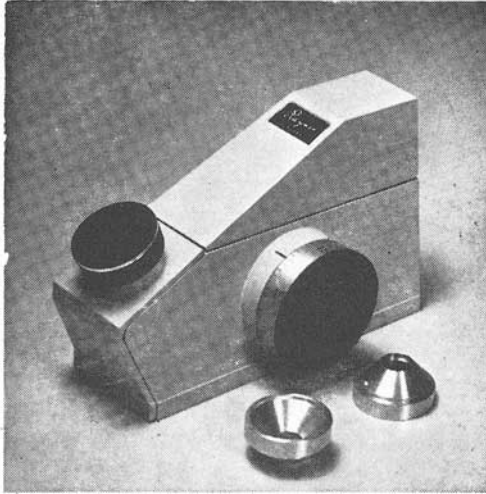
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