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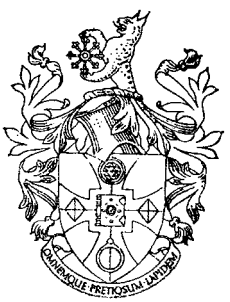
THE JOURNAL OF GEMMOLOGY

and

PROCEEDINGS OF THE
GEMMOLOGICAL
ASSOCIATION
OF GREAT BRITAIN



GEMMOLOGICAL ASSOCIATION
OF GREAT BRITAIN
SAINT DUNSTAN'S HOUSE, CAREY LANE
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THE JOURNAL OF GEMMOLOGY
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Vol. XIV No. 2 APRIL 1974

NOTES FROM THE LABORATORY

By A. E. FARN, F.G.A.

I WAS asked fairly recently to write a series of articles on synthetics, simulants, and a general commentary on gems commonly used in jewellery. I voiced the opinion that this had been done before many times: without wishing to advertise, two at least of my former colleagues had written tomes on these subjects. I was assured that not everyone possessed such books and that there is always a steady flow of people beginning, new classes starting, and there was always something new for someone. On this premise I have prepared some notes of interest in general terms of work recently done in the laboratory. As some may know, we have a fairly new nucleus of staff, and so of course things occur which to them are new and to others are well established.

A small flat cylindrical piece of deep fine blue lapis-lazuli with pyrite inclusions was sent to test for staining. Much of today's lapis-lazuli is "improved" by colour finishing. This can be readily detected by putting a small drop of acetone on a swab of cotton-wool and rubbing the lapis-lazuli in an unobtrusive place. If staining agents have been used a blue stain will show quickly and easily upon the cotton-wool. We have found that a light rubbing

removes the staining (and if tested a second time no more colour comes away). The piece of lapis-lazuli in question however yielded no signs of staining. It was quite a small piece and the owner remarked, "you can do what you like with it: I am suspicious". We decided to try to extract some colouring and put it into a small test tube with acetone, shook it vigorously and poured the solution through a filter-paper: no staining resulted.

Somewhat reluctantly I felt it must be right, since it had some quite distinct pyrite inclusions. Alan Clewlow, B.Sc., one of our recent additions of staff, fortunately has an enquiring turn of mind and checked recent publications on blue stones imitating lapis-lazuli. So far as I was concerned the nearest approach to lapis-lazuli is sintered synthetic spinel coloured by cobalt. A quick test for this is by viewing through the Chelsea colour-filter. The sintered synthetics appear a blood red, whereas lapis-lazuli and the other simulant, "Swiss lapis" (a blue stained jasper), both appear a liver-brown colour. Further, the sintered spinel is much denser at 3·52. We have also seen opacified blue glass with included copper crystals triangular in shape, which is a blue counterpart to the "goldstone" imitation aventurine-glass. Sodalite (itself a constituent of lapis-lazuli) with a refractive index of 1·48 and a density of 2·30 is in fact a different blue to lapis-lazuli: lapis-lazuli is a deep or saturated blue whereas sodalite is a *bluer* blue, for want of a better term. When one remembers that artists used crushed lapis-lazuli as a colour pigment and termed it ultramarine one appreciates the depth of colour true lapis-lazuli has.

Having exhausted our stock of suspects we decided to try a specific gravity test (we could not obtain a refractive index reading). Lapis-lazuli, being a rock and not a mineral, does not have a fixed characteristic density: it can vary from 2·7 to 2·9, but if much pyrite is present then the density will increase. Alan Clewlow then carried out a series of checks in known density liquids and established a final density of 2·20. Now the alarm bells were ringing loud and clear. Further reading found a description in "Gem Testing"*, by B. W. Anderson, of crushed Chile lapis-lazuli (poor quality) containing pyrite bonded with plastic. We crushed our specimen, poured the contents into a small test-tube and gently heated it. A distinct smell as of burning fat or wax came away and,

*8th edn (1971), p. 312.—Ed.

on cooling, the sides of the test-tube were seen to be coated with a waxy brown substance and at the bottom of the tube there was a charred residue (which we will offer back to our customer). This crushing and burning is *not* our usual custom! We treat emeralds, rubies, black opals and other stones with due care and deference, but when a customer tells us we can do what we like in testing we take full advantage of it. Had this piece been in a pendant or ring, thus disguising the density, and as it had pyrite inclusions, it could have passed.

Bonding with plastic is also used with poor quality turquoise. Plastic bonding has a "wetting" effect upon the turqoiuse, giving it a deeper hue, and, worse, heightens the appearance of the absorption spectrum. For many years we of the older brigade of gemmologists were quite happy with a poorish distant vision reading (I still call it "Lester Benson" after its discoverer on the staff of the Gemological Institute of America). Today's students probably find it puzzling to think that for years we never knew how to obtain this useful reading on a curved surface. When in testing turquoise we found these poor distant vision readings and coupled them with a fairly good absorption spectrum in the blue and violet at 4600Å and 4320Å respectively we were happy that we had proved turquoise. As in all things, one learns by a lot of trial and a little error. This "wetting" which enhances the spectrum is now recognized as a "suspicious" characteristic, whereas earlier we were pleased to think we had a positive indication of turquoise. In defence one could claim that a chemical analysis would yield a compound formula for turquoise—it seems one must have an eternally enquiring mind and suspect everything.

A MOLDAVITE
SOME TYPICAL INCLUSIONS AND THEORIES

By T. F. ZOOK, M.A., F.G.A.

MOLDAVITE is a bottle-green natural glass which is designated as being a tektite. The name comes from the Moldau River. In 1788, Joseph Mayer first described moldavites as having been found within a radius of 50 km of České Budějovice. Then, in 1878 scientists reported finding moldavites in Moravia, west of Brno, in an area extending from Tyebiv southeastward for about 28 km.(1) The term tektite embraces besides moldavites, australites, javanites, billitonites, indochinites, philippinites, Darwin glass, Ivory Coast tektites, Libyan Desert glass and bediasites.

Two main hypotheses exist to explain the origin of tektites. Summarizing briefly, one theory holds that tektites are of an extraterrestrial origin, having come from outer space no farther away than the moon; the other theory attempts to relate the origin of tektites to a terrestrial derivation.

One hypothesis for terrestrial origin was explored in 1961 by Gentner, Lippolt and Schaeffer who suggested that the moldavite-strewn fields may have resulted from the same impact which produced the Ries Crater in Southern Germany.(2) In support of this theory they pointed out that both moldavites and the dense Ries glass share two similarities: (1) K/A (Potassium/Argon) ages approximating 15 million years, and (2) a chemical peculiarity which is a marked deficiency of volatiles. In contradiction to the terrestrial shared origin theory suggested above is the fact that a different origin is suggested by the stratographic evidence that the two events were not simultaneous although both belong to the same K/A datings. The stratographic evidence is based on finding a slightly different index fossil *Cepae silvestrina* inside the Ries Crater, which means that the Ries Crater was formed near or at the boundary of the Tortonian and the Samartian Stages while Janoschek (1936) had associated moldavites with an earlier period, the Oncophora layers of the Upper Helvetian.(3)

Moldavites, especially those from Bohemia, show their non-homogeneous nature in a flow-structure which is seen as streaks (schlieren). The streaks are layers of composition and/or orientation of particles which are different from the enclosing glass and are a

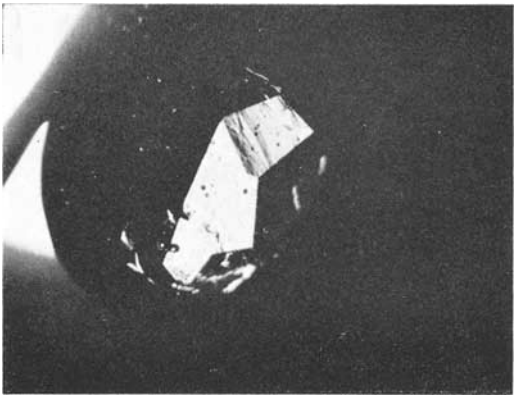

FIG. 1. Moldavite—Bubbles and schlieren, characteristic inclusions, transmitted light. 10 ×

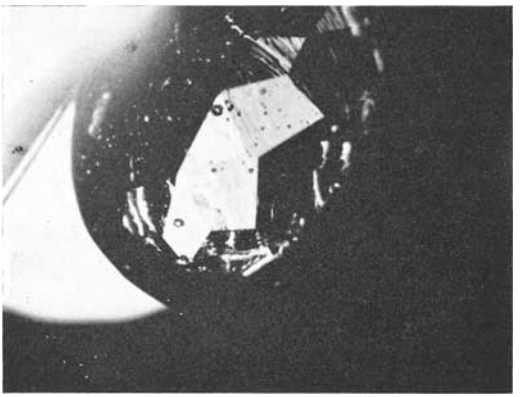

FIG. 2. Moldavite—Round bubbles and schlieren (or flow-structure) inclusions transmitted light. 10 ×.

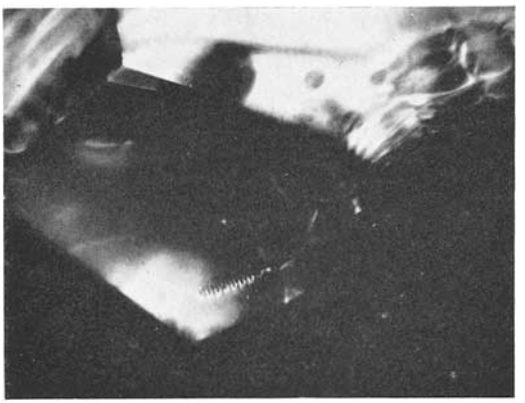

FIG. 3. Moldavite—Schlieren or flow-structure which shows "wrinkled cloth" look, and screw type stringer inclusions, transmitted light. 50 ×.

manifestation of differential movement within the tektite.[4] The streaks are seen in Figs. 1 and 2, but are particularly noticeable in the latter study. Chao in his studies of tektites characterizes the look of the flow-structure under a microscope as looking like a piece of wrinkled cloth (see Fig. 3).

Chao found that the colour-bands in tektites may vary from dark brown to colourless and that the variation is probably due to the oxidation state of the iron content or the minor colouring elements. He attributed the flow-structure to be evidence of rapid fusion and quenching of pre-existent mineral rock or glassy material which formed glasses of slightly different composition. Tektites are therefore composed of glassy materials which did not have time enough to diffuse or homogenize, as is the case with volcanic glasses.[5]

Fig. 7 clearly shows strain-birefringence, a characteristic which Chao found was associated with flow-structure and colour-bands. Barnes in 1939 had found that strain was created by rapid cooling.

Bubbles are another feature of tektites. The shape of the bubble tells something about the conditions of the glass during the cooling process. Specifically, in examining over 500 different tektites for their internal characteristics, Barnes found bubbles to be an important feature of all tektites (except for around 20 per cent of the bediasites from Texas). Spherical bubbles, according to Barnes, show that the glass was not deformed while it cooled. Elongated bubbles show that a deformation took place as the glass cooled. Irregular, branching or unsymmetrical bubbles (which are found particularly in Libyan Desert glass) are the result of trapped intergranular porosity in a glass that did not reach sufficient fluidity to allow the surface tension to draw the bubbles into spheres and therefore indicates a glass formed at lower temperatures.[6]

Fig. 2 shows the spherical nature of most of the bubbles in the specimen moldavite. Chao, in a study of the petrographic and chemical properties of 1330 tektites, found that vesicles (bubble cavities) could vary in size from a few microns (one micron, designated μ, equals one millionth of a metre or a thousandth of a millimetre = 0·001 mm)[7] to more than one centimetre in diameter, although the majority he found to be spherical and less than 500 microns in diameter.[8] Chao suggested that bubble cavities are shrinkage bubbles and that the "sparsity of vesicles in tektites in

FIG. 4. Moldavite—Contorted stringer inclusion of siliceous glass, transmitted light. 100×.

general is evidence that the tektites were heated at a very high temperature consistent with the high fluidity of the glass and its inclusions."(9)

An interesting and characteristic type of inclusion found in moldavites is seen in Fig. 4. This contorted stringer type of inclusion is of siliceous glass according to Chao, who found that the R.I. could range from 1·458 to an R.I. of 1·470 for pure silica glass. He found that these stringers were colourless but could appear slightly pink in transmitted light through the microscope because of their low index of refraction.(10) The theory he suggested for the formation of these contorted stringers was that both the tektite and the glass inclusion were highly fluid when formed, and that the "high fluidity or low viscosity of a pure silica melt would suggest a temperature of nearly 2,000°C, in spite of the fact that the quartz may have begun melting metastably at a much lower temperature."(11) Furthermore, Chao explains that because the glass inclusions show a sharp contact with the glass of the tektite which encloses them, the time span for heating must have been extremely short and therefore there was little time for homogenization by diffusion.

The round spherules seen in most of the photomicrographs, but most strikingly in Figs. 5 and 6, have been described in most previous writings as gas bubbles. However, this description should apply only to the transparent clear area in the centre, for it is

possible that the surrounding darker area (which also is spherical) morphologically bears a resemblance to the metallic spherules found by Chao both in Ries impactites[12] and in philippinites.[13] Chao et al. (1962) compared the metallic spherules found in the philippinite tektites with deep-sea spherules, cosmic spherules and nickel and iron spherules from impactites. The similarity of philippinite metallic spherules to those of the Wabar spherules according to Chao appeared to point to a formation by a meteoritic or asteroidal impact in a siliceous medium.[14]

O'Keefe writing on the origin of tektites in 1969 states that tektites probably come as a result of an impact on some surface somewhere and are not volcanic. To O'Keefe the fact that Chao found nickel-iron spheres embedded in tektites together with trace elements found in iron meteorites (specifically schreibersite, which is an iron phosphide, and troilite, which is an iron sulphide) is proof of the impact origin of tektites.[15]

Roedder and Weiblen reported inclusions with similar morphology in olivine samples taken from Kilanea Iki Lava Lake, Hawaii, at a depth of 0·7 feet and they describe the inner portion as a glass inclusion trapped during enclosure by a solid black object. They also found a similar inclusion in the prehistoric Makaopuhe Lava Lake, Hawaii, inside a sulphide globule. In this latter instance, they described the inner area of the inclusion as a relatively small shrinkage bubble typical of inclusions in olivines from these Hawaiian lava lakes.[16]

However, since this suggestion of metallic spherules in Figs. 5 and 6 is based only upon a morphological similarity to the pictures in the works cited of the other studies, and since there is no desire to destroy the faceted specimen stone, the true identification must remain a mystery. Cohen (1963) stated that none (metallic spherules) had been found in a moldavite, so that were it a metallic spherule it would indeed be a rare inclusion in a moldavite.[17]

Fig. 8 shows an interesting, different, and challenging inclusion. The host material within the inclusion shows anomalous double refraction. The indented area near the facet-line shows some tiny clear veining which may possibly be a type of glass different from the host substance. In addition, the darkened area down the middle of the inclusion may represent an isotropic minute granular inclusion.

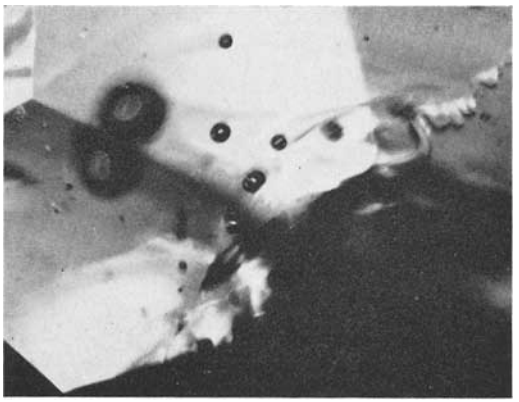

FIG. 5. Moldavite—Dark spherules encircle a clear centre which may be a bubble, transmittedlight. 50 ×.

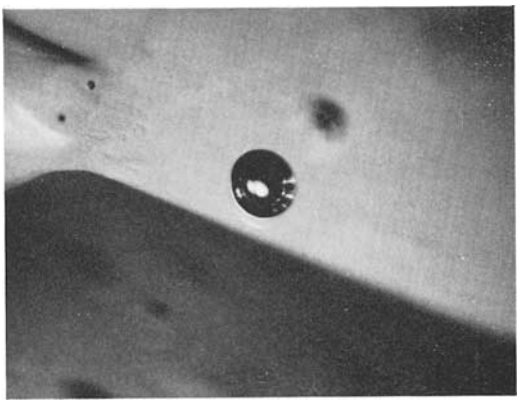

FIG. 6. Moldavite—Dark spherule encircles a transparent centre which may be a bubble, transmitted light. 100 ×.

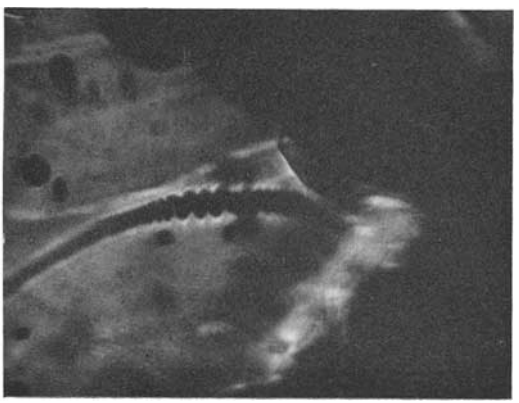

FIG. 7. Moldavite—Strain birefringence, and another contorted stringer inclusion, transmitted light. 100 ×.

An ellipsoidal glass particle, morphologically similar, but considerably smaller than that shown in Fig. 8, was reported in the lunar fines of Apollo 11 and Apollo 12 by Masson, Götz, Jamieson, McLachlan, and Volborth. They described the slightly indented portion of their particle (which portion corresponds in Fig. 8 to the area near the indentation on the broad part of the inclusion near the facet-line) as an impact centre. They have also reported finding all stages of devitrification in lunar glass from fresh clear glass shards, spheres and dumb-bells to completely devitrified optically birefringent and also dark opaque glasses. They theorize that the different recrystallization stages of spheres and dumb-bells may represent what in chondritic meteorites would be called chondrules in different stages of development. Also, they found spheres and dumb-bells in the fines which contained two immiscible glasses with droplets of darker and possibly heavier glass concentration either in the centre or on the rim of the spheres or at the outer ends of the dumb-bells. They believe that the separation of heavier phases outward might be due to spin in the lunar gravitational field. (Please note on Fig. 8 that a slightly out-of-focus dumb-bell inclusion also is present in the moldavite specimen of this article.) They also report finding many rounded mineral grains which are covered by a crust of glass. The results of their studies led them to speculate that there may be present yet undetected mineral phases with discrete silicate framework as microlites or crypto-

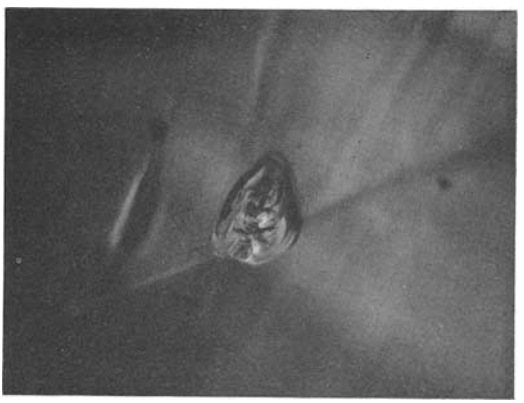

FIG. 8. Moldavite—Ellipsoidal inclusion, possibly glass, enclosing fine black granules, transmitted light. 100×.

crystallites in the shocked and partially melted minerals and glasses in the lunar fines.[18]

The specimen faceted moldavite examined for these photomicrographic studies did not exhibit the following inclusions which have previously been found by Chao in other moldavites:[19]

(1) "finger-print inclusions"

(2) oblong lenticular inclusions

(3) cigar-shaped inclusions

(4) bag-shaped inclusions with enclosed glass particles of low index of refraction

(5) criss-crossing of fine fibres which suggests that the glass inclusions were free in space prior to being embedded and engulfed by the matrix (the fibres in this case remain because the cooling took place rapidly and allowed no time for homogenization). However, in Fig. 8 we did find within the ellipsoidal inclusion aligned inclusions which might prove that the inclusion was derived from a rock rather than a single mineral, as has been suggested by Chao.

The moldavites, which are estimated to be about 15 million years old, are the second oldest group of tektites (the bediasites are much the oldest group since it is estimated that they were formed about 33 million years ago [20, 21, 22, 23] and all other tektite groups are shown in the literature to be of much younger age). Since the chemical data on tektites have suggested to researchers an extraterrestrial origin, it is very appropriate that as the investigations on the moon rocks progress the gemmologist might like to take a closer look at any moldavites or other tektites which are made available to him. Since other gemmologists may have more ready access to numerous tektites, some may wish to conduct more extensive investigations into the definite identification of the inclusions (i.e. where they do not mind destroying the specimen to provide the narrow slices necessary for petrological studies). An understanding of the types of inclusions and the theories for their origin can make this a more interesting study for any gemmologist rather than to think of a moldavite or other tektite as merely a piece of natural glass.

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2. Ibid., O'Keefe, J. A. Chap. VIII "Origin of Tektites", p. 174.
3. Ibid., O'Keefe, J. A. Chap. VIII "Origin of Tektites", p. 175.
4. Ibid., Barnes, V. E. op. cit., p. 42.
5. Ibid., Chao, E. C. T., Chap. III "Petrographic and Chemical Characteristics of Tektites", p. 65.
6. Ibid., Barnes, V. E., op. cit., pp. 46, 47.
7. Poindexter, J. S. *Microbiology, An Introduction to Protists*, The MacMillan Company, N.Y., Collier-MacMillan Company Ltd., London, 1971, p. 27, footnote [1]. Poindexter on this same page states that a light microscope does not allow visualization of components less than about 200 nanometres (nm or $m\mu = 0{\cdot}001$ microns) which means that the best light microscope does not allow visualization of components below 0·20 microns or 0·0002 mm. (To achieve this differentiation with a light microscope a high-powered oil immersion lens would have to be used for the study probably.) An electron microscope, however, does allow visualization of components less than 200 nm.
8. O'Keefe, op. cit., Chao, E. C. T., op. cit., p. 63.
9. Ibid.
10. Ibid., p. 61.
11. Ibid., p. 62.
12. Ibid., p. 62. Chao tentatively believed that lechatelierite is derived from quartz and the other impure but highly siliceous glass is probably derived from a mineral fraction such as feldspar. He further believed that any clayey fraction or the mafic (dark) mineral fraction is converted into the matrix glass. Impactites are highly vesicular and they may or may not have a flow structure, while in the case of tektites the flow structure is distinctly shown and the tektites are nearly non-vesicular.
13. Ibid., See Plate V*f* and V*a* by Chao, E. C. T., between pp. 52 and 53.
14. Randall, Charles A. Jr. ed., *Extra Terrestrial Matter*, Proceedings of a Conference at Argonne National Laboratory, March 7-8, 1968, O'Keefe, John A., "Origin of Tektites," p. 71, fig. 3-12, Ni-Fe Spheres embedded in Tektites, courtesy of E. C. T. Chao, Northern Illinois University Press, DeKalb, Illinois, 1969.
15. Ibid., p. 71.
16. Roedder E., and Weiblen, P. W., "*Petrology of silicate melt inclusions, Apollo 11 and Apollo 12 and terrestrial equivalents*," Proceedings of the Second Lunar Science Conference, Vol. 1, "Mineralogy and Petrology," Suppl. 2 Geochimica et Cosmochimica Acta, ed. Levinson, A. A., p. 510, fig. 3, p. 511, figs. 4 and 5, The MIT Press, Cambridge (Massachusetts) and London, 1971.
17. O'Keefe, op. cit., Chap. IX, Cohen, A. J. "Asteroid or Comet Hypothesis", p. 207.
18. Masson, C. F., Götz, J., Jamieson, W. D., McLachlan, J. L., and Volborth, A. "*Chromatographic and mineralogical study of lunar fines and glasses*", p. 963, fig. 17, p. 957 Abstract, Proceedings of the Second Lunar Science Conference, Vol. 1.
19. O'Keefe, op. cit., E. C. T. Chao, see Plate IV between pp. 52 and 53, also see pp. 60, 61, and 62. Chao's sample of 1330 tektites included 35 moldavites: see p. 41.
20. Randall, op. cit., O'Keefe, op. cit., p. 61. O'Keefe states that Libyan Desert glass which may or may not be related to the tektite problem is also about 33 million years old. Ivory Coast tektites are about one million years old.
21. O'Keefe, op. cit., V. E. Barnes, Chap. II, "Tektite Strewn Fields", p. 26, refers to the Gentner, Lippolt and Schaeffer study in 1961 which found moldavites to be $14{\cdot}7 \pm 0{\cdot}6$ million years in age by the potassium-argon method of age determination.
22. Ibid., p. 40, cites the Gentner and Zähringer study in 1960 which found a potassium-argon age of 29·4 million years for the bediasites. Randall, Charles A. Jr., *Extra-Terrestrial Matter*, op. cit. 1969, O'Keefe, John A., "Types and Distribution of Tektites", p. 61 refers to the age of bediasites as being around 33 million years and states that they are found in Texas and more recently in Georgia.
23. O'Keefe, op. cit., Chao, E. C. T., op. cit., p. 68; Chao states that the youngest group of tektites includes the indochinites-philippinites-javanites and australites.

BEFORE AND AFTER: AN ILLUSTRATED DOCUMENTATION ON LASER DRILLING OF DIAMOND

By DR G. LENZEN, F.G.A., G.G.

THROUGH the kindness of Messrs Hans-Dieter Krieger, Idar-Oberstein, the author got to see a 1·76 carat brilliant before the planned drilling by laser to allow him to make comparisons. The stone contained, among others, two black inclusions under the table, one of which was twice reflected in the nearest table and bezel facets (Fig. 1).

After the drilling by laser and the cleaning of the stone the two inclusions showed up white and seemed to be decidedly of a smaller size than before. It was this reduction in size that made the inclusion next to the table much less obvious (Fig. 2).

The drilling of the twice reflected inclusion was effected through a pavillion facet (Fig. 3A, Fig. 4), that of the other inclusion through the table (Fig. 3B). The stone had to be qualified before the laser treatment as Second Piqué because of the occurrence of still other lighter inclusions. An improvement of the degree of purity, e.g. to First Piqué, was not achieved, the more so as particularly the vertical hole through the table was repeatedly reflected in the stone (Fig. 5): the total number of inclusions has even increased by the laser treatment (drilling holes!). In spite of this rather negative instead of positive result diamond dealers confirmed that the treatment has favourably influenced sales opportunities of the stone. Meanwhile, experiments have been going on to fill and seal the drilled inclusions and holes with a refractive fluid. We shall report in due time on the results of these experiments.

For a nomenclaturally correct description of laser drilled diamonds we refer to the decision of the C.I.B.J.O. special commission that will most probably be internationally accepted: "Diamonds with inclusions changed by artificial treatment must be marked in such a way, that the artificial treatment is unequivocally indicated as such". The exact description of the brilliant, discussed here, must consequently read: "Second piqué, laser drilled".

This article first appeared in English in *Diamant*, Sept. 1973, by courtesy of *Zeitschrift der Deutschen Gemmologischen Gesellschaft* (abstracted in *J. Gemm.*, XIII(8), 323).—Ed.

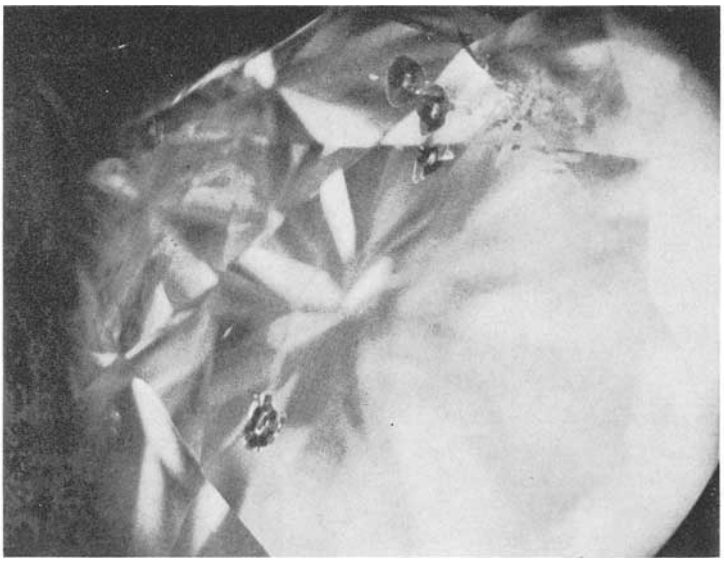

FIG. 1. Brilliant of 1·76 ct weight with two conspicuous black inclusions, of which one is twice reflected in facets on the top.

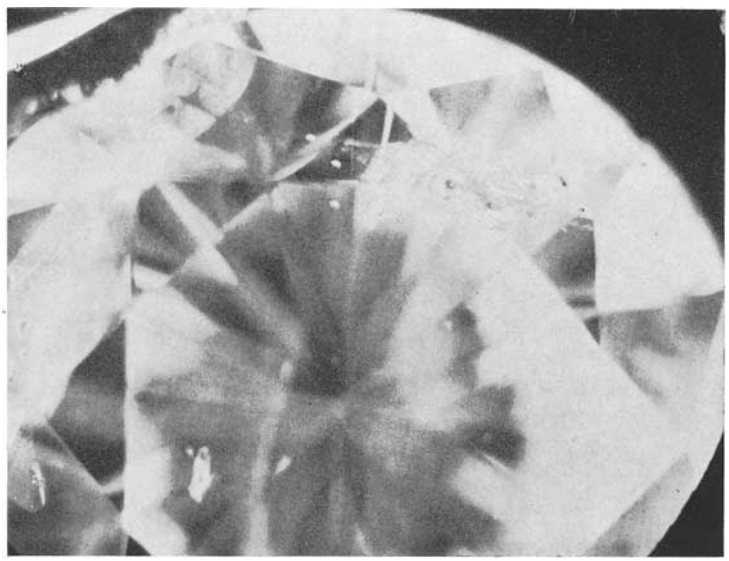

FIG. 2. The same brilliant after laser treatment. The inclusions are clear, their size seems evidently decreased and the reflection is less obvious.

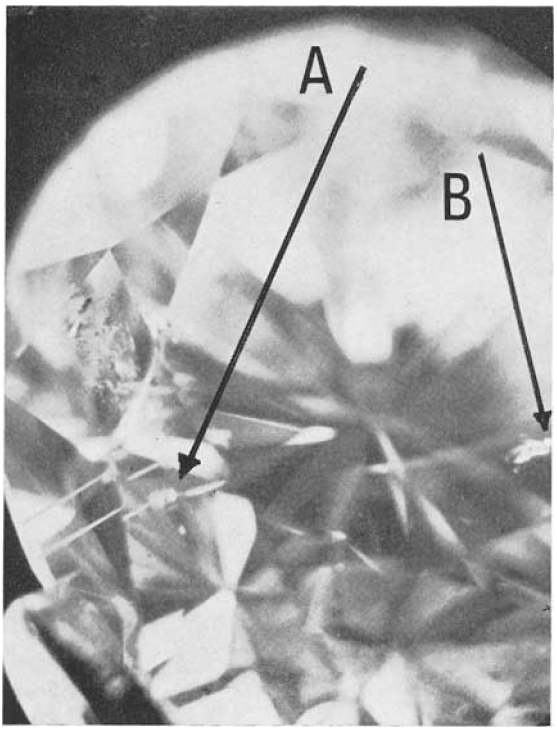

FIG. 3. A. The inclusion reflected along the table edge was reached by drilling through a pavillion half; the drilling hole is reflected in facets of the bottom side when viewed through the table side. B. The other inclusion was reached by drilling vertically through the table.

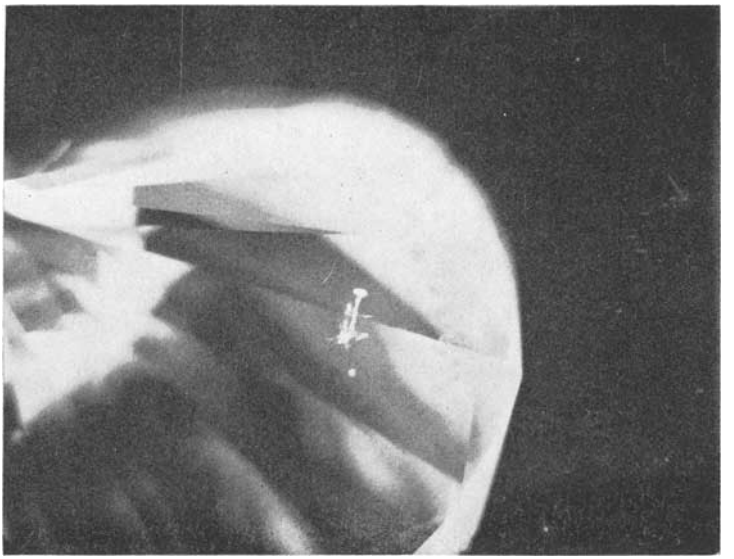

FIG. 4. The laser drilling hole starting from a pavillion facet is clearly visible. As with every drilling hole a new exterior blemish (hole) of the stone has appeared, that must be marked in the drawing of the stone with a green dot, if necessary with an explanatory symbol L (= laser) added to it.

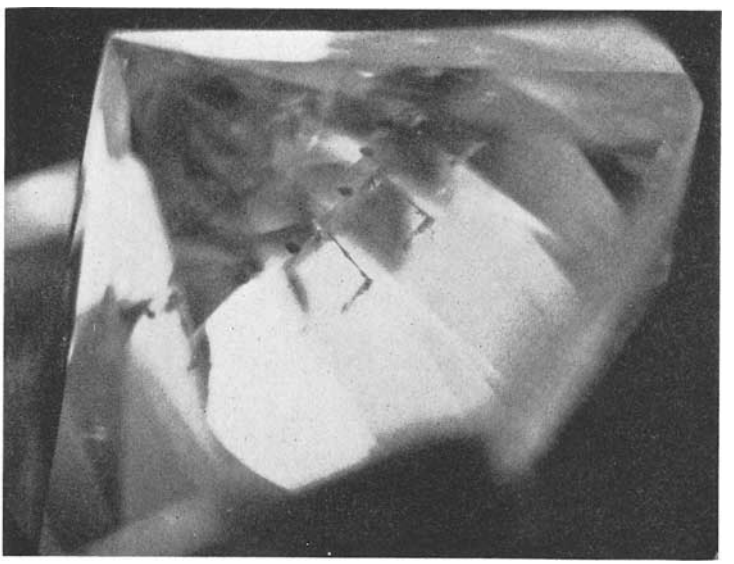

FIG. 5. The repeated reflections of the drilling hole made vertically to the table in the pavillion facets do not contribute towards an improvement of the degree of purity of the stone.

A KORNERUPINE FROM EAST AFRICA

By ROBERT WEBSTER, F.G.A.

WHILE the writer was deputizing at the London laboratory recently a dealer submitted for examination five pieces of rough crystals. Two of these were easily identified by their spectrum as garnets, which, from their colour, might be called "rhodolites". Two of the remaining three specimens were identified as tourmalines, as they showed some crystal faces from which refractive index readings could be taken. One of these was a lovely rich yellow colour and the other a pale green. This latter stone showed a reddish residual colour through the Chelsea colour filter and this implied that the stone was of a type rich in chromium and/or vanadium and could have come from the Umba river area of Tanzania.

The remaining piece of crystal was one of greater interest and gave most trouble. Owing to its very strong dichroism both the dealer and the writer considered zoisite to be a distinct possibility and the first approach was made on this assumption.

The crystal was a broken piece with no prominent crystal faces and had been broken into the rough shape of a cube. It was seen that across two pairs of "faces" the colour was an excellent green reminiscent of some demantoid garnets and through the remaining pair of "faces" the colour was a rich purple.

The absorption spectrum showed little in the way of convincing bands and the density was found to be 3·272, a value which was considered a little low for zoisite. Further, when the crystal was examined under both long- and short-wave ultra-violet light the stone exhibited a strong yellow glow. This also contra-indicated that the stone was zoisite, so to obtain more evidence a flat was polished on the stone and a measurement of the refractive indices made. This produced values of 1·660 and 1·673, giving a birefringence of 0·013.

The values of density and refractive indices agreed with those of the rather rare mineral kornerupine, and some slight confirmation was afforded by the experiment carried out by Mr. F. Hird of the laboratory staff who attempted to obtain an interference figure. This appeared to be uniaxial but was not proved certain. This was, however, certainly significant for it is known that gem kornerupine is pseudo-uniaxial.

Everything then pointed to the crystal being kornerupine, but the fluorescence shown by the crystal did not seem to agree with the only references to be quickly found in the literature[1,2,3], which suggested that kornerupine did not fluoresce under ultra-violet light stimulation. The situation was then re-examined: two specimens of kornerupine were examined under the lamps: these were both stones known to have come from the Ceylon (Sri Lanka) gem gravels and neither showed any fluorescence. However, a specimen of green kornerupine from Burma did fluoresce with a yellow glow, although somewhat less strongly than did the crystal under investigation.

It was then recalled that Payne had written up this green variety of kornerupine from Burma and his article[4] was then consulted. In this there was no mention that the luminescent properties had been examined with regard to the stones that writer had examined; nor was there any mention of any absorption spectrum for these stones. Anderson[5], however, mentions that the green kornerupines from Burma do not show any definite absorption bands. From our investigations a tentative report that the stone was kornerupine was submitted to the jeweller.

The crystal was said to have come from East Africa; the exact locality was not known, but Tanzania was favoured. The occurrence of kornerupine in Africa was not known to the writer at the time, the short note by Anderson[6] having been overlooked. This gives Kenya as a locality for kornerupine. Anderson was asked to amplify the note given in his book "*Gemtesting*" and he wrote[7] "The stone was probably identified by me (B. W. A.) for Dr Saul and was done quickly so that no note of the characters of the stone was made at the time." Later, Gübelin[8] gave the information that he had heard of kornerupine being found in East Africa and that some people had mentioned Kenya and others Tanzania as sources of the material but that no definite information as to localities had been received.

In view of the new types of minerals coming out of Africa it was considered that a further investigation should be made in order to confirm our findings that the specimen was indeed kornerupine. To this end the dealer kindly donated a specimen of this material to the scientists of the Institute of Geological Sciences who, by x-ray powder photography, confirmed that the crystals were indeed kornerupine. There was, however, some slight difference

in the size of the unit cell, but this was attributed to trace elements which may be the cause of the colour. Chromium has been suggested as the cause of the colour in the Burma kornerupines, but there is some doubt that chromium is the complete answer in the case of the East African stones. Vanadium has been suggested as a possibility, and more work on this point is envisaged by the workers at the Institute of Geological Sciences, but this will take some considerable time.

From the first piece of this rough kornerupine a faceted stone has been cut, which, although the writer has not seen it, is said to have produced a beautiful green gem.

Thanks are due to Messrs Wolff of Hatton Garden for the sight of the first specimen and for presenting the second specimen to the officers of the Institute of Geological Sciences for further investigation; and to these officers of the I.G.S. are due the writer's thanks for carrying out the x-ray identification.

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AN OLD SOURCE FOR SPINEL?

By S. B. NIKON COOPER, B.D., F.G.A.

OUR forebears who named the gems might have lacked modern scientific knowledge, but they more than made up for this in the directness and literalism of their descriptions. If a stone looked like a piece of ice (κρύσταλλος)—they called it, simply: "crystal". If it were red (ruber), then "ruby" it became. So the usual derivation of spinel (Italian diminutive "spinella" from Latin "spina" = "spine") = a "little spine", becomes the more intriguing. Admittedly, spinel crystals can be found as sharp-angled octahedra—but spiny? There are many other crystal forms which can (and do!) run themselves into the fingers with greater ease. So, we have to look elsewhere. Obviously there has been a confusion.

Our earliest references to spinel are themselves very late; only from the 16th century Agricola (*De Natura Fossilium*)(1)—"Spinellus", or again, Camillus Leonardus (*Speculum Lapidum*)(2)—"Spinella", as one of the "burning gems".

But are these the earliest references? If we turn to Theophrastus,(3) 4th century B.C. (De Lapidibus II.13) we find Σπῖνος ("Spinos") which was to be found in Thrace. In this passage, Theophrastus refers to various substances, grouped as "anthrakes", one of which he describes; black, combustible, and burning with an appreciable smell of asphalt; the mines at Binas (Spinos?) are mentioned. One thing is absolutely certain, however: these cannot be our spinel.

Or could they. . . ? Note two points: (1) the group title—"anthrakes"; and (2) one particular phrase—". . . it ("spinos") burns all the more fiercely when water has been sprayed and sprinkled on and around it." (II.13).

Now, "anthrax" has two meanings:— "coal" or "charcoal"—which is the one obviously referred to here; but it could also be used, at the same date, as a description for a gemstone having a glowing red colour, like that of burning charcoal. So, the gems: "anthrax", "anthracitis" etc.; or, carrying over to its Latin form: "carbunculus", "carbuncle" and so on—i.e. like charcoal, glowing red gems.

As proof that confusion has occurred, both Pliny[4] (1st century) and Isidore[5] (7th century) following him, as well as other authors, apply Theophrastus' description of "spinos" (a "coal") to their glowing red gems. So Pliny: *Naturalis Historia* XXXVII:27 (anthracitis)— ". . . if they are drenched with water, they become doubly glowing." Again, Isidore: *Etymologiarum* XVI:14:*— ". . . if sprinkled with water, appears to catch fire." Or once more, Albertus Magnus[6]: *Mineralia* II.ii.3 (carbunculus)— ". . . it shines in the dark if clear limpid water is poured over it", and so on. All the ancient authorities, in writing about the "burning gems", follow Pliny and keep alive the memory of Theophrastus' "spinos" (which, you remember, burns brighter when water is sprinkled over it!)

Perhaps a final clue comes in Agricola (16th century) *De Natura Fossilium*. Speaking of the gems which glow like "burning coals", he says:— ". . . all carbunculi are red and brilliant, and variations in this gem have given rise to several species." (His "spinellus", "rubinus", "pyropus" etc.). His yard-stick: ". . . stones that are especially red and brilliant, *but usually small*, are called 'spinellus'", or again:— ". . . if the 'spinellus' were large they would compare favourably with the best, but *they are so small* that they are usually classed among the least valuable." So, the diminutive "-ellus" in Agricola, "-ella" in Camillus Leonardus, is used. "Carbunculus", (its original diminutive sense by then largely forgotten) a "burning coal"; "spinellus", a "*little* burning coal".

Note, of course, that all spinels are red. If they were inconveniently blue, they were of course transferred to a different species.

Another possible derivation for "spinel" has been sought in the Greek word: *Σπινθήρ* = "spark"; but this, whilst reasonable, fails in its etymology, and nowhere occurs in any of the ancient texts— there is no reason, therefore, why it should suddenly be adopted in the 16th century.

We hope we have shown though, that there is reason, and proof, for "*Σπίνος*". We must remember that the 16th century acted as a kind of watershed in gemmology: before it, myth and magic hold sway; afterwards, science. The true beginnings of mineralogy are seen only now; Agricola has rightly been called

*"Anthracitis vocatus quod sit et ipse coloris ignei ut carbunculus, sed candida vena praecinctus; cuius proprium est quod iactatus igni velut intermortuus, extinguitur at contra aquis perfusus exardescit.

its "father". Confronted with the problem of attempting to systematize the confusion of "red" stones, more names become necessary. What more natural than to go back to one of the ancient sources—Theophrastus—and to use the old name for a new gem? This, especially as we have reason to believe that by a happy coincidence, the text of Theophrastus had just been re-discovered, and was once more available to scholars. Pliny, in the 1st century A.D. used, and cited, Theophrastus; but after him there is a gap; none of the medieval Latin or Arab sources mentions him—until the 16th century, with Agricola, (and a source used by the Italian, Camillus Leonardus(?)). Agricola cites Theophrastus, and, significantly, in this all-important section on the "fiery" gems.

And so "spinellus"—our spinel—comes into the jeweller's vocabulary. Its ultimate derivation; whether a memory of the mine, "Binas", or, even more strangely, that it was first found at a place where the small birds—"spinoi"—a delicacy the Greeks so loved—were caught, still remains a mystery. What is certain however, is that the name, and description, originate with Theophrastus, and have nothing at all to do with spines—even little ones!

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2. Camillus Leonardus, *Speculum Lapidum*, Venice, 1502. Eng. trans. by J. Freeman, *The Mirror of Stones*, London, 1750.
3. Theophrastus, *De Lapidibus*, ed. with Eng. trans. by Eichholz, Oxford, 1965.
4. C. Plinius Secundus (the Elder Pliny), *Naturalis Historia*, ed. with Eng. trans. by Eichholz, Loeb's Classical Library, 1962; Eng. trans. by J. Bostock & H. T. Riley, *The Natural History of Pliny*, Bohn's Classical Library, 1858.
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DEALING WITH DIAMONDS:

Including some practical methods of measuring diamonds for cut and weight (and other set stones for weight)

By DAVID WILKINS, F.G.A.

AS practically everyone who has any dealings with diamonds, even in the humblest of ways, will know, the 4C's of colour, clarity, cut and carat weight provide the basis of assessing a stone.

Carat weight is probably the simplest to deal with. If the stone is unset, it may be weighed to two places of decimals, and that is that. If the stone is mounted, then an accurate measurement of diameter and depth and reference to tables can provide a close estimate of the weight. Again, most people will know that the "Leveridge" gauge and tables are pre-eminent in this field.

Clarity is not too difficult after a certain amount of practice: either the marks are in the stone and can be seen or they aren't! It is easier, certainly, if the stone is unset, but in a claw mount, well cleaned and with a watchmaker's bellows to clear the dust specks from the pavillion facets, this aspect may be carried out with some degree of accuracy.

Colour is more difficult, and is subjective. Two people may not even see the same colour, and will possibly put a different name to it anyway. Also the weather conditions or colour of the walls surrounding the viewing area can affect what is seen.

To help overcome this and to provide a standard, no matter what the conditions, the firm for whom I work have had a series of diamonds mounted and a stone may be compared directly with these. There are nine stones, each of approximately half a carat, ranging from "fine white" down to "cape". The difference between the first and last is obvious even to the untrained eye, and, besides being a tool, this is an extremely useful aid in sales at the counter.

Judging cut should be simple, but it is surprising how far many modern-cut stones are removed from the ideal proportions recorded in the text-books, and, whilst one's eye can judge that the cut is not correct, it is good sometimes to have definite measurements from which to work.

The measurements required are diameter of girdle, thickness of crown, thickness of pavillion and diameter of table.

With a Leveridge gauge it is easy to obtain a diameter and a total depth, but not so easy to get an accurate reading for the others. A small metric micrometer proves very useful here. The stone, or shank of the ring if it is mounted, may be embedded in a knob of plasticine, and, with the aid of a desk lamp and a watchmaker's eyeglass, a direct measurement of the table may be taken (see Fig. 1). The lamp should be adjusted so that the table of the stone reflects the light from the lamp straight into the observer's eye. It will then be easy to know when the micrometer has been screwed out to the corners of the octagon forming the table, and the low powered watchmaker's eyeglass makes this easier as well as leaving both hands free.

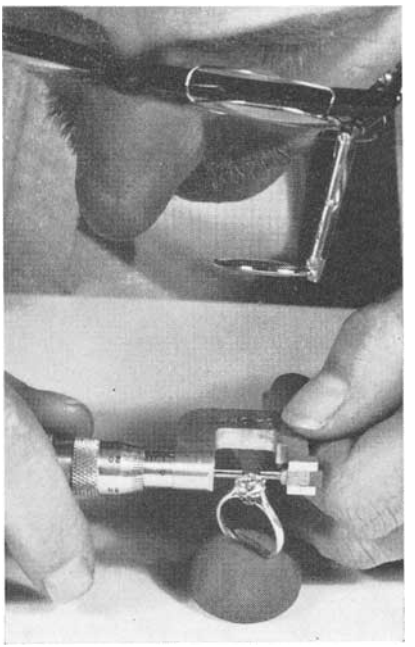

FIG. 1

To measure crown height above the girdle is more difficult, requiring the two measuring points to be offset, or one of much greater diameter than the other. I have achieved this simply and cheaply by using an hour wheel from a scrap alarm clock and

opening out the hole until it fits friction tight on to one spindle of the micrometer. With the table of the stone against this wheel, the micrometer is screwed out until the girdle is level with the face of the other spindle, and the reading is taken. This operation is facilitated if the micrometer is held firm in a knob of plasticine (see Fig. 2).

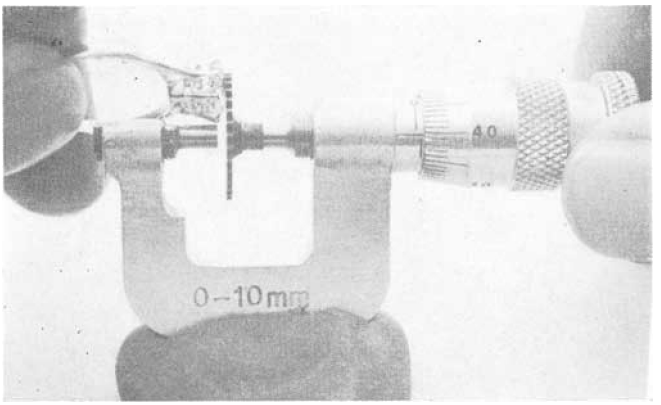

FIG. 2

One part of the tool usually gets in the way and has to be filed off, but this does not ruin it, and in any case a micrometer of the quality used for measuring watch mainsprings and costing less than a couple of pounds is quite sufficient for this work.

To make the conversion of direct measurement to proportion I use a slide rule (the circular "prayer wheel" rather than the straight "guessing stick" type being the more convenient.) As there may be some who think a slide rule is an extremely complicated piece of equipment requiring great mathematical knowledge to work it, may I explain how simple it is? The photograph (Fig. 3) shows a typical example. The outer scale is fixed and is called the "D" scale (labelled next to the 1 arrow), and all the rest of the scales may be revolved against this one. The scale adjoining the "D" is the "C" and these are the only two which concern us. They run from nought to a hundred—or from a hundred to a thousand, or to any size number depending on how many noughts you use or where you put the decimal point. For our purpose we call the "D" scale millimetres and the "C" scale becomes the percentage.

Having measured the diameter of the diamond and found it to be 7·4 mm we turn the "C" scale until the 1 pointer is opposite the 7·4 mark on the "D" scale, and reading around on the "C" scale we find that 57·5 (percentage) is opposite 4·25 (millimeters), so the table diameter should be 4·25 mm and not the 4·70 mm, or 63·5% that it actually is. By a similar examination we find that the crown thickness of 0·96 mm (13%) should be 1·08 mm (14·6%). (See Fig. 3.)

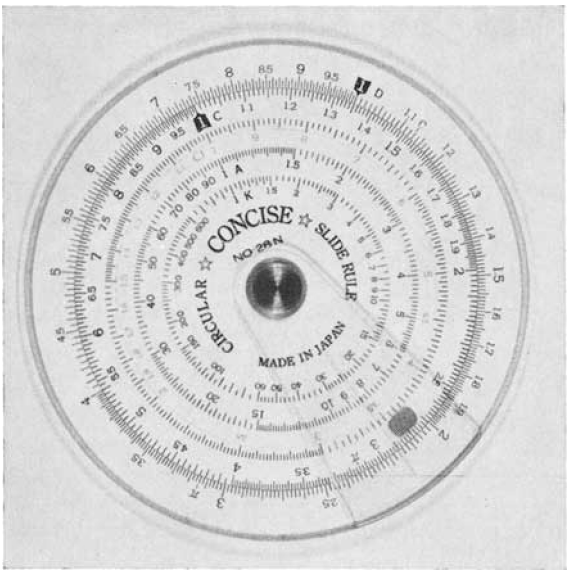

FIG. 3

Pavillion thickness is difficult to measure if the stone is mounted, but to all intents and purposes it is simply total depth minus crown thickness.

The various "make" proportions are summarized in the table below, but it is surprising how few modern stones come near any of these, and to anyone who is used to seeing only this modern type of cutting a stone which does conform to the suggested "ideal" make looks positively old fashioned and lumpy with what seems a very small table.

There are three sets of proportions recognized, all varying slightly, but they take as their starting point the diameter of the stone. The Tolkowsky set is more favoured in the U.S.A. with the Europeans following the other two.

	Diameter	*Crown Thickness*	*Pavillion Thickness*	*Table Diameter*
SCAN	100	14·6	43·1	57·5
Eppler	100	14·4	43·2	56·0
Tolkowsky	100	16·2	43·1	53·0

Calculating Weights

The formulae given in the Leveridge tables to calculate the weight of diamonds larger than those given in the pages of the tables are very useful. Not having tc deal with many diamonds over 7 carats (I wish I did) I find these formulae of greatest use in calculating the weights of other larger but less costly gemstones—the amethysts, aquamarines, tourmalines, etc., found in rings and brooches. The formulae are calculated in the normal way, but, with the addition of another factor to correct the result, the approximate weight of any species may be arrived at. This correcting factor is to multiply by the specific gravity of the stone being examined, and divide by the specific gravity of diamond, e.g. for a citrine $\times \frac{2{\cdot}65}{3{\cdot}52}$

Leveridge gives formulae for calculating the weights of circular brilliant-cut, trap-cut, marquise and pear-shaped stones, but does not mention oval brilliant-cut stones, probably because there are very few oval diamonds. Unfortunately, in stones other than diamond oval is probably the most common shape found, and after some trial and error I have adapted one of the formulae which provides a result fairly close to the actual weight. This is—length less a third of the width, times the width, times the depth, times point zero one one. This would give the result for a diamond and the S.G. fraction must be added for other stones. A long culet or a bulging pavillion can require the addition of, say, 5% to the total, but if the stone comes to a point rather than a line culet, 5% of the discovered weight should be subtracted.

Whilst no formulae can be expected to give 100% accurate results, this method is much better than an inspired guess. The calculations may appear complicated but take only a few seconds with a slide rule, which gives a result sufficiently accurate for our purposes.

Gemmological Abstracts

BANK (H.). *Euclase (von Santana de Encoberto) mit hoher Doppelbrechung.* (Euclase (from Santana de Encoberto) with high double refraction.) Z. Dt. Gemmol. Ges., 1973, 22, 4, 183-184.

This type of euclase is found in a pegmatite in the Minas Gerais in Brazil, about 131 km west of Diamantina. The double refraction is 0·025.

E.S.

BANK (H.). *Vesuvian aus Kenya mit sehr kleiner "maximaler Doppelbrechung".* (Vesuvianite from Kenya with very small maximal double refraction.) Z. Dt. Gemmol. Ges., 1973, 22, 4, 185-187.

The yellow-green cut stone was mineralogically found to be vesuvianite. This stone has a R.I. of 1·722-1·723 and a maximal double refraction of 0·001 which was difficult to determine. The double refraction varies also between 0 and 0·015 depending on the iron content. The stones come from Southern Kenya.

E.S.

BANK (H.). *Farbloser, durchsichtiger schleifwüerdiger Colemanite.* (Colourless transparent colemanite of gem quality.) Z. Dt. Gemmol. Ges., 1973, 22, 4, 188-189.

Fairly rarely found as cut stone, colemanite, first discovered in 1882, is Ca $(B_3O_4(OH)_2) \times H_2O$; density 2·42, R.I. 1·586-1·614.

E.S.

BANK (H.). *Niedriglichtbrechender durchscheinender roetlicher und gruener Grossular aus Afrika.* (Transparent red and green grossular with low R.I. from Africa.) Z. Dt. Gemmol. Ges., 1973, 22, 4, 190-192.

Various tests were made and it was shown that the R.I. of the pink-reddish grossular could be as low as 1·700 and of the green variety 1·720.

E.S.

CASEY (M.) & WILKS (J.). *Cathodoluminescence in deformed diamond.* Nature, 1972, 239, 393-394. 2 figs.

Ring crack damage produced during polishing of a (100) diamond surface is readily detected by means of a reduction in cathodoluminescence intensities. Of two possible explanations for the phenomenon, internal reflections at subsurface cracks preventing emitted light from leaving the crystal, or the effect on emission conditions of elastic strain due to unhealed cracks, the second is preferred.

F.B.A.

DARRAGH (P. J.) & PERDRIX (J. L.). *Precious opal—developments towards synthesis.* Australian Gemmologist, 1973, 11, 11, 17-21. 8 illus.

The authors review the various researches into the cause of colour in precious opal and recount some methods of growing the material in the laboratory. Sodium silicate dissolved in distilled water and run through a series of ion-exchange columns gave a very pure silicic acid solution which was concentrated by evaporation. About 100 hours was needed to produce a reasonable yield of 4000Å particles. Another method involved the use of a silicon ester, either tetraethyl orthosilicate or tetramethyl orthosilicate. Uniform droplets of silicon ester suspended in a water-alcohol mixture are hydrolysed by a mild alkali to form spherical particles of hydrated silica. The problem of hardening the array of spheres gave some trouble. Partial sintering of the array at temperatures between 500° and 800°C caused both the spheres and the voids to shrink and gave quite good strength and hardness. Impregnation with silica gave shrinkage problems, the added silica tending to shrink away from the spheres. The Gilson synthetic opal showed healed cracks under the electron microscope but in other respects its constants fell within the range for the natural stone.

M.O'D.

DERN (H.). *Die nachträgliche Korrektur von Farbfehlern an natuerlichen und synthetischen Korunden.* (Post-operative correction of discoloration of natural and synthetic corundum.) Z. Dt. Gemmol. Ges., 1973, 22, 4, 179-182.

The described treatment is based on U.S. patent 988230 and

1004505. It can improve asterism, the colour or produce change of colour in corundum. It is suggested that the manufacturer could use colourless corundum cabochons and then treat these to obtain required colour. Corundum produced by the flux method is often streaky and this condition can also be improved by this method. The cabochons are heated with the surfaces covered in aluminium oxide, titanium oxide and perhaps another metal oxide as colouring agent. The stones must not touch each other. The vessel containing the cabochons in the oxides is heated to 1700-1800°C (temperatures under 1600°C are not economical) for 2-200 hours depending on the effect wanted and the material used (highly polished stones need more time, rough need less). The oven should provide a natural gas atmosphere mainly consisting of methane. Various "recipes" for treatment of specific stones are given.

E.S.

FOILES (Lewis & Rose). *There is moonstone in Mississippi.* Lapidary Journal, 1973, 27, 8, 1176-1178. 3 illus.

Moonstone was found in gravels near Greenville, Miss. Colours included white, blue, red, smoky, brown, green and black. The degree of transparency varies from clear to completely opaque. Some stones show twinning striations on cleavage faces.

M.O'D.

GARRISON (P.). *The rocks of Texas.* Rocks & Minerals, 1973, 48, 90-92.

Numerous rocks and minerals occurring in Texas can be used as gems. These are described and specific localities are given. Varieties of quartz are included as well as topaz, gadolinite, turquoise, and others.

R.S.M.

HEMRICH (G. I.). *Sealing porous turquoise.* Lapidary Journal, 1973, 27, 7, 1136-1137.

Seam turquoise is placed in a solution of water and sodium silicate and left until the solution is curdled. This process is repeated and the stones then dried for a period of up to a week. Once dry, the stones are heated for 30 minutes at 150° and the temperature is then raised to 300°-350° and the stones left until they are seen to

be covered by bubbles. On cooling the material is ready for cutting. The bubbles have to be ground away during the cutting process. Cabochons cut from turquoise treated in this way are harder and more resistant to grease or chemicals.

M.O'D.

HUEBNER (G.). *Bericht ueber Versuche zur Unterscheidung von Bernstein und Kopal.* (Report about experiments to differentiate between amber and copal.) Z. Dt. Gemmol,. Ges. 1973, 22, 4, 197-199.

When heated, copal resin begins to melt at 125-130°C, when it forms small gas bubbles. When heated above this temperature, the melted mass becomes more viscous, colours brown at about 200°C and carbonizes at 300°C. Amber, however, seems to stay unchanged at about 200°C, the yellow colour gradually turning to brown at about 250°C: at 340°C the sample was practically black. Details of experiment and illustrations of apparatus used are given.

E.S.

MACNIVEN (A. A.). *Sapphire mining in New South Wales.* Australian Gemmologist, 1973, 11, 11, 14-16. 1 map.

Sapphires in New South Wales are found in Quaternary deposits, the most important field being that in the area Inverell-Glen Innes, where the sapphires are found in streams draining the basalt plateau. Pleonaste is a constant associate of sapphire in all New South Wales deposits. Crystals take the form of tapering hexagonal prisms. About 20 per cent of the output is saleable and stones up to 40 ct have been recorded.

M.O'D.

MACOLIVE (J.). *Multirotational microscope immersion cell.* Lapidary Journal, 1973, 27, 7, 1016-1030.

An immersion cell equipped with a universal stone-turning device was constructed from thermoplastic polymethymethacrylate with a R.I. of 1·49 and a 92 per cent transmission of light. The immersion liquid employed in observations with the cell is monobromonaphthalene.

M.O'D.

MUMME (I. A.). *Irradiation of gemstones.* Australian Gemmologist, 1973, 11, 11, 7-10, 3 figs.

A review of the various techniques employed in the irradiation of gemstones. It is thought that when a diamond is subjected to irradiation, carbon atoms are knocked out of their normal lattice positions to vacant interstitial sites. Colour centres, to which the name Frenkel defects has been given, appear to be connected with these vacant sites and with interstitial atoms which absorb certain wavelengths, thus altering the colour of the diamond. Blue colour in diamond is believed to be caused by single Frenkel defects, green by groupings. Radium emanations have been used to deepen the colour of corundums. Citrine and amethyst, discoloured by heating, are reported to have had their colour restored by similar treatment.

M.O'D.

NASSAU (K.) & WOOD (D.). *The nature of the new Maxixe-type beryl.* Lapidary Journal, 1973, 27, 7. 1032-1058.

Dark blue beryl in shades ranging from deep blue to green in colour and stated to be from Goyaz, Brazil, were examined by the authors. The stones were considered after examination to be of the Maxixe type and to be liable to fading. Blue and green beryl may be considered to be of this type if the following criteria are fulfilled: unusual dichroism with the colour being in ordinary ray; narrow absorption bands in the ordinary ray only between 5000 and 7500Å; fading on heating ($\frac{1}{2}$ hour at 200F to 450F) or on exposure to light (more than one week in the sun or 150 hours at 6 inches from a 100 watt tungsten lamp bulb). Colour can be returned in most cases by irradiation with neutrons, gamma rays or with x-rays, but it will once again fade with exposure to heat or light. Of 30 Maxixe-type beryls examined, three were proved to have been treated with neutrons.

M.O'D.

RECKER (K.). *Zur kuenstlichen Herstellung von Schmucksteinen.* (The synthesis of gemstones.) Z. Dt. Gemmol. Ges., 1973, 22, 4, 145-178.

This is a reprint of a lecture read by the author to the German Gemmological Association in Bonn 25th-27th May, 1973. 18 illustrations and a bibliogrpahy of 132 items. The article is a

detailed survey of the more commonly used synthetic processes of corundum, spinel, beryl, quartz, rutile, diamond, fabulite and yttrium aluminium garnet. The various choices open to the manufacturer, their advantages and disadvantages are discussed. A very useful table shows the additives that can be added to corundum to produce 23 different colours: a similar table lists 23 additives to synthetic spinel: quartz is produced in seven colours varying from blue to smoky. A chronological table lists emerald synthesis from 1848 to 1969 with short notes on type of synthesis used. The article ends with a survey of synthetic diamonds. The gem quality stones produced by G.E. of America are still many times more expensive than the natural variety and it seems that this state of affairs is unlikely to change. But the methods evolved help us in many ways, not least in obtaining knowledge of the birth of minerals.

E.S.

ROBINSON (G.). *Dekalb diopside.* Lapidary Journal, 1973, 27, 7, 1040-1059.

Gem quality diopside is found in pockets in silicated marble varying in composition between a tremolite schist and nearly pure white diopside. The Dekalb mine is situated along a north-west trending ridge of interbedded quartzite and silicated marble in St Lawrence County, New York. The typical colour is grass-green and the average crystal length is one inch. Good quality cat's-eye may be obtained from associated tremolite cleavages.

M.O'D.

ROESCH (S.). *Ein Diamant mit Innenleben: der Sterndiamant.* (A diamond with an inner life: the star diamond.) Z. Dt. Gemmol. Ges., 1973, 22, 4, 193-196. 5 illus.

Amongst industrial diamonds, probably from Venezuela, Dr U. Kurz-Tesch found a unique diamond of 2·01 ct, a rough octahedron with rounded edges, slightly yellow-grey, showing on all eight faces a six-rayed star, the axes of this star being parallel to the octahedron edges. The star is caused by a very small inclusion: even under the microscope it was not possible to determine whether this inclusion was of positive or negative nature. The actual centre of the "star" was clear, the rays starting a little distance from it. Under the polariscope strong stress double refraction was found.

The stone also has a very interesting infra-red spectrum. After the discovery of this stone, a few more specimens were found by Dr Kurz-Tesch in rough from the same source.

E.S.

RUZIC (R. H.). *Amber in Chiapas, Mexico.* Part 1. Lapidary Journal, 1973, 27, 8, 1300-1305.

Amber deposits in Chiapas are exposed by landslides. The amber is fossilized resin from the miocene and oligocene periods. Most of the material is fashioned into ornaments and prayer-beads.

M.O'D.

SANTOS MUNSURI (A.). *Glosario alfabético de los minerales de cuarzo.* (Alphabetical glossary of the quartz minerals.) Boletin del Instituto Gemologico Español, 1973, 2, 5, 12-31.

A list of the quartz minerals including a number of varietal names for members of the agate family. The list accompanies an earlier article on the quartz minerals printed in the previous issue.

M.O'D.

ANON. *Process of making diamonds in U.S.A.* Diamant, 1973, 16, 166, 42.

A brief report referring to a method of producing and using a greatly amplified shock wave to produce the necessary pressure and heat to manufacture synthetic diamonds from graphite.

H.J.B.

BOOK REVIEWS

DEESON (A. F. L.), editor. *The collector's encyclopaedia of rocks and minerals.* David and Charles, Newton Abbot, 1973. pp. 288. Illustrated in colour. £5.95.

It is difficult to speak temperately of this book, which on first appearance seems useful and is certainly well-produced. The errors are so numerous, however, that the whole aim of the book is vitiated. It would appear that the scholarship of the compilers is limited to the extraction of incorrect data from unreliable sources: the results say little for their scientific integrity. Apart from pure mistakes of attribution, peridot being classed as a variety of tourmaline, heliodor as a chrysoberyl and almandine as a spinel, tired old names appear—for example, oriental emerald for green sapphire. Ruby spinel is classed separately from spinel. There is no bibliography. An octahedron is said to have eight square faces. Ignorance of mineralogy is hardly a serious matter *per se*, but when paraded in a book bearing every sign of haste and poor judgment, offered in a developing market where young enthusiasts need expert guidance, it becomes something very close to cynicism.

M.O'D.

DESAUTELS (P. E.). *Edelstein, Perlen, Jade.* (Gemstones, Pearls and Jade.) Ott Verlag, Thun, 1971. pp. 252. Illustrated in colour. Photographs by Lee Boltin. Sw. fr. 64.00.

A German version of the author's *The Gem Kingdom*, reviewed in *Journal of Gemmology*, 13, 2, 74.

M.O'D.

FIRSOFF (V. A.). *Working with gemstones.* David and Charles, Newton Abbot, 1974. pp. x, 210. Illustrated in black-and-white and colour. £3.50.

Divided into two parts, this book comprises a section on the gem materials and a longer section on the art of fashioning them. The gems themselves are well illustrated in colour by plates originally prepared for the fourteenth edition of Herbert Smith's *Gemstones*. These plates were supplied for that book by the Institute of Geological Sciences, who should have been mentioned. There are

a number of inconsistencies in the first part: the phrase "the rainbow play of reflected light" (describing precious opal) is meaningless: boron nitride is scarcely a gem: silicon carbide is SiC, not Si_3C: streak is irrelevant when considering gemstones. Some unusual examples are chosen to illustrate the crystal systems: dyscrasite, which is shown as an orthorhombic bipyramid, is not known as a gem and its common habit is pseudo-hexagonal. In the chapter on optics the statement that fire depends upon double refraction, among other things, and the assertion that pleochroism means "more colouredness" surely need close attention. The paragraph on polarization is completely confused. The description of asterism in corundum reads in the opposite sense to what actually occurs. The second part of the book, dealing with lapidary work, is very like a number of others recently published and contains no features of note. There is a bibliography in which the name Sinkankas is misspelt and B. W. Anderson's *Gem Testing* listed in its 1958 edition. Readers looking for inspiration or instruction can do a lot better than this.

M.O'D.

GAERTNER (H.). *Achate. Steinerne Wunder der Natur.* (Agate, wonder stone of nature.) Alles/Brillant Fachverlag, Friedrichsdorf, 1971. pp. 71. Illustrated in colour. DM 36.

Thirty-two coloured plates of high quality depict agates in all forms from a number of countries. There are notes on production and fashioning and the standard of photography is far higher than that previously attained in books attempting to reproduce agate colouring.

M.O'D.

JACKSON (Bob and Kay). *A rockhound's guide to metropolitan New Jersey.* Jax Products, Seattle, Washington. 1973, pp. 50. Includes maps. $2.50.

A detailed account of the minerals to be found in the metropolitan area of New Jersey, this short guide lists the mines, dumps and means of access to some of the best-known collecting areas in the United States. Each location is described in detail and illustrated by a sketch map. Prominent in the area are the mines of Franklin and some localities for Herkimer diamonds.

M.O'D.

KUNZ (G. F.). *Rings for the finger.* Reprint of 1917 edition. Dover Publications, New York, 1973. pp. xviii, 381. Illustrated in black-and-white. $3.50.

A survey of the use and significance of the ring from the earliest times to the present. Close attention is paid to the magical and talismanic associations connected with rings and there are numerous reproductions of early representations. Later chapters deal with seal rings and the manufacturing side is well described. M.O'D.

KUNZ (G. F.). *The curious lore of precious stones.* Reprint of the 1913 edition. Dover Publications, New York, 1971. pp. xiv, 406. Illustrated in black-and-white and colour. $4.50.

The best account at the time of publication of all forms of legendary attributes of precious stones. Subjects included are stones of ill-omen, birthstones, crystal gazing, Biblical stones, therapeutic properties and luminous stones. There are numerous illustrations which have reproduced well. M.O'D.

LIEBER (W.). *Der Mineraliensammler.* (Mineralogy Textbook). Ott Verlag, Thun, 1971. pp. 274. Illustrated in black-and-white and colour. Sw. Fr. 39.80.

A well-illustrated course in mineralogy, this book is particularly notable for some excellent text diagrams. The crystal systems are depicted with examples of common forms and also combinations of forms, a most useful adjunct for practical study. A lengthy section gives detailed particulars of mineral locations in Germany, Austria, Switzerland and other countries accompanied by maps. There is an index and a five-page bibliography. M.O'D.

LIEBER (W.). *Kristalle unter der Lupe.* (Crystals under the lens.) Ott Verlag, Thun, 1972. pp. 244. Illustrated in colour. Price on application.

A superbly illustrated book in which 88 mineral specimens are shown magnified and in colour. The range of magnification is from 10 × to 70 × and the instruments used for the magnification and photography are described, with settings quoted for each example. Facing each coloured plate is a diagram of the crystallographic habit of the mineral and a short description. M.O'D.

ASSOCIATION NOTICES

MEMBERS' MEETINGS

London

A meeting was held at Goldsmiths' Hall on Monday, 25th February, 1974, when the films "The Magic of Diamonds" and "Of Jewels and Gold" were shown.

Scottish Branch

On Tuesday, 19th February, 1974, members attended a meeting at the Royal British Hotel, Edinburgh, when Mr Chaplin of the Department of Geology, Edinburgh University, gave some inside information on practical methods of locating gem-bearing sites.

Midlands and Nottingham Branches

The Annual Dinner and Dance of the Midlands Branch was held on the 25th January, 1974, and that of the newly-formed Nottingham Branch on the 11th February, 1974.

GIFTS TO THE ASSOCIATION

The Council of the Association is indebted to Dr P. C. Zwaan of Leiden, Holland, for a copy of his article "Garnet, corundum and other gem minerals from Umba, Tanzania".

OBITUARY

Mr Josef Podhorodecki, Nottingham, who gained the Association's Diploma in 1965, died on the 3rd September, 1973.

CORUNDUM FROM SALONIKA

It has been reported to the Association, through Greek Government sources, that there are large deposits of an ore which has yielded allegedly gem-quality rubies and sapphires. If any reader is interested in pursuing the matter, please communicate with the Association.

COUNCIL MEETING

At a meeting of the Council of the Association held on Monday, 25th February, 1974, the following were elected to membership:

Fellowship

Bagant Pons, Jorge, Barcelona, Spain. D. 1973
Barrows, Mark C., Halesowen, D. 1973
Bollen, Neil D., London, D. 1973
Haakonsen, Hans O., Sandefjord, Norway. D. 1973
Hanrott, Michael R., Banstead, D. 1973
Klimek, Karol S., Deal. D. 1966
Minty, Janet, London. D. 1973
Mozolowski Horczyczak, Barbara, Barcelona, Spain. D. 1973
Niinobe, Hiroko, Kobe, Japan. D. 1973
Procter, Vicky, London. D. 1973
Reynolds, James I., Mexborough. D. 1973
Whitaker, Peter W., Huntingdon. D. 1973

Ordinary Membership

Ahmad, Masud, London.
Atapattu, Savinda B., Colombo, Sri Lanka
Barbier, Michel E., Lucerne, Switzerland
Barrett, Evelyn, Hemel Hempstead
Bartoli, Anne M., Gex, France
Bates, Andrew, Nottingham
Berkelaar, Pieter L., Commugny, Switzerland
Bickers, O. Martin, Welling
Birch, Peter C., Gloucester
Blackley, Robert, Ilford
Bowker, Malcolm J., Woodthorpe
Brackman, Derek S., Stanmore
Brauns, Sandra M., Hong Kong
Bredebusch, E., Hong Kong
Brooks, Ferriel M., Hong Kong
Bryan, John C., Kriens, Switzerland
Burr, Kevin F., Little Bookham, nr Leatherhead
Coffer, Harrell E., San Diego, Cal., U.S.A.
Davis, Lee S., Louisville, Ky., U.S.A.
de Kock, H. M., Gouda, Holland
Diefenthal, Edward L., New Orleans, La., U.S.A.
Dissanayake, Jayasinghe M. E., London
Eramanis, Edward, Singapore
Fitzgerald, Patrick W., Hoo, nr Rochester
Frazier, Claren L., Berkeley, Cal., U.S.A.
Gabel, F., Yorkton, Sask., Canada
Galat-Noumer, Jorge, Bogota, Colombia
Gayton, Mildred P., Southport
Grant, Mary J. L., London
Guenassia, Robert, Courbevoie, France
Haddy, Helen J., Melville, Western Australia
Harrison, Andrew D., Harrow
Haskings, Theresa M., Wollaton, nr Nottingham
Hemachandra, Vidyapathi I. W., Colombo, Sri Lanka
Horder, Heather A., Windsor
Hoskins, Robert C., Annandale, Va., U.S.A.
Houghton, R. J., London
Hudson, Hubert, Kingston-upon-Thames

Hudson, Jeanne I., Kingston-upon-Thames
Hughes, Charles J., St. John's, Newfoundland, Canada
Ishida, Shinichi, Tokyo, Japan
Jamieson, Vivienne, Shefford
Jayasuriya, Ronald V., Colombo, Sri Lanka
Jinadasa, Anthony N. C., Colombo, Sri Lanka
Kaji, Yoshimichi, Tokyo, Japan
Katz, R., Johannesburg, S. Africa
Knight, Ronald C., Stockton-on-Tees
Leslie, Catherine E., Hong Kong
Li, Raymond, Kowloon, Hong Kong
Lun, Lau T., Tokyo, Japan
Mahan, Lisbeth G., Del Mar, Cal., U.S.A.
Mazloum, Charles J., Beirut, Lebanon
Memon, Abu B., London
Milner, Paul, Camborne
Mitsuno, Sakae, Sasebo City, Japan
Montrucchio, Virgilio, Turin, Italy
Morris, Valda O., Moana, South Australia
Nelson, Keith E., Arvada, Col., U.S.A.
Newman, Eveleigh E. D., Twickenham
Nijo, Noritada, Kanagawa Pref., Japan
Nootenboom, Winnie, Kowloon, Hong Kong
O'Connell, William, Salisbury, Rhodesia
O'Donnell, Ann, Leeds
O'Mer, Robin, London
Pandithakoralege, D. R. M., Nugegoda, Sri Lanka
Pattison, J. R., Bognor Regis
Paul, Ann C., Hong Kong
Petersen, Graeme E., Lower Hutt, New Zealand
Pike, Christopher R., East Burton, nr Wareham
Pratt, John C., Toronto, Ont., Canada
Rajput, Jagdish C., Alperton
Retz, Alexander J. F., Liege, Belgium
Richards, Haik, London
Rubin, Clive S., Manchester
Sadler, Barry D., Walsall
Saunders, Corinne M., Roodepoort, Transvaal, S. Africa
Schwartzman, Sonja S., Bethesda, Md., U.S.A.
Sevdermish, Menahem, Wembley
Shah, Shujaat A., Rawalpindi, Pakistan
Strachan, Anne R. N., Hong Kong
Sutton, Jeffrey A., Melbourne, Victoria, Australia
Thornton, Simon J., Kettering
Tolmie, Nigel L., Birmingham
Turc-Baron, Adrien, Jarrie, France
Van, Ann-Catrin, Hong Kong
Wright, Henry K., Llandeilo
Yao, Gladys, Kowloon, Hong Kong
Young, Martin J. P., Aberdeen

Corrigendum

On page 14 *ante* the chemical formula of chlorite was wrongly printed and should read—"$(Mg, Al, Fe)_{12}$ $[(Si, Al)_8$ O_{20} $(OH)_{16}]$".

Vol. XIV
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CONTENTS

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