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OF GREAT BRITAIN

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OF GREAT BRITAIN
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BLUE COLOUR-CHANGE GEM GARNET FROM EAST AFRICA*

By E. A. JOBBINS, J. M. SAUL, ANNE E. TRESHAM and B. R. YOUNG

A SMALL water-worn pebble, weighing 0·078 grams (0·39 carats), was sent to the Institute of Geological Sciences via Mr B. W. Anderson, consultant to the Gem Testing Laboratory, Hatton Garden, in March 1974, for detailed investigation. The pebble along with other gem minerals including corundum, tourmaline and garnets, were obtained over a six year period from a group of Wakamba prospectors who live in Emali, Kenya. Although these prospectors never divulged precise information concerning their operations, it became quite clear in the course of time that most of their prospecting trips were to the lower Umba River Valley, downstream and to the east of the well-known Umba River mine producing pastel shades of gem corundum. The precise area must have been very close to the Kenya/Tanzania border, probably on the Kenyan side. A few stones may have been obtained by exchange or purchased, but even if this was the case it is unlikely that the geological notes given later would be invalidated.

The pebble, of gem-quality material, is greenish-blue in daylight, but shows a distinct magenta by tungsten illumination. The colour change closely resembles that displayed by the synthetic

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sapphires which are said to simulate alexandrite. By comparison, a sapphire in the IGS collections (registered number MI 32274) from the Umba river appears greyish-green by daylight and reddish-violet by tungsten lighting.

A small flat had been polished on one side of the pebble and this facilitated the determination of the refractive index as 1·757 in sodium light. The stone is not completely isotropic between crossed polars. Through the Chelsea filter the stone appears bright red (as do the synthetic corundums simulating alexandrite), but between crossed filters it appears a faint red only (in contrast to the bright reds of the synthetic corundums) and no fluorescence spect-

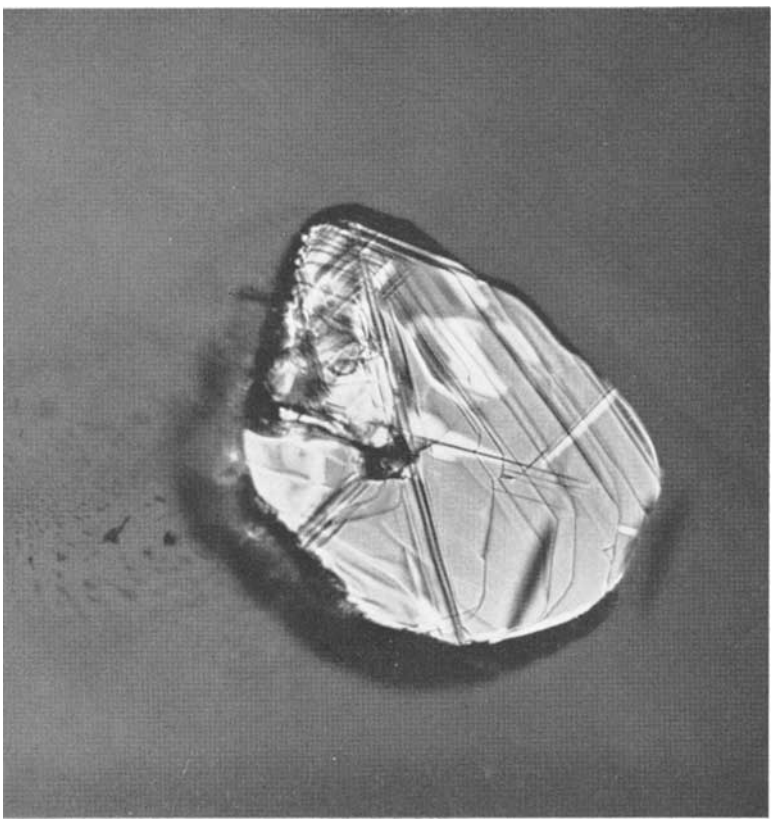

FIG. 1. Photomicrograph of hematite inclusion in colour-change garnet showing growth planes and twinning striae at 60°. A "finger-print" inclusion shows left of the hematite. Magnification × 120.

rum is seen when using copper sulphate solution as a filter. There is no fluorescence either by long or short wave ultra-violet radiation. The specific gravity is 3·816.

Three types of inclusion are present within the stone. The most prominent type is of a dark platy mineral showing a broadly hexagonal outline and resembling biotite mica at first inspection. However, it shows very high relief (in a garnet matrix of RI 1·757) and has a distinct metallic lustre. By reflected light three sets of striae at 60° to each other are clearly seen (see Fig. 1). This mineral appears to be specular hematite showing polysynthetic twinning on the basal pinacoid, and there appears to be a vestigial rhombohedral face. A second small group of interpenetrating hematites is also present. Associated with the larger hematite, but also in other areas, are several liquid feathers of the "finger-print" type. Fine rutile silk, orientated in three directions, shows beautifully by reflected light.

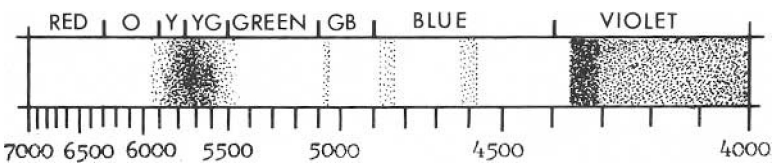

FIG. 2. Absorption spectrum of blue colour-change garnet from East Africa through prism spectroscope.

The absorption spectrum is illustrated in Fig. 2. A strong band is prominent in the 4350Å-4300Å region, but it was difficult to penetrate the gloom of the deep violet regions where there is almost complete absorption. A rather weak band is centred in the 4610Å region and there is another broad band in the 4850Å region. These bands are all consistent with the presence of the spessartine garnet molecule. A faint line near 5050Å and a fuzzy broad band centred around 5750Å (which probably has a strong influence on the colour) are possibly due to the iron of the almandine garnet molecule. Initial consideration of the absorption spectrum suggests that the stone is a modified spessartine garnet with minor amounts of the almandine molecule. However, the refractive index is near the pyrope range and the garnet shows a very unusual colour change which needs explanation.

A small scraping was removed, therefore, and subjected to examination by x-ray methods. The x-ray powder data set out in Table I were obtained from film X 7052B, taken in an 11·46 cm diameter camera, using FeKα radiation (d is the interplanar spacing, I/I_1 is the relative intensity of the powder line and *hkl* are the Miller indices of reflecting planes). The unit cell dimension 11·578Å (at room temperature) was obtained by plotting the values obtained from the high angle lines against $\frac{1}{2}(\cos^2\theta/\sin\theta + \cos^2\theta/\theta)$ and extrapolating to $\theta = 90°$. The intensities were estimated visually by comparison with an intensity scale. The space group is Ia3d. The density calculated from the x-ray data is 3·84, which compares well with that obtained from hydrostatic weighing.

TABLE I

X-ray powder data for colour-change garnet from East Africa

d	I/I_1	*hkl*	*d*	I/I_1	*hkl*
2·894Å	50	400	1·447Å	10	800
2·589	100	420	1·425	2	811,741,554
2·468	18	332	1·3838	1	653
2·363	20	422	1·2945	10	840
2·271	20	510,431	1·2633	14	842
2·114	16	521	1·2485	1	921,761,655
2·047	3	440	1·2342	10	664
1·878	20	611,532	1·2204	1	930
1·831	3	620	1·1695	3	941,853,770
1·671	16	444	1·1353	1	10,2,0;862
1·606	25	640	1·0750	18	10,4,0
1·547	50	642	1·0569	16	10,4,2
			1·0233	16	880

A preliminary qualitative elemental analysis carried out on the "Stereoscan" scanning electron microscope and the "Ortec 6200" multichannel analyser showed the presence of major Si with subordinate Al, Mn, Mg, Ca and other minor elements including vanadium. A quantitative analysis using the "Geoscan" electron microprobe was then made for the elements shown in Table II using silicates and oxides of known composition and pure metals as appropriate standards. All the elements were analysed using an accelerating voltage of 20kV. The results have been corrected for absorption, atomic number effect and fluorescence using the Mark V version of the BM-IC-NPL computer programme written by Mason, Frost and Reed. In the Table the present analysis is compared with the analyses of typical spessartine, grossular and pyrope garnets (see Deer, Howie & Zussman 1962) and the colour-change garnet described by Crowningshield which has

rather higher physical constants (Crowningshield 1970). The number of cations on the basis of 24 oxygen ions and the molecular percentages of the end-members have been calculated for Crowningshield's data so that all the analyses may be more easily compared.

With the electron microprobe it is not possible to distinguish the valency states of iron, and the faint line at 5050Å and the broad band around 5750Å in the absorption spectrum are not really conclusive evidence for the presence of Fe^{2+} as in the almandine molecule. We give, therefore, two possible interpretations of the analysis into conventional garnet molecules, using divalent and trivalent iron respectively. Essentially the garnet may be considered to be a pyrope-spessartine with subordinate grossular and smaller amounts of an iron-bearing garnet molecule. Titanium is here considered as substituting as a trivalent cation (octahedral or six-fold co-ordinated by oxygen) and is grouped with the Fe^{3+} and Al^{3+} (see Hartman 1969).

Vanadium is known to occur in several valency states (V^{2+}, V^{3+}, V^{4+}, V^{5+}) in its compounds and its role here is not certain. A calcium vanadium garnet (goldmanite) containing 12·5% V has been described by Moench and Meyrowitz (1964) from Laguna, New Mexico, who reasonably assumed that the vanadium was present as V^{3+}. The end-member $Ca_3 V_2 Si_3 O_{12}$ was later synthesized by Strens (1965). We have tentatively allocated the vanadium to the sites usually occupied by trivalent iron or aluminium.

Unfortunately, chromium cannot be detected completely satisfactorily in this specimen by microprobe methods because its emission lines are overlapped by V and Mn lines, and the line energies are so close that it is impractical to separate them by pulse height analysis. However, no Cr lines were seen in the absorption spectrum, nor was any chromium fluorescence spectrum seen, which is normally a very sensitive indicator of the presence of Cr. The influence of chromium on the colour would, therefore, appear to be minimal and the colour change must be ascribed to the presence of vanadium, which has been previously found or suspected to be the cause of the colour in gem tourmaline, zoisite (tanzanite), axinite, grossularite and perhaps kornerupine, all of which were found in the Arusha-Voi-Tanga portion of the Kenya-Tanganyika Province of the Mozambique Mobile Belt.

TABLE II

SHOWING ANALYSES OF BLUE COLOUR-CHANGE GARNET (1), TYPICAL GARNETS QUOTED BY DEER, HOWIE AND ZUSSMAN (2, 3, 4), AND COLOUR-CHANGE GARNET DESCRIBED BY CROWNINGSHIELD (5).

	(1a)	(1b)	(2)	(3)	(4)	(5)
SiO_2	40·3	40·3	35·87	38·96	41·97	38·35
TiO_2	0·05	0·05	tr	0·71	0·24	0·1418
Al_2O_3	21·8	21·8	20·84	19·93	21·73	26·45
Cr_2O_3	n.d.	n.d.	—	—	0·72	0·54
V_2O_3	0·75	0·75	—	—	—	0·324
Fe_2O_3	—	1·33	0·06	3·43	2·36	1·45
FeO	1·2	—	1·78	3·25	6·17	—
MnO	18·2	18·2	38·24	0·03	0·97	16·73
MgO	12·9	12·9	0·22	1·31	20·45	13·1
CaO	5·3	5·3	2·72	32·52	5·52	2·38
$H_2O > 105°C$	—	—	—	—	0·02	—
$H_2O < 105°C$	—	—	0·15	—		—
ZnO	0·03	0·03	—	—	—	—
CuO	n.d.	n.d.	—	—	—	0·0019
NiO	n.d.	n.d.	—	—	—	0·0032
CoO	0·03	0·03	—	—	—	—
	100·56	100·69	99·88	100·14	100·15	99·47
	n.d. = not detected					
n	1·757	1·757	1·798	1·747	1·7385	1·765
$D_{obs.}$	3·816	3·816	4·15	3·599	3·668	3·88
$D_{calc.}$	3·842	3·836	4·13	—	—	—
a (Å)	11·578	11·578	11·62	—	—	—

NUMBERS OF IONS ON THE BASIS OF 24(0)

Si	5·99	6·00	5·97	6·00	5·905	6·00	5·940	6·00	5·977	6·00	5·66	6·00				
Al	0·01		0·03		0·095		0·060		0·023		0·34					
Al	3·81	3·90	3·78	4·02	3·943	3·95	3·509	3·98	3·617	3·98	4·26	4·54				
Cr	—		—		—		—		0·086		0·06					
V^{3+}	0·09		0·09		—		—		—		0·04					
Fe^{3+}	—		0·15		0·008		0·392		0·251		0·16					
Ti	0·005		0·005		—		0·082		0·025		0·02					
Mg	2·86	6·15	2·85	5·98	0·055	5·83	0·293	6·01	4·334	6·02	2·88	5·35				
Co	0·004		0·004		—		—		—		—					
Fe^{2+}	0·15		—		0·245		0·411		0·734		—					
Mn	2·29		2·28		5·333		0·004		0·119		2·09					
Zn	0·004		0·004		—		—		—		—					
Ca	0·84		0·84		0·198		5·306		0·838		0·38					

MOLECULAR PERCENTAGE OF END-MEMBERS

Pyrope	46·5	47·7	0·9	4·9	70·4	53·7
Spessartine	37·3	38·2	87·3	0·1	2·0	39·0
Almandine	2·4	—	4·0	6·8	11·9	—
Andradite	—	3·7	0·2	11·8	6·7	4·5
Grossular	11·6	8·1	7·6	76·4	6·9	—
Uvarovite	—	—	—	—	2·1	1·7
$Ca_3V_2Si_3O_{12}$	2·2	2·2	—	—	—	1·1

1. Blue colour-change garnet, Umba River Valley, East Africa. Electron probe anal. A. E. Tresham. The oxidation state of iron cannot be determined by electron probe analysis and so 1a shows Fe content as FeO and 1b as Fe_2O_3.
2. Spessartine, rhodonite-spessartine-rhodochrosite schist, Arrow Valley, Kawarau Survey District, western Otago, New Zealand. (Hutton, 1957). Anal. C. O. Hutton.
3. Reddish yellow grossular, in crystalline limestone, Liconi, Val d'Aosta, Italy. (Sanero, 1935).
4. Pyrope, pyroxenic eclogite, Čerrín, southern Moravia. (Kokta & Němec, 1936).
5. Colour-change garnet, Tanzania. (Crowningshield, 1970). Semi-quantitative spec. anal. Pacific Spectrochemical Lab., Inc.

The colour-change garnets and virtually all of the other gems from this region had their origins in the Basement Complex rocks which are assigned to the Mozambique Mobile Belt. This underwent its last phase of metamorphism during the so-called Pan-African event. Ages obtained from metasediments and pegmatites in this part of East Africa date this event at around 550 million years ago (Cahen and Snelling 1966).

Gem almandine (rhodolite) and spessartine garnets are reliably reported to have been seen *in situ* in metasediments just east of the ultrabasic intrusion in which the pastel-shaded corundums are found. Tourmaline is also found in association with the ultrabasic intrusives and scapolite, clino- and ortho-pyroxenes of gem quality are among the other gem minerals found in the area. Gem zircon also occurs. More than one ultrabasic intrusion is known in the region and the possibility of their continuity at depth should not be excluded.

A possible origin for some of the garnets with unusual properties may have been the interaction between ultrabasic intrusions and garnets of various compositions found in the metasediments and other deposits. This occurred especially, perhaps, in the contact aureole which at the mine for the pastel-shaded corundums is complex and zoned.

The ultrabasic intrusives of East Africa have not been adequately dated, but, if the existence of a single gem-forming phase is confirmed, a case can be made for assigning a *circa* 550 m.y. or slightly younger date to the emplacement of these rocks.

The authors gratefully acknowledge assistance from colleagues in the Petrographical Department at the Institute of Geological

Sciences without whose co-operation this work could not have been completed; they also thank Mr B. W. Anderson for much helpful discussion and Mr J. M. Pulsford for the inclusion photograph.

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INCLUSIONS IN BERYLLONITE FROM STONEHAM, MAINE, U.S.A.

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BERYLLONITE, $NaBePO_4$, is a rare gem material originally found at Stoneham, Maine, U.S.A., in 1886. The mineral was originally noted by Dana in 1888 and described by Dana and Wells in 1889. Beryllonite was found as highly modified etched monoclinic crystals in a soil containing feldspar, quartz and common pegmatite minerals. The three prominent cleavages produce blocky, rectangular sections well suited to oval, cushion and emerald cuts. Beryllonite is colourless, has low refractive indices of $\alpha = 1{\cdot}552$, $\beta = 1{\cdot}558$, $\gamma = 1{\cdot}561$, weak dispersion, a hardness of $5\frac{1}{2}$, and is uncommon, hence it is not frequently encountered in jewellery but is cut as a specialty stone for gem collectors and museums.

Four cut stones weighing 2·5, 3·3, 3·9, and 5·0 carats, and 55 uncut crystals and crystal fragments in the Smithsonian Institution collections were examined for inclusions. Although Dana and Wells noted apatite inclusions in their description of beryllonite,

apatite was not observed in the gem material examined in this study. The most obvious and abundant inclusions in Stoneham beryllonite are very fine, parallel tubes oriented parallel to [010]. Healed fractures, resembling a trellis, and very thin curving acicular crystals (Fig. 1) are less frequently observed.

The most interesting inclusions in the Stoneham beryllonite are two-phase inclusions consisting of a liquid and one or two gas bubbles (Fig.2). These are of two types: irregular flat cavities and elongated cylindrical tubular cavities. In both cases, the long dimensions of the inclusions are normal to the *b*–axis. The tubular cavities, which are of variable length, and the irregular cavities are usually concentrated in planes parallel to {010}.

FIG. 1. Unknown acicular crystals rarely observed in beryllonite from Stoneham Maine. (N.M.N.H. Specimen B-12474). (40×).

In the course of photographing these inclusions, a 5 carat cushion-cut stone was exposed to the heat from the illuminator of a darkfield gemscope. The warming of the stone (to about 55°C) caused the expansion of an inclusion and produced a minute fissure cleavage parallel to {010}. The inclusion was observed to boil as the cleavage occurred and the escaping liquid and gas formed an evaporite residue on the clean polished surface of the gem (Fig.3). This residue was x-rayed, utilizing a Gandolfi powder camera and CuKα nickel filtered radiation. Examination of the x-ray pattern indicated that the evaporated residue was halite, NaCl, and

FIG. 2. Two-phase irregular inclusion in beryllonite from Stoneham, Maine. (N.M.N.H. gem #423). (40 ×).

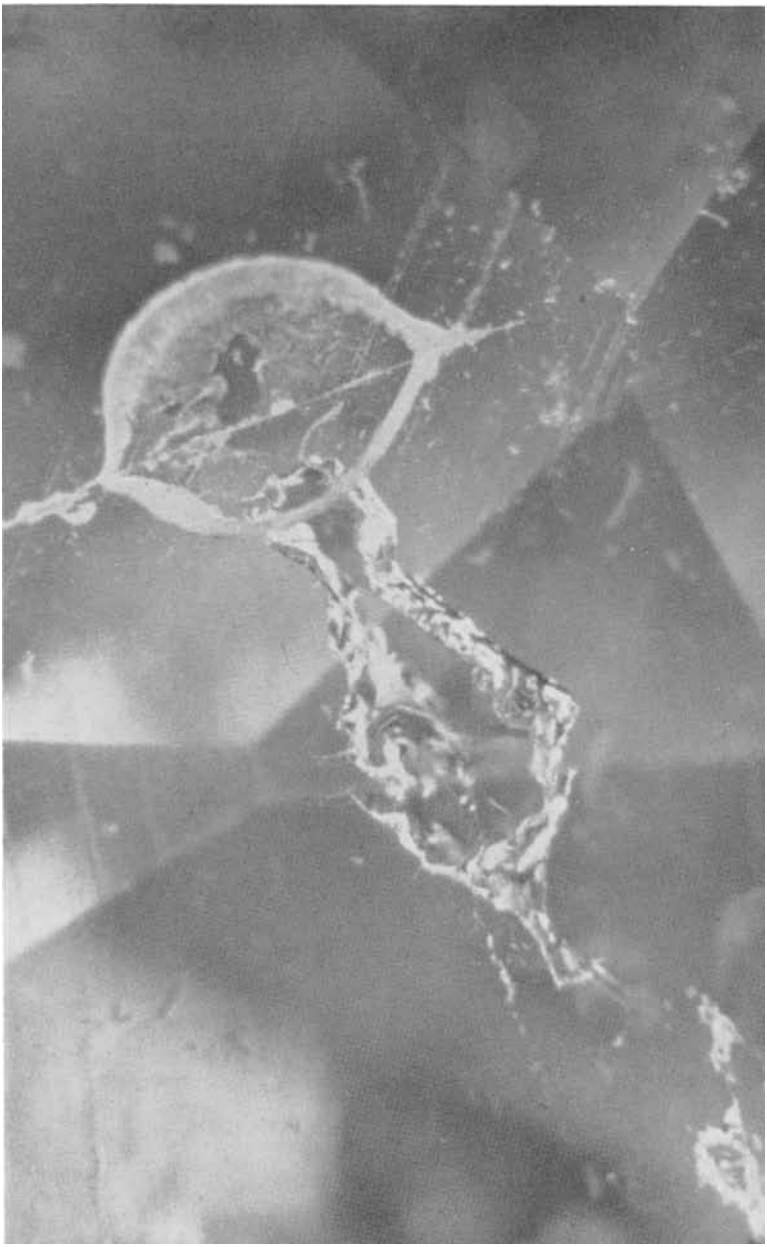

FIG. 3. Same inclusion as Fig. 2 (at 20 ×) showing minute fissure cleavage and evaporated residue on a facet of the gem.

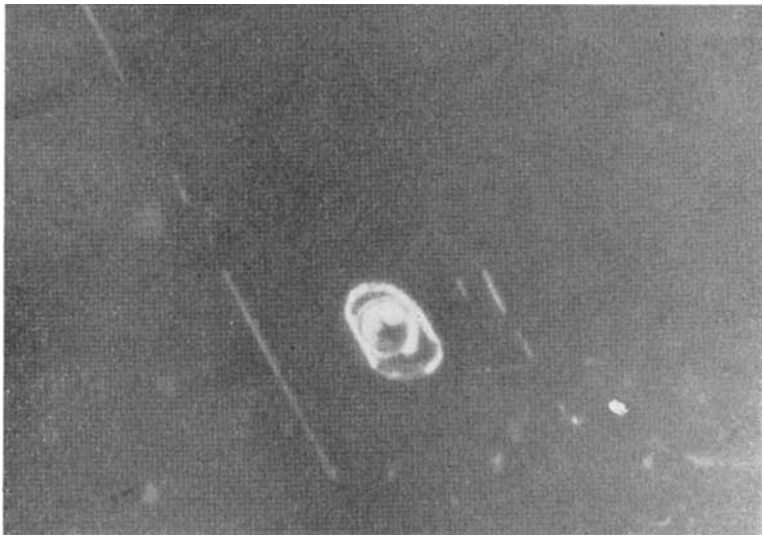

FIG. 4. Two-phase inclusion in beryllonite from Minas Gerais, Brazil. (N.M.N.H. Specimen #128109). (60 ×).

nahcolite, $NaHCO_3$, suggesting that the original inclusion was comprised of a sodium chloride bicarbonate solution and CO_2. The presence of CO_2 was also postulated by Dana and Wells (1899). Figures 2 and 3 show the inclusion before and after the escape of the liquid and gas components. The gas bubbles in this material comprise less than a third of the volume of the inclusion.

Gem beryllonite from Minas Gerais, Brazil, also has similar inclusions with the same crystallographic orientation. The tubular inclusions in the Brazilian beryllonite have a larger gas bubble which comprises more than half the volume of the inclusion cavity (Fig. 4).

The author wishes to thank Mr John S. White, Jr, for his critical reading of the manuscript and Mr Grover Moreland and Mr Richard Johnson for the preparation of polished samples.

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LE MARCHÉ COMMUN

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

XENOPHOBIA has been attributed to me by my friends (gemmologically speaking) but this is not so. Insular and conservative yes, but I enjoy my holidays particularly if I can manage to go abroad for them.

As a country, its people and tongue, I thoroughly enjoy France. Paris, the capital, has an excellent laboratory of which Monsieur J.-P. Poirot is the director. We have exchanged visits whilst on holiday and find we have an accord which bodes well for each country. When time permits perhaps I may have the pleasure of meeting other of our Common Market friends.

One such friend (an anglophile) is Monsieur Hubert Mornard. He runs the Brussels Laboratory in a very capable manner single-handed. He, shall we say, took the bull by the horns and came to London on a good-will visit just over a year ago and spent an agreeable period in and around Hatton Garden, the offices of the Gemmological Association and our laboratory.

One hears constantly of the work of eminent gemmologists of the larger laboratories for which all of the gemmological world and trade at large are grateful. In this persent day of synthetics founded upon isomorphous structures, seeded hydrothermal rubies, synthetic black opals, bombarded diamonds, and not forgetting non-nucleated third growth cultured pearls (which are a pearl-tester's nightmare), we do need well-equipped laboratories.

We are particularly grateful to our American friends who send out a stream of useful information in their *Gems and Gemology* (their *Journal of Gemmology*).

It is difficult in these days of staff shortage and increase of work to find time to digest all that is published, let alone comment upon it. A very old friend of the London laboratory is Mlle Dina Level, who writes beautifully on gemmological historic items in the bulletin of the Association Française de Gemmologie. Their bulletin no. 35 has an article entitled "Les Mystères de la Coupe Verte, racine d'émeraude, prase ou . . .?" This is a typical Dina Level article written with great love and understanding of gemstones as only someone literate, French and poetic could hope to achieve.

Among other publications emanating from the Common Market (and there are many) is *Technica*, a jewellery magazine/

journal published in French and Flemish, which in itself gives it a unique flavour. It is quite interesting to read a subject in French when one knows most of the phrases and then read across the page its equivalent in Flemish. Among the many interesting articles on jewellery, watches and everyday news items (such as are found in their British counterparts over here) are gemmological notes chiefly emanating from Hubert Mornard. Apart from running his own jewellery business (two shops I believe) he finds time to run the laboratory gem-testing and writes up items of interest for its readers. Browsing through a few recent copies of *Technica*, I found a very succinct and workmanlike account of synthetic quartz samples donated to the Brussels laboratory by Sawyer Research Products Incorporated of Ohio, U.S.A. Among the specimens were a rough crystal of 1·051 ct and a golden-yellow stone of 52 ct. Due to the rapid growth in the autoclave, some anomalies occur in the crystal morphology. A description is given of the various faces, which with the appearance of the seed crystal within are reproduced in photographs. Mornard notes that the dichroism of synthetic yellow quartz is more obvious than that of burnt amethyst, and that natural quartz is more transparent to long-wave ultra-violet rays (3650Å) than synthetic quartz.

Among other stones tested were a 5·32 ct moldavite, a stained quartzite, an opal of bluish-black colour sprinkled with small iridescent points of blue and green on the cabochon surface and of blue only on its base. The opal was not porous, plasticized or apparently treated. No reaction to acid or acetone was found. Rather more than a treated opal it seems, but on sight it looked like a treated stone. Perhaps not noteworthy to some, but obviously a laboratory is expected to come up with an answer. A dealer can give an opinion which is not binding. This day and age of, dare one say, 'clever' techniques of gemmology aimed at the gemmologist make life very trying for the laboratory worker—particularly one on his own. Perhaps we shall all benefit from our entry into the Common Market; at least gemmologically speaking we have a common interest.

NOTES ON SYNTHETIC PRECIOUS OPAL

By P. J. DARRAGH, B.Sc.(Hons) and J. L. PERDRIX

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IN many compounds colour is caused by selective absorption and the resulting colour is of a complex nature, the absorption being caused usually by foreign ions in the structure. Bayliss and Males (1965) have shown that there is little or no difference in the chemical composition of precious and potch opal from the same areas. This suggests that the colour in opal is not due to impurities. It was recognized about the middle of the last century that the colours produced by precious opal were pure spectral colours, and hence were not related to chemical properties. Early efforts at synthesis of precious opal were directed towards some physical structure which would produce diffraction; however, these efforts were handicapped because the structure of precious opal was not deducible simply from optical effects. Its structure was discovered by Jones, Sanders and Segnit (1964) with further details given by Darragh and Gaskin (1966). CSIRO (1968) is the holder of patents for the production of opaline materials.

Precious opal is composed of uniformly sized silica spheres, which stack to form a regular array. The voids between the spheres are also regularly spaced and these act as optical discontinuities, giving rise to three-dimensional diffraction. The maximum wavelength (λmax) of the diffracted light is related to the radius of the sphere (R) and is dependent upon the type of stacking. For face-centred cubic stacking

$$\lambda\text{max} = 4{\cdot}74R,$$

and for hexagonal stacking

$$\lambda\text{max} = 5{\cdot}02R \text{ (Sanders 1968).}$$

Natural opal occurs in two distinct environments. In many parts of the world precious opal occurs associated with volcanic rocks, and such opal is also found in Australia, for example at Tintenbar. However, most of Australia's production of precious opal comes from a sedimentary environment. These differing environments produce two distinctly different types of opal, each having different optical properties. The smaller voids found in volcanic opal give it greater transparency, and the more uniform orientation of the particles produces broad bands of colour rather

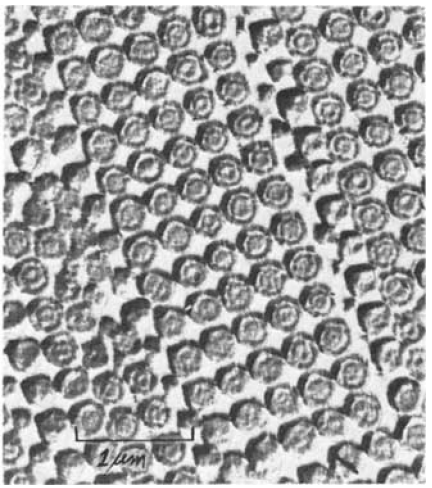

FIG. 1. Electron micrograph of etched surface of sedimentary opal showing concentric rings within the spherical clusters of silica.

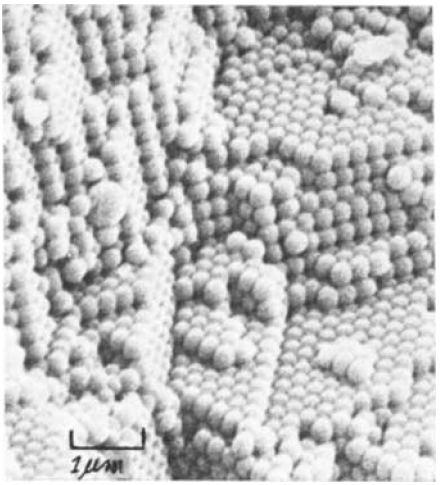

FIG. 2. Scanning micrograph of stacked latex spheres. By courtesy of Dr C. A. Anderson, CSIRO, Division of Textile Industry.

than a distinct pattern. Generally, etching of volcanic opals before examination by electron microscopy does not indicate structure within the sphere, although there are some exceptions—Rocky Bridge and Warrumbungle material for instance. On the other hand, sedimentary opals show detailed structures within the spheres (Figure 1). A primary sphere of 100-500Å diameter is often seen to be acting as a nucleus, with other similarly sized spheres surrounding it, giving a larger spherical cluster capable of diffracting white light. The expression above shows that spheres or clusters of spheres of 1700-3800Å diameter are required to diffract white light. It could be mentioned that similar diffraction effects have been observed in materials other than silica. For example, latex spheres of the correct size will produce prismatic colours (Figure 2). A similar effect is reported to occur in tobacco mosaic virus crystals (Wilkins *et al.* 1950).

Natural opals grow by the concentration of silica solutions and the subsequent precipitation of silica, even though the solubility of monomeric silica is only about 120 parts per million at room temperature. In the authors' first method, sodium silicate was used as the starting material for the growing of the spheres. It was found that this was too slow, that the spheres produced have too

large a range of particle size distribution (Figure 3), and that unless great care was taken the silica cross-linked to form sheets or needles rather than spheres. It has also been found that silica particles will grow by aggregation if dilute solutions of silicic acid are allowed to stand for some months. This is so slow that control of particle size has not been investigated.

Stöber, Fink and Bohn (1968) developed a method for the controlled growth of monodisperse silica spheres which could be used for instrument calibration, etc. and this became the basis of another method to produce opal. The starting material is a silicon ester, either tetraethyl orthosilicate or tetramethyl orthosilicate, and the technique produces uniform droplets of silicon ester suspended in a water-alcohol mixture. The droplets of ester are then hydrolysed by mild alkali, such as ammonia, to form spherical particles of hydrated silica. This process is adjusted to produce uniformly sized droplets and hence uniformly sized silica spheres (Figure 4), the actual sizes of which are controlled by the concentrations of water and ammonia in the system. It was found that more uniform spheres were obtained when the silicon ester was added slowly over a period of several minutes to a gently agitated mixture of the other

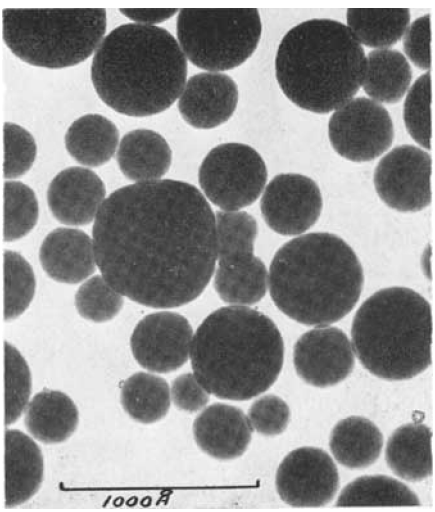

FIG. 3. Electron micrograph showing particle size distribution of silica spheres produced from sodium silicate.

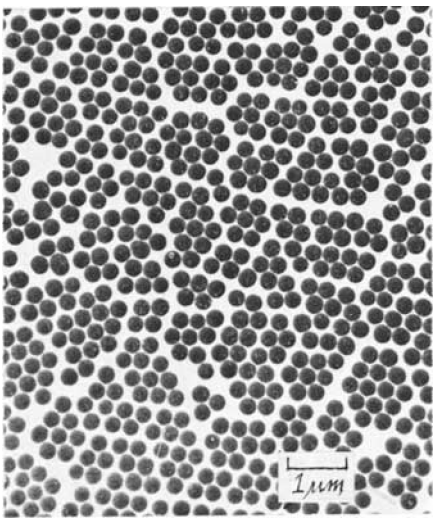

FIG. 4. Electron micrograph showing particle size distribution of silica spheres produced from tetraethyl orthosilicate.

reagents, with agitation being continued for half an hour or so after the addition is completed.

In order to achieve a narrow particle size distribution of the range required for precious opal, it is essential to control accurately both the concentrations and volumes used of the reagents, which should be of the highest purity. Figure 5 shows stacked silica spheres which diffract white light. These arrays were obtained by allowing the particles to settle over a period of several weeks. The final stage in the process is to harden the arrays of stacked spheres, and this has proved to be quite difficult.

The unconsolidated arrays of spheres made by these processes may show quite good colour when the voids are filled with liquid. If the liquid is removed, then the body becomes white and opaque due to the scattering of light and a considerable amount of colour is lost. A similar effect is observed in hydrophane opal. For best results, the refractive index of the liquid filling the voids should be close to, but not identical with, that of the silica spheres. However, to produce a material approaching natural opal these voids must be reduced in size or permanently filled.

The authors' first approach to this problem was to impregnate the arrays with plastic, which, by definition, would produce an

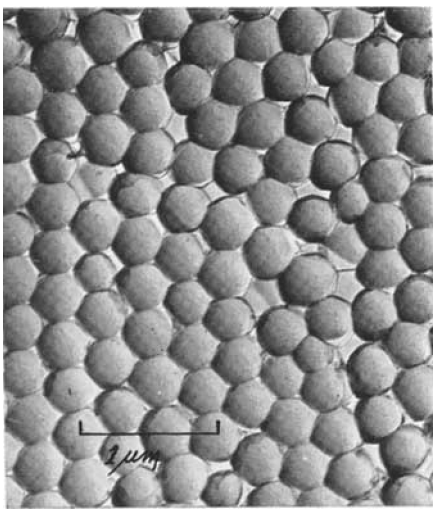

FIG. 5. Stacked spheres in synthetic opal as shown by the electron microscope.

imitation rather than a synthetic opal. This procedure is successful only if the shrinkage of the plastic on polymerization is very small. Impregnation with silica is much more difficult as the shrinkage is much higher and the added silica tends to shrink away from the spheres. Repetition of impregnation becomes more difficult as the permeability decreases.

The application of heat to produce partial sintering causes both the spheres and the voids to shrink, and quite good hardness and strength may be obtained at temperatures between 500 and 800°C. Most precious opal is amorphous, and heating creates another problem, since above about 800°C a phase change from an amorphous structure to crystalline tridymite takes place. A sample made from silicic acid heated for half an hour at 1200°C produced a mixture of cristobalite and tridymite; however, at lower temperatures it was found that sintering occurred without crystallization. This work is still being investigated by the authors.

In 1972 the authors learned that the New York jeweller, Benedict, had announced the coming sale of a synthetic opal early in 1973. A small sample of the material manufactured by Pierre Gilson, Saint Sulpice, Switzerland was made available to CSIRO. This is the only specimen which has been studied in detail by CSIRO, although some even better quality material was made available briefly for non-destructive investigation. The physical properties of the Gilson opal are well within the range covered by natural opal, so that no simple diagnostic test appears likely. As opal is an hydrous mineral, the water content of the Gilson opal was compared with that of some natural opals. A non-destructive test was desirable, so infrared spectroscopy was used. Although the Gilson opal contained considerably less water than most natural opals, it did contain detectable amounts comparable to those in some Queensland boulder opals studied by the authors—in the order of 3%.

Examination of the Gilson material in the electron microscope showed very many cracks in the opal (Figure 6), many of which have healed during manufacture. These cracks appear characteristic of Gilson material as shown in Figure 7. This is a scanning micrograph of a finished Gilson gem, again showing numerous cracks. These cracks are probably due to stresses developed during manufacture and are not the normal crazing types common in some opal. Although not obvious in the scanning mode, the

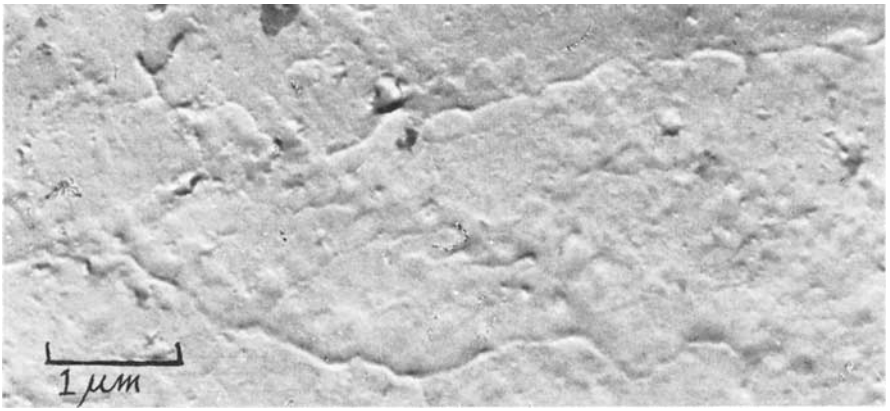

FIG. 6. Electron micrograph of synthetic opal produced by P. Gilson showing healed cracks.

internal structure of Gilson opal (Figure 8) as seen by transmission microscopy is quite different from any natural opal that the authors have examined.

Most opals found in nature are not pure silica, but contain small, however significant, amounts of other elements, notably aluminium and calcium. Table 1 lists some of the impurities found in precious opals from a number of areas together with their total water. When the Gilson specimens were examined in the electron microprobe, neither aluminium nor calcium were detected, yet the small amount of aluminium in the Californian sample is within the detectable range of this instrument.

The examination of the microstructure and the detection of aluminium and calcium require expensive specialized equipment not readily available to the gemmologist. Until further samples have been examined, the authors are not prepared to state that physical properties are likely to lead to positive identification. Even the presence of numerous cracks common to the two specimens could be misleading; however, at the present state of the authors' knowledge, this constitutes the easiest test for recognition of Gilson opal. The comments on Gilson synthetic opal in this article apply only to the original specimen supplied by P. Gilson to CSIRO. The authors have not examined any of the specimens in Plate 1.

The authors thank Dr J. V. Sanders and Mr B. Dawson for the electron micrographs.

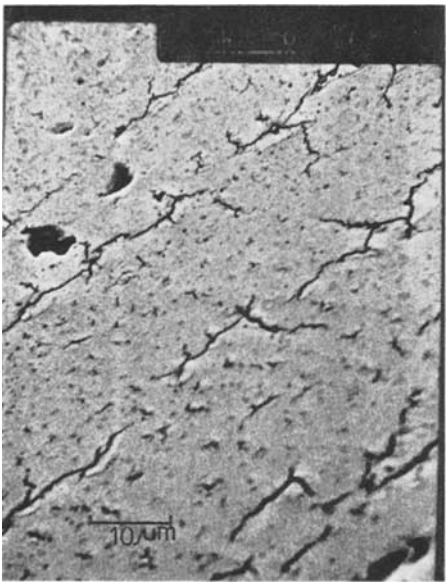

FIG. 7. Scanning micrograph of Gilson gem showing cracks.

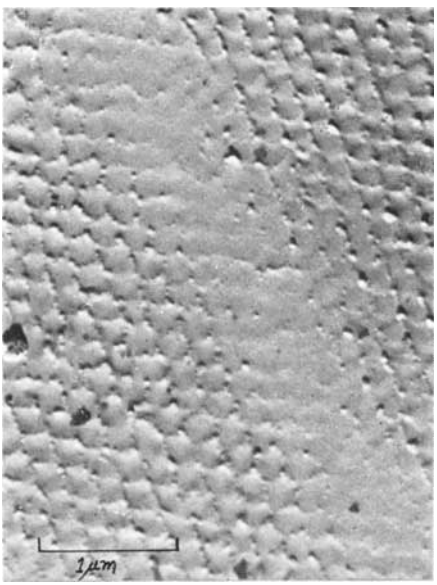

FIG. 8. Electron micrograph of synthetic opal produced by P. Gilson showing microstructure.

PLATE I. Specimens of the new Gilson synthetic black and white opal.

TABLE I

PARTIAL ANALYSIS OF PRECIOUS OPALS

Specimen:	1	2	3	4	5	6	7
Al_2O_3	0·7%	0·9%	1·6%	0·1%	2·5%	1·8%	1·3%
CaO	0·1	0·1	0·5	0·01	0·9	0·8	0·3
Fe_2O_3	0·06	0·2	0·2	0·1	0·3	0·2	0·2
MgO	0·02	0·04	0·09	0·005	0·1	0·05	0·05
Na_2O	0·06	0·2	0·05	0·04	0·4	0·4	0·05
H_2O	8·5	6·1	10·2	4·2	6·0	6·4	5·7

Specimen locality and type:

1. Mullumbimby, N.S.W.; volcanic
2. Mexico; volcanic
3. Indonesia; volcanic
4. California; volcanic
5. Lightning Ridge, N.S.W.; sedimentary
6. Coober Pedy, S.A.; sedimentary
7. Andamooka, S.A.; sedimentary

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TWO NOTES

By M. J. O'DONOGHUE, M.A., F.G.A.

1. GILSON SYNTHETIC RUBY

THROUGH the kindness of M. Pierre Gilson the writer recently received a large piece of the new synthetic ruby manufactured at Campagne-Lez-Wardrecques in the Pas de Calais.

The crystal is of tabular form displaying uneven upper and lower pinacoids, pyramidal, prism and rhombohedral faces. Some of the faces show striations, and from two faces protrude pieces of the platinum wire used to suspend the seed in the autoclave during manufacture.

The colour varies from orange to a dark red, reminiscent of Siam ruby. Dichroism is marked showing the same two colours. The absorption spectrum is typical for ruby, though with no emission line—this is probably due to an iron content, as the dark red colour seems to suggest. There is only a faint luminescence under ultra-violet radiation and the stone appears a very dark red through the Chelsea colour filter.

The inclusions are those to be expected in a flux-melt manufactured material, "paint-splashes", twisted veils and a haziness in some parts which presumably are adjacent to the seed. The R.I. was measured at 1·764 and 1·776.

The seed was visible when the stone was examined through the pinacoid face, this direction also giving the best colour, more like ruby than in the other directions. I am grateful to Mr Keith Mitchell for this observation.

Although this particular specimen is rather dark, I have seen others of a much lighter shade of red, inclining to pink. These specimens were in the form of groups of thin platy crystals, which are offered for sale presumably as an ornamental material, as they were too thin to cut; this form of ruby has also been offered by the makers of the Kashan synthetics.

It remains to be seen whether M. Gilson produces a fine-coloured stone; experience with his other productions suggests that this will not be far off.

2. A NEW DOUBLET TO IMITATE DIAMOND

THE writer recently received, through the kindness of M. Eugène Naftule, of the firm of Naftule, Geneva, three specimens of a doublet made with a crown of synthetic corundum and a pavilion of strontium titanate. At first glance the fire still seems to be considerable and greatly in excess of that to be expected from diamond. On one of the stones the join is so far below the girdle as to show a prominent ring which is visible without a lens; the other specimens are better made and the junction coincides with the girdle. The crown gives a normal R.I. for corundum and the stones are free from heavy inclusions, though the ladder-like cracks typical of strontium titanate were visible in the pavilion of all three stones.

TEN TANZANIAN COLOURLESS GROSSULAR GARNETS AND THEIR PHYSICAL CHARACTERISTICS

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

TEN colourless grossular garnets were found in a parcel of eighty-one purchased from a company which formerly had owned the mine from which they were taken in Tanzania. The garnets ranged from three and a half to four millimetres and were cut in modified brilliant-cut form.

The group of ten had a total weight of 2·43 carats. The specific gravity of the entire group by the hydrostatic method was 3·62.

Only four stones gave a clear-cut refractive index reading of 1·735. Six stones gave readings indicative of anomalous double

refraction with five readings showing a range from 1·732–1·738 and the sixth showing a refractive index from 1·735–1·738.(1) Many inclusions were found in the stones with a refractive index range and fewer inclusions were found in the four stones which gave a single refractive index. However, all ten stones showed evidence of anomalous double refraction when examined with the polariscope.

All ten colourless grossular garnets fluoresced a strong apricot colour under short-wave ultra-violet light and nine fluoresced a weak apricot under long-wave ultra-violet light. The tenth garnet was an exception in that it fluoresced apricot colour more strongly under long-wave ultra-violet light than it did under short-wave. A mirror was placed under the garnets while performing this test and all showed a translucency to ultra-violet light.(2)

According to Anderson most colourless or nearly colourless stones do not show absorption bands, since in such stones the colouring oxides which produce bands are absent; however, some off-colour white diamonds (e.g. Cape diamonds), synthetic rutiles, and white zircons do show absorption bands.(3) Therefore, it seemed pertinent to examine these colourless grossular garnets with the Beck prism spectroscope. The spectroscope scale showed that there

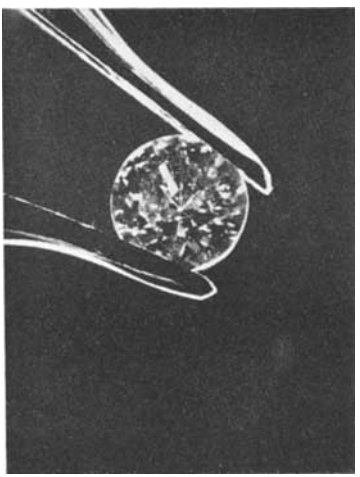

FIG. 1. Breadcrumb-like and bubble inclusions. 10×.

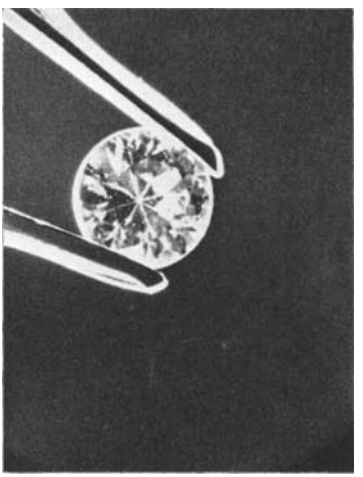

FIG. 2. Fingerprint inclusion. 10×.

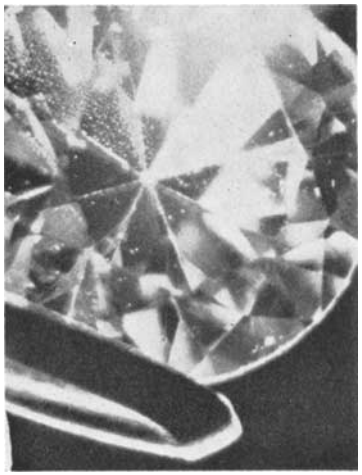

FIG. 3. Same stone—fingerprint inclusion. 30×.

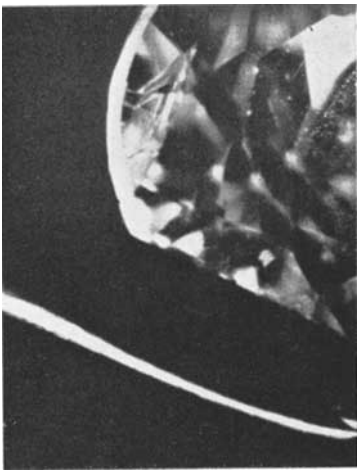

FIG. 4. Two-phase inclusion. 30×.

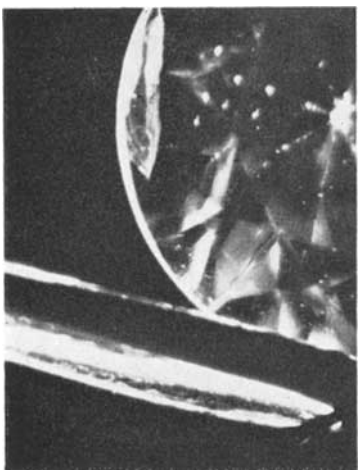

FIG. 5. Three-phase inclusion; octahedral and tube inclusions. 30×.

FIG. 6. Tube inclusion. 30×.

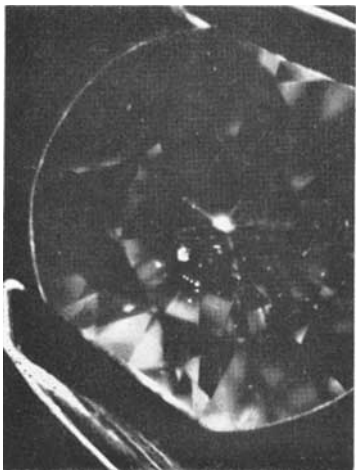

FIG. 7. Bubble-chain inclusion. 10×.

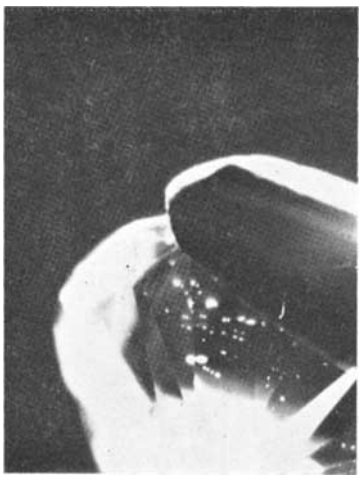

FIG. 8. Same bubble-chain inclusion. 30×.

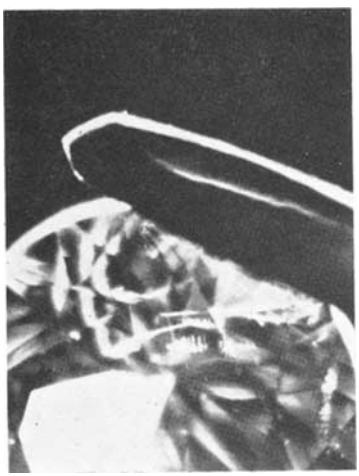

FIG. 9. Feathers in parallel orientation. 30×.

FIG. 10. Ladder-like inclusions. 100×.

was a sharp cut off in the blue at 4900 Å and absorption in the red from 6750–7000 Å for all ten garnets in the study.

Inclusions found in the ten garnets included:—

Breadcrumb-like and proliferated bubble inclusions (Fig. 1)
Fingerprint inclusion (Figs 2 and 3)
Two-phase inclusion (Fig. 4)
Three-phase inclusion (Fig. 5)
Octahedral inclusions (Fig. 5)
Tube inclusions (Figs 5 and 6)
Bubble chains (Figs 7 and 8)
Feathers in parallel orientation (Fig. 9)
Ladder-like inclusions (Fig. 10) which at higher magnifications of 200 × resolved into parallel lath-like forms (not shown).

From close examination of the first three photomicrographs (Figs 1, 2 and 3), it can be seen that care must be used in the identification and differentiation of colourless grossular garnets from colourless synthetic spinels. The slightly higher refractive indices of the colourless grossular garnets together with their apricot fluorescence should be decisive determinants in their separation from synthetic colourless spinels.[4]

REFERENCES

1. Other researchers have reported slightly different results, for example: Bank, H. *Transparenter weiss-farbloser Grossular aus Tanzania*, Z.Dt. Gemmol. Ges., 1971, **20,** 1, 22-25, (*Mineralog. Abstr.*, Jan. 1972, **23,** 2, 106, #72-1183) reported n 1·732-1·736, S.G. 3·65, based on the examination of one colourless grossular garnet from Tanzania.
Liddicoat, Richard T., Jr, *Handbook of Gem Identification*, G.I.A., 9th edn, 1972, p. 363, states that the R.I. of colourless grossular garnet from Tanzania is slightly above 1·73 and the specific gravity is about 3·60.

2. Liddicoat, op.cit., pp. 363-364, states that grossular garnet shows a weak green fluorescence to short-wave and a weak orange to long-wave ultra-violet light, and the strong orangy-yellow fluorescence to x-ray which characterizes grossular is present.

3. Anderson, B. W. *Gem Testing*, 8th edn, Butterworth & Co. Ltd, 1971, pp. 146-147.

4. Anderson, op.cit., p. 180, states that most white synthetic spinels fluoresce with a strong bluish glow under short-wave ultra-violet light.

Gemmological Abstracts

BANK (H.). *Aus der Fortbildungspraxis.* (Items from further studies). Z. Dt. Gemmol. Ges., 1974, 23, 3, 217-223.

The author discusses five different items. Differentiating between natural spinel and taaffeite is sometimes difficult, as is occasionally recognizing synthetic spinel; chalcedony can be mistaken for opal; synthetic spinel, glass and garnet are sometimes mixed up; and lastly the author discusses zonar built emeralds, synthetic "sandwich-emeralds" and emerald/emerald doublets. E.S.

BANK (H.). *Hochlichtbrechender vanadiumhaltiger Beryll aus Minas Gerais, Brasilien.* Vanadium-containing beryl with high R.I. from Minas Gerais in Brazil). Z. Dt. Gemmol. Ges., 1974, 23, 3, 212-213.

A new beryl from the Minas Gerais district in Brazil with emerald colour was shown to be coloured by vanadium (not red under the Chelsea filter). It had a very high R.I. (1·595—1·586), high density (2·75) and also high double refraction (from 0·008 to 0·01). E.S.

BANK (H.). *Durchsichtiger grüner Grossular (granat)—Unterschiebungen bezw. Imitationen.* (Transparent green grossularite (garnet)—substitutions and imitations). Z. Dt. Gemmol. Ges., 1974, 23, 3, 195-198.

Characteristics of grossularite, also known as "Transvaal Jade", are enumerated. Instead of the chrome-containing grossularite, chrome-containing tourmaline (specially from Tanzania) is sometimes sold. Comparatively easily recognizable are glass, and grossularite/glass doublet imitations, although lately grossularite doublets as well as glass of very similar colour and same R.I. as grossularite have been on the market and it may need an examination under the microscope to distinguish them. E.S.

BANK (H.). *Durchsichtige Grüne Enstatite aus Tansania.* Transparent green enstatites from Tanzania). Z. Dt. Gemmol. Ges., 1974, 23, 3, 192-194.

Orthopyroxenes (or orthaugites) are important rock-forming minerals rarely used as gems. Sometimes they are found in transparent form and cut—enstatite, bronzite, hypersthene. Their characteristics are enumerated and a new find of green enstatite from Tanzania is described. E.S.

BANK (H.). *Farbloser durchsichtiger geschliffener Whewellit.* (Colourless transparent cut whewellite). Z. Dt. Gemmol. Ges., 1974, 23, 3, 189-191.

Another colourless transparent substance which was found in a cut and polished condition was whewellite, a calcium oxalate; it is monoclinic, usually forms small crystals, often heart-shaped twins, hardness 2½, density 2·23, R.I. 1·49-1·65, has a mother-of-pearl lustre, found in Germany, USSR, Bohemia and Alsace (France), often together with anthracite. E.S.

BANK (H.), BERDENSKI (W.), OTTEMANN (J.) and SCHMETZER (K.). *Durchsichtiger rötlicher eisenhaltiger Rhodonit aus Australien.* (Transparent reddish iron-concontaining rhodonite from Australia). Z. Dt. Gemmol. Ges., 1974, 23, 3, 180-188.

Detailed examination of a rhodonite from Australia, with density and refractive index readings, chemical composition and absorption values. Bibliography of 21 items. E.S.

BUNDY (F.P.). *Superhard materials.* Scientific American, 1974, 231, 2, 62-70. 7 illus. 4 graphs and 1 table.

An important article, written by one of the team who produced the American synthetic diamonds, discusses the hardness of substances and the methods used to evaluate hardness, with particular reference to diamond and boron nitride. Corundum, the mineral ranked next to diamond on Mohs's scale, is said to be only a fifth as hard as diamond. The Knoop indenter hardness measurement is discussed in relation to Mohs's scale and to the Mohs-Wooddell scale which depends on the loss of weight after grinding for a standard time. Covalent bonding produces hard materials, while substances bound ionically are relatively soft. Comparison is made between the crystal lattices of diamond and boron nitride. The cleavage of diamond is referred to and much is told of the plastic flow of diamond under pressure and heat. Type II diamonds deform more easily than Type I diamonds. There is a discussion of the thermal conductivity of diamond and in this connexion much is told of uses and possible uses of diamond in the realm of "heat sinks" and as semi-conductors. It is said that in principle it is not impossible to find a substance harder than diamond, but the chances are small. An article which must be read. R.W.

COLLINS (A. T.). *Visible luminescence from diamond.* Industr. Diamond Rev., 1974, 131-137. 10 figs.

The major emission systems in diamond which give rise to luminescence in the visible region are reviewed. Blue photoluminescence is characteristic of type Ia diamond; blue cathodoluminescence is often observed from all types of natural diamond, but is particluarly strong for type II samples. Most unirradiated synthetic diamonds exhibit a green cathodoluminescence; green photoluminescence is seen in natural diamonds which have been subjected to radiation damage and thermal annealing. No H4 cathodoluminescence (zero phonon line at 496·2 nm) has ever been observed from synthetic diamond. Red cathodoluminescence in the 575 nm system is characteristic of type II or type Ib diamonds which have undergone radiation damage. Emission characteristic of radiation damage may also be observed in the vicinity of dislocations in the diamond. R.A.H.

CROWNINGSHIELD (R.). *Developments and Highlights at the GIA's Lab in New York.* Gems & Gemology, 1973/4, XIV, 7, 212-215; 8, 230-240. 27 illus.

Fade tests on gamma irradiated quartz and topaz are discussed and some remarks are made on the turquoise used in south-west American made jewellery, much of which is pale coloured and not treated in any way, although one piece was found to have been dyed. Something is told about dyed lavender jadeite and of experiments carried out on this material. More notes on the laser drilling

of diamonds are given, and mention is made of a misidentification by a jeweller, who scratched the soft direction of a diamond with the hard direction of the test stone. Several cases of damage to diamonds are reported where stones had been set too close together and damaged one another. A new opal doublet had an irregular back consisting of powdered ironstone, some opal, and plastic, probably an epoxy resin. Another unusual opal is mentioned. Damage to stones which are heat sensitive is recorded. A black tourmaline needle travelling from culet to table produced a striking picture by reflection and gives thought to interesting possibilities. Yellow conch pearls not often seen are mentioned. A parcel of natural sapphires were found to fluoresce under both ranges of ultra-violet light and this was found to be due to the stones being heavily oiled. Greenish-yellow or yellowish-green 'citrines' which look like chrysoberyl or some peridot are mentioned and there is some evidence that these stones have been treated by gamma radiation plus gentle heating: they may fade. Unusual diamond imitations are described—one, a yellow stone which fluoresced sulphur yellow under ultra-violet light and by its absorption spectrum was found to be europium "doped" yttrium aluminate, and the other a light brown stone which turned out to be gadolinium gallium garnet (G.G.G.). Problems in the testing of carved articles are discussed. R.W.

ELLINGHORST (G.) and BRÜCK (G. K.). *Über die Haerte von Diamanten.* (About the hardness of diamonds). Z. Dt. Gemmol. Ges., 1974, 23, 3, 207-210.

The authors discuss the crystallography of the diamond crystal. They point out the connexion between cleavage and hardness. This means that the maximum hardness of a diamond is its octahedron face; this fact is applied in diamond cutting—"softer" parts of the diamond can be worked fairly easily. E.S.

EPPLER (W. E.). *Natural and Synthetic Turquoise.* Gems & Gemology, 1973/74, XIV, 8, 226-229. 5 illus.

A short article on natural and synthetic turquoise, including some man-made simulants. It is suggested that the Gilson synthesis was developed from the original work of Hoffman in 1927. Most of the study has been carried out by microscopic examination of thin sections. Rather surprisingly the Eilat Stone from Israel is classed as a turquoise. R.W.

LIDDICOAT (R. T.). *Developments and Highlights at the GIA's Lab in Los Angeles.* Gems & Gemology, 1973-4, XIV, 7, 200-207; 8, 248-255. 36 illus.

A diamond which exhibited an unusual fluorescence is reported, as are some other diamonds with unusual characters, such as a diamond with a "halo", a diamond with a natural on the culet and a diamond with an inclusion which was reflected from all the crown facet surfaces. Cameos made of a clam shell and another of green beryl are mentioned. An "alexandrite" glass and "Venetian blind" inclusions in a natural sapphire are described. Said to have come from British Columbia was a cabochon which was found to consist of nephrite with grossular garnet and/or andradite garnet. A note is given on synthetic turquoise and a chrysoprase ring with a rotating setting. Interesting inclusions in a diamond and in glass are mentioned. Unusual amber pieces are described as is a jadeite

cabochon showing a coarse pyroxene crystal. A strange way of forming a glass bead is illustrated as well as a Colombian emerald full of pyrite crystals. A "fingerprint" pattern of bubbles was seen in a synthetic sapphire. A star sapphire with a double star effect was assumed to be a twin. A rich blue kyanite, probably from East Africa, was examined. R.W.

MALES (P. A.). *Brazilian precious opal.* Australian Gemmologist, 1974, 12, 2, 56-57.

Describes the examination of a number of opals from Brazil and compares them with the opals found in Australia. The writer mentions that the Brazilian opal does not react to long-wave ultra-violet light, as does the similar opal found in Australia. There is a short list of references. R.W.

MARINER (T. H.). *Crystal-balling future synthetic gemstones.* Gems & Gemology, 1973/74, XIV, 8, 241-247. 9 illus, 4 diagrams.

A survey to consider what synthetics would be likely to be produced in the future. A list of the stones which are currently synthesized, as far as the twenty principal gemstones are concerned, the method of growth in each case being given. The reason why some stones which could be grown are not, is probably economic. Jadeite might be the next stone to be synthesized, but whether it would be a true synthetic or not is debatable. It is considered that the synthesis of organic gem materials is impossible. Nothing is said of the likelihood of other man-made stones coming on the market. R.W.

MARSHALL (C. E.). *The Jet Age.* Australian Gemmologist, 1974, 12, 2, 42-54 8 illus, 2 graphs and 1 table.

The article is the report of the Presidential address given to the Gemmological Association of Australia. In this a very full study of jet is made. The history of its use in ornamentation through the ages is given as well as details of the recovery and working of Whitby jet and the rise and fall of the industry. The material itself and its relation to the coals are discussed. The physical and optical properties are given with much information which was found out by thin-section examination. This important article is completed with an excellent list of references. R.W.

MATTHEWS (W. L.). *Gemstone occurrences at Sisters Creek.* Technical Rept Dept Mines Tasmania, 1973, 16, 13-15. 1 fig.

Zircon and sapphire are found in the beds of two small creeks, about 15 km W. of Wynyard, NW. Tasmania. The minerals may either be derived from Devonian granite or from Precambrian sedimentary rocks. E.L.M.

MENDELSSOHN (M. J.) and MILLEDGE (H. J.). *Computing the consequences of differential growth, etch and abrasion rates in diamond.* Diamond Research 1974, 26-32. 9 figs.

It is shown that computer graphics can be used to systematize quantitative information on diamond morphology in the three main categories—natural, synthetic, and shaped. Once such a system has been set up, it should be possible not only to analyse the history of natural diamonds but to specify the conditions for growth of synthetic diamonds of a particular morphology and to analyse the time-honoured procedures used in diamond-cutting. R.A.H.

MORNARD (HUBERT). *Un examen Difficile.* (A difficult examination) Technica, 1974, 336, 360-363.

In the examination of an emerald, which at first sight could be taken for a Chatham or Gilson, the distribution of canals in strands gave an aspect of certain hydrothermal structures without the typical curled or twisted feathers usually seen in current synthetics. Refractive indices 1·573-1·580 plus S.G. 2·71 indicated Colombian emerald. Inert to S.W. lamps, inert to Chelsea filter, but distinctly reddish between crossed filters. Spectroscope showed a doublet in red, 6850Å and 6700Å, and a diffuse band in the region of 6500/6450Å. Under 12 × magnification two flaws showed a jagged/tufted structure closely resembling flux-fusion pattern. The strands formed by numerous minute liquid canals were rigidly sharp and parallel, with no signs of "flow" structure due to convection currents of mother solution usually seen in artificial stones. Under 200 × magnification the structures seen in the flaws appeared to have contained colouring mixture (chromium?). Confirmation by Professor Duyck based on R.I., S.G., inertia under U.V.L., the absence of accompanying elements seen in synthetics, plus the arrangement perpendicular to the flaws which gemmologists describe as "rain". A.E.F.

MÜCKE (A.), STRUNZ (N.) and WILK (H.). *Chalcosit-Gestein von Ambatofinandrahana/Madagascar.* (Chalcosite type rock from Ambatofinandrahanan in Madagascar). Z. Dt. Gemmol. Ges., 1974, 23, 3, 169-177.

The article is illustrated with 13 photomicrographs, one in colour, and a map of Madagascar showing the location of the find, which is in the centre of the island. The chalcosite consists of about two thirds of a reddish-brown potassium feldspar and green plagioclase, which have definite contact lines and thus present a decorative colour contrast, and about a third of quartz and mica, mainly biotite, but also some muscovite; the biotite is very black and increases the beautiful colouring. Throughout the rock there are veins of copper. The copper silicate chrysocolla in the oligoclase is of secondary formation. E.S.

NICHOL (D.). *Opal occurrences near Welbourn Hill Homestead.* Min. Resrcs Rev., South Australia, 1971, 135, 164-168. 1 fig.

Precious and common opal occur in Lower Cretaceous or Tertiary sediments at Ouldburra Hill and Sarda Bluff, west of Welbourn Hill, 900 km northwest of Adelaide, South Australia. The geology of the occurrences is briefly described and an origin for the opal involving entrapped supergene water is proposed. Petrographic descriptions of the opal and enclosing rock type are appended. J.L.K.

POUGH (F. H.). *Three fashionable minerals.* Mineral Digest, 1973, 5, 24-32.

Chrysoberyl, autunite and erythrite are reviewed and illustrated in high-quality colour. The finest pure autunite comes from the Daybreak Mine, Spokane, Washington, though crystals from Limoges, France, and Guarda and Urgereica in Portugal make the finest specimens. The finest erythrite comes from the Bou Azzer mine in southern Morocco. Autunite is $Ca(UO_2)_2(PO_4)_2$ 10-12H_2O. Erythrite is $CO_3(ASO_4)_2.8H_2O$. M.O'D.

REAM (LANNY R.). *Washington gem jade.* Lapidary Journal, 1974, 28, 4, 708.

A new location for nephrite has been found in the western foothills of the Mountains about 7 miles west of the community of Darrington. The nephrite is found in serpentine at an elevation of 3,000 feet on the south side of Mt Higgins. Colours include green to grey, which are the commonest, blue-grey and yellowish-grey. Some white pieces contain gold and silver wires. M.O'D.

RIEMAN (HARRY M.). *The blue rock called lapis lazuli.* Lapidary Journal, 1974, 28, 5, 866-870.

A review of the types, localities, tests and imitations relating to lapis lazuli. Some lapis is produced by mines in California and Colorado. M.O'D.

SCHMETZER (K.) and MEDENBACH (O.). *Chrom-diopsid aus Kenya.* (Chrome-diopside from Kenya). Z. Dt. Gemmol. Ges., 1974, 23, 3, 178-179.

During routine tests on the absorption spectra of vanadium-containing cornerupine from Kenya an individual light-green stone was separated. It was found to be chrome-diopside, density 3·31. Chemical composition and absorption spectra are given. Previously these stones were only found in Finland, the USSR and rarely in Brazil. E.S.

SOROKIN (YU. P.) and PEREVOZCHIKOV (B. V.). *Ruby from glimmerites of the Rai-Iz ultrabasic massif (Polar Urals).* Zap. Vses. Min. Obshch., 1973, 102, 692-696, (in Russian). 3 figs.

The glimmerite vein complex occurs in rocks of the dunite-harzburgite series. The phlogopitic glimmerites consist of phlogopite 92·67, ruby 5·13, and chromite 2·20 wt%. Isometric grains of ruby have a short-columnar and prismatic habit and are polysynthetically twinned along the $(10\bar{1}1)$ plane. Morphometric data of the mineral are included. The carmine-red ruby has a vitreous lustre, hardness 1830-2370 kg/mm^2, sp.gr. 4·003; ε 1·766-1·722, ω 1·776-1·784. Chemical analysis gave TiO_2 0·39, Al_2O_3 92·04, Fe_2O_3 2·86, CaO 0·93, Cr_2O_3 3.72, V_2O_5 0·06, = 100·00. The optical absorption spectrum shows a maximum in the 550 nm wavelength region. X-ray powder data are included. R.A.H.

SURROCA (ALFREDO). *El cuarzo como cristal piezoelectrico.* (Quartz as a piezo-electric crystal). Boletin del Instituto Gemologico Español, 1973, II, 8, 9-21.

An illustrated article summarizing the history of research into the piezo-electric properties of quartz and comparing them with those displayed by other crystalline materials. M.O'D.

SUTHERLAND (F. L.) and HINGLEY (J. E.). *Gemstones in and out of the Australian Museum collections.* Australian Gemmologist, 1974, 12, 2, 31-35. 5 illus.

Tells of the growth of the collection of gemstones in the Australian Museum in Sydney. Owing to repeated depredations by burglars the main and valuable part of the collection is kept in bank vaults. The collection has, besides the important Australian gemstones, a wide variety of gems from other countries. Some of the specimens are of large size. R.W

THORNTON (A. G.) and WILKS (J.). *The polishing of diamonds in the presence of oxidizing agents.* Diamond Research 1974, 39-42. 11 figs.

The presence of an oxidizing agent ($KClO_4$ or KNO_3) considerably alters the mechanism of the polishing of diamond by diamond powder on a scaife and gives a much smoother surface. R.A.H.

ZARA (LOUIS). *The tourmaline.* Mineral Digest, 1973, 5, 33-46.

The first instalment of a series on the tourmaline reproducing in colour the illustrations form A. C. Hamlin's The Tourmaline (though this is not stated). The early search for tourmaline in the Mount Mica area of Maine is recounted. M.O'D.

ZEITNER (JUNE CULP). *Quartz gems, the lapidary favorite.* Lapidary Journal, 1974, 28, 4, 612-622.

Interest in and use of the quartz gems are increasing and prices are rising as a consequence. Top quality jasper may cost up to $50.00 for a thin slab and rough chrysoprase may cost up to $75.00 a pound. M.O'D.

ANON. *Passion for Opals.* Mineral Digest, 1973, 5, 80-85.

An account of the work of Dr Archie Kalokerinos on the opal of Australia with magnificent coloured illustrations. M.O'D.

BOOK REVIEWS

CHUDOBA (Karl F.) and GÜBELIN (Eduard J.). *Edelsteinkundliches Handbuch.* (Handbook of information on precious stones). Wilhelm Stollfuss Verlag, Bonn, 1974. pp. 409. Illustrated in black-and-white and in colour. DM 65.

The new edition of this well-known text follows familiar lines. The first 160 pages are occupied by a glossary including cross-references to later sections of the book and details of synonyms, incorrect names and constants. Following this section is an account of the crystal systems and other physical and chemical data. The section on absorption spectra is expanded and improved in this edition with clear diagrams of spectra pertaining to the newer synthetics.

As may be expected in a book by these authors, the chapters on inclusions are comprehensive. Although illustrations in the text would have been useful here (and generally throughout the work), there is a booklet of black-and-white photographs of inclusions in a pocket at the end of the book.

A chapter on synthetics includes such unlikely candidates as BaF_2 and MgF_2, the first of which is slightly water-soluble; but there is no mention here or anywhere in the book of gadolinium gallium garnet, now on the market as a cut diamond simulant, nor of Gilson synthetic opal. This section is, however, very well written

and comprehensive. A reading of Linde for Gilson on p. 340 is one of the rare misprints.

For a book of this size and scope the coloured illustrations are not worthy and the world map of gemstone deposits is too crowded. A more serious criticism is the presence of material in the body of the book which appears neither in the glossary section nor in the short index. However, the usefulness of the work is considerable. M.O'D.

DESAUTELS (Paul E.). *Rocks and minerals.* Ridge Press/Hamlyn, London, 1974. Illustrated in colour. pp. 159. £2·50.

The illustrations, which occupy a full page in most cases, are already familiar to many readers, since they emanate from the Smithsonian Institution. Apart from the cheapness, this book closely resembles a number of others which have appeared during recent years. The paper leaves a good deal to be desired and a bibliography would have been useful. M.O'D.

GILMAN (J. J.). *The art and science of growing crystals.* John Wiley & Sons, New York and London, 1963. pp. ix, 493. £13·60.

Beginning with general principles this major guide to crystal growth covers the specific substances, metals, organic compounds, sulphides, silicon, silicon carbide and ice under the general heading vapour growth, elements, ionic salts, silver halides, hydrothermal growth, and molten salt solvents are included under the heading precipitation from liquid. Further sections cover solidification, including the Verneuil method, and the final section deals with recrystallization. Each chapter includes a bibliography. M.O'D.

KRÜGER (Karl). *Das Reich der Mineralien und Gesteine.* (The kingdom of minerals and stones). Safari-Verlag, Berlin, 1974. pp. 383. Illustrated in black-and-white. DM 29·80.

An account of the present-day work of the mineral prospector and description of the methods of recovery of strategic minerals, this book brings knowledge of this field up-to-date. Well-drawn diagrams illustrate the modes of excavation and the geological formations from which the ores are recovered. Although useful lists of active companies are included, there is no bibliography. M.O'D.

LAUDISE (R. A.). *The growth of single crystals.* Prentice-Hall, Inc., Englewood Cliffs, 1970. pp. xv, 352. £9·25.

This excellent introductory work, the best by far that I have seen in monograph form on this subject, forms part of the *Solid state physical electronics* series. Each form of crystal manufacture is related and illustrated by well-drawn diagrams in the text; there are subject and author indexes in addition to references given at the end of each chapter. M.O'D.

LOBACHEV (A. N.), editor. *Crystallization processes under hydrothermal conditions.* Translated from the Russian. Consultants Bureau, New York, 1973. pp. viii, 255. £17·25.

This work froms part of the series *Studies in Soviet Science.* The experiments described took place in the Hydrothermal Synthesis Laboratory of the Institute

of Crystallography, Academy of Sciences of the USSR. It includes accounts of the synthesis of zincite, the oxides of titanium, sodalite and the lithium silicates. Each chapter includes a bibliography. M.O'D.

MEGAW (Helen D.). *Crystal structures: a working approach.* W. B. Saunders Co., Philadelphia, 1973. pp. xviii, 563. £9·30.

This book forms part of the series *Studies in physics and chemistry* and sets out to cover the crystallographic concepts and to include accounts of representative structures with additional notes on thermal effects, treated from the geometrical rather than the thermodynamic viewpoint. There is a classified bibliography, an authors' index and a formula index as well as a list of references pertaining to each chapter; this is placed at the end, perhaps not the ideal position. Altogether this is a first-class book and is directed at readers with no first-hand knowledge of crystallography but with some general physical background. M.O'D.

SCHOON (Theo). *Jade Country.* Jade Arts, Sydney, 1973. Illustrated in colour. pp. 143. $5·95.

The author has studied Maori art for many years and this book is described as an episode in his life. It is lucidly written, and, for the price, very well illustrated with coloured plates of most types of New Zealand jade. There is an account of the jade trade in Hong Kong, and some of the author's designs are shown. M.O'D.

SMITH (Norman R.). *Users' guide to industrial diamonds.* Hutchinson Benham, London, 1974. pp. 352. £4·50.

Although the greater part of this well-illustrated book deals with the employment of diamond in such works as the construction of grinding tools, borers, glass and stone tools, much of the information is more easily assimilated here than in other larger books; indeed, comparatively little has been brought together in monograph form previously. The chapter on "diamond cut diamond" contains some information on the use of diamond in the watchmaking and jewellery industries. M.O'D.

VILLIARD (Paul). *Gemstones and minerals.* Winchester Press, New York, 1974. pp. xi, 228. Illustrated in black-and-white and in colour. £3·95.

Subtitled a guide for the amateur collector and cutter, this book, which is quite cheaply priced, is quite accurate and useful. The section on the fashioning of gemstones appears to be lucidly written and that on the materials themselves comprehensive. For readers in North America the details of mine availability will prove valuable. M.O'D.

ASSOCIATION NOTICES

MEMBERS' MEETINGS

London

A talk was given at Goldsmiths' Hall on the 9th October, 1974, by Mr B. W. Anderson entitled "Twenty-Five Years". A full report of this talk and the Reunion of Members and Presentation of Awards held on the 25th November, will appear in a future issue of the *Journal*.

Scottish Branch

A lecture entitled "The Uniqueness of Diamond" was given by Mr Henry Whitehead, F.G.A., on the 8th November, 1974, at the Station Hotel, Aberdeen.

Midlands Branch

An all-day gem-testing meeting was held at the Jewellers' School, Birmingham, on the 13th October, 1974.

Nottingham Branch

Mr Robert Webster, F.G.A., gave a "teach-in" dealing with new aspects of gemmology and new testing methods on the 14th October, 1974, at the Trent Polytechnic, Nottingham. Among other topics he covered new types of doublets, synthetic opals, ultra-violet screening, testing for the organics, and the Tisdall method of direct R.I. measurement.

A meeting was also held at the Trent Polytechnic on the 11th November, 1974, when Mr Eric Bruton, F.G.A., gave an illustrated talk on his visit to South Africa.

ACTIVITIES BY FELLOWS

Mr Herbert Tillander, F.G.A., (Tully medallist 1935) was admitted as an Associate of the Worshipful Company of Goldsmiths in London on the 2nd October, 1974.

Mr Michael O'Donoghue, M.A., F.G.A., gave a talk at the Imperial College on the 27th November, 1974, entitled "Recent Developments in Synthetic Gemstones", to the British Association for Crystal Growth.

GEMMOLOGICAL ASSOCIATION OF AUSTRALIA

The Annual General Meeting and Gemmological Symposium of the Gemmological Association of Australia is to be held on 18th-20th April, 1975, at the Australian Mineral Foundation, Adelaide, South Australia. Symposium theme —non-destructive analysis methods and the occurrence and geology of opal.

All members and interested visitors are welcome. Programme: Federal Publicity, G.A.A., Box 1532, G.P.O. Sydney 2001, N.S.W., Australia.

GEM DIAMOND EXAMINATION

Forty-one candidates entered for the Association's 1974 Gem Diamond Examination, of whom thirty-six qualified, one with distinction. The following is a list of successful candidates, arranged alphabetically.

QUALIFIED WITH DISTINCTION

Daly, Patrick Joseph Edward, Chelmsford

QUALIFIED

Andreu Griera, Juan, Barcelona, Spain
Backshall, Henry George Robert, Hainault
Bayarri Bosch, Federico, Barcelona, Spain
Blanco Artiques, Jose Ma., Barcelona, Spain
Bonet Coll, Jose, Barcelona, Spain
Butterworth, Joan Louise, Rochdale
Canals Cadafalch, Ma. Montserrat, Barcelona, Spain
Comely, Christopher Norman, London
Costa Ramon, Maria, Barcelona, Spain
Culi Perarnau, Jose, Barcelona, Spain
Dewhirst, Stephen Clive, Stockport
Doman, Eleanor Margaret, Ilford
Esquerra-Torrescasana Llobet, Jose-eloy, Barcelona, Spain
Esteve Vila, Vicente, Barcelona, Spain
Farreny Riera, Andres, Barcelona, Spain
Frampton, Derek Nigel, Bognor Regis
Frost, Frank Roger, London
Frost, Julia Josephine, Cambridge
Gardner, Wilfred Charles, Reading
Jeffries, Colin Levi, Newport
Juan Prevosti, Leopoldo, Barcelona, Spain
Leek, Janet Sylvia, Alcester
Lopez Perez, Oceano, Barcelona, Spain
Marshall, Terence, Nottingham
Maymo Mas, Jaime, Barcelona, Spain
Mones Mendoza, Luis, Barcelona, Spain
More Andujar, Francisco, Barcelona, Spain
Mozolowski Horczyczak, Barbara, Barcelona, Spain
Poultney, Sidney Augustus, Salisbury, Rhodesia
Salloway, Mary Adene, Lichfield
Scarratt, Kenneth Vincent Granville, Ilford
Solans Huguet, Joaquin, Oviedo, Spain
White, Paul John, Nuneaton
Winter, Colin Howard, Dorking
Yamaguchi, Takashi, London

EXAMINATIONS IN GEMMOLOGY 1974

In the 1974 examinations in gemmology organized by the Gemmological Association of Great Britain, 637 candidates sat for the preliminary examination and 315 for the diploma examination. Centres were again established in many parts of the world.

Upon the recommendation of the examiners the Tully Memorial Medal has been awarded to Helen Muller, M.Sc., Leeds, and the Diploma Rayner Prize to Edith Daras, London.

The Preliminary Rayner Prize has been awarded to Kalevi Roine, Jarvenpaa, Finland.

The following is a list of successful candidates, arranged alphabetically.

DIPLOMA EXAMINATION

TULLY MEMORIAL MEDAL
Muller, Helen, Leeds

DIPLOMA RAYNER PRIZE
Daras, Edith, London

QUALIFIED WITH DISTINCTION

Alvarez Fernandez, Manuel, Grado-Oviedo, Spain
Amoros Angel, Julio, Valencia, Spain
Ballin, Peter Edward, Birmingham
Campon Fernandez, Enrique, Oviedo, Spain
Clewlow, Alan Joseph, London
Daras, Edith, London
Ferrer Arbona, Santiago, Mislata, Valencia, Spain
Garcia Igual, Arturo, Valencia, Spain
Gill, Robert, Boston
Gimenez Torro, Vicente, Valencia, Spain
Goynshor Frederick Jay, Chicago, Ill., U.S.A.
Hahn, Eckhart J., Idar-Oberstein, W. Germany
Haupt, Inge, Idar-Oberstein, W. Germany
Heintzberger, C. P., Bilthoven, Holland
Holt, Paul G., Tuckahoe, N.Y., U.S.A.
Kaku, Baikei, Kobe, Japan
Kammerling, Manfred, Idar-Oberstein, W. Germany
Jose, Latre David, Valencia, Spain
Lopez Van, Ma. Carmen, Valencia, Spain
Maes, Jurgen, Idar-Oberstein, W. Germany
Manser, Jutta Elisabeth, Southampton
Muller, Helen, M.Sc., Leeds
Palomares Carbonell, Remedios, Valencia, Spain
Parkinson, Joanna May, Salisbury, Rhodesia
Sanchez Cabello, Antonio, Valencia, Spain
Sevdermish, Menaham, Tel Aviv, Israel
Smalley, David Francis, Nottingham
Sow, Hock Guan, Selangor, Malaysia
Thomas, Geoffrey Andrew, Hertford
Turner, Michael James, Stockton-on-Tees
Wailes, Rosemary Margaret, Chertsey

Allin, Frederick Garner,
Port Elizabeth, S. Africa
Alvarez Fernandez, Laurentino,
Grado-Oviedo, Spain
Anderson, Susan Margaret,
Salisbury, Rhodesia
Asano, Seigo, Tokyo, Japan
Ayache, Nicholas, Beirut, Lebanon
Barker, Margaret Mary, Southport
Bates, Andrew, Nottingham
Berkowitz, Rosa,
Toronto, Ont., Canada
Birtley, George, Hull
Blasi Casal, Juan, Barcelona, Spain
Booker, Peter Edward,
Melton Mowbray
Bravo Agudelo, Ma. Luisa,
Barcelona, Spain
Buijs, F. J., Schoonhoven, Holland
Canals Cadafalch, Ma. Montserrat,
Barcelona, Spain
Carbonell Alos, Concepcion,
Valencia, Spain
Carlsen, Gunnar J., Jr,
Haugesund, Norway
Chiba, Taigen, Tokyo, Japan
Clark, Stuart Duncan, Sale
Clayton, Rosamund Susan,
Hong Kong
Cooper, Elizabeth Ashley, London
Costa Ramon, Maria,
Barcelona, Spain
Davidner, Gail Ruth, London
Din, Richard Aziz, Edgware
Duyvendyk, Pieke v.,
Krimpen g/d Yssel, Holland
Dwyer-Hickey, Peter Robin, Ilford
Eagleton, David, Sheffield
Engel, Gerhard,
Idar-Oberstein, W. Germany
Fearnside, Gerald Michael,
Sutton Coldfield
Findlay, Kenneth William,
Johannesburg, S. Africa
Fish, Lorraine Alison,
Cape Town, S. Africa
Folch Soler, Mercedes,
Barcelona, Spain
French, Frank Geoffrey, Purley
Galofre Munne, Ma. Rita,
Barcelona, Spain
Gayton, Mildred Prudence,
Southport
Goerlitz, Rolf,
Idar-Oberstein, W. Germany
Gonzalez Gimenez, Anastasio,
Barcelona, Spain
Gonzalez Sanchez, Juan Manuel,
Valencia, Spain
Haefner, Dr Richard,
New Paltz, N.Y., U.S.A.
Handley, Michael, Plumers Plain
Heaviside, Desmond,
Middlesbrough
Hettema, Jan Anton Hyacint Maria,
Silvolde, Holland
Hill, Roger Colin, Whitecraigs
Hofelt, Joris Corneliis,
Utrecht, Holland
Howell, Philip Edward, Worthing
Howell, Timothy Joseph,
Cirencester
Hulse, Kenneth, Sale
Ishikawa, Taeko, London
Jamieson, Vivienne, Shefford
Jayasinhji, Prince of Dhrangadhra,
New Delhi, India
Klar, Michael,
Idar-Oberstein, W. Germany
Koike, Kiyokatsu, London
Laing, Michael Neilson, Troon
Langthon, Kjell-Odvar,
Oslo, Norway
Larah, Howard Anthony,
Manchester
Lewis, Sheila Judith, Kenton
Leyser, Karl-Georg,
Kirschweiler, W. Germany
Lopez Perez, Oceano,
Barcelona, Spain
Lorenz, Dagmar,
Idar-Oberstein, W. Germany

Lyall-Grant, Mary Jennifer, London
MacGregor, Elizabeth Jane, Lourenço Marques, Moçambique
Majo Llopart, Miguel, Barcelona, Spain
Marshall, John Michael, South Bend, Ind., U.S.A.
Martorell Gisbert, Ma. Isabel, Valencia, Spain
Matsumoto, Kikuo, Gunma-Ken, Japan
Maymo Mas, Jaime, Barcelona, Spain
Möller, Gerd, Pirmasens, W. Germany
Montane, Miguel Bard, Andorra La Vieja
Munne Cardona, Ana Ma., Barcelona, Spain
Nelson, Keith Elwin, Arvada, Colo., U.S.A.
Nohara, Koichi, London
Nowak, W., Bexley
Ohhashi, Naoko, Tokyo, Japan
O'Donnell, Ann, Leeds
O'Rourke, Edward Thomas, Brisbane, Queens., Australia
Palmer, Eileen Marion, Liverpool
Palmer, John Redvers, Hitchin
Pearson, Barry Earle, Southport
Piccione, Amedeo, San Remo, Italy
Quitllet Pou, Guillermo, Barcelona, Spain
Richards, Haik, London
Richardson, Paul Leslie, Nottingham
Riche Feliu, Susana, Barcelona, Spain
Rosenberg, Joya, Chevy Chase, Md, U.S.A.
Rovira Rabell, Manuel, Barcelona, Spain
Rowe, Leonard James, Hanworth
Sato, Ikuo, Los Angeles, Cal., U.S.A.
Schwartzman, Sonja S., Bethesda, Md, U.S.A.
Scrymgeour, David John, Newton Abbot
Sluis, Jan, Vlaardingen, Holland
Snyder, Julia Truitt, Philadelphia, Pa, U.S.A.
Stappenbacher, Joseph J., Bamberg, W. Germany
Stevens, Eric Leslie, French's Forest, N.S.W. Australia
Swart, Willem Roux, Stellenbosch, S. Africa
Tasker, Glenn Vincent, Worthing
Tatiwala, Nawal Kishore, Jaipur, India
Thum, Koh Teik, Penang, Malaysia
Tormo Cruanes, Delia, Gandia, Valencia, Spain
Townsend, Michael John, Wakefield
Uden, Penelope Alison, Seaford
Upchurch, David Ward, Colchester
Van Gogh, Mieneke, Epe (Gld.), Holland
Van Thiel, Carolina Josephina Sophia Maria, Helmond, Holland
Villar Lopez, Luis Fernando, La Coruña, Spain
Waterhouse, Philip Arthur, Auckland, N.Z.
Watkins, Sandra, Bouldon
Weeks, Milton D., Annandale, Va, U.S.A.
Wicks, Sylvia Beryl, London
Will, R. A. F., Salisbury, Rhodesia
Woodhouse, Neville, Inkersall
Yabsley, Anthony John, St Sampson's, Guernsey
Yao, Gladys, Hong Kong

PRELIMINARY EXAMINATION

RAYNER PRIZE

Roine, Kalevi, Jarvenpaa, Finland

QUALIFIED

Agee, Carl Bernard, Rotterdam, Holland
Ahmad, Masud, London
Aklin-Zieseniss, Maria-Luisa, Zurich, Switzerland
Allen, David, Blachly, Oreg., U.S.A.
Amerasinghe, Amarsinghe Gamaethige Bodhipala, Colombo, Sri Lanka
Angell, John V., Dover
Arquer Pocell, Pedro, Barcelona, Spain
Asano, Seigo, Tokyo, Japan
Atapattu, Savinda Buweneka, Colombo, Sri Lanka
Baird, Ian Newton, Glasgow
Baker, Brian Dennis, Birmingham
Ballin, Juliet, Birmingham
Barbier, Michel, Lucerne, Switzerland
Bartoli, Anne Marie, Gex, France
Bates, Adrian John, Birmingham
Beale, Arthur Malcolm, Southampton
Beck Kaiser, Margit, Barcelona, Spain
Benito Lizarralde, Eduardo, Barcelona, Spain
Benjamin, John Circus, Wembley Park
Berkowitz, Roza, Toronto, Canada
Besse Desbiolles, Françoise, Geneva, Switzerland
Bettis, Amanda E., London
Beya Colomer, Ma Antonia, Barcelona, Spain
Bickers, O. Martin, Welling
Blampied, Richard Eric, St Helier, Jersey
Bloom, André David, Streetly
Bolli, Bruno, St Gallen, Switzerland
Bootz-Verbunt, G. H. H., Hilversum, Holland
Bosch Senao, Fco. Javier, Barcelona, Spain
Brauns, Sandra M., Hong Kong
Brewer, Peter Charles, Scarborough
Bristol, Anthony Paul, Aberdeen
Brown, Grahame, Brisbane, Queens., Australia
Bryan, John Charles, Kriens, Switzerland
Buhler, Stefan Sugar, Geneva, Switzerland
Burr, Kevin F., Leatherhead
Caffoor, Ali Allapitchai, Yundum, The Gambia
Camble, Elaine, Petts Wood
Canet Vez, Ma Lourdes, Barcelona, Spain
Capell, Elaine, Port Elizabeth, South Africa
Carey, David Alan, Haxby
Carnaghan, John, Purley
Carrera Poblet, Jaime, Barcelona, Spain
Cartwright, Donald Roy, Little Bookham
Castle, Graeme Robert William, Timaru, New Zealand
Chandrasena, Kaluthantrige Nimal Ravindra, Panadura, Sri Lanka
Charron, Joseph Francis Anthony, Toronto, Ont., Canada
Chiba, Taigen, Tokyo, Japan
Choi, Kim Chow Peter, Hong Kong
Cidoncha Castellote, Christine, Valencia, Spain
Cidoncha Castellote, Reyes, Valencia, Spain
Cidoncha Garcia, Miguel Angel, Valencia, Spain

Clapperton, Elizabeth Morag, Aberdeen
Clewlow, Alan Joseph, London
Cohen, Michael John, Stanmore
Collie, Ann Elizabeth, Cape Town, S. Africa
Connolly, T. J., London
Contretas Ros, Manuel, Barcelona, Spain
Cook, Judith Anne, Northwood
Cookson, Margaret Gillian, London
Cooper, Roy, Disley
Cooper, Sean, Disley
Cornelius, Richard Alan, London
Cornford, Carol Rae, Crowborough
Cornford, Richard, Crowborough
Cottrill, Robin Stephen, Cheadle
Crossland, Julie Hall, Horbury
Danianaryana, Malinie, Colombo, Sri Lanka
Daras, Edith, London
Dash, Anthony Lanyon, Manchester
Dave, Mayur, London
Davey, J. W., Hartlepool
Davidson, Geraldine Ann, Skene
De Gier, Johannes-Willem, Krimpen a/d Lek, Holland
De Hey, W. C. M., Schoonhoven, Holland
De Silva, Lindamulage Mohan Lal, Nawala, Sri Lanka
De Silva, Noeline, Colombo, Sri Lanka
Dharmage, Irandathi, Matugama, Sri Lanka
Dharmage, Prasad Manabharana, Matugama, Sri Lanka
Dissanayake, Jayasinghe Munandiram Ernest, Hounslow West
Domaas, Odin, Trondheim, Norway
Domenech Casellas, Ma Victoria, Oviedo, Spain
Dorrepaal, Carla Vvonne, Gouda, Holland
Douglass, James, Stockton
Dowling, W. A., Liverpool
Duckworth, Andrew Sinclair, Bolton
Duyvendyk, Pieke v., Krimpen g/d Yssel, Holland
Edwards, Randall, London
Edmonds, W. P., Salisbury, Rhodesia
Eklad, Henry, Joensuu, Finland
Engel, Corinne Frances, London
Engel, Gerhard, Idar-Oberstein, W. Germany
Erling, Patricia Britt, Helsinki, Finland
Evans, Martine Jayne, London
Fabregas Guardiola, Virginia, Barcelona, Spain
Fernando, Unagamdadige Findlay Collin Sinclair, Panadura, Sri Lanka
Finlayson, James Cameron, Stevenage
Fisher, Peter Norman, London
Forshaw, Edward David John, Newcastle-upon-Tyne
Forsyth, James Perry, Norfolk, Va., U.S.A.
Franco Aradas, Jose Manuel, Bilbao, Spain
Fransz, Frederique, Arnham, Holland
Franz, Rudolf Siegmar, Paarl, S. Africa
Freeman, Michael John, Enfield
Freijser-Ligthart, Maria Wilhelmina, Voorburg, Holland
Fritzsh, Anja, Helsinki, Finland
Frowein, Carl Richard, Stellenbosch, S. Africa
Fujihara, Shigeru, Yamanashi-Ken, Japan
Fujimoto, Naomi, Osaka, Japan
Gabrielle, L. T. M., West Hill, Ont., Canada
Galotta, Ted, Niagara Falls, Ont., Canada
Garcia Abril, Ana Ma, Valencia, Spain

Giercke, Nicolaus, London
Goerlitz, Rolf,
Idar-Oberstein, W. Germany
Goldberg, Richard,
Canberra, Australia
Gomez Perez, Pilar, Valencia, Spain
Graham, Anthony Francis,
Salisbury, Rhodesia
Grant, Malcolm John
Fordingbridge
Griffiths, Cedric Mills,
Rowlands Gill
Haefner, Dr Richard,
New Paltz, N.Y., U.S.A.
Hahn, Eckhart J.,
Idar-Oberstein, W. Germany
Hakulinen, Maija, Helsinki, Finland
Hammett, Roger Stewart, Southall
Haupt, Inge,
Idar-Oberstein, W. Germany
Hebbard, Christopher Roy,
Fareham
Heckman, Hayo Willem,
The Hague, Holland
Hegarty, T. M., Leatherhead
Hemachandra, Vidyapathi
Indraratne Wijesurendra,
Colombo, Sri Lanka
Hendrickson, James Edward,
Los Altos, Cal., U.S.A.
Heuser, Max, Hilversum, Holland
Hewitt, Leonard Eric, Lincoln
Hidellarachchi, Sujatha,
Pannipittya, Sri Lanka
Holness, Malcolm Henry, Effingham
Holt, Paul G.,
Tuckahoe, N.Y., U.S.A.
Honeker, Vera Mary, Esher
Hopkins, Gwyneth Margaret,
Salford
Horder, Heather Aileen, Windsor
Horn, David Ernest, Ripon
Houghton, John Anthony,
New Malden
Hughes, Charles James,
St. John's, Newfoundland
Hulse, Kenneth, Sale
Hummel, Frank August,
Weiser, Ida., U.S.A.
Hutchinson, Janice, Plymouth
Imai, Takayasu, London
Ishikawa, Koki, Tokyo, Japan
Iwahori, Mitsuo, London
Jaatinen, Markku,
Myyrmaki, Finland
Jackson, Marilyn E.,
Willowdale, Ont., Canada
James, Alan Roy, Walsall
Javeri, Kishan, Kobe, Japan
Jefferson, Barbara Janet, London
Jhaveri, Ravindra J., Bombay, India
Jones, Alison, Woking
Jousmaa, Toivo Juhani (Jussi),
Lahti, Finland
Jubany Socas, Jose Ma.,
Barcelona, Spain
Jucker, Ronald Werner,
Salisbury, Rhodesia
Kaduruwewa, I. M. P. B.,
Panadura, Sri Lanka
Kaku, Eishu, Kobe, Japan
Kallioniemi, Seppo, Helsinki, Finland
Kammerling, Manfred,
Idar-Oberstein, W. Germany
Kanai, Seiji,
Yokohama-City, Japan
Karasik, Morris,
Downsview, Ont., Canada
Karna, Outi, Oulu, Finland
Keckman, Markku Tapio,
Helsinki, Finland
Keeley, Helen Christine Maud,
London
Kelso, Roger Joseph,
Christchurch, N.Z.
Kitano, Keiko,
Yokohama-City, Japan
Kitch, Stephen Charles, Nottingham
Kitcher, John, Burford
Kitson, Malcolm, Rustington
Kiviluoto, Pekka, Helsinki, Finland
Kiviluoto, Raija, Helsinki, Finland
Klar, Michael,
Idar-Oberstein, W. Germany

Kleinendorst, Trudy, Edinburgh
Kojima, Mieko,
Yokohama-City, Japan
Kortelainen, Sirpa, Helsinki, Finland
Kortman, Caj, Helsinki, Finland
Koskipirtti, Eila Marjaana,
Helsinki, Finland
Krasner, Harold,
Johannesburg, S. Africa
Kulatileke, Semage Arnold Allen,
Rathmalana, Sri Lanka
Laguarda Mestres, Joaquin,
Barcelona, Spain
Laine, Simo E. W., Helsinki, Finland
Laurila, Riitta Marketta,
Hyvaneula, Finland
Law, Peter, Sheffield
Lawson, Wendy Angela,
Nottingham
Lee, Po Chu Helen, Hong Kong
Leewis, P. E.,
Schoonhoven, Holland
Legg, Veronica, Hong Kong
Leow, Yong-Siew, Singapore
Leslie, Elisabeth, Hong Kong
Lewis, Ian Rhys Morien, Sheffield
Lewis, Leonard Roy, Bristol
Leyser, Gerarda Sebilla,
Arnhem, Holland
Leyser, Karl-Georg,
Kirschweiter, W. Germany
Li, Sheung Shun, Hong Kong
Lincoln, Anthony David,
Waltham Abbey
Lintott, Diana Cherrill, Aberdeen
Lintunen, Viktor,
Kuusankoski, Finland
Lipscomb, Edward Martin, London
Lo, Wing Yat Sunny, Hong Kong
Logsdon, Maxon Andrew,
Wethersfield, Conn., U.S.A.
Lopez Hijos, Ma Carmen,
Barcelona, Spain
Lorenz, Dagmar,
Idar-Oberstein, W. Germany
Lyall, Angus C., Dundee
McCartney, Robert Martin,
Atlanta, Ga, U.S.A.
McGill, Fiona Macleod, Edinburgh
McIlroy, Isabella McCallum,
Romford
McKell, Letitia, Glasgow
Maeda, Kikuko, Tokyo, Japan
Maes, Jurgen,
Idar-Oberstein, W. Germany
Mahendrarajah, Maureen,
Colombo, Sri Lanka
Mahuroof, Fahmi Noor, London
Malamed, M. R.,
Cape Town, S. Africa
Manzke, Lothar, Geneva, Switzerland
Marsal Astort, Montserrat,
Barcelona, Spain
Marshall, John Michael,
South Bend, Ind., U.S.A.
Marttila, Anne-Maija,
Angelniemi, Finland
Matthesius, Johannes Gerardus,
Amstelveen, Holland
Matthews, Bernard Roy,
West Wickham
Maurer, Robert John, Brentwood
Mayer, Marianne,
Vaud, Switzerland
Mayor Giner, Juan Enrique,
Vinaroz-Castellon, Spain
Meintjes, Arthur Harry,
Stellenbosch, S. Africa
Merriman, Timothy, Northampton
Merritt, Joan, Richmond
Miles, Christopher Robert, Poole
Miller, Charles Robert,
Southfield, Mich., U.S.A.
Miller, Wilda H., Hong Kong
Mingo, Jose-Marie,
Geneva, Switzerland
Möller, Gerd,
Pirmasens, W. Germany
Mones Mendoza, Jose,
Barcelona, Spain
Mora Roses, Eduardo,
Valencia, Spain
Morrill, Christine, Witherley
Moule, Alexander John,
Brisbane, Queens., Australia

Mtuye, Riessen Saliel,
Moshi, Tanzania
Muchmore, Leslie Robert, Liskeard
Muris, Simon Christopher, London
Mustonen, Rauni,
Raanujarvi, Finland
Navaratne, Kiriporunage Gamini,
Colombo, Sri Lanka
Need, Mary, Lelant Downs
Noble, Patrick, Heckmondwike
Nogradi, Maria Irene, Deeside
Nohara, Koichi, London
O'Clee, Caroline Harriet, Hythe
O'Connell, William,
Waterford, Ireland
Ohhashi, Naoko, Tokyo, Japan
Ohhashi, Yasuhiro, Tokyo, Japan
Okuzumi, Hiromi, Tokyo, Japan
O'Mer, Robin, London
O'Rourke, Edward Thomas,
Brisbane, Queens., Australia
Padro Olano, Ma Pilar,
Barcelona, Spain
Padro Tortajada, Angeles,
Barcelona, Spain
Pandithakoralege, Don Reginald
Melvyn, Nugegoda, Sri Lanka
Pang, Kin Kee, Hong Kong
Parker, Raymond John, Worthing
Patni, Arun, London
Paul, Anne C., Hong Kong
Peck, Christopher A., Nottingham
Perera, Sita Angeline, Napier, N.Z.
Periera, Edwin Albert,
Bangkok, Thailand
Petch, Annette, Sheffield
Petersen, Graeme Edward,
Lower Hutt, N.Z.
Pethe, Dilip Madhav,
Bombay, India
Phillipson, Erica, Boxmoor
Piech, Olwen, London
Pieris, Anomasita,
Colombo, Sri Lanka
Pietilainen, Juhani, Helsinki, Finland
Pla Corominas, Francisca,
Barcelona, Spain
Platt, Beryl, Ellon
Pons Gomez, Joaquin,
Barcelona, Spain
Pountney, Iris, Shipley
Pratt, John Charles,
Toronto, Ont., Canada
Price, Grenville James, Arnold
Prior, Alan Frederick, Camberley
Race, William Philip, Pontypridd
Ramsay, Donald Ian, Eastbourne
Rappitt, Toby James, Maidenhead
Read, Peter George, Northwood
Recatala Bensach, Jose Ma,
Valencia, Spain
Rider, Stephen George, Strood
Risku, Helena Kristina,
Vaasa, Finland
Roca, Juan Servent,
Andorra La Vieja
Rodriguez Clemente, Rafael,
Barcelona, Spain
Roine, Kalevi, Jarvenpaa, Finland
Rosenberg, Joya,
Chevy Chase, Md, U.S.A.
Rossetti, Luigi,
Idar-Oberstein, W. Germany
Rossi, Eila Marita,
Rautalampi, Finland
Round, Anthony William Reginald,
Epsom
Rowe, Elaine, Greensforge
Rowe, Kathleen Eccleston, Torquay
Rushton, Margrit Florence Gerda,
Bath
Sanchez Garcia, Paloma,
Valencia, Spain
Sandberg, Dag, Kjeller, Norway
Sansone, Richard,
Johannesburg, S. Africa
Santamaria Sanchez, Vicente,
Seo De Urgel, Lerida, Spain
Sato, Ikuo, Los Angeles, Cal., U.S.A.
Scavia, Fulvio M., Milan, Italy
Schatzman, Edward Earl,
Columbus, Ohio, U.S.A.
Senanayake, N. R.,
Homagama, Sri Lanka
Seneviratne, Panagoda Liyanage I.
Chitragani, Panadura, Sri Lanka

Sevdermish, Menaham,
Tel Aviv, Israel
Shida, Junko,
Kanagawa Pref., Japan
Shrimal, Kanak, Jaipur, India
Simonin, Daniel,
St Gallen, Switzerland
Sinclair, Ian, Workington
Skelton, Brian, Newton Abbot
Smalley, David Francis,
Nottingham
Smit, Neil Conrad,
Pietersburg, S. Africa
Smosna, Edward J.,
Mundelein, Ill., U.S.A.
Snyder, Julia Truitt,
Philadelphia, Pa., U.S.A.
Soons, J. H. A. M.,
Utrecht, Holland
Sow, Hock Guan,
Selangor, Malaysia
Speekenbrink, Wilhelmus A. M.,
Schoonhoven, Holland
Stanislaus, Savermuttu Joseph Louis,
Colombo, Sri Lanka
Stappenbacher, Joseph J.,
Bamberg, W. Germany
Stears, Trevor William, Bromley
Stephen, Mary Jean, Kintore
Stevens, Marjolein,
Teteringen, Holland
Stevenson, Robert K.,
Ocean City, Md, U.S.A.
Stewart, James W.,
Rio de Janeiro, Brazil
Stolvoort, J. M. L. A. L.,
Schoonhoven, Holland
Strachan, Anne, Hong Kong
Subasinghe, Subasinghe Arachuge
Malkanthi, Ratmalana, Sri Lanka
Sum, Ho Kwok, Tokyo, Japan
Sutherland, Shirley Margaret,
Johannesburg, S. Africa
Swart, Willem Roux,
Stellenbosch, S. Africa
Sweeting, Penny, London
Sze, Richard Yeong Miin,
Taipei, Taiwan
Taank, A. P., Hounslow
Tabiner, Paul, Northampton
Tagarro Tagarro, Amaro,
Barcelona, Spain
Tarazona Almenar, Federico,
Valencia, Spain
Tarkiainen, Kari Juhani,
Helsinki, Finland
Tatiwala, Nawal Kishore,
Jaipur, India
Tenkate, Iris, Schoonhoven, Holland
Thomas, Elizabeth Lynda Watson,
Salisbury, Rhodesia
Thomas, Richard, Swansea
Thompson, Aileen, Birkenhead
Tillander, Paula,
Helsinki, Finland
Timonen, Esko Tapio,
Keslahti, Finland
Tolmie, Andrea Joan, Birmingham
Tolmie, Nigel Lester, Birmingham
Tomita, Koichi, Tokyo, Japan
Tschudin, Françoise Fernande,
Lausanne, Switzerland
Turner, Michael James,
Stockton-on-Tees
Turner, Nigel Davenport, London
Uusi-Hallila, Irma Heleena,
Ylivieska, Finland
Vaid, Arvindkumar Harakhchand,
Edgware
Vainikainen, Tuomo Kalevi,
Raikku, Finland
Vainio, Erkki, Helsinki, Finland
Vaissi, Vesa Pekka, Lahti, Finland
Van, Ann-Catrin, Hong Kong
Van Baal, Ted, Nymegen, Holland
Van Der Meer, B.,
Schiedam-Zuid, Holland
Van Der Zwaan, Jan-Willem,
Breda, Holland
Varjonen, Pekka, Turku, Finland
Vidler, Kenneth R.,
Windsor, Ont., Canada
Viitasalo, Pirkko Tuulikki,
Lahti, Finland
Virtanen, Anne, Helsinki, Finland

Vleeschhouwer, Willy Alida, Schoonhoven, Holland
Vuorijarvi, Terhikki, Helsinki, Finland
Walker, Graham, Liverpool
Wang, Liu Mei, Kobe, Japan
Wang, Raymond Sheng-Wu, Hong Kong
Warr, David Arthur, Gloucester
Warren, Michael Oliver, Hayes
Wavish, Constance Elizabeth, Hong Kong
Wennell, Susan Dorothy, Stockport
Westerback, Ralf, Helsinki, Finland
White, Ann Stephanie, Torquay
White, John, Nottingham
Whitty, Anthony Michael, Westcliff-on-Sea
Williams, Dr Jack Daniel, Philadelphia, Pa., U.S.A.
Wisdom, Terence Roy, Gt. Kingshill
Wong, Leung Kim Po Joanna, Hong Kong
Woods, Kevin John, Idar-Oberstein, W. Germany
Wratton, Lynnette Kathryn, Bexhill-on-Sea
Yano, Kiyoko, Kobe, Japan
Yoda, Mitsuhiro, Tokyo, Japan
Young, Martin James Paul, Aberdeen
Zeegers, Franciscus Bernardus Maria, Wassenaar, Holland

COUNCIL MEETING

At a meeting of the Council of the Association held on Wednesday, 9th October, 1974, the following were elected to membership:

FELLOWSHIP

Amor Cubeiro, Carmen, Barcelona, Spain. D. 1973
Andreu Griera, Juan, Barcelona, Spain. D. 1973
Asano, Seigo, Tokyo, Japan. D. 1974
Astrain Calvo, Rafael, San Sebastian, Spain. D. 1972
Barlow, Seaton, Totnes. D. 1968
Birtley, George, Hull. D. 1974
Bonet Coll, Jose, Barcelona, Spain. D. 1973
Buijs, Frans J., Schoonhoven, Holland. D. 1974
Chiba, Taigen, Tokyo, Japan. D. 1974
Clark, Stuart D., Sale. D. 1974
Culi Perarnau, Jose, Barcelona, Spain. D. 1973
Davidner, Gail R., Wembley. D .1974
Dwyer-Hickey, Peter R., Ilford. D. 1974
Farreny Riera, Andres, Barcelona, Spain. D. 1973
Fearnside, Gerald M., Sutton Coldfield. D. 1974
Flo Tomas, Ma. Rosa, Barcelona, Spain. D. 1973
Howell, Philip E., Worthing. D. 1974
Howell, Timothy J., Cirencester. D. 1974
Juan Prevosti, Leopoldo, Barcelona, Spain. D. 1973
Krijger, Bart, Amsterdam, Holland. D. 1973
Lambert, Norman A., London. D. 1953
Littman, Steven D., Curaçao, Netherlands Antilles. D. 1973
Marshall, John M., South Bend, Ind., U.S.A. D. 1974

Möller, Gerd, Pirmasens, W. Germany. D. 1974
Montanes Moreno, Diego, Malaga, Spain. D. 1973
Muller, Helen, Leeds. D. 1974
Richardson, Paul, L., Nottingham. D. 1974
Stevens, Eric L., French's Forest, N.S.W., Australia. D. 1974
Tasker, Glenn V., Worthing. D. 1974
Townsend, Michael J., Wakefield. D. 1974
Valta, Akseli, Helsinki, Finland. D. 1973

Transfers from Ordinary Membership to Fellowship

Ayache, Nicholas, Beirut, Lebanon.
Ballin, Peter E., Birmingham.
Barker, Margaret M., Southport.
Bates, Andrew, Nottingham.
Clayton, Rosamond S., Hong Kong.
Daras, Edith, London.
Findlay, Kenneth W., Johannesburg, S. Africa.
French, Frank G., Purley.
Gayton, Mildred P., Southport.
Gill, Robert, Boston.
Goynshor, Frederick J., Chicago, Ill., U.S.A.
Haefner, Richard, New Paltz, N.Y., U.S.A.
Handley, Michael, Plumers Plain.
Ishikawa, Taeko, London.
Jamieson, Vivienne, Shefford.
Kaku, Baikei, Kobe, Japan.
Koike, Kiyokatsu, London.
Laing, Michael N., Troon.
Lewis, Sheila J., Kenton.
Lorenz, Dagmar, Idar-Oberstein, W. Germany.
Lyall-Grant, Mary J., London.
MacGregor, Elizabeth J., Lourenço Marques, Moçambique.
Nelson, Keith E., Arvada, Colo., U.S.A.
Nohara, Koichi, London.
Nowak, W., Bexley.
O'Donnell, Ann, Leeds.
Ohhashi, Naoko, Tokyo, Japan.
Palmer, Eileen M., Liverpool.
Palmer, John R., Hitchin.
Parkinson, Joanna M., Salisbury, Rhodesia.
Piccione, Amedeo, San Remo, Italy.
Richards, Haik, London.
Rowe, Leonard J., Hanworth.
Schwartzman, Sonja S., Bethesda, Md, U.S.A.
Sevdermish, Menahem, Tel Aviv, Israel.
Sluis, Jan, Vlaardingen, Holland.
Stappenbacher, Joseph J., Bamberg, W. Germany.
Swart, Willem R., Stellenbosch, S. Africa.
Thomas, Geoffrey A., Hertford.
Uden, Penelope A., Seaford.
Upchurch, David W., Colchester.
Wailes, Rosemary M., Chertsey.
Waterhouse, Philip A., Auckland, N.Z.
Watkins, Sandra, Bouldon.
Will, R. A. F., Salisbury, Rhodesia.
Yabsley, Anthony J., St Sampson's, Guernsey.
Yao, Gladys, Hong Kong.

Ordinary

Abe, Nobumasa, Okayama-shi, Japan
Abel, Reginald E., Colombo, Sri Lanka.
Abraham, Gabriel A. R., Colombo, Sri Lanka.
Airey, Michael J., Hong Kong.
Akazawa, Kouichi, Okayama-shi, Japan.
Alden, Jill, Ossining, N.Y., U.S.A.
Alpert, Charles, Green Baoy, Wis., U.S.A.

Amin, Mohammad, Kuala Lumpur, Malaysia.
Anandavadivel, Kumarasamy, Ratmalana, Sri Lanka.
Arnold, Audrey K., Radlett.
Aurora, Mohindar S., Harrow.
Baars, Barnett, London.
Baker, Elaine C., Lihue, Hawaii.
Banfill, Paul D. T., Sutton.
Barclay, William H., Chateauguay, Que., Canada.
Barker, Brian L., Swanage.
Barma, Uaima S., Osaka, Japan.
Barrance, John D., Trowbridge.
Bastiansz, Maxwell A., Colombo, Sri Lanka.
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