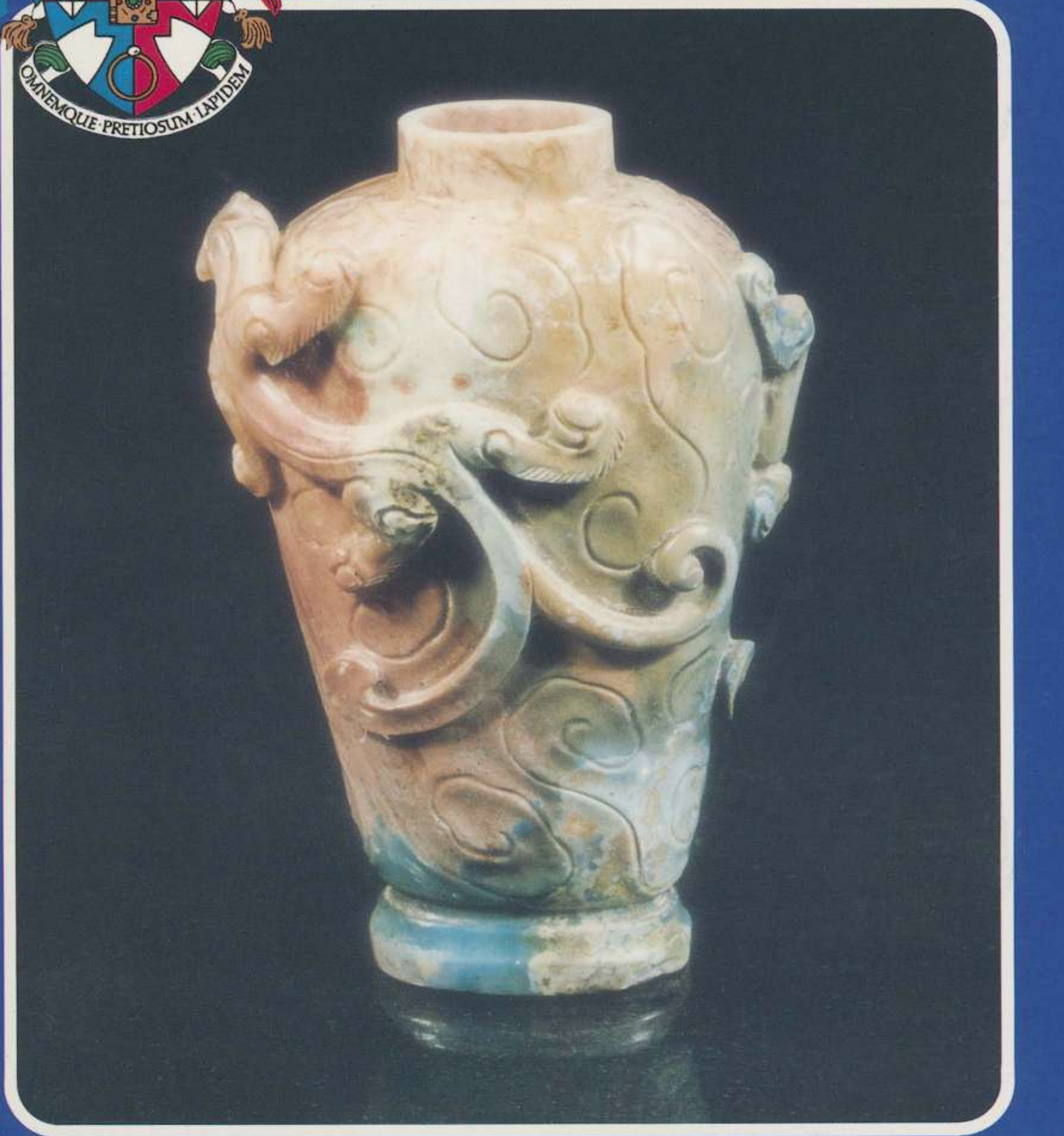
Volume 23 No. 2.

April 1992

The Journal of Gemmology



THE GEMMOLOGICAL ASSOCIATION AND GEM TESTING LABORATORY OF GREAT BRITAIN

The Gemmological Association and Gem Testing Laboratory of Great Britain
27 Greville Street, London ECIN 8SU
Telephone: 071-404 3334 **Fax: 071-404 8843**

The Journal of Gemmology

VOLUME 23

NUMBER TWO APRIL 1992

Cover Picture

The photograph represents a vase carved from nephrite jade during the late Ming period (circa 1580). The original colour of the stone was probably a cream/white with a few veins and mineral inclusions. Unlike jadeite, nephrite will usually sustain heating to considerable temperatures, and many carvings were burnt by accident in fires, and survived the ordeal. The item illustrated is quite striking as it must have been heated in close association with other domestic objects, as metallic oxides from these have coloured some areas of its surface (if the stone is re-polished the surface colour is usually only skin deep). During the 19th century these jades were very popular in China and were manufactured and burnt intentionally in furnaces, to supply the demand for this extraordinary material. The vase stands 8.5cm tall, and varies in thickness from 1.5mm to 2.5mm.

Photograph C.R. Cavey

ISSN: 0022-1252

Vanadian grossular garnet (tsavorite) from Pakistan

Brian Jackson, FGA

National Museums of Scotland, Chambers Street, Edinburgh EH1 1JF

Abstract

Faceted vanadian grossular garnets from Swat, Pakistan make exquisite gems. Though small they have a strong 'emerald green' colour attributed to vanadium. The physical properties and chemistry are similar to vanadian grossular garnets from East Africa: n 1.743, D 3.640; SiO_2 38.17, TiO_2 0.44, Al_2O_3 18.33, Fe_2O_3 0.04, V_2O_3 4.60, MnO 0.29, Cr_2O_3 0.00, MgO 0.10, CaO 36.52, Na_2O 0.00, Total 98.05 (goldmanite 12.83%, grossular 86.08%, others minor). Inclusions include graphite, wollastonite, mica, zircon negative inclusions.

Preamble

Tsavorite is the name given to the green to slightly yellowish-green variety of grossular garnet (Stockton *et al.*, 1985). 'Emerald green' tsavorite, from African sources, have been known since the late 1960's. The cause of colour in these garnets has been variously assigned to chromium and/or vanadium: the colouring agents being locality specific. Green vanadium-rich grossular garnets from Kenya engendered a great deal of interest and much has been written about them. In contrast the vanadian 'emerald' green tsavorites from Pakistan, even though equally attractive, have receive little gemmological attention presumably because they are less abundant and generally smaller.

Anderson (1966) described transparent green grossular sent from Pakistan in the hope that they might be emerald. These, he states, were similar to a specimen he had examined a year before and all specimens showed a chromium absorption spectrum. Tsavorite, from the Swat area of northern Pakistan, has been recorded, though not in detail* (O'Donoghue *pers comm.*).

This study is based on a parcel of 25 cut stones, weighing 2.5ct, from the Swat area.

*Green grossular has been found in graphitic schists in Jambil area of Swat, near Koy in Malakand Agency and near Targhao in Bajaur Agency. The Jambil garnets are of excellent green colour though very small.

Colour and chemistry

The overall colour to the eye is one of rich vivid greens with no apparent yellow component. Even the smallest stones, 0.02ct, display a strong depth of colour.

The analyses presented in Table 1 were carried out on a Microscan V electron probe microanalyser operating at an accelerating potential of 20kV with a probe current of 30 nanoamps. Standards used in calibration were as follows:- wollastonite for silicon and calcium, jadeite for sodium, corundum for aluminium, periclase for magnesium, and rutile for titanium; other elements (vanadium, chromium, manganese and iron) were calibrated against pure metals.

Surprisingly, even given the difficulty in estimating chromium because of VKβ and CrKα overlap, chromium is believed to be absent or in quantities below the resolution of peak overlap. Cr_2O_3 concentration based on the calculated limits of detection has a maximum value of 0.05% though any Cr_2O_3 presence is likely to be even less than this. Studies of the effect of weight %Cr_2O_3 on the % of green coloration trends (Manson *et al.* 1982) indicated that Cr_2O_3, despite two exceptions, in amounts of less than 0.05% contributed to no more than 35% of the green coloration. On the other hand V_2O_3 concentrations above 2% contribute over 80% to the green coloration trend. With V_2O_3 concentrations averaging 4.52% the major, if not sole, influence on colour is therefore clearly vanadium. The fact that no colour change was observed through the Chelsea Colour Filter reinforces this view.

No significant chemical zonation was detected in either sample though the relationship between the proportions of V_2O_3 and Al_2O_3 indicated that vanadium was replacing aluminium in the ideal grossular formula $Ca_3Al_2(SiO_4)_3$ giving the general formula $Ca_3(Al,V,Fe)_2(SiO_4)_3$: Table 1.

Physical properties

The optical and specific gravity properties of

 ISSN: 0022-1252

Table 1: Analyses of green vanadian grossular garnets from Swat, Pakistan.

	Sample 1 (1-8)								Sample 2 (9-15)						
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
SiO_2	37.73	38.17	37.96	38.19	38.42	38.00	38.36	38.12	38.22	38.41	37.81	38.42	38.36	38.07	38.21
TiO_2	0.44	0.43	0.44	0.43	0.45	0.47	0.44	0.44	0.43	0.43	0.46	0.46	0.43	0.46	0.44
Al_2O_3	18.33	18.54	18.63	18.44	18.29	18.17	18.81	18.58	18.47	18.71	18.67	18.81	18.19	18.33	18.66
Fe_2O_3	0.04	0.05	0.05	0.05	0.04	0.07	0.03	0.03	0.05	0.04	0.05	0.06	0.05	0.06	0.05
V_2O_3	4.60	4.56	4.53	4.56	4.69	4.93	4.27	4.43	4.60	4.38	4.41	3.87	5.14	4.62	4.27
MnO	0.29	0.29	0.31	0.28	0.29	0.27	0.31	0.32	0.31	0.30	0.29	0.30	0.26	0.30	0.32
Cr_2O_3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MgO	0.10	0.09	0.10	0.09	0.09	0.11	0.10	0.11	0.09	0.10	0.11	0.10	0.10	0.09	0.09
CaO	36.52	36.61	36.56	36.65	36.72	36.66	36.69	36.67	36.28	36.44	36.61	36.83	36.54	36.75	36.71
Na_2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	98.05	98.74	98.58	98.69	98.99	98.68	99.01	98.70	98.45	98.81	98.41	98.85	99.07	98.68	98.75

	(a)	(b)	(c)
SiO_2	38.17	38.70	39.26
TiO_2	0.44	0.25	0.43
Al_2O_3	18.51	20.90	21.28
Fe_2O_3	0.05	*0.05	0.10
V_2O_3	4.52	3.30	1.70
Cr_2O_3	0.00	0.19	0.00
MnO	0.30	0.75	0.74
MgO	0.10	0.50	0.50
CaO	36.62	35.10	36.12
Na_2O	0.00	0.10	0.02
Total	98.71	99.84	100.15
Uvarovite	00.00	00.55	00.00
Andradite	00.13	00.00	00.27
Grossular	86.08	86.31	91.41
Pyrope	00.35	1.82	1.81
Spessartine	00.60	1.55	1.53
Almandine	00.00	00.10	00.00
Goldmanite	12.83	9.68	4.98

(a) Average analysis of tsavorite from Swat Valley, Pakistan

(b) Tsavorite from Lualenyi, Kenya (Gubelin & Wiebel, 1975) (* as FeO)

(c) Average analysis of tsavorite from Lualenyi (Taita Taveta locality) (Key & Hill, 1989)

Uvarovite to Goldmanite: % molecular end members

Table 2

	n	D	n (calc)	D (calc)
Grossular	-----	-----	1.734	3.594
Goldmanite	-----	-----	1.832	3.765
Tsavorite (Swat Valley)	1.743	3.640	1.735	3.62
Tsavorite (Lualenyi)	1.743	3.610		

grossular vary considerably as the non grossular components, particularly andradite, increase. The above analyses (Table 1) indicate that the tsavorite from Swat Valley has a high goldmanite ($Ca_3V_2(SiO_4)_3$) component. Table 2 presents the calculated values of refractive index and specific gravity for end member grossular (Deer *et al.*,1982) and goldmanite (Strens,R.G.J., 1965) together with the observed and calculated mean values for Swat Valley and observed values for Lualenyi, Kenya (O'Donoghue, M.,1988) tsavorite.

Absorption spectrum

The absorption spectra of tsavorites vary with the colouring agent. Those tsavorites coloured by chromium can show a doublet at 697mn with weaker lines at 660nm and 630nm and diffuse bands near 605nm and 505nm: these are often difficult to observe.

Vanadian tsavorites on the other hand rarely show anything other than general absorption of the far blue and violet beginning at about 460nm. In addition to this some very faint diffuse absorption of the red/orange and yellow was observed in the Swat Valley material.

Inclusions

Most stones show fracturing to varying degrees some of which has been partially healed or filled with secondary iron staining. There are occasionally very small platy, irregular to crudely hexagonal, negative gas filled inclusions. These, along with tiny droplets which often show necking down features, are characteristically arranged in wispy veils. There are also a considerable number of very small mineral particles included in most stones; those anisotropic crystallites with high relief and surrounded by tension haloes are thought to be zircons, the remainder, as yet unidentified, often forming dark spotted wispy trails. The latter may be due to small negative inclusions, the walls of which have been coated with secondary material. Slightly rounded hexagonal platy inclusions of, presumably, graphite are common. These occur as black opaque crystals and aggregated crystal masses and tend to occur in swathes with a high degree of preferential alignment though isolated crystals are not uncommon (Figure 1). Minor leaching of the graphite and subsequent replacement with secondary iron oxides gives rise to brown and reddish-brown rounded hexagonal patches.

Hexagonal and rectangular columnar inclusions with low relief and no evidence of extinction are thought to be negative crystals formed by the leaching of the original material and subsequent coating of the cavity walls with secondary staining (Figure 2). These are similar to the so called corrosion tubes found in East African green vanadian

Fig.1 Aligned rounded plates of graphite with iron staining and minor mica.

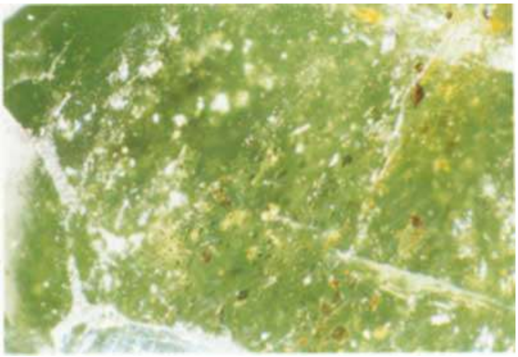
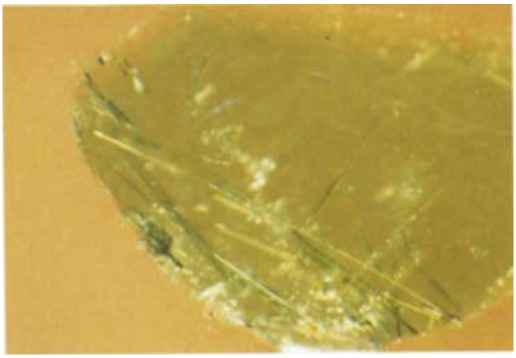


Fig.2 Elongated negative inclusions (gemstone is immersed in di-iodomethane)



grossular garnets. Occasionally small thin plates of mica are seen. During microprobe analysis an inclusion was encountered that gave the following analysis (Table 3).

Table 3: Microprobe analysis of an inclusion in vanadian grossular garnet from Swat, Pakistan, compared with wollastonite polymorphs.

	mineral inclusion	wollastonite -1T	-7T	-2M
SiO_2	51.46	50.57	51.73	50.42
TiO_2	00.00	00.16	00.00	00.01
Al_2O_3	00.08	00.33	00.00	00.00
Fe_2O_3	00.00	03.09	00.00	00.00
V_2O_3	00.00	00.00	00.00	00.00
Cr_2O_3	00.00	00.00	00.00	00.00
MnO	00.10	01.94	00.00	00.16
MgO	00.06	00.42	00.00	00.02
CaO	48.27	43.65	48.30	48.65
Na_2O	00.00	00.14	00.00	00.01
Total	99.97	100.25	100.03	99.29

On the basis of the analysis and a subsequent match using Minident-PC (A computer program for mineral identification) the inclusion is thought to be one of the wollastonite polymorphs.

The inclusions in tsavorite from Swat Valley are very similar to the inclusions seen in tsavorite from East Africa. This reflects the comparable geological environment in which they occur: graphitic gneiss in East Africa and graphitic schist in Pakistan.

Summary

Faceted vanadian grossular garnets from Pakistan make exquisite gems. Though small they have a strong 'emerald green' colour attributed to the high vanadium content (4.60%). The properties and inclusions are similar to vanadian grossular garnets from East Africa.

Acknowledgements

I am most grateful to P.G. Hill, Geology Dept., Edinburgh University, for undertaking the microprobe analyses.

References

Anderson, B. W., 1966. Transparent green grossular - a new gem variety; together with observations on translucent grossular and idocrase. *Journal of Gemmology*, X, 4, 113-9

Deer, W. A., Howie, R. A., Zussman, J., 1982. *Rock-forming Minerals*. - 2nd ed., Vol. 1A: Orthosilicates. Longman Group Ltd, England.

Gubelin, E. J., Weibel, M., 1975. Green vanadium grossular garnet from Lualenyi, near Voi, Kenya. *Lapidary Journal*, May. **29**, 2, 402-26.

Key, R. M., Hill, P. G., 1989. Further evidence for the controls on the growth of vanadium grossular garnets in Kenya. *Journal of Gemmology*, **XXI**, 7, 412-22.

Manson, D. V., Stockton, C. M., 1982. Gem -quality grossular garnets. *Gems and Gemology*, **XVIII**, Winter, 204-13.

O'Donoghue, M.,1988. Gemstones. Chapman and Hall, London, England.

Stockton, C. M., Manson, D. V., 1985. A proposed new classification for gem quality garnets. *Gems and Gemology*, **XXI**, Winter, 205-18.

Strens, R. G. J., 1965. Synthesis and properties of calcium vanadium garnet (goldmanite). *Amer. Mineral.* **50**, 260.

[*Manuscript received 3 October 1991.*]

An examination of 'Aqua Aura' enhanced fashioned gems

Robert C. Kammerling and John I. Koivula

Gemological Institute of America, Santa Monica, California 90404, USA

Fig. 1. Two faceted rock crystal quartz gems prior to treatment by the 'Aqua Aura' process. *Photo by Robert Weldon, Gemological Institute of America.*

Fig. 2. These four faceted gems have all been treated by the 'Aqua Aura' process. The two in the centre are quartz, shown in their pre-treatment state in Figure 1; the two outer specimens are topaz. *Photo by Robert Weldon, Gemological Institute of America.*

Abstract

This article reports on the background and gemmological properties of faceted quartz and topaz gems enhanced by the 'Aqua Aura' process. This treatment involves the deposition of a fine surface layer of gold on the fashioned stones.

Introduction

The authors have reported previously in the gemmological literature on 'Aqua Aura' quartz, single crystals and crystal clusters of colourless quartz which had a thin film of gold applied to their external, natural surfaces. These treated specimens displayed both the blue to greenish-blue transmission colour of the gold as well as a thin-film, superficial iridescence (Koivula and Kammerling, 1988; Kammerling and Koivula, 1989).

Subsequent to the publication of those reports, the authors contacted the vendor, Mr Bob Jackson

ISSN: 0022-1252

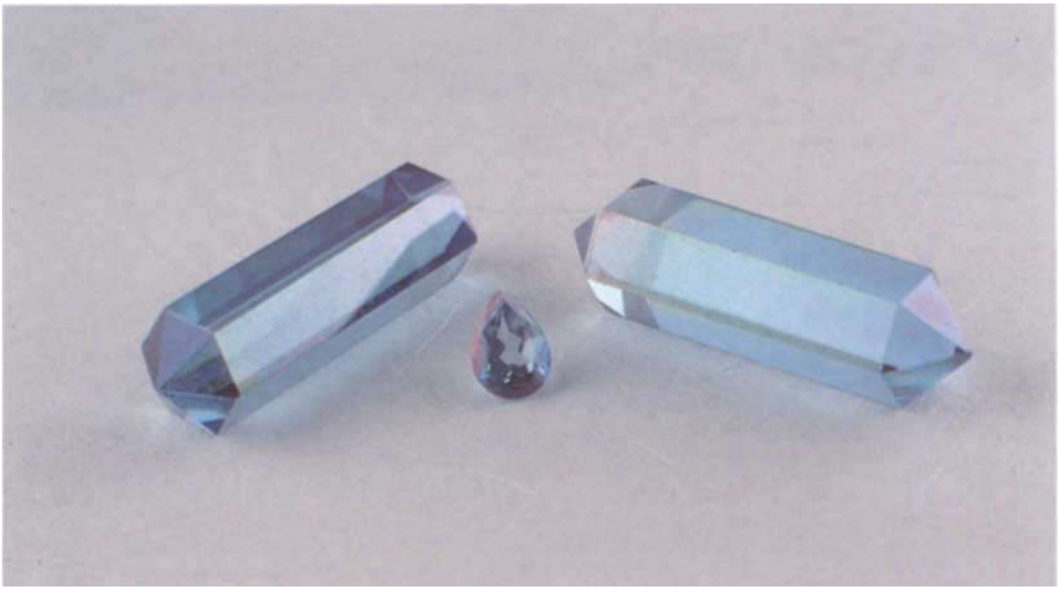


Fig. 3. The two faceted 'prisms' and pear-shape brilliant are all quartz gems treated by the 'Aqua Aura' process. *Photo by Maha Smith, Gemological Institute of America.*

of Renton, Washington, who agreed to attempt treatment of some faceted stones for us on an experimental basis. Submitted for this purpose were two each colourless quartz (Figure 1), beryl, synthetic cubic zirconia and topaz. Mr Jackson later returned the successfully treated faceted quartz gems which had taken the treatment (Figure 2); also returned were the unsuccessfully treated cubic zirconia and topaz, plus fragments of the beryls. According to Mr Jackson, at that time only the quartz gems had taken the treatment and the beryls had 'exploded' (the latter, we surmise, may have been due to fluid inclusions which ruptured during treatment). Mr Jackson indicated, however, that these were some of the first faceted stones they had attempted to have treated with this process (B. Jackson, pers. comm.). Thus, successful treatment of gems other than quartz was not ruled out.

In the spring of 1989 a report in a US lapidary hobbyist magazine shed further light on this enhancement method (Hadley, 1989a). According to the report, the process was developed by Messrs. Bill McKnight and Tom Stecher of Vision Industries, Lynnwood, Washington. A second report appearing four months later in the same publication indicated that faceted gems were also being treated (Hadley, 1989b).

This treating of faceted stones is now taking place on a commercial basis. In the autumn of 1989 we obtained two fashioned pieces at a gem show in Santa Monica from International Crystal

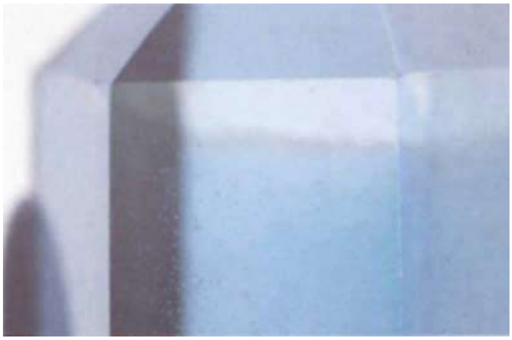


Fig. 4. Note the large colourless area on this treated quartz gem where there is no surface treatment Magnified 4x. Diffused transmitted light. *Photomicrograph by John I. Koivula, Gemological Institute of America.*

Fig. 5. The apparent body colour and superficial iridescence are both noticeable in these three faceted 'Aqua Aura'-treated topazes. *Photo by Maha Smith, Gemological Institute of America.*

Company, Inc., of Seattle, Washington. These were quartz that had been fashioned into hexagonal 'prisms' with pyramidal terminations (Figure 3). Then, at a Los Angeles gem show in November 1989 we first saw 'Aqua Aura' treated faceted topaz set in silver pendants. The vendor, TransGem Corporation of West Bend, Wisconsin, was contacted for further information. In response, Mr Johnathan J. Parentice of TransGem informed us that they were soon to begin marketing this material nationwide and that some 10,000 carats were being submitted for enhancement in December. Mr Parentice also kindly provided us with several samples for our examination.

Gemmological Properties

Quartz: The quartz gems examined gemmologically consisted of a 0.70 ct pear-shape brilliant cut supplied by TransGem and the two faceted 'prisms' (16.63 and 18.18 ct) obtained from International Crystal Company (again, see Figure 3).

Topaz: The treated topaz gems examined gemmologically consisted of eleven faceted stones supplied by TransGem. These included two oval brilliants of 2.12 and 2.21 ct and nine pear-shape brilliants ranging from 0.71 to 2.19 ct (again, see Figure 2; also, Figure 5).

Table 1: Gemmological properties of 'Aqua Aura' treated gemstones.

	Quartz	Topaz
Colour	Ranging from medium light to medium dark slightly greenish-blue with weak to strong superficial iridescence. The pear-shape brilliant and smaller of the two 'prisms' appeared quite uniform in colour; the larger 'prism' displayed one large colourless area (Figure 4).	Ranging from medium light to medium dark blue to greenish-blue; in all cases the stones faced up a very uniform colour. They exhibited an overlying weak to moderately strong iridescence that was most noticeable on the larger stones.
Diaphaneity	Transparent	Transparent
Refractive Indices	Readings obtained on the two 'prisms' were somewhat vague at 1.542-1.550 while the pear-shape stone gave similarly somewhat ill-defined readings at 1.543-1.551. Birefringence on all three specimens was 0.008. All readings taken with a Duplex II refractometer and near-sodium equivalent light source.	Alpha = 1.610, +/- 0.001; beta =1.614, - 0.001; gamma= 1.620, - 0.001; birefringence 0.009-0.010 .
Optic Character	All three specimens displayed 'bull's-eye' uniaxial optical interference figures between crossed polaroids and plotted uniaxial positive on the refractometer.	Biaxial optical interference figures were resolved on nine of the eleven stones; all eleven plotted biaxial positive on the refractometer.
Pleochroism	None noted when examined with a calcite dichroscope.	None noted when examined with a calcite dichroscope.

	Quartz	Topaz
Ultraviolet Fluorescence	All three specimens were inert to both long- and short- wave radiation; there was no phosphorescence.	All eleven stones were inert to both long- and short- wave radiation; there was no phosphorescence.
Chelsea Filter Reaction	Inert (appeared brownish-green).	Inert (appeared brownish-green to green).
Absorption Spectra	No distinct features noted when examined with either a Beck prism spectroscope or a DISCAN digital-readout diffraction grating unit.	No distinct features noted when examined with either a prism or diffraction grating unit.
Specific Gravity	All three stones sank very slowly when immersed in a solution of methylene iodide and benzyl benzoate calibrated to S G 2.67. The S G was thus estimated to be approximately 2.70.	The specific gravity was determined on two of the larger stones using the hydrostatic weighing method. This produced values of 3.58 for both stones.

Magnification

Examination using a stereoscopic binocular microscope revealed diagnostic features of the 'Aqua Aura' enhancement of faceted gems. When examined with diffused, direct transmitted light, all of the faceted specimens— both topaz and quartz exhibited one or more of the following features: (1) diffused, dark outlining of some facet junctions (Figure 6); (2) white-appearing facet junctions where either the treatment did not 'take' or where it had been abraded away (Figure 7); (3) a combination of fine white-appearing facet junctions immediately bordered on either side by slightly dark blue outlining; (4) irregular, minute, random white-appearing abrasions on facet junctions and/or surface pits, scratches and areas where the treatment did not take on facet surfaces (Figure 8); (5) irregular blue coloration on some facets and slight iridescence visible even in diffused transmitted light (Figure 9); areas of no colour on some facets (again, see Figure 8). One of the pearshape topazes exhibited an area of exceptionally heavy deposition near its point. When examined in surface-reflected light under magnification, the iridescence became very noticeable on all specimens and the surface irregularities were easy to detect (Figure 10).

Durability

Additional testing was carried out to determine some of the durability characteristics of this surface enhancement. Both quartz and topaz specimens were first exposed to the electrically heated tip of a thermal reaction tester, this produced no noticeable effect on the treatment later even when the tip was a bright reddish orange. Furthermore a number 6 Mohs hardness point failed to scratch an 'Aqua Aura' faceted quartz gem and a number 7 Mohs hardness point similarly had no apparent effect on one of the enhanced topazes. However, subsequent testing with a buffing wheel and jeweller's rouge--the kind of abrasive action a stone might face when prongs are buffed--resulted in the removal of some of the gold coating from stones where they came in contact with the polishing wheel. The fact that normal polishing in the course of jewellery manufacture or repair will remove some of the coating should be taken into consideration by anyone working with 'Aqua Aura'-treated gems. Stone repolishing or recutting also would be expected to remove the treatment layer (Koivula and Kammerling, 1991).

Discussion and Conclusions

The more greenish-blue specimens of 'Aqua Aura' treated quartz or topaz could be visually mistaken for heat-treated zircon, especially those displaying fairly prominent iridescence, as this might at first glance be mistaken for dispersion. Refractive index, birefringence and specific gravity readings, however, would quickly help to identify the gem materials as topaz or quartz respectively.

While there is no natural blue single-crystal quartz with which the 'Aqua Aura' quartz could be confused, it does bear a resemblance to some

Fig. 6. Dark, diffused outlining of facet junctions, as exemplified by this topaz, is a key feature of 'Aqua Aura' treatment of faceted gems. Magnified 6x. Diffused transmitted light. *Photomicrograph by John I. Koivula, Gemological Institute of America.*

Fig. 7. The diagnostic white-appearing facet junctions on this treated topaz represent areas where either the treatment did not 'take' or where it has been abraded away. Magnified 10x. Diffused transmitted light. *Photomicrograph by John I. Koivula, Gemological Institute of America.*

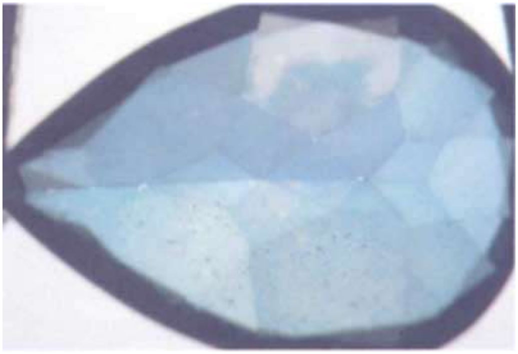


Fig. 8. This 'Aqua Aura' treated topaz exhibits characteristic irregular, minute, random white-appearing abrasions on facet junctions and surface pits and scratches on facet surfaces. Note also the colourless area at the top of the photo. Magnified 4x. Diffused transmitted light. *Photomicrograph by John I. Koivula, Gemological Institute of America.*

Fig. 9. Several of the facets on this treated topaz display irregular blue coloration. Magnified 6x. Diffused transmitted light. *Photomicrograph by John I. Koivula, Gemological Institute of America.*

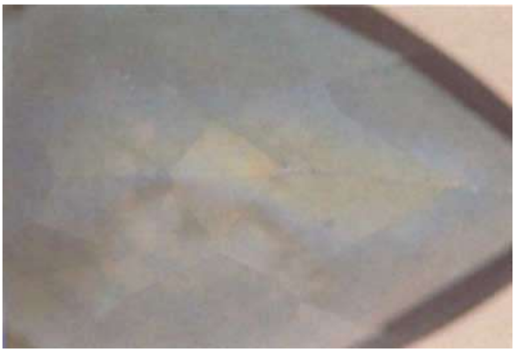
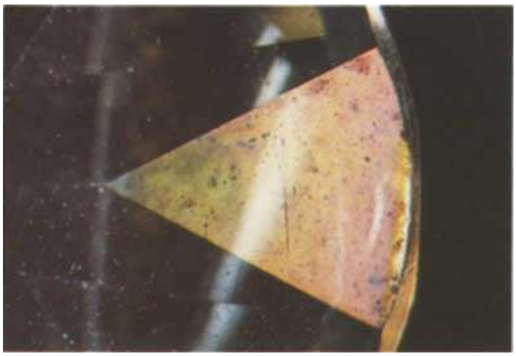


Fig. 10. When examined in surface-reflected light under magnification, the iridescence on this 'Aqua Aura' treated topaz becomes very noticeable and the surface irregularities are easy to detect. Magnified 12x. *Photomicrograph by John I. Koivula, Gemological Institute of America.*



cobalt-doped blue synthetic quartz. In this instance Chelsea filter reaction and absorption spectrum would make the separation, as the synthetic quartz appears pinkish through the filter and exhibits cobalt absorption (Liddicoat, 1989). The 'Aqua Aura' topaz might easily be mistaken initially for the irradiated blue topaz which is so prevalent in today's gem market; Mr Parentice did in fact acknowledge that TransGem's product could be used as an alternative (J. Parentice, pers. comm.). In all cases, however, with both the topaz and quartz gems the superficial iridescence is a strong indicator and magnification would quickly reveal the 'Aqua Aura' treatment. The total absence of pleochroism might also draw suspicion.

One final point worth noting relates to two of the features seen under magnification. It struck the authors that both the dark concentrations of colour along facet junctions and the uneven coloration were similar to features we have noted on blue diffusion-treated sapphires which are being seen with more regularity in the gem trade (Kane *et al.*, 1990).

Acknowledgements

The authors would like to thank Mr Bob Jackson of Renton, Washington, for treating and providing materials; and Mr Johnathan J. Parentice of TransGem Corporation, West Bend, Wisconsin, for providing treated gems and information.

References

Hadley, W., 1989a. 'Aqua Aura': A revolutionary enhancing process turns quartz into a rainbow! *Rock & Gem*, **19**, 5, 48-50.

Hadley, W., 1989b. 'Aqua Aura' Chess Set. *Rock & Gem*, **19**, 9, 68-9.

Kammerling, R.C., Koivula, J.I., 1989. 'Aqua Aura' enhanced quartz specimens. *Journal of Gemmology*, **21**, 6, 364-7 .

Kane, R.E., Kammerling, R.C., Koivula, J.I., Shigley, J.E.,Fritsch, E., 1990. The identification of blue diffusion-treated sapphires. *Gems & Gemology*, **26**, 2, 115-33.

Koivula, J.I., Kammerling, R.C., 1988. Gem News: 'Aqua Aura' quartz. *Gems & Gemology*, **24**, 4, 251.

Koivula, J.I., Kammerling, R.C. 1991. Gem News: Faceted 'Aqua Aura' update. *Gems & Gemology*, **27**, 2, 122.

Liddicoat, R.T., 1989. Handbook of Gem Identification, 12 edn, 2nd revised printing, *Gemological Institute of America*, Santa Monica.

[Manuscript received 8 October 1990]

A Book Anniversary

R. Keith Mitchell, FGA

Orpington, Kent

For gemmologists this is the fiftieth year of one of our best and most enduring textbooks. I refer of course to the late B.W. Anderson's *Gem Testing*, first published by Heywood & Company under the slightly more limiting title *Gem Testing for Jewellers* in 1942.

Anderson had at that time headed the London Chamber of Commerce Pearl and Precious Stone Laboratory for some seventeen years and was the foremost gemmologist in this country and already renowned world-wide. It would have been difficult to find a more suitable author for such a book, or one more capable of conveying his very considerable knowledge in an eminently readable form to the comparatively unscientific reader.

That first modest hard-cover edition ran to 194 pages with 43 illustrations, and retailed for the now astonishingly low price of 7/6 in old coinage, 37.5p today. 2nd and 3rd editions appeared in 1943 and '44 which were in truth simply reprints of the first owing to war-time restrictions on paper and other materials.

1947 saw the re-written 4th edition which ran to 224 pages and 53 illustrations, plus a coloured frontispiece of absorption spectra drawings as seen through a diffraction grating instrument, which had been recommended in the earlier editions, although the text now came down firmly in favour of the Beck 2458 prism instrument.

A 5th edition in 1951 (German version in 1955) was augmented to 246 pages and 62 illustrations, and included synthetic rutile, synthetic star rubies and sapphires and added some 20 of the rarer gems to the appendix list of stones.

The 6th edition (1958) brought in synthetic strontium titanate, new emerald synthetics and a sintered spinel imitation of lapis lazuli. New identification techniques included immersion contrast photography and the crossed filter fluorescence test, both introduced to gemmology by Anderson some years earlier.

Further types of synthetic emerald were included in the 7th edition (1964), and new sources of fine ruby and emerald from African locations were dealt with. The newly discovered radio-active mineral ekanite from Ceylon (Sri Lanka) was included for the first time, while flesh-nucleated fresh-water cultured pearls from Japan, and other non-nucleated ones from the coastal waters of Australia and Burma, were also discussed.

The 8th edition (1971) (French and Italian 1973; Spanish 1977) introduced the 'rare-earth garnets', man-made products of laser research many of which were cuttable as gems; more new synthetic emeralds and new jade-like massive natural garnets and chalcedonies. The most important new gem included in this edition was the violet-blue form of the mineral zoisite which was named tanzanite after its country of origin.

The 9th edition (1980) (Japanese and Russian 1983, Italian 1984) described more innovative gems than any previous edition. These included synthetic turquoise, alexandrites and opals; cubic zirconia, by far the most successful simulant of diamond; Slocum imitation opals; new opal doublets; various synthetics by processes more akin to those of nature; colour improvement by oiling, impregnating, staining and irradiation; fine green grossular garnets; garnets with a colour change; new sources of fine rubies, emeralds and other gems in Africa.

The Dialdex refractometer by Rayner, and the RIPlus which reads to 2.26, and other instruments involving the reflection of infrared light were described. And in this edition prism type spectra were illustrated in black and white both in the European 'red on the left' version, and the American 'red on the right' version.

That, very regrettably, was to be the last edition prepared by Basil Anderson himself, for he died suddenly and peacefully aged 82 in January 1984. But such a valuable and popular textbook could not be allowed to die with its author, and several years later Mr E.A. Jobbins, formerly Curator of Gems and Minerals at the Geological Museum, was asked to produce another edition.

The 10th and current edition (1990) ran to 389

 ISSN: 0022-1252

larger pages, with 160 illustrations in black and white (a few of which span the half century), plus seventy excellent colour plates which were largely the very skilled work of Mr Jobbins himself.

It still contains a great deal of Anderson's original and explicit text from the earlier editions, but has been skilfully and compatibly updated and expanded to give new chapters on the manufacture of synthetics and imitations, and on gemstone enhancement, while the existing chapter on the detection of synthetics, imitations and composite stones has been rearranged, and in part re-written.

Faceted yellow synthetic diamonds are dealt with and new reflectivity and conductivity meters to combat diamond simulants are described. The artificial production of fancy colours in diamond by various types of irradiation is discussed and ways to identify such treatment are given.

Many new sources of gems from such widely differing places as Brazil (fine alexandrites); Nigeria (sapphire and aquamarine); Kenya/Tanzania (new colours in garnets); Pakistan (fine emeralds and natural pink topaz); Afghanistan (kunzite) and a very promising range of gems from China, are described.

Over the years various of the earlier editions have been translated into many languages. In view of the vastly enhanced compilation of valuable gemmological facts now within the covers of this tenth edition, I feel there is a good case for further translations into those and other languages to bring students in foreign countries up to date in the gemmological scene.

Basil Anderson, the enthusiast and pioneer of so much of our trade science, has passed on in the fullness of time, but this splendid textbook remains as a best-selling tribute to his remarkable genius and life-long love of gems, and may well do so for many more editions and years to come.

[*Manuscript received January 1992.*]

Radioactive glass imitation emeralds and an unusual Verneuil synthetic ruby

J. M. Duroc-Danner, FGA, GG

Geneva, Switzerland

Abstract

Radioactivity in glass substitutes has been reported recently ([1, 2]). Induced fingerprints in Verneuil synthetics are not unknown, but in a lamellar-twinned synthetic they can be even more deceiving. This article reports on the use of treatments to alter the appearance and consequently to make a straightforward identification more difficult.

Radioactive glass imitation emeralds

A pair of emerald-cut green stones that approached the finest emerald colour were received recently by the author for identification.

Approx. measurements and weight
14.69 × 11.97 × 7.60mm, 12.46 carats
14.99 × 11.94 × 6.81mm, 11.07 carats

Under a Bausch & Lomb Mark V Gemolite binocular microscope using dark field illumination, the stones were found to contain skeins of large and small gas bubbles, which with a 10× lens could easily have been mistaken for natural fluid inclusions (Figures 1 and 2).

The refractive index determination carried out using a Rayner Dialdex refractometer and monochromatic sodium light gave 1.635. Under the polariscope, the stones confirmed their optic character to be isotropic.

Their specific gravity was obtained by hydrostatic weighing of the stones in distilled water using a Mettler electronic PL 300C carat scale, and the stones were found to have a specific gravity of 3.754 and 3.767.

The fluorescence was examined with a Multispec combined LW/SW unit, and both stones showed under long-waves chalky orange; and under short-waves chalky green.

The absorption spectrum seen through a Gem Beck Spectroscope Unit showed a strong absorption 400-440 nm, a set of two lines centred at 460, 470 nm, and a strong absorption 600-700 nm.

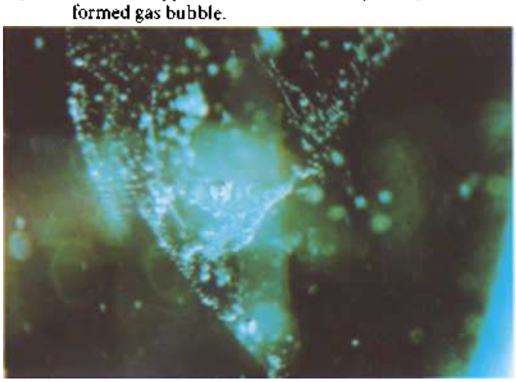
The two stones were identified as glass, and according to Bannister's graph could be either lead glasses or barium glasses ([3]).

A routine test performed by the author is to submit all stones he receives to a Geiger counter. To his great surprise, when the glass imitation emeralds were submitted to a Solar Electronics Radiation Alert Monitor 4, they were found to be radioactive (Figure 3).

Although the radioactivity recorded showed 0.08 mR/h if only one glass rested on the counter window of the Monitor 4, it records 0.12 mR/h when the two glasses were tested together under the same condi-

Fig. 1. Skeins of large and small gas bubbles found as inclusions in the radioactive glass imitation emerald.

Fig. 2. A similar type of inclusion showing a large and well formed gas bubble.



ISSN: 0022-1252

tions (Figure 4). It should be noted here that background levels indicate 0.00 mR/h to 0.02 mR/h. This means that these two glasses when tested together were registering up to twelve times background levels.

Discussion

Unfortunately, the author was unable to perform a qualitative chemical analysis to determine the heavy elements contained in these glasses (lead, iron, uranium, etc.), so the question remains open as to their composition.

According to the gemmological data, the author believes that these glasses could be lead glasses containing uranium and iron. This would be an answer both for the radioactivity observed and for the iron absorption spectrum recorded. Anyway, this is purely of an academic interest only. The important point is to be aware that since many gemstones are irradiated, it is wise to check these routinely with a Geiger counter for radioactivity. It is also important to realize that as shown in Figure 3, the radioactivity increases with quantity. In other words, if a sole 'weakly' radioactive stone presents 'little' danger, a set composed of these would

Fig. 3. The radioactivity of 0.08 mR/h recorded by Solar Electronics Radiation Alert Monitor 4, for a single glass imitation emerald.

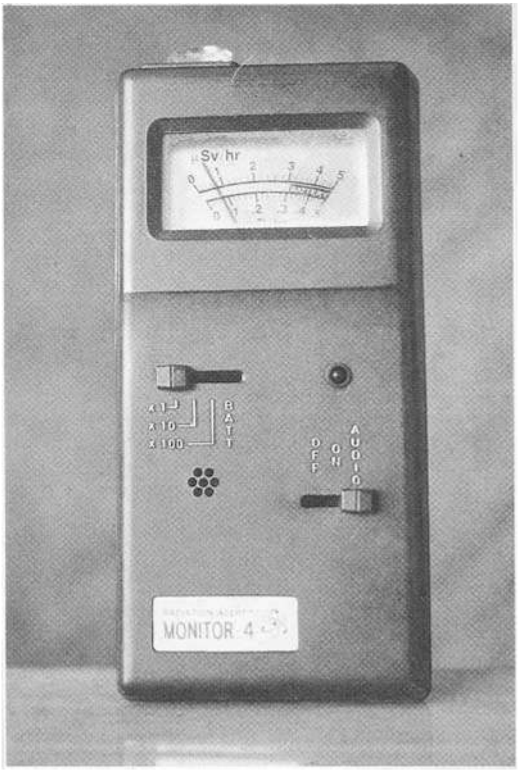


Fig. 4. The radioactivity of 0.12 mR/h recorded under the same conditions, but for the pair of glass imitation emeralds.

certainly be of 'some' risk.

Lastly, considering these glasses formed a pair, what would be the consequences if these were set as ear-clips, worn daily near the lymphatic glands.

The question as to why simulate emeralds with radioactive glass finds no positive answer, for there exist very good imitations with colouring agents other than uranium.

A Verneuil synthetic ruby showing polysynthetic twin lamellae and induced fingerprints

Among the interesting stones held by a private collector was a 6.84 ct cushion-shaped red stone that was bought some 15-20 years ago as a ruby.

Although the owner had some doubts concerning the authenticity of the stone, it is only recently that he decided to have it tested.

Routine gemmological tests: refractive indices, absorption spectrum and specific gravity, confirmed the stone to be corundum, variety ruby. The next step was to tell whether the ruby was natural or synthetic.

The stone measured approx. 11.15 × 9.76 × 6.20mm, was surprisingly well proportioned with a symmetrical pavilion.

Fig. 5. Fractures and fingerprints as they appeared under the microscope, in the Verneuil synthetic ruby.

Fig. 6. Induced fingerprints showing a dendritic-like pattern, observed under the microscope in the Verneuil ruby.

The visual appearance revealed many internal fractures, with some breaking the surface. Under a 10× lens, numerous 'feathers', some with healed 'fingerprint' patterns could be seen. Since 'fingerprints' are also encountered in many modern sophisticated synthetics (Chatham, Kashan, Knischka, Ramaura, etc.), and can be induced in Verneuil synthetics ([4]), these had to be closely examined to see if they contained liquid and gas-filled voids, like the genuine corundums, or were filled with solid flux, like the synthetics.

Observed under the microscope, the fractures and the 'fingerprints' were immediately seen (Figure 5). With higher magnification, the filled healed fractures showed a dendritic-like pattern, probably due to the crystallization of the low temperature melt (?) induced in them (Figure 6).

Another deceiving inclusion observed under high magnification consisted of a small dense 'nest' of very fine gas bubbles (Figure 7). These found lying between internal strain fractures could incorrectly have been taken for exsolved rutile needles.

Straight and parallel twinning lines were also present in this stone (Figures 8 and 9).

It should be noted here that with crystal inclusions, healing planes filled with liquid drops and zonal effects in straight lines, polysynthetic twin lamellae are regarded as one of the characteristics of genuine corundum. If this twinning occurs frequently in rubies (Thai, East Africa), it is less so in sapphires (Pailin, East Africa). In synthetic Verneuil corundum, and due to the fact that a 'boule' consists in general of a monocrystal, this type of twinning is encountered rather exceptionally. To this day, out of hundreds of synthetic Verneuil corundums observed by the author, only two showed this type of twinning ([5]).

Prominent tightly curved structure lines, similar to the grooves seen on a gramophone record, were present as could be expected in a flame-fusion synthetic ruby (Figure 10).

Although it was evident that this was a synthetic flame-fusion Verneuil ruby, it was decided for effectiveness to perform an ultimate test.

Fig. 7. Small dense 'nest' of very fine gas bubbles lying between internal strain fractures. Observed under the microscope in dark-field illumination, in the synthetic Verneuil ruby.

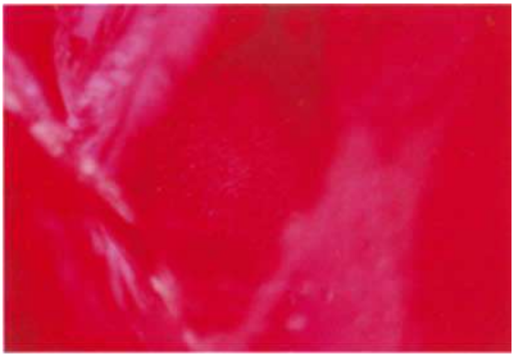


Fig. 8. Straight and parallel twinning striations as they appeared under the microscope, in the synthetic Verneuil ruby.

Fig. 9. Detailed view of a polysynthetic twin lamellae, observed under the microscope. Notice the fracture breaking the surface of the synthetic Verneuil ruby.

The stone was immersed in methylene iodide, between crossed polars set to their dark position; once the optic axis was located, a 'Plato striation' effect, which betrays Verneuil synthetics was obtained (Figure 11).

Discussion

The unnatural appearance of synthetic Verneuil stones that are devoid of inclusions can be considerably improved by the act of 'quench-crackling', and letting a chemical substance such as borax crystallize into the cracks to form 'fingerprint-like' patterns.

If the former is an early synthetic Verneuil, like the one described here, then the existing small groups of gas bubbles it contains, in conjunction with the newly created environment, can be misinterpreted, and add to the confusion.

Had this stone been cut by an innocent lapidary, with a 'native' cut instead of the mechanical symmetrical cut this stone showed, this surely would have increased the possible confusion. Especially if a jeweller came across this stone on a buying trip in gem localities, where he would normally expect to see genuine stones, with a 10× lens as his sole equipment.

Concluding thoughts

For the author, radioactive glass imitations, and induced fingerprints in synthetics, cannot be regarded as innocent imitations, or ordinary synthetics. They are intentionally made to deceive, can be a threat to the health, should be considered forgeries, and for these reasons, these treatments must be disclosed.

References

Nassau, K., Lewand, E.A., 1989. Mildly radioactive rhinestones and synthetic spinel-and-glass triplets. *Gems & Gemology*, **XXV**, 4, 232-5.

Fig. 10. Curved growth lines and the fractures, observed under the microscope in the synthetic Verneuil ruby.

Crowningshield, R., 1990. Gem Trade Lab Notes. Radioactive glass egg. *Gems & Gemology*, **XXVI**, 2, 155.

Webster, R., 1987. *Gems, Their Sources, Description and Identification*, 4th edn. 443.

Koivula, J.I., 1983. Induced fingerprints. *Gems & Gemology*, **XIX**, 4, 220-7.

Duroc-Danner, J.M., 1985. Polysynthetic twin lamellae in synthetic Verneuil sapphire. *Journal of Gemmology*, **XIX**, 6, 479-83.

[*Manuscript received 4 January 1991.*]

Fig. 11. 'Plato striation' obtained parallel to the *c*-axis while the stone was immersed in methylene iodide between crossed polaroids in their dark position. Observed in the synthetic Verneuil ruby.

The French Connection

A.E. Farn, FGA

Seaford, East Sussex

The cordial understanding engendered by Edward VII's visit to Paris in 1903 was a valuable precursor towards the Anglo-French Entente of 1904. The term 'Entente Cordiale' may equally well be used to describe the gemmological ties between the laboratories of London and Paris. Long long before CIBJO there was a strong bond of mutual assistance between these two pearl trade centres.

However it is not my intention to write of the early days of pearl testing. Rather it is to write of one particular member of the Paris laboratory. I have been brought to this historic pitch through leafing among some of the writings of Mlle Dina Level. Each time I read Dina's writings I marvel afresh at her effervescent enthusiasm.

She served under both Georges Gôbel the first director and Jean-Paul Poirot the second (present) director of the Paris laboratory. Details of her years of service, awards and presentations appear in the July 1988 *Journal of Gemmology* (21, 3, 140-1).

If I could liken her to any other gemmologist it would be Robert Webster. Both were of small stature, both were giants in their sphere. Dina Level was an important petite person who could wax enthusiastic with the merest frond of moss agate, a fugitive fluorescence, a nuage of gas bubbles or the watered silk reflection from a pale pink pearl.

Vivid, vivacious, volatile, Dina was truly Gallic yet was nevertheless an anglophile. It is impossible in English to convey the personal approach she took when describing colour, size, weight or any characteristic of a gem. She had a sympathy and concern for the mis-shapen, the lop-sided, the baroque and the broken. She *talked* to her gems (pierre tu vas me dire quelque chose).

Being Dina Level, 'Grande amoureuse des gemmes' she employed the intimate 'tu' rather than the usual 'vous'. In the '*Revue du Gemmologie*,' afg, 24, Sept 1970, pp4-6, Dina Level wrote of her 'Aventures dans les Musées d'Angleterre'.

She often conducted parties of students on tours of selected museums in the south east of England using Newhaven as the arrival port. In a brief description she describes a visit to 'the charming museum of Hove' close to Brighton and relates, 'L'Aventure d'une aventurine'.

A rough, bronze-coloured block entered triumphantly through the main entrance. It was large and heavy, 70cms in length, 50cms wide and of a similar height. Placed in the centre of a gallery it was mounted on a low pedestal supported on four feet and enclosed by wooden rails. Thus visitors could see without touching and at the same time admire the bright spangled reflections from its uneven surface.

Alas one day some gemmologists recognized what it was. A block of sub-translucent glass with inclusions of triangular copper spangles. Unceremoniously it was relegated to a position at street level at the entrance and labelled, 'Aventurine Glass'. In this account written in 1970, Dina says that it was some 15 years ago, which places it at about 1955. 'In my early days at the laboratory I remember Basil Anderson speaking of his encounter with a local museum where a large block of aventurine glass was imposingly displayed. Basil Anderson was living at that time in the nearby Sussex village of Ditchling.

Dina's final comment on this little episode was to write philosophically; 'If it is still in the same place the inclement weather will tarnish it. Unfortunately after its brilliant but ephemeral success it has to be like any other stone.' (Regrettably, from recent enquiries, there no longer seems to be a display of gemmological interest.) I was informed that changes had taken place in the museum. This observation must have a familiar sound to some of us?

In an earlier article by Dina Level in the June 1970 *Revue de Gemmologie* she writes in retrospective mood of 'Quarante ans dẽrriere la Binoculaire', 'Quarante ans d'enthousiasme', literally 40 years behind the binocular microscope and in italics 40 years of enthusiasm.

She remembers her first sight of No 18 Rue de Provence in April 1930. In the office of La Chambre Syndicale des Négociants en Diamants, Perles Fines, Pierres Précieuses et des Lapidaires there was a wall chart. One half was printed in red

 ISSN: 0022-1252

showing the rutile needles in natural rubies and curved structures of synthetic rubies. The other half, printed in blue, depicted the straight line hexagons and chevrons of natural sapphires with the soft curves and bubble clouds of synthetic sapphires.

Memories and images follow in succession sometimes overlapping. She recalls the great fly-wheel structure looking like a ship's steering wheel of the X-ray generating set. This like London's early X-ray set only produced lauegrams. The memory of black cloth-covered trays full of pearls, the subtle nuances and éclat completely escaping her novice's eye.

The tiny hollow needle of the endoscope (shades of Arsène Lupin), whose minute point sheltered two mirrors thanks to which one could see a fleeting ray of 'sunshine' lifting in succession the theatre curtains of the golden layers (conchiolin?) of natural pearls or the uniform snowy centres of cultured pearls.

There was another image which, whilst agreeable to the eye, tortured her for a week; she vowed she'd never stay a week in this laboratory. It was the density balance of gilded copper gleaming in its cage of glass, its pans suspended by chains and the diabolical beam of such sensitivity that to take a density for her was as difficult as it was for a camel to pass through the eye of a needle. Dina repeats 'When I say take a density, I wish to say attempt once, twice, ten times to measure the density of the same stone and to get the same result. At last I succeeded and the cyclopic eye of the balance out of its glass cage ceased to wither me every morning'. She was able at last to verify the true identity of a variety of gemstones used in tests for 'eye spotting'. (In the old lab we used well established specimens such as slices of innocuous indeterminate coloured gem material for early practice in establishing densities by hydrostatic method.)

She pays tribute to the untiring patience of Georges Gôbel who showed her how to take photographs of inclusions and how to develop and fix her negatives. Whether it is the development of a negative for a print, or an enlargement, she confesses that she never fails to see the image appear in the developing dish without emotion. The action in the developing dish she describes 'As if it is coming back from a vanished world and is reborn dancing in the liquid depths'.

This magic fluid has a name which is fully justified (sensible); it is the revélateur (revealer) and can be allied to the unrolling of the wrappings of mummies. Finally the fixer which will, as the hardening element, preserve the portrait of the inclusion long after the host gem has rejoined its owner.

She describes the examination of hundreds and hundreds of calibré sapphires using the binocular microscope as: 'A diver amazed and wonderstruck in these hermetically sealed waters. Fish following each other, liquid drops in flight, waving fronds of seaweed, phantom vessels stranded amongst the mountains of the sea bed'.

Dina describes how she spent one night alone in the laboratory taking photo-micrographs of inclusions and external features of some rough industrial diamonds. Many were clean and had good crystal shapes; she was entranced by the Egyptian beauty of these 'double' pyramids, looking like the reflections of the pyramids in the Nile at Giza. One in particular captivated her; she describes one of its faces as a hollow triangular engraving like a staircase becoming narrower and narrower as it penetrated towards the centre of the octahedron.

Plunged into a new ecstasy she wanted to make them re-live in her photo-micrographs – 'To which sleeping Pharaoh did the steps of the hollow pyramid lead?' All equal intersections, luminous, transparent, perfect. What divine chisel cut them in this adamantine block? How should they be illuminated in order to transfer to a flat film the dimensional relief seen in the lens of the microscope?

After a long session of photography, placing film, siting the diamonds for maximum result and aware of the war-time shortage of good quality film she was ready. The portable lamps had been placed in a circle surrounding the camera and microscope, the diamond being literally the cynosure of all. Dina switched off the lights, but in the centre a blue-mauve glow was being emitted – the diamond was phosphorescent. It seemed about 15 seconds before the glow finally died.

She says, 'That moment was the most intense of my life. Imagine the silence of the night, undetected behind the black-out curtains, impossible to go out, the seclusion imposed by the curfew, and the solitude of the deserted laboratory. To wonder in that desperate war-time atmosphere, what made this message of hope come not from outside but from inside this solid substance, this materialization of the eternity of this immaculate carbon. This gem made from a unique element, omnipresent in every thing which lives and breathes. I can at will re-live this dazzling tête à tête but I do not dwell on this memory, I lift up my eyes towards that staircase divine to the steps to the Light'.

Dina Level ends her long reminiscence saying, 'Ah, if it was to be done again I would re-do it'.

She died on 17 July 1988 at Nimes in the south of France – she was 85. With Basil Anderson and Robert Webster she leaves her mark in the annals of Gemmology. *We shall never see her like again.*

[*Manuscript received 12 December 1991.*]

On the properties of meteoritic gem olivine from a pallasite from Esquel, Patagonia, Argentina

Dr Ulrich Henn[1] *and Andreas F.A. Becker*[2]

[1] German Foundation for Gemstone Research, Idar-Oberstein, Germany
[2] Friedrich August Becker, Idar-Oberstein, Germany

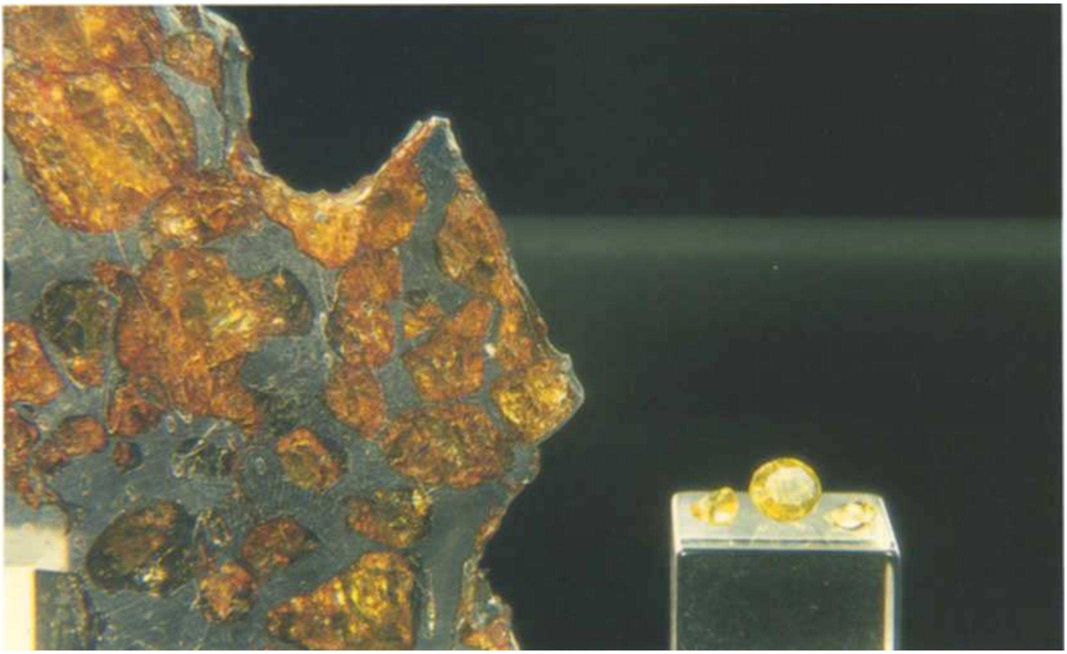


Fig.1. Pallasite plate from Esquel, Patagonia, Argentina, and three faceted meteoritic gem olivines (largest 1.6 ct).

1. Abstract

The properties of faceted gem olivines (peridot) from a stony-iron meteorite (pallasite) found at Esquel, Patagonia, Argentina, are described.

2. Introduction

Olivine is one of the common rock-forming minerals in the earth's crust with an average content of about 3.5%. Transparent green crystals of gem quality olivine are generally called peridot. The most important occurrence was on the island of Zeberget (Egypt) in the Red Sea; today's commercial production is from the Mogok District of Upper Burma and Arizona, USA.

The minerals of the olivine group form a complete series of mixed crystals with the end-members forsterite Mg_2SiO_4 and fayalite Fe_2SiO_4; another diadochy is present between fayalite and tephroite Mn_2SiO_4. In magnesium-rich olivines nickel is commonly present. The green colour is due to Fe^{2+} of the fayalite component.

Olivine as a constituent of meteorites is well known, and Webster (1983) mentioned specimens said to be of a sufficient size and quality to be suitable for cutting into gemstones. One of the authors has now separated transparent green fragments from a meteorite plate from Esquel in Patagonia, Argentia, and cut these into faceted stones up to 1.60 cts (Figure 1).

Meteorites are fragments of celestial bodies of the asteroid belt between Mars and Jupiter and are divided into three types: (1) iron meteorites, (2)

 ISSN: 0022-1252

iron-stone meteorites and (3) stony meteorites. The gem quality olivines described here originate from a type of stony-iron call pallasite, which consists of a network of nickeliferous iron (iron meteorite) with crystals of olivine about 1 square centimetre in size. The meteoritic olivines are distinctly fractured, but clean cuttable parts are present up to 5 square millimetres in size.

Gemmological investigations of the physical, chemical and microscopical properties have been carried out to compare the meteoritic olivines with sublunary gem olivines.

3. Physical properties

3.1. Refractive indices, birefringence and density

Within the olivine group the values of refractive indices, birefringence and density increase linearly with the chemical composition from forsterite to fayalite, between which there is continuous variation: n_x=1.635-1.827, n_y =1.651-1.869, n_z=1.670-1.879, Δn=0.035-0.052, D=3.22-4.39 g/cm³ (Deer, Howie & Zussman, 1983). The values of gem quality olivines hitherto published in literature vary between n_x=1.640, n_y =1.657, n_z=1.675, Δn=0.035, D=3.20 g/cm³ for a nearly colourless stone from Sri Lanka with a forsterite content of 95% (Bank, 1984) and n_x=1.670, n_y=1.688, n_z=1.706, Δn=0.036, D=3.43 g/cm³ for a green specimen from the Eifel, Germany, with a FeO content of 16.79 wt.% (= 81% forsterite) (Bank, 1986).

The meteoritic olivine of the pallasite from Esquel in Argentina has refractive indices, birefringence and density of n_x=1.658-1.660, n_y=1.671-1.673, n_z=1.693-1.696, Δn=0.034-0.037, D=3.34-3.37 g/cm³, which are in the known range of gem olivines.

3.2 Absorption spectrum

The unpolarized absorption spectrum in the 300-2000 nm (33,333-5,000 cm^{-1}) range (Figure 2) shows absorption bands of Fe^{2+}, which are typical for olivine (Runciman et al., 1973; Smith & Langer, 1982). The maxima are at 9,350, 11,490, 15,770, 19,120, 20,280, 22,120 and 24,810 cm^{-1} (1070, 870, 634, 523, 493, 452 and 403 nm).

4. Chemical properties

The results of semi-quantitative EDS-analyses of three samples of the meteoritic olivines are listed in Table 1. The calculated composition characterizes the material as mixed crystals with dominant contents of forsterite and distinct fayalite distributions. The tephroite contents are relatively low. These olivine compositions correspond to the values of refractive indices, birefringence and density given in the known correlation diagrams for the minerals of the olivine group (e.g. Deer, Howie & Zussman, 1983).

Fig. 2. Unpolarized absorption spectrum of a meteoritic gem olivine in the 300-2000 nm range.

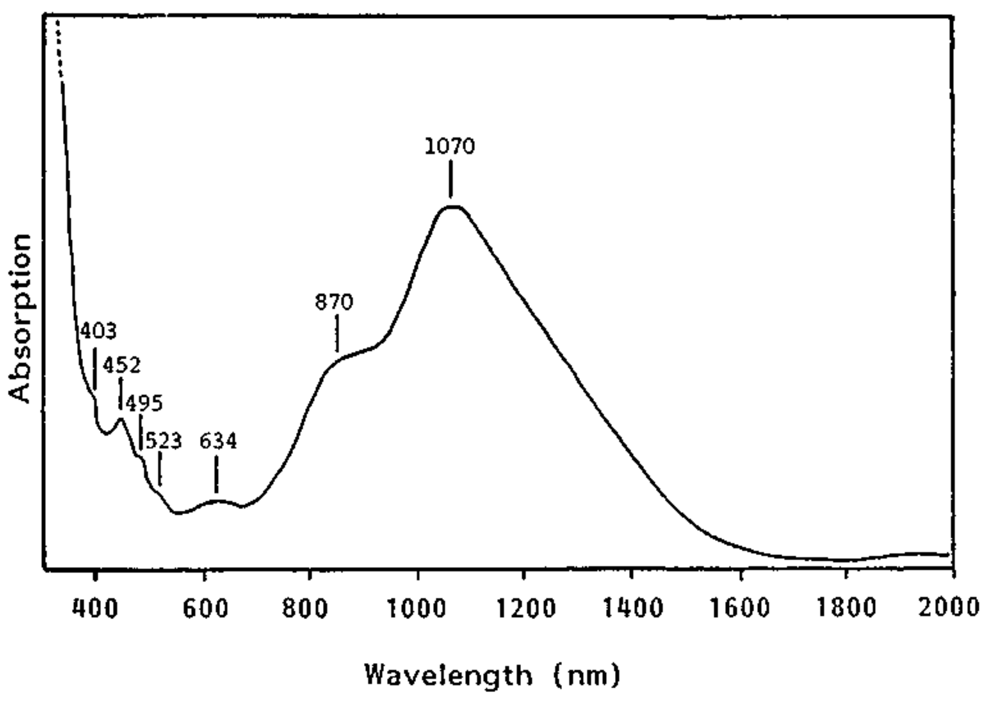


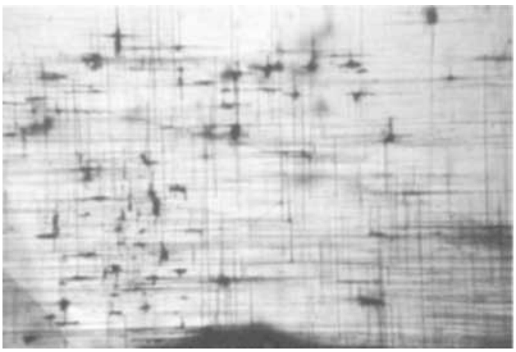
Table 1. Chemical composition of meteoritic olivines from Esquel, Argentina

	1	2	3
wt.%			
SiO_2	40.69	40.75	41.09
MgO	43.13	43.28	43.49
FeO	14.21	14.02	13.57
MnO	0.34	0.38	0.32
number of cations on the base 0=4			
Si	1.03	1.03	1.04
Mg	1.63	1.63	1.63
Fe	0.30	0.30	0.29
Mn	0.01	0.01	0.01
percentage distribution			
forsterite	84.02	84.02	84.46
fayalite	15.46	15.46	15.03
tephroite	0.52	0.52	0.51

5. Microscopical features

Studies with an immersion microscope yielded very interesting internal features. All samples investigated show needle-like inclusions (probably hollow tubes) running through the whole stone and crossing at angles of 90° due to the orthorhombic crystal system of olivine (Figure 3). At the crossing points black opaque shapeless inclusions (probably residues of the nickeliferous iron of the meteoritic matrix) are embedded.

Fig. 3. Needle-like inclusions (probably hollow tubes) crossing at angles of 90°. At the crossing points opaque shapeless inclusions (probably residues of the nickliferous iron of the meteoritic matrix) are embedded. Immersion. x25.



6. Conclusions

The cut meteoritic olivines of the pallasite stony-iron from Esquel in Patagonia, Argentina, possess physical and chemical properties typical of sublunary olivines. The microscopical features, however, are unusual and not typical for sublunary gem olivines.

References

Bank, H., 1984. Fast farbloser Olivin aus Sri Lanka. *Z. Dt. Gemmol. Ges.*, 33, 139-40.

Bank, H., 1986. Hochlichtbrechende Olivine aus der Eifel. *Z. Dt. Gemmol. Ges.*, 35, 185-6.

Deer, W.A., Howie, R.A., Zussman, J., 1983. *An Introduction to the Rock-Forming Minerals.* 14th edn. Longman.

Runciman, W.A., Sengupta, D., Courley, J.T., 1973. The polarized spectra of iron in silicates. II Olivine. *American Mineralogist*, 58, 451-6.

Smith, H.G., Langer, K., 1982. Single crystal spectra of olivines in the range 40,000-5,000 cm^{-1} at pressures up to 200 kbar. *American Mineralogist*, 67, 343-8.

Webster, R. (revised by Anderson, B.W.), 1983. *Gems, Their Sources, Descriptions and Identification.* 4th edn. Butterworths, London.

[*Manuscript received 1 November 1991*]

The Museum of Ouro Preto, Minas Gerais, Brazil

Dr Francisco Müller Bastos, FGA, GG

Belo Horizonte, Minas Gerais, Brazil

In early times, the establishment of many small villages in the State of Minas Gerais and also in other parts of Brazil, was a consequence of the search for gold, diamonds and precious stones. The city of Ouro Preto followed this rule. By the year 1696, a man known as Duarte Nunes, also known as 'The Mulato', first discovered gold in Ouro Preto – small nuggets with a steel colour. Thus, the first name given to this place was Vila Rica do Ouro Preto (Rich Village of Black Gold). Later this name was changed to Vila Rica, and finally to Ouro Preto. Until 1729, only gold was found by the 'mineiros' in the soil of Minas Gerais, but later diamonds of the Tejuco, in the village of Serro do Frio (later known as Diamantina) were also discovered.

Historic episodes of the 'Inconfidencia Mineira', a movement which resulted in national independence, occurred during the gold cycle. From the years 1721 to 1897, Ouro Preto was the capital of Minas Gerais State. On 12 December 1897, the new city of Belo Horizonte was inaugurated and the capital of the State of Minas Gerais was transferred from Ouro Preto to this new location.

Ouro Preto, one of the oldest cities in Brazil, located at an altitude of 1150 metres, can be reached by two fairly good paved roads 97 kilometres distant from Belo Horizonte; approximately 33 kilometres by the BR-040 and 64 kilometres along another state road. Companies which work iron ore are located along the road. The famous Pico de Itabira (69% pure hematite) which as a landmark for the 'bandeirantes', scouts in search of gold, who departed from the coast in Rio de Janeiro and headed into the interior, can be seen on the right. Ten kilometres from Ouro Preto, a large aluminium factory in the Saramenha district, exploits the large resources of bauxite which exist in the region. Finally, we arrive in Ouro Preto, where the Itacolomi Peak (the stone and the daughter in Indian language), 1752 metres high, can be seen as a

Fig. 1.
The exterior of the Museum at Ouro Preto.

(Photo: the author)

ISSN: 0022-1252

background to the city.

Ouro Preto was nominated by the United Nations as a World Historical Monument. The city and the small villages which surround it are also known as the best topaz producers in the world, including yellow, red, orange and pink colours.

Claude Henry Gorceix, born in France in Saint Denis des Murs (Haute Vienne) on 19 October 1842, arrived in Brazil on 17 October 1876 and at the age of 34 years founded the Ouro Preto School of Mines in a building which was formerly the Palace of the Government of the State of Minas Gerais. Gorceix brought with him several samples of minerals, and continued to collect samples in the Ouro Preto region, creating a collection which is presently one of the most important in the world. From 1881 to 1885, Gorceix also wrote many articles about Brazilian minerals. These articles and archives are preserved in the Ouro Preto School of Mines Museum.

The museum is an old, two storey building located on Praça Tiradentes N° 20 (Tiradentes Square) in the centre of town (Figure 1). The museum was restored in 1974 and exhibits are open to the public from 12 noon to 5.00pm. A 50 cents (American) admission fee is charged and the money is used to buy new specimens and for the conservation of the museum. In the entrance hall we see a huge quartz crystal weighing 6000 kilograms, which measures one metre high by one metre wide (Figure 2). It should be noted that the floors of the great hall on the ground level are made of a perfectly

Fig. 2. A very large quartz crystal weighing some 6000kg and measuring 1m x 1m, in the entrance hall of the Museum. *(Photo: R. Mendes)*

Fig. 3. A view of the exhibition in the great hall of the Museum; note the floor of beautifully polished quartzite. *(Photo: R. Mendes)*

Fig. 4. A fine terminated crystal of orange topaz 13cm in height in the Museum. *(Photo: R. Mendes)*

polished, beautiful white and grey quartzite (Figure 3).

About 98% of the specimens displayed in the museum are from Brazil. However, a lovely vivianite from France is shown in one of the glass cases on the first floor.

There are two distinct mineral collections. The first, more technical and started by Gorceix, which presently comprises over 24,000 items, occupies a large room on the first floor of the museum. The best minerals belong to this first collection, which is displayed in ten glass island cases and in seven wall cases around the room. Four spots of special lighting are placed over each glass case, giving perfect illumination.

The second collection, not as rich as the first, has approximately 2000 minerals occupying five rooms on the second floor of the museum. These minerals are distributed in some forty glass cases in various rooms. All minerals are classified according to name, place of origin and chemical formulae. Some outstanding specimens of the collection include a perfectly terminated yellowish-red topaz measuring 13cm in height (Figure 4), considered one of the best specimens of the museum; a spectacular specularite 21 x 17cm (Figure 5) considered one of the world's best; a dark green flawless crystal of the rare mineral euclase, shown together with other euclase crystals – blue, light blue and pale yellow in colour; a beautiful round morganite 10cm in diameter; a transparent yellowish-green baryte; a group of magnesite crystals, each crystal measuring approximately 7cm and a tabular pyrrhotite crystal about 12cm long.

Many varieties of beryl can be seen, including goshenite, morganite, heliodor, aquamarine and emerald. The tourmaline group is represented by the species elbaite, dravite, uvite, liddicoatite, schorl, buergerite and ferridravite.

Special exhibitions include a collection of iron minerals, which are abundant in this region including hematite, martite, magnetite, limonite, pyrolusite and also a glass case with calcium carbonate minerals enrich the museum, as well as tektites, platinum, gold, silver and the reproduction of the largest diamonds in the world which ensures that all the minerals found in Brazil are displayed in the museum collections.

On the second floor of the museum, besides the five rooms with the minerals, there is a chapel with old images of saints and another room with paleontological specimens, fossils, shells and skeletons of birds and wild animals.

Finally, a room is dedicated to Gorceix, the founder, showing some old instruments used to test stones and also some early mineralogical literature

Fig. 5. A spectacular specimen of hematite measuring 21 x 17cm in the Museum. *(Photo: R. Mendes)*

Fig. 6. The author (right) and Mr Cesar Mendonça in front of a bust of Claude Henry Gorceix, the founder of the Museum.

(Photo: the author)

and historical documents. Eugene Hussack, the famous German mineralogist, discovered a mineral which he named gorceixite in his honour. Hussack also wrote many papers which are housed in the museum archives.

In addition to the Mineralogy Museum, Ouro Preto has the most important School of Engineering in Brazil. A committee composed of Mr Geraldo Cardoso, Mr Osmar Alves de Oliveira Jr, and Mr Cesar Mendonça, is responsible for the acquisition and display of the minerals in the museum.

Acknowledgements

The author expresses his thanks to Mr Jorge Geraldo Brito dos Santos who made the arrangements to visit the museum, and to Mr Cesar Mendonça for all his advice and co-operation during this visit.

[*Manuscript received 5 July 1991.*]

Lamellar inclusions in spinels from Morogoro area, Tanzania

Dr Karl Schmetzer[1] and Dr Axel Berger[2]

[1]Marbacher Str. 22b, D-8067 Petershausen, Germany
[2]Institut für Mineralogie der Technischen Hochschule, Schnittspahnstr. 9, D-6100 Darmstadt, Germany

Abstract

Lamellar double refractive inclusions in spinels from Morogoro area, Tanzania, were identified by transmission electron microscopic techniques as iron-free, high titanium-bearing högbomite. The inclusions occur as four sets of thin lamellae parallel to the octahedral faces of the spinel host crystals.

In June 1987, one of the present authors received the first samples of an apparently new source of natural gem quality spinels. The red, pink, orange, reddish-purple, purplish-blue and blue crystals forming octahedra up to about 1cm in size supposedly originated from the Morogoro area, which is situated about intermediate between Dodoma and Dar es Salaam in central Tanzania (see also Hänni and Schmetzer, 1991). Meanwhile, the authors obtained several parcels of faceted and rough gem quality spinels from the new Tanzanian source, which were submitted by different persons in the trade to the authors or to colleagues. All those dealers, with one single exception, independently named the Morogoro area in Tanzania as the origin of the gemstones. According to the fact that most of the samples from all different parcels, which were examined by the present authors contained doubly refractive, lamellar inclusions to be described later, it is almost certain that all these parcels of gem spinels came from one single locality only. Consequently, the Umba valley, in northern Tanzania, close to the Kenyan border, which is quoted by Bank *et al.* (1989) as source of the new East African gem spinels, most probably is invalid as a locality for these new gem materials.

Physical and chemical properties of the spinels were found to be in the range of natural gem quality spinels, e.g. from Sri Lanka and Burma. Trace element analyses as well as spectroscopic investigations (cf. Schmetzer *et al.*, 1989) revealed results, which indicated no differences worth mentioning between samples of this new source and gem spinels from the long known localities in Sri Lanka and Burma. Dependent on the colour of the individual samples, trace element contents in the range of 0.05 wt.% to 0.55 wt.% Cr, 0.25 wt.% to 1.25 wt.% Fe, up to 0.15 wt.% V and up to 0.2 wt.% Ti were determined by electron microprobe (cobalt contents were below the detection limit of the microprobe but were proven by X-ray fluorescence analyses), and the absorption bands in the spectra of spinel crystals with different coloration were consequently assigned to chromium, vanadium, iron (in different valence states) and cobalt (Schmetzer *et al.*, 1989). In contrast to these non-spectacular results, microscopic investigations indicated that about 70% of the spinel samples from the new source in Tanzania showed lamellar inclusions as a characteristic feature, which was neither observed by the authors in gem quality spinels before nor was described and identified in specific mineralogical or gemmological papers. The first hint towards these characteristic lamellae is found in the publication of Bank *et al.* (1989), who mentioned 'irregular growth structures' in their Tanzanian spinels. In addition, Kane (1990) mentioned 'numerous sheets of polysynthetic twinning planes' in spinel from Tanzania.

The lamellar structures to be described were observed in four different orientations parallel to the octahedral {111} faces of the spinel host crystals. In each view parallel to one of the <110> axes of the spinel hosts (Figure 1), two sets of thin lamellae were observed parallel to the octahedral spinel faces, forming characteristic angles of 109.47° and 70.53°, respectively. Under crossed polarizers in the gemmological microscope using methylene iodide as immersion liquid (Figure 2), the inclusions were found to consist of doubly refractive lamellae. Because of the small thickness of the lamellae, characterization and identification of the mineral inclusions by electron microprobe was not successful.

However, by the application of transmission electron microscopic techniques using ion-beam thinned petrographic thin sections, the present authors were able to characterize and identify the inclusions (Schmetzer and Berger 1990). The exact thickness of different lamellae was determined to be

 ISSN: 0022-1252

Fig. 1. Plane polarized light, 40x.

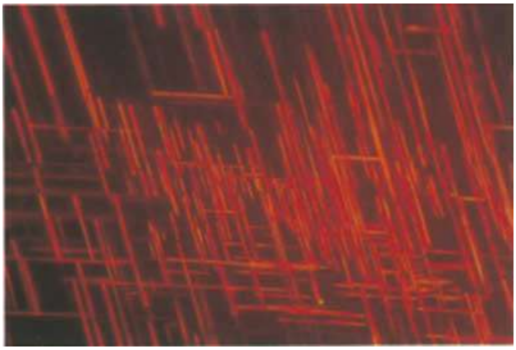


Fig. 2. Crossed polarizers, 40x.

Figs. 1, 2. Double refractive lamellae of högbomite in pink spinel (Fig. 1) from Tanzania. The lamellae are orientated parallel to two octahedral {111} faces of the host. View parallel to an <110> axis of the spinel crystal, using an immersion microscope with methylene iodide as immersion liquid.

variable between 0.01 μm and 0.1 μm. Using electron diffraction, the lamellae were found to have trigonal (rhombohedral) symmetry with unit cell dimensions of a_0 = 5.7 Å and $c_0 \approx$ 12 x 4. 65 Å = 55.8 Å. Quantitative EDX-analyses with a 15nm diameter electron spot characterized the lamellae as Mg-Al-Ti oxides. In summary, the lamellae were identified as an iron-free, high titanium-bearing member of the chemically varying högbomite series.

Högbomites are hexagonal or trigonal (rhombohedral) Fe-Mg-Al-Ti oxides with complex chemical composition (Petersen *et al.* 1989). Structurally, högbomite is closely related to spinel in that the högbomite structure is derived from a spinel structure through partial replacement of magnesium atoms by titanium (Gatehouse & Grey, 1982) according to the formula 2 $Mg^{2+} \rightarrow Ti^{4+}$ (Coolen, 1981). Similar structures are also known for the Be-Mg-Al oxides taaffeite and musgravite (Nuber & Schmetzer, 1983).

In practical gemmology, the observation of different sets of doubly refractive lamellar inclusions in a spinel of unknown origin is able to characterize the sample as natural spinel originating from Tanzania. According to the fact that flux-grown synthetic spinels are now appearing in increasing quantities in the trade, the diagnostic feature described in this paper may be helpful occasionally.

Acknowledgements

The authors are grateful to Dr H.A. Hänni of Basel, Switzerland, and to the companies of Gebrüder Leyser, Julius Petsch Jr and Karl Egon Wild, all of Idar Oberstein, Germany, who kindly submitted the major parcels of spinels from Tanzania for the present investigation.

References

Bank, H., Henn, U., Petsch, E., 1989. Spinelle aus dem Umba-Tal, Tanzania. *Z. Dt. Gemmol. Ges.*, **38**, 166-8.

Coolen, J.J.M.M.M., 1981. Högbomite and aluminium spinel from some metamorphic rocks and Fe-Ti ores. *N.Jb.Miner.Mh.*, 1981, 374-84.

Gatehouse, B.M., Grey, I.E., 1982. The crystal structure of högbomite-8H. *Amer. Mineral.*, **67**, 373-80.

Hänni, H.A., Schmetzer, K., 1991. New rubies from the Morogoro Area, Tanzania. *Gems & Gemology*, **27**, 156-67.

Kane, R.E., 1990. Spinel from Tanzania. *Gems & Gemology*, **26**, 156-7.

Nuber, B., Schmetzer, K., 1983. Crystal structure of ternary Be-Mg-Al oxides: taaffeite, $BeMg_3Al_8O_{16}$, and musgravite, $BeMg_2Al_6O_{12}$. *N.Jb.Miner.Mh.*, 1983, 393-402.

Petersen, E.U., Essene, E.J., Peacor, D.R., Marcotty, L.A., 1989. The occurrence of högbomite in high-grade metamorphic rocks. *Contr. Mineral. Petrol.*, **101**, 350-60.

Schmetzer, K., Berger, A., 1990. Lamellar iron-free högbomite-24R from Tanzania. *N.Jb.Miner.*, 1990, 401-12.

Schmetzer, K., Haxel, C., Amthauer, G., 1989. Colour of natural spinels, gahnospinels and gahnites. *N.Jb.Miner.Abh.*, **160**, 159-80.

[*Manuscript received 23 May 1991.*]

Determination of dispersion using a refractometer

W. Wm. Hanneman, Ph.D.

PO Box 2453, Castro Valley, CA 94546, USA

When using white light with a refractometer, the rainbow effect on the shadow edge resulting from dispersion is readily apparent. Since the refractometer is already used to determine refractive index, birefringence and optic character, it seems reasonable to expect that it also could be used to determine dispersion. Indeed, it can.

Dispersion, by definition, is the numerical value equal to n_G minus n_B. It would appear that one could use red and blue filters to define the light sources, determine the indices of refraction on the refractometer scale, and calculate the value for dispersion.

Over the years, a number of investigators have tried this approach. However, only Americans seem to get reasonable results. There is an explanation for this. Besides demonstrating why such results were simply fortuitous, this paper will present a method which can be used by anyone to actually determine dispersion using a refractometer.

For all gemstones, the index of refraction for blue light (n_G) is greater than that for red light (n_B). However, when these 'apparent values' are determined on the refractometer scale, 'n_B' has a greater value than does 'n_G'. This is why, when using a red filter to produce monochromatic light, one must subtract the value of 0.003-0.005 from the refractometer scale reading in order to obtain the correct RI value.

The reason for this is that dispersion and RI are measures of what happens to light at the interface of a gem and air. The refractometer reading, on the other hand, is a function of what happens to light at the interface between the gem and the refractometer prism.

Since air has an index of refraction lower than that of the gem and the prism has one higher than the gem, the rainbow in the refractometer appears to spread in the 'wrong' direction.

Consequently, in order to be useful, refractometer scales are all calibrated in terms of a single wavelength – 589nm., i.e. n_D or yellow light. This value has been designated as the RI (refractive index). Any 'index of refraction' values obtained from the refractometer scale when using other wavelengths of light have no real meaning.

Nevertheless, the numerical scale on a refractometer can be used for indicating the effects of dispersion occurring at the gem-refractometer prism interface. The dispersion value is an intrinsic physical property of a gem, however, the optical properties of refractometer prisms are defined by their manufacturers. Consequently, a separate calibration scale is required for each make of refractometer. The actual calibration scale is also a function of the red and blue light sources used.

A useful calibration scale can be constructed from the results obtained from two reference gems – benitoite, having a dispersion value of 0.047, and fluorite, having a dispersion value of 0.007. Red and blue light is produced by the use of filters and the numerical difference of the refractometer scale readings (△ scale) is plotted against the known dispersion values. A line is constructed connecting these two points to serve as the calibration. Figure 1 shows the calibration scales for two widely used commercial refractometers – the British Dialdex and the American Duplex II.

The points for garnet, ruby and tourmaline, were positioned on the basis of published dispersion values and experimentally measured △ scale values. They confirm the general validity of this calibration scheme.

Fortuitous Results

The reason for Americans getting 'reasonable' results even though using the invalid assumption that the △ scale reading = dispersion, is also illustrated in Figure 1. This erroneous relationship is represented by the dotted line extending upwards to the right. Note the slope is opposite to those of the calibration lines.

The dotted line intersects the American Duplex II calibration line at a dispersion value of 0.020. Since a great number of the lower RI coloured gemstones have dispersion values of that magnitude

 ISSN: 0022-1252

(e.g. ruby, garnet and tourmaline), 'reasonable values' can be obtained by using either line as the calibration line.

On the other hand, English investigators using the Dialdex refractometer would find that the true calibration curve is crossed by the dotted line at a value of only 0.010. For most gemstones, this is not a 'reasonable value' of dispersion and the investigator is immediately alerted to the error.

Determination of dispersion using a gemmological refractometer

Equipment:

Gemmological refractometer of any manufacture. Red and blue filters to define light sources. Dispersion reference standards: fluorite (0.007) and benitoite (0.047).
Graph paper.

Procedure:

1. Determination of upper standard point.
A. Using the blue filter, determine the refractometer scale reading corresponding to the shadow edge for benitoite.
B. Repeat step A using the red filter.
C. Determine the absolute difference of the two readings. This is designated the △ Scale Reading.

2. Determination of lower standard point.
A. Repeat steps 1A, B, and C using the fluorite standard.

3. Construction of Calibration Chart.
A. Construct a graph relating △ Scale Reading vs. Dispersion and plot the points for the standards as shown in Figure 1.
B. Construct a straight line connecting the reference points.

4. Determination of Dispersion of Unknowns.
A. Repeat the steps outlined in 1A, B, and C using the unknown specimen.
B. Using the value of △ Scale Reading and the calibration chart, determine the dispersion of the unknown.

[*Manuscript received 24 September 1990.*]

Determination of dispersion using a refractometer

W. Wm. Hanneman, Ph. D.

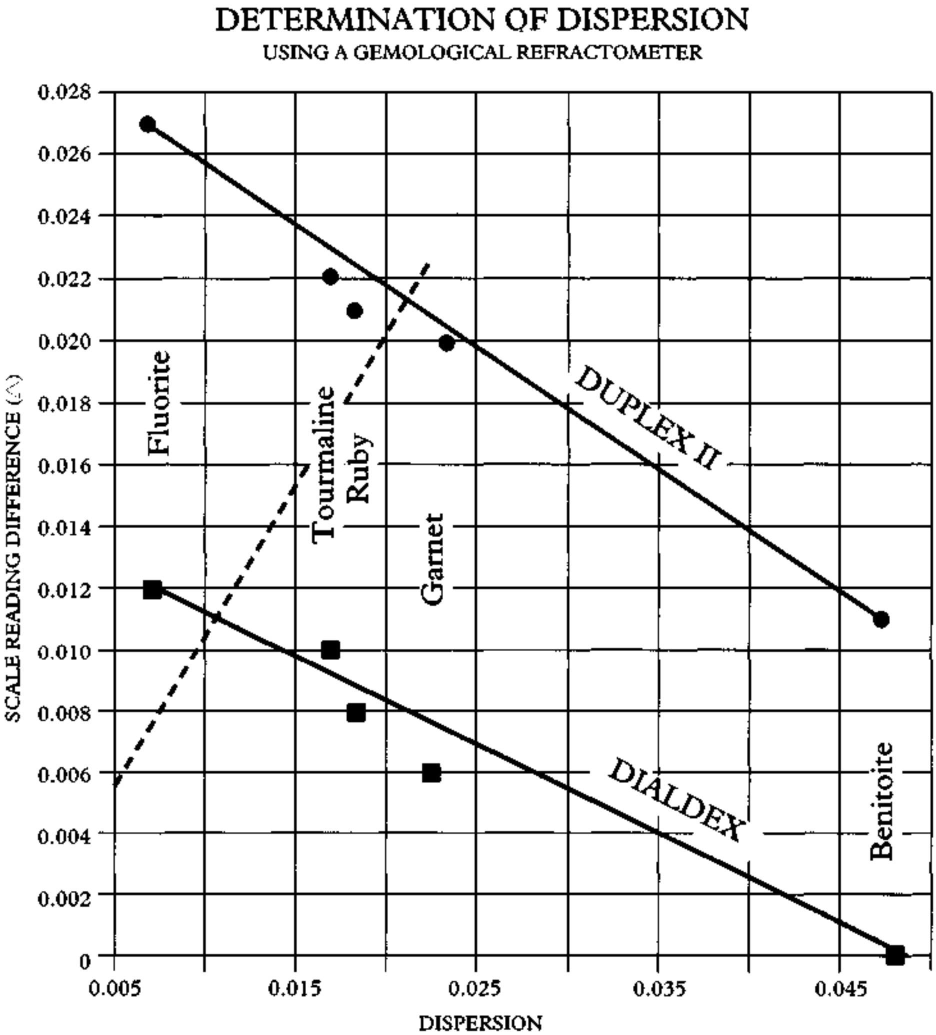


Fig. 1. The calibration scales for two widely used commercial refractometers – the British Dialdex and the American Duplex II.

Magnetic resonance distinction between synthetic and natural 'padparadscha' sapphires

G.J. Troup, D.Sc.,[1] D.R. Hutton, Ph.D.,[1] and Belinda Turner

[1]Physics Department, Monash University, Clayon 3168, Victoria, Australia
[2]Tyler, Texas, USA

Abstract

The examination of natural and synthetic sapphires, in the 'padparadscha' ('lotus flower') colour range, by magnetic resonance spectroscopy, gave the following results. Ferric iron is readily detectable in Sri Lankan and Tanzanian natural material, but is absent, or very difficult to detect, in synthetic boule (flame fusion) material. The lines are much broader in the Tanzanian stones than the Sri Lankan. Ferric iron is also easily detectable in flux-grown (Chatham) material, but the lines are so narrow that 'forbidden' transitions in the ferric spectrum, and hyperfine structure in the chromic spectrum, are seen.

We conclude that magnetic resonance spectroscopy can distinguish synthetic from natural sapphires in the 'padparadscha' colour range; may give a lead to the point of origin of naturals; and can distinguish the mode of manufacture of synthetics.

Introduction

It is usually possible, by thorough microscopic examination, to determine whether a correctly identified 'padparadscha' variety of sapphire is natural or synthetic. In the comparatively few cases where this is inconclusive, is there another possible test?

In 1975, Scala and Hutton[1] showed that magnetic resonance spectroscopy could be used to distinguish between natural (Australian) and synthetic golden sapphire. In 1981, the technique was extended by Anderson, Hutton and Troup[2], to enable the distinction between synthetic and natural blue sapphire to be made. At the Gemological Institute of America International Symposium in Los Angeles, June 1991, one of us (GJT) was asked whether magnetic resonance would distinguish between natural and synthetic 'padparadscha' sapphire. This paper gives the reply to that question.

'Padparadscha' sapphire lies somewhere between 'apricot' and 'pink' in colour, and usually has a slight brownish tinge also[3]. The main source is Sri Lanka, but similarly coloured stones have recently been found in Tanzania. Verneuil flame-fusion (boule) synthetics exist, as do flux-melt ones (Chatham). Strangely enough, we found it more difficult to obtain the synthetic material than the natural! In the Chatham case, this is presumably because Chatham ceased production of their 'padparadscha' sapphire in 1990, after commencing about 10 years before, with no plans to continue.

Materials and Methods

A variety of natural 'padparadscha' and similarly hued sapphires from Sri Lanka and Tanzania were obtained, as were a cut boule 'padparadscha' and a cut Chatham 'padparadscha'. Similarly coloured boule samples were also prepared to be examined. The stones were examined in a previously described magnetic resonance spectrometer[4]. The perpendicular spectrum, when the DC magnetic field is perpendicular to the trigonal axis of the sample, is readily found, and was recorded for each sample: for some samples, the parallel spectrum (DC magnetic field parallel to the trigonal axis) was also recorded. The microwave frequency used was in the vicinity of 9.2 GHz, and all measurements were carried out at room temperature.

Results

(a) Natural material

Figure 1 shows the perpendicular spectra for four natural stones from Sri Lanka: 'apricot', 'padparadscha', and close to 'pink'. All specimens showed Fe^{3+} signals, and contained various amounts of Cr^{3+}; the concentration of Cr^{3+} increased from 'apricot' to 'pink'. The variation in the relative intensities of the Fe^{3+} lines is due to the change in transition probabilities of the various lines as the direction of the DC magnetic field with respect to the microwave magnetic field differs.

Figure 2 shows the spectra of four natural sapphires, in the appropriate colour range, from Tanzania. It is seen that the Fe^{3+} lines are very much broader than in the Sri Lankan cases, and that there appears to be relatively less Cr^{3+}. This gives grounds for using magnetic resonance in helping to establish the point of origin of 'padparadscha'-like sapphires. In a previous study[2], it was already noted

 ISSN: 0022-1252

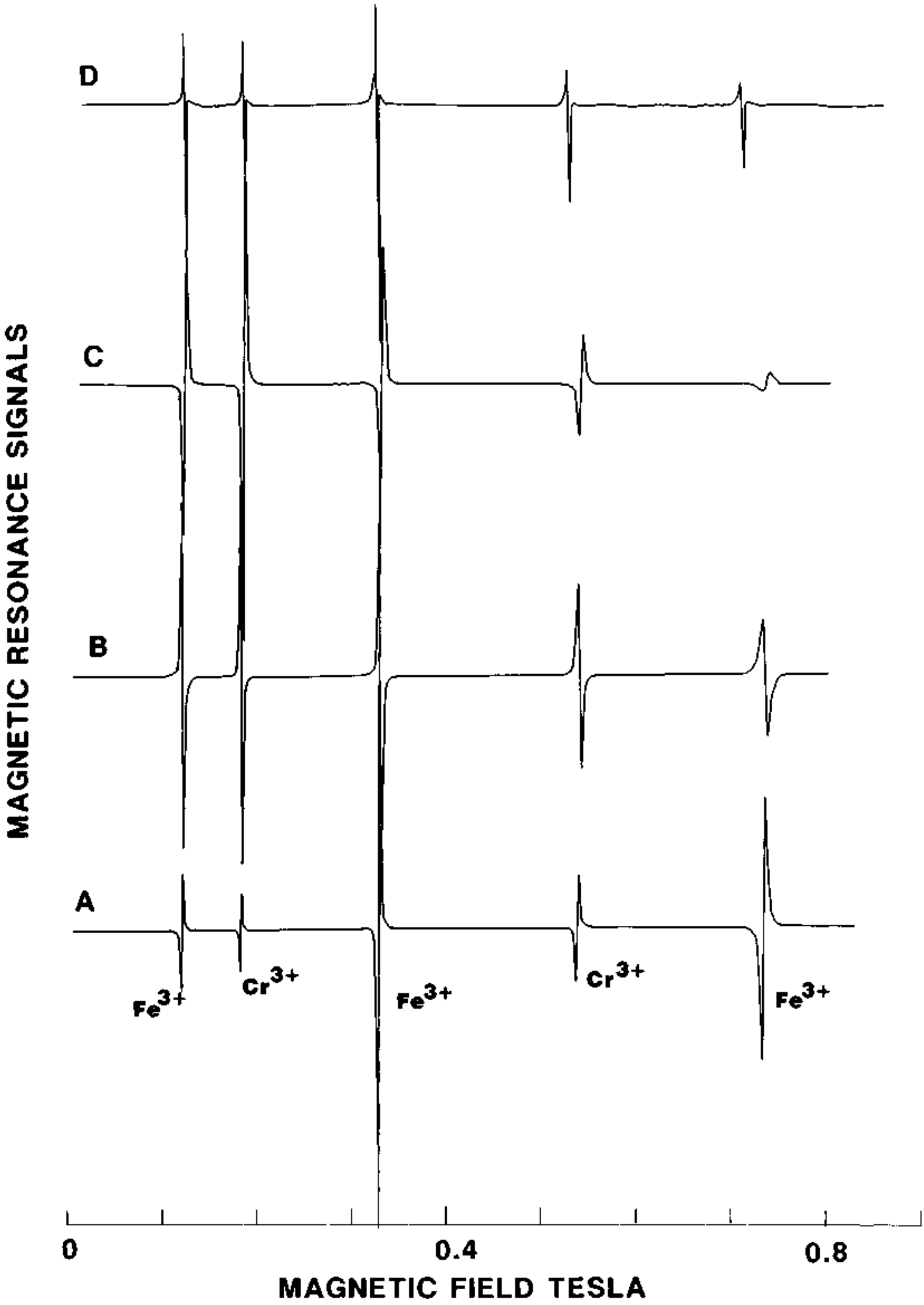


Fig. 1. Perpendicular spectra of 4 sapphires from Sri Lanka. A: 'apricot' sapphire; B: 'pink' sapphire; C: 'Padparadscha' (0.37 ct); D: 'Padparadscha' (0.74 ct).

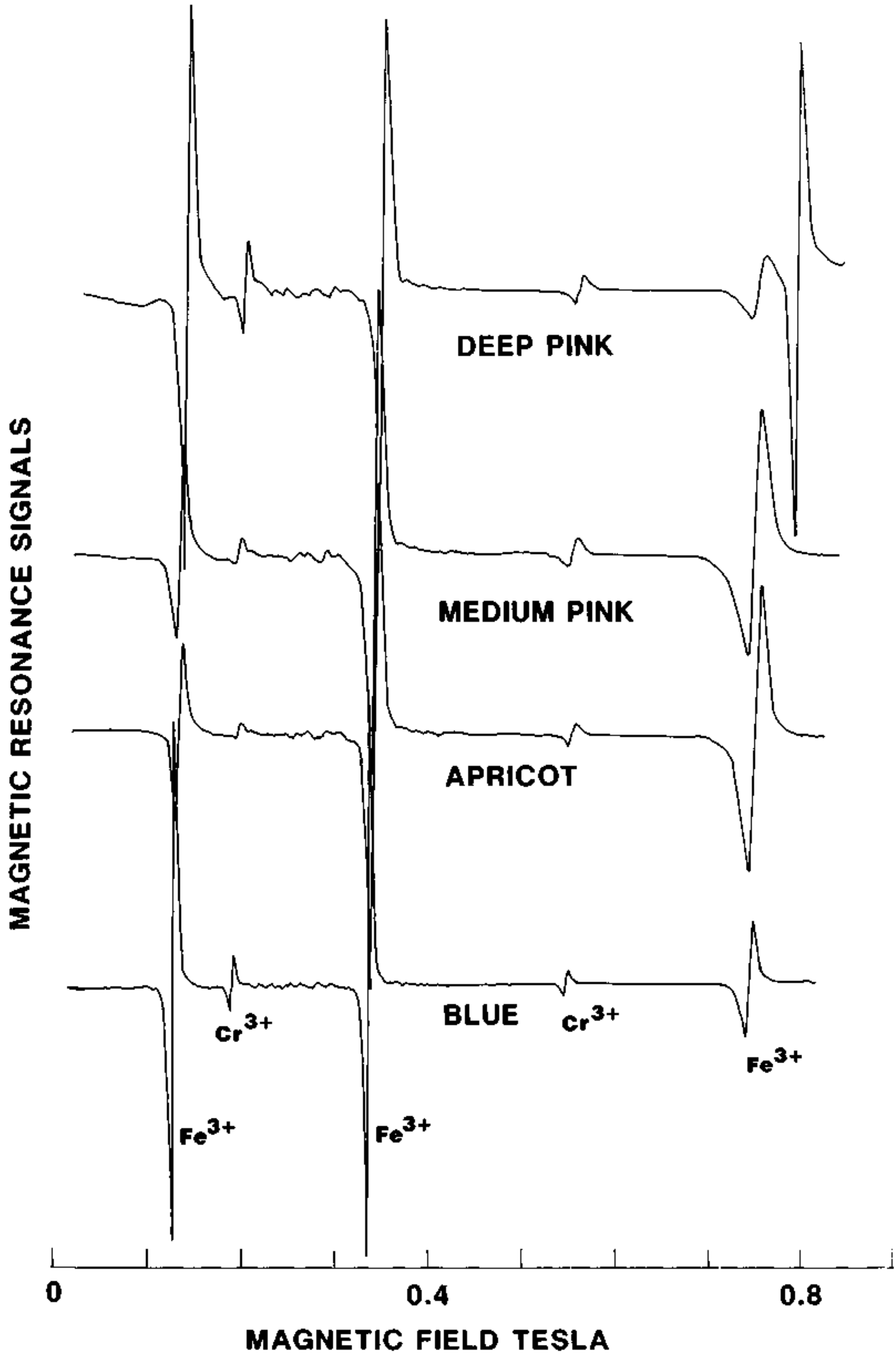


Fig. 2. Perpendicular spectra of 4 sapphires in the 'Padparadscha' colour range from Tanzania.

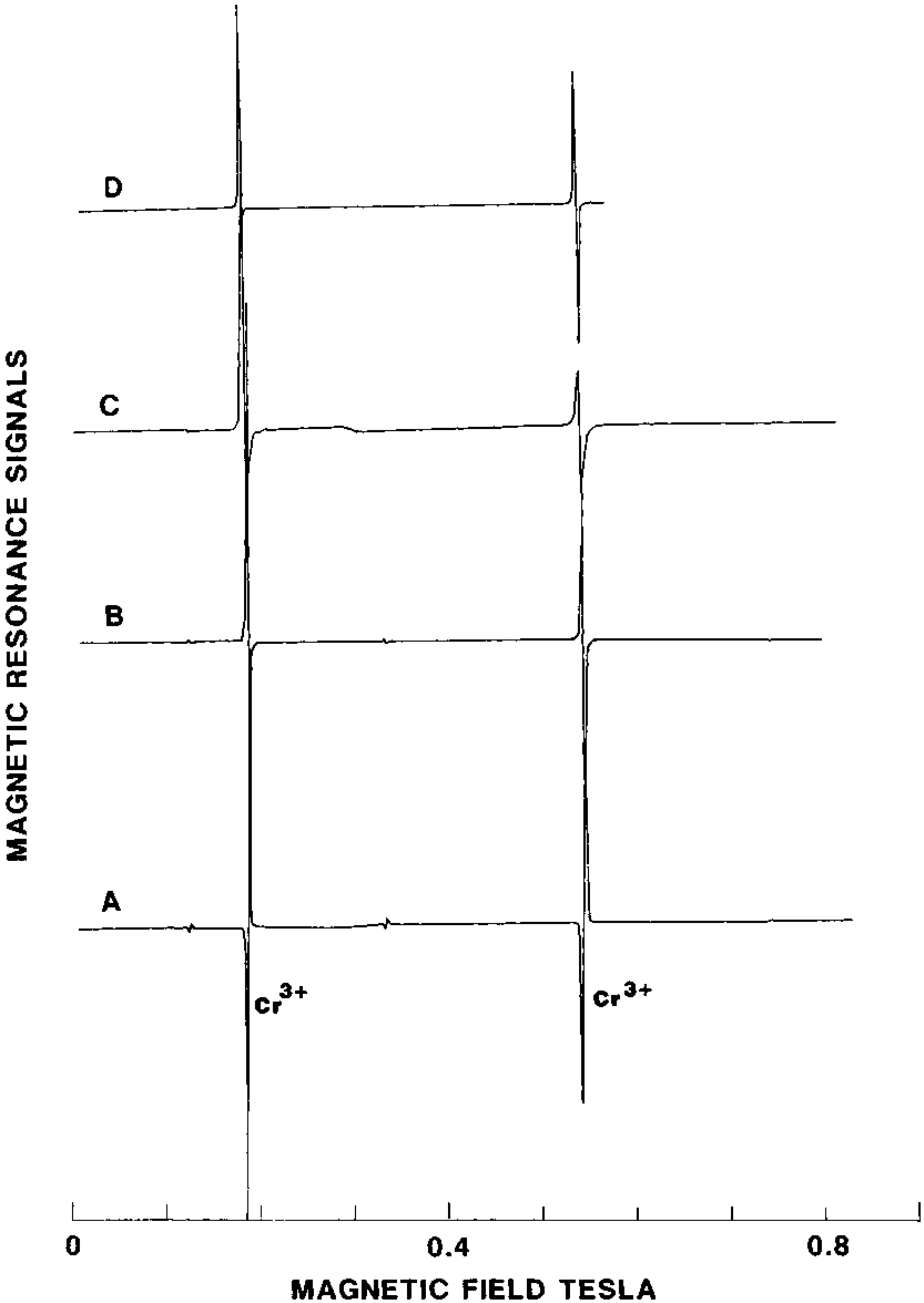


Fig. 3. Perpendicular spectra of flame-fusion (boule) synthetics, in the appropriate colour A: Orange; B: brown-red; C: purple; D: cut synthetic 'Padparadscha'.

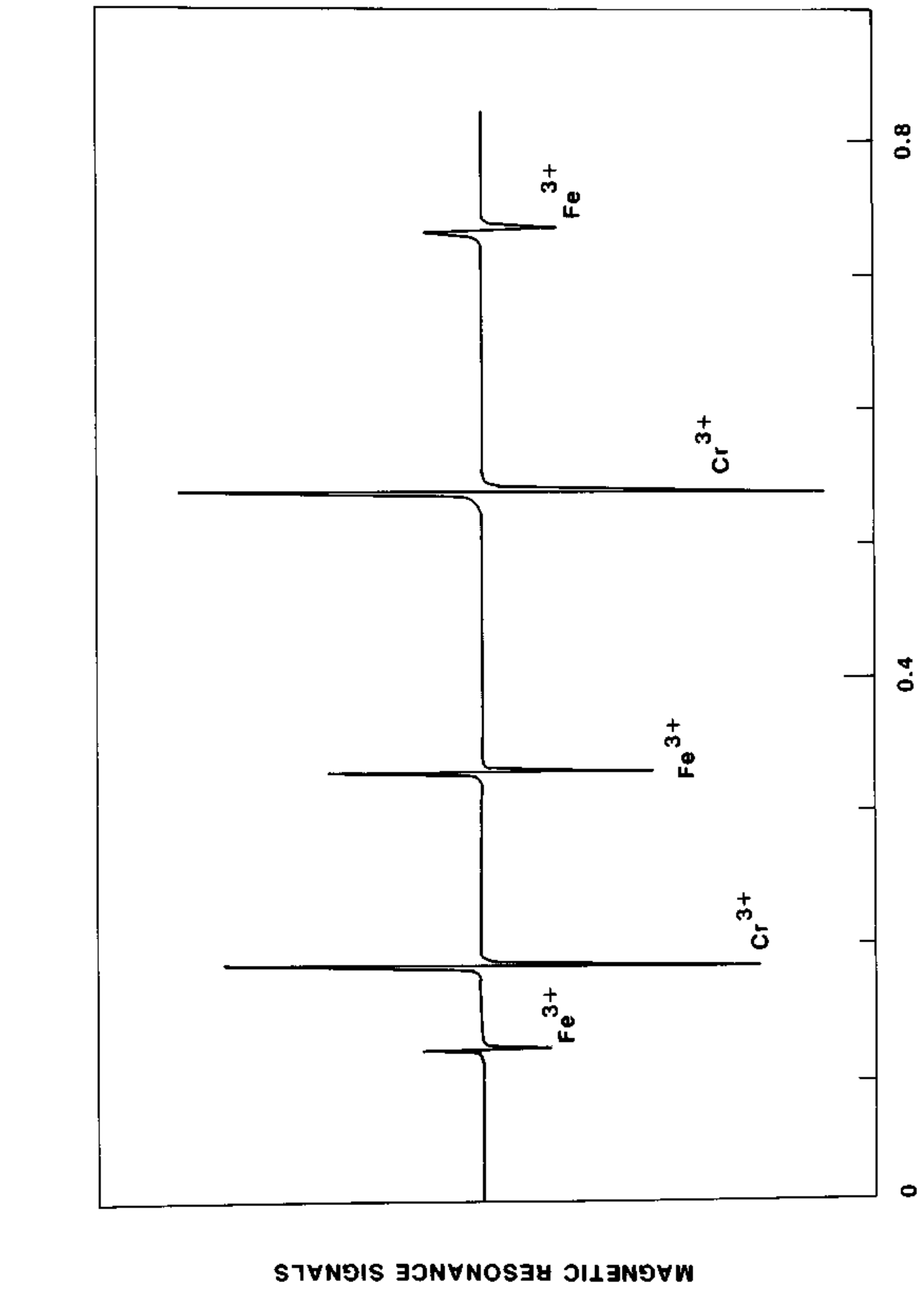


Fig. 4. Perpendicular spectrum of Chatham synthetic (flux-melt).

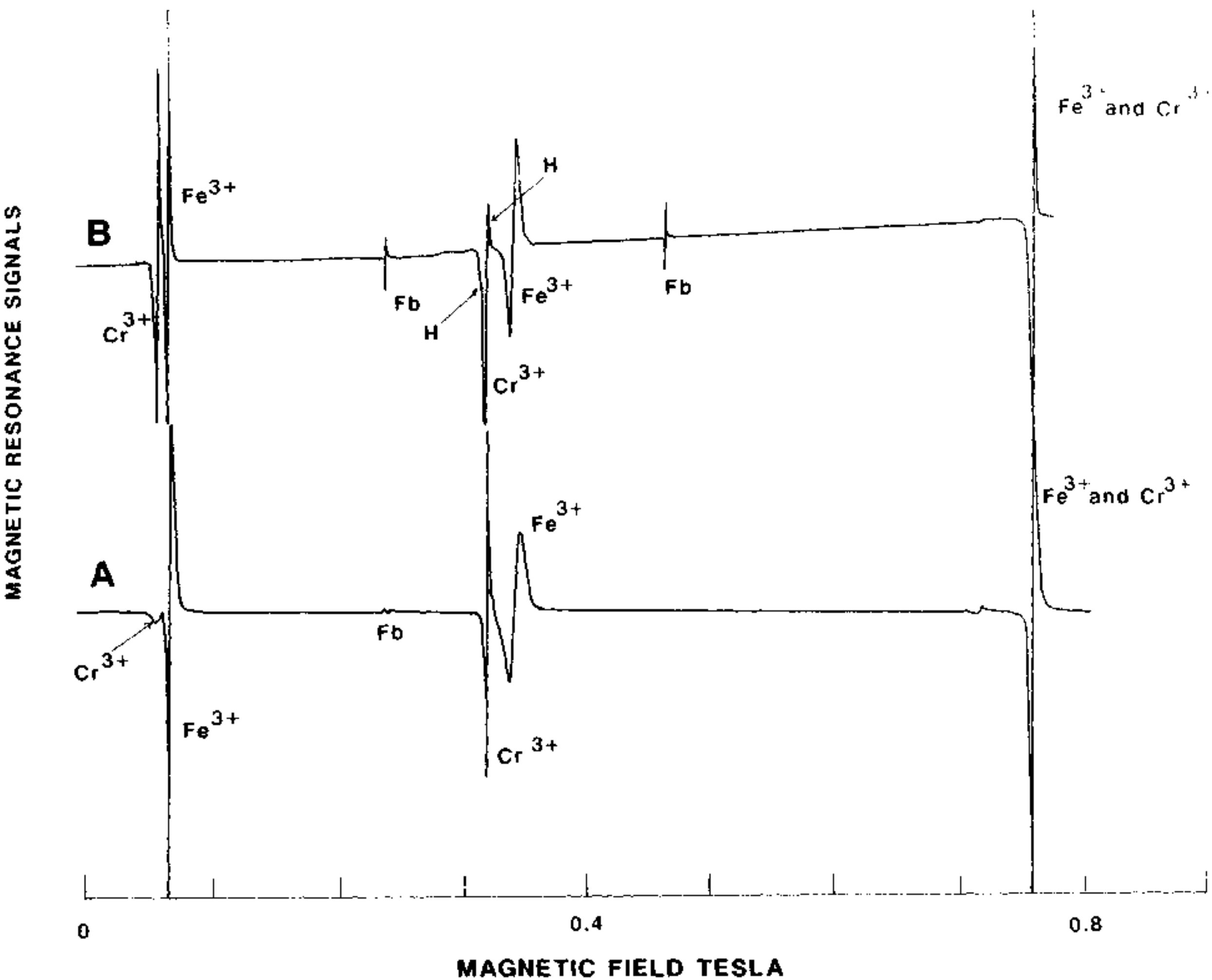


Fig. 5. Parallel spectra of A: Sri Lanka 'Padparadscha' (0.37 ct); B: Chatham synthetic. *H* means Cr^{3+} hyperfine structure; Fb means 'forbidden' transition.

that Sri Lankan sapphires had the narrower magnetic resonance lines.

(b) Synthetic materials

Figure 3 shows the perpendicular magnetic resonance spectra of four boule (synthetic) samples in the appropriate colour range, including a 'certified cut padparadscha'. It will be seen that the amount of Fe^{3+}, as judged from the signals, is very significantly (1:100) less than that in the natural stones of the two known provenances.

Figure 4 shows the perpendicular spectrum of the Chatham synthetic. While Fe^{3+} and Cr^{3+} are present, the lines are significantly narrower than those in even the best quality natural Sri Lankan stone. Figure 5 shows the parallel spectra of the best Sri Lankan 'padparadscha', and the Chatham synthetic. Significant differences are apparent.

Discussion

That synthetic 'ruby', 'brown sapphire' and 'yellow sapphire' made by the Verneuil process contain little Fe^{3+} in comparison to Cr^{3+} was already known[1]. The synthetics of intermediate hues, close to the 'padparadscha' range, could therefore be expected to behave similarly, and this has been verified. Therefore, a stone of 'padparadscha' hue, with little or no Fe^{3+}, is very likely to be from a boule.

Both Sri Lankan and Tanzanian naturals show comparatively large Fe^{3+} signals: the Fe^{3+} concentration is obviously larger in the Tanzanian stones, both because of signal height and of the much greater line width. As pointed out earlier, these properties can help in the determination of place of origin.

The Chatham synthetic is an extremely good synthetic 'simulant' of the natural spectrum. As pointed out in an earlier work[2], it is *too* good, because of the sharpness of the lines, which give an indication of crystal lattice perfection. A careful comparison with the best Sri Lankan 'padparadscha' spectrum will show that the lines of the Chatham stone are much narrower. As in previous work[2], for confirmation, it may be necessary to go to the parallel spectrum; the comparison is given in Figure 5, between the Chatham, and the best Sri Lankan 'padparadscha'.

Admittedly, the number of stones studied has been small, but the results are remarkably consistent. However, we would like to requote Barrington's[5] comments on the original work of Scala and Hutton[1]: 'Whilst the number of tests performed may fall short of ideal requirements for statistical proof, the uniformity of the results achieved point to the fact that this method is a worthwhile technique *where there is doubt**, and other more readily available tests are inconclusive'. Gemmological identification is based on a *battery* of tests, not one single test, and with this we agree. [*Our emphasis.]

Finally, Nassau and Valente[6] speculate, in accordance with their 'seven types of yellow sapphire' classification, that there may be seven types of 'padparadscha'. These types include synthetics and heat-treated material (synthetic and natural). The 'no iron' and therefore 'no Fe^{3+}' natural classification is very difficult for us to agree with. Work on Sri Lankan (and other) yellow sapphires will be the subject of a future publication.

Acknowledgements

We would like to thank Gillian Finch Inskeep, of Lanka Gems, Sonoma, California 95476, USA, for posing the original question. For obtaining natural and synthetic material of known provenance, we would like to thank Grant and Debbie Hamid, of Hamid Bros, Melbourne, Victoria, Australia; Julia Myers, of Affiliated Importers, Sydney, New South Wales, Australia; and the US suppliers, Chatham, New York 10036 for their 'padparadscha', and New Era, Grass Valley, California 95945 for the Tanzanian material; and E. Gamini Zoysa, Mt. Lavinia, Sri Lanka, for 'padparadscha' (natural).

References

1. Scala, C.M., Hutton, D.R., 1975. A definitive test for golden sapphires, *Australian Gemmologist*, 16, 160.
2. Anderson, Carole M., Hutton, D.R., Troup, G.J., 1981. Magnetic resonance distinction between synthetic and natural blue sapphire. *Australian Gemmologist*, 14, 87.
3. Crowningshield, R., 1983. Padparadscha: what's in a name? *Gems and Gemology*, 19, 30.
4. Hutton, D.R., Seed, T.J., 1966. Crystal rotation and orientation for Electron Spin Resonance Studies. *Journal of Scientific Instruments*, 43, 949-50.
5. Barrington, E.N., 1975. Electromagnetic resonance in yellow sapphires. *Australian Gemmologist*, 12, 159.
6. Nassau, K., Valente, G.K., 1987. The seven types of yellow sapphire and their stability to light. *Gems and Gemology*, 222.

[*Manuscript received 30 October 1991.*]

Gemmological Abstracts

ASTRIC, R., MERIGOUX, H., ZECCHINI, P., 1991. Etude theorique de l'aspect d'un diamant taille brillant en fonction de ses parametres de taille. *Revue de Gemmologie*, 107,

The brilliant cut for diamonds is described with notes on cutting parameters. Various versions of the brilliant cut are compared.

M.O'D.

BOSSHART, G., 1991. Les emeraudes de Colombie [continuation]. Revue de Gemmologie, 107, 7-12, 9 figs in colour.

French version of a paper first published in German. M.O'D.

BOWERSOX, G., SNEE, L.W., FOORD, E.E., SEAL II, R.R., 1991. Emeralds in the Panjshir Valley, Afghanistan. *Gems & Gemology*, 27, 1, 26-39, 19 figs.

A nicely illustrated paper on the emeralds and mines of a valley high in the Hindu Kush mountains north of Kabul. Access is very difficult, and the unsafe adit mines are high in the rugged limestone mountains several thousand feet above the villages. The emerald crystals are often colour-zoned with pale centres, most about 5 carats, but larger stones are found, including one of 190 carats. Crystal habit normal for emerald, but often eroded or etched. RIs (e) 1.574 and (o) 1.580 variable but generally high; SG 2.68 to 2.74; no reaction to UV; pink or orange under Chelsea filter; inclusions numerous, often multi-phased (brine, gas, and several different mineral crystals in cavities reminiscent of the jagged ones of Muzo), solid crystals include limonite, pyrite, a carbonate and feldspar. Most output is exported by mule-train to Pakistan where it is almost certainly oiled. The multi-crystal content of three-phase inclusions identifies provenance of these emeralds.

Area is thought to be producing about $10 million rough a year, cut stones available world-wide. With end of the Russian war production is expected to increase. R.K.M.

BRACEWELL, H., 1991. Gems around Australia, Part 5. *Australian Gemmologist*, 17, 11, 454-6, 5 figs.

The Bracewells, continuing their long tour, reached Kununurra some 200km north of the Argyle diamond mine and home of the red-striped siliceous argillite known as zebra stone. To Mrs Bracewell's surprise the difficult problem of polishing this strange form of sandstone is over-come by using a spray can of Dulux lacquer. Prehnite and quartz were found in this area but were scarcely worth extracting. The gold area of Hall's Creek, 370km south, billed a natural 'China Wall' of quartz as a tourist attraction, while Geiki Gorge to the west yielded some rather disappointing calcite.

R.K.M.

BRACEWELL, H., 1991. Gems around Australia, Part 6. *Australian Gemmologist*, 17, 12, 502-3, 2 figs and map.

Describes pearling and shell industry at Broome and its environs, including culture of large pearls since 1956 in Kuri Bay. Names on map are illegible.

R.K.M.

BRACEWELL, H., 1991. Faded amethyst. (Letter). *Australian Gemmologist*, 17, 12, 525.

Mrs Bracewell reports on a pair of amethysts which were mislaid in a dark cupboard for three years and faded to almost colourless. R.K.M.

BRAUNS, S., 1991. Nya Fyndorter under 1980-Talet. *Gem Bulletinen*, 1/91,7-9.

Brief details of gemstone finds during the 1980s are given. Adapted from a paper in Gems & Gemology 1990. M.O'D.

BRIGHTMAN, R., 1991. Gem quality almandine garnets from Antarctica. *Australian Gemmologist*, 17, 11, 470-3, 2 maps, 6 figs.

Crystal fragments collected in the Rauer Islands, Prydz Bay, Antarctica, were found to be dark red almndine garnet, RI 1.770 to 1.782, SG 3.955 to 4.040. Thin pieces had normal absorption spectra. Inclusions of rutile (?) silk, other crystals and large healed finger-print cracks were seen. Occurrence is unlikely to be exploited since there is an embargo on commercial mining. R.K.M.

BROWN, G., 1991. Quality assessment - to be or not to be? GAA Presidential Address. *Australian Gemmologist*, 17, 10, 393-6.

The President suggests that quality assessment and valuation should be taught in gemmology. [The idea is not new but its achievement is set with considerable difficulties: e.g. who is to decide what constitutes fine colour; who to fix prices and at what levels? How do impoverished schools acquire the fine stones to teach quality? Valuation is dependent on many years of buying and selling by people prepared to back their judgement with hard cash. Colour and quality are very much a matter of individual opinion and taste.] R.K.M.

BROWN, G., 1991. Corallium precious corals. *Wahroongai News*, 25, 11, 28-32, 2 figs.

A short paper based on researches of Professor Rick Gregg of University of Hawaii, dealing with *C. rubrum*, *C. secundum*, *C. konojoi*, *C. japonicum*, *C. nobile*, *C. elatius*, *C. regale* and a *C. sp. nov.* and principally concerned with the possible exhaustion of supplies of these precious corals in the next decade or so, due to over-fishing. R.K.M.

BROWN, G., 1991. Treated Andamooka matrix opal. *Gems & Gemology*, 27, 2, 100-6, 11 figs.

This carbon impregnated opal appeared in the 1950s [offered in London as 'completely natural black opal']. The matrix opal is shaped and polished, then heated to 105°C in a slightly acid 20% solution of glucose and lactose (1:4) until sugars solidify and darken. Stones are broken out and then boiled in concentrated sulphuric acid for five hours, and washed for several hours to eliminate residual acid. A final polish has to be light to avoid removing the shallow layer of carbon. [In London the first parcels were bought at high prices with a view to repolishing, a move which failed miserably].
R.K.M.

BROWN, G., 1991. Jewfish pearl. (Letter). *Australian Gemmologist*, 17, 12, 525, 1 fig.

A 'pearl' the size of a small human skull is illustrated, but comes from a sperm-whale, and is identified as an otolith (inner-ear bone). That of the jew-fish (jewel-fish) grows to about 4cm. R.K.M.

BROWN, G., BEATTIE, R., 1991. A new surface diffusion-treated sapphire. *Australian Gemmologist*, 17, 11, 457-9, 10 figs.

One parcel of Kanchanaburi sapphires purchased in Thailand for recutting in Australia, consisted entirely of rather crudely surface-diffusion treated stones which lost colour when repolished. Easily recognized after discovery by low-power magnification while immersed. Many imperfections, pock-marks, colour concentration at facet and girdle edges belied the good face-up colour. Authors say *'Caveat emptor!'* R.K.M.

BROWN, G., HAMID, D., 1991. A faded amethyst necklace. *Australian Gemmologist*, 17, 10, 426-8, 4 figs.

A necklace of tumbled light amethyst beads faded badly after prolonged exposure to window lighting and sunlight. A few beads shielded by the display case did not change but the rest had changed to pale citrine or colourless. [This fade factor in these stones appears to vary considerably with the origin of the amethyst, rather as does its reaction to heat. Some heat must have been involved here but this would probably have affected the covered section too if it was responsible for the change.] R.K.M.

BROWN, G., KELLY, S.M.B., 1991. Lechleitner coated corundums. *Australian Gemmologist*, 17, 10, 408-11, 14 figs.

Flux-coated seeds of synthetic or natural corundum have been produced by Lechleitner since 1983. 12 specimens of rough and finished gems were examined, gemmological properties corresponded with those of natural corundums, but wispy veils, reticulated fractures in the synthetic coating and curved colour striae in the synthetic seeds were easily seen. [The excellent colour illustrations here make it obvious that the seeds are crudely pre-formed and one would expect some patchy removal of the colour layer when finishing.] R.K.M.

BROWN, G., KELLY, S.M.B., BRACEWELL, H., 1991. Gemmology study reports. *Australian Gemmologist*, 17, 10, 417-25, 31 figs.

Reports on plastic imitation of walrus tusk scrimshaw with blebs of plastic in the 'engraved' lines; metz heshi devitrified glass by Iimori of Tokyo possibly imitating malachite; star ruby and sapphire imitations achieved by ruling flat base of synthetic corundums with lines intersecting at 120°; Czochralski pulled lithium niobate in various colours made to imitate fancy diamonds, RI 2.20 to 2.30, high DR and high dispersion 0.120 make distinction simple, SG also high (4.64), included bubbles. Basal and rhombohedral parting were seen in yellow sapphire crystal from Queensland; massive rutile from Mt Perry, Queensland, resembles hematite when polished; a carved opal doublet was from Lightning Ridge; profiled bubbles as in synthetic spinel [and synthetic rubies] found in Verneuil synthetic rutile; a jelly opal had been 'improved' by backing with black paint; zebra stripes in amethyst are discussed and illustrated; a bakelite imitation of amber had been carved with a drill, SG and RI too high for amber; influx of South Africans to Australia is bringing Zambian, Sandawana and other African emeralds in increasing numbers, excellent photomicrographs of Zambian inclusions are printed. R.K.M.

BROWN, G., KELLY, S.M.B., BRACEWELL, H., 1991. Gemmological study club lab reports. *Australian Gemmologist*, **17**, 11, 475-8, 15 figs.

Green smithsonite; Gilson triplet opals; inclusions in synthetic spinel; imitation pearl made from fish jaw-bone; faceted sodalite; South African 'jade' (hydrogrossular garnet); Mississippi mussel nacre cabochons and agatized dinosaur bone are examined and reported upon. R.K.M.

BROWN, G., KELLY, S.M.B., BRACEWELL, H., 1991. Gemmology study club reports. *Australian Gemmologist*, **17**, 12, 526-31, 16 figs.

Deals with heated cornelian known as 'Fires of Mt Warning'; cat's-eye emerald; a green doublet which seemed to have quartz crown and natural beryl base [cutters have been known to dop doublets upside down by accident]; an imitation star sapphire doublet [?] which had both dome and base of cobalt blue spinel, and three intersecting sets of scored lines at its back; a dubious Chinese turquoise that was proved to be natural; a new focusing pen torch useful for microscopy; a new imitation jade from Kowloon identified as dyed calcite coated with wax; a natural sapphire/synthetic ruby doublet, set to conceal the girdle, which was identified by careful scrutiny by binocular microscope; and a large crystal of ekanite from Ratnapura which weighed 210 grams. R.K.M.

CASSEDANNE, J.-P., ALVES, J.-N., 1991. L'aigue-marine au Bresil-I. *Revue de Gemmologie*, **107**, 13-16, 7 photos (2 in colour), 2 maps.

First part of a paper on Brazilian aquamarine describing pegmatitic and alluvial occurrences with notes on the general geomorphology of the areas described. M.O'D.

CAVENEY, R.J., 1991. De Beers Research Laboratory Report 1991. *Indiaqua*, 1991, 241-6, 22 figs (21 in colour).

The Laboratory has synthesized a 14.2 ct industrial diamond crystal of good quality which is thought to be the largest yet to be manufactured. Over 500 hours of high temperature/high pressure running was needed to complete the synthesis. The crystal is yellow, the colour being attributed to nitrogen. In general synthetic single crystals of this type are sliced for industrial products rather than used in jewellery. M.O'D.

[Abstractor's note: *Indiaqua* now appears annually rather than quarterly.]

CHIPENKO, G.V., et al., 1990. A new habitus type of diamond crystal. *Doklady Akademii Nauk SSSR*, **312**, 1990, 876-9 (in Russian). Abstr. *Industrial Diamond Review*, **51**, 1991, 148.

Describes the production of a new synthetic diamond crystal habit by the recrystallization method. The major factors influencing the growth of this form of diamond crystal are found to be temperature, rate of transfer of carbon and amount of nitrogen present. The crystals are characterized by the predominance of an unusual combination of forms, mainly of the (111), (110) and (311) forms. E.S.

COENRAADS, R.R., VAN DER GRAAF, R., 1991. An occurrence of gem garnets from Horse Gully in New England gemfields, New South Wales. *Australian Gemmologist*, **17**, 10, 412-15, map and 4 figs.

Pyrope-almandines of red to purplish colours have been found in association with sapphires and other gems, some with slight tendency to colour change to orange red in incandescent light. RIs vary from 1.759 to 1.772 in the seven stones examined, euhedral crystals probably of apatite were included. [A small inset map has towns of Inverell and Glen Innes transposed.] R.K.M.

EDIRIWEERA, R.N., PERERA, S.I., WEERASINGHE, W., 1991. Method of creating required atmospheric conditions within crucibles placed inside a furnace. *Australian Gemmologist*, **17**, 11, 443-5, 3 figs.

A simple and inexpensive way to pipe oxygen or reducing gases through a furnace base to surround geuda sapphire or other stones during heat treatment. R.K.M.

FRYER, C.W., Ed., CROWNINGSHIELD, R., HARGETT, D., HURWIT, K.N., 1991. Gem Trade Lab notes. *Gems & Gemology*, **27**, 1, 40-5, 18 figs.

An alexandrite had figures and initials scratched just below the girdle, natural turquoise-coloured chalcedony from Mexico is to be marketed; a 1.07 ct grey-blue diamond was exceptionally electro-conductive; a sharply zoned emerald was suspected as doublet but a fracture crossing the 'join' proved otherwise; a rare banded Afghan lapis lazuli was seen.

Iolite and coloured moonstone necklaces were seen and considered unusual; natural bronze pearl reported fished from La Paz area of Baja, California, suggest that a naturally destroyed former source has regenerated; 17mm cultured pearls seen by East Coast Lab, one thinly coated, the other exceptionally thick nacre.

A large antique cabochon emerald and diamond pendant had been enlarged by adding diamond set cultured pearls of much later date; Verneuil ruby had cut 'natural' crystal prism, pinacoid and rhombohedral faces; an orange-red flux-grown synthetic corundum had straight banding [gemmologists need to be wary of all kinds of deception].

A weak star sapphire revealed surface diffusion treatment for both star and colour enhancement, the dual surface diffusion process has not been a commercial success, it is questioned whether heat-treatment of star material to produce clean and facetable crystals is depleting supply of star stones; six calibrated blue synthetic sapphires had unusual triangular two-phased inclusions. R.K.M.

FRYER, C.W., CROWNINGSHIELD, R., HARGETT, D., MOSES, T., HURWIT, K., KANE, R.E., 1991. Gem Trade lab notes. *Gems & Gemology*, 27, 2, 108-14, 19 figs.

An amber necklace 'washed' in alcohol had developed a white 'bloom' and lost its polish; electron-treated coloured diamonds are recently more numerous and a 37ct yellow was identified as irradiated by colour zoning near the culet; another old-cut yellow diamond was found mounted in an art nouveau brooch, but was again a treated stone although the brooch apparently dated from before the treatment was available; a 'filled' crack in a diamond had anomalous orange and green flashes against dark ground illumination [these colours would surely vary with the width of the crack?]; a light green octahedron was a predicted pale yellow when cut, the GR1 absorption band was present in the green coating, but was lost when that was cut away; two instances of irradiation staining in etch cavities in cut diamonds are illustrated and theorized upon.

A cultured pearl with nacre covering only half the bead was examined, the other half was pinkish brown and non-nacreous for reasons unknown; 'rose-bud' pearls forming a necklace were typical products of the American fresh-water *Unio* mussel; a pair of cultured blister pearls were found to be plugged, and therefore assembled, when X-rayed.

An early flux-grown synthetic ruby had a natural seed with a blue outline; a violet spinel became pinkish purple in incandescent light and fluoresced chalky green in LUV; a cobalt blue synthetic spinel had veil inclusions possibly due to strain; a blue topaz had 'lightning' streaks of damage due to radiation treatment; a radio-active low zircon [green?] emitted 0.4 milliroentgens per hour and would probably be unsafe to wear, no uniaxial interference figure could be obtained. R.K.M.

FRYER, W., CROWNINGSHIELD, R., HARGETT, D., MOSES, T., HURWIT, K., KANE, R.E., 1991. Gem Trade Lab notes. *Gems & Gemology*, 27, 3, 174-9.

A rare hexagonal pit (combined positive and negative trigon) and a quite extraordinary hexagonal acicular tube in diamond are illustrated and explained; a type IIb blue diamond exhibited natural radiation stains on its girdle – first time this has been noted.

A 15.17ct 'accidental' sea-water tissue-nucleated cultured pearl, is probably the largest so far seen – it is thought that none are in deliberate production; an unusual greenish-black necklace of natural pearls had been dyed; another black necklace had been dyed except for two pearls which were naturally black and appeared brownish on immersion and gave a chalky-green colour under LUV; a bullet-shaped cultured pearl of natural colour had a deep hole in its back which was partly filled by another natural black cultured pearl, author speculates on how this could occur.

A pendant earclip had a half-drilled pearl which was 'smooth to the teeth' and identified initially as imitation, but X-rays showed it to be cultured which had been worked (polished). The Tucson Show offered white mabe pearls with strong pink over-tones due to a plastic core with a reflecting lacquer coating; a pair of matching mabe also had lacquer on their inner surfaces but one lacked a solid insert.

A pendant drop of diamonds and 94 calibre rubies contained only 8 natural rubies, the rest being early synthetics, possibly Geneva rubies cut from pea-sized boules, pre-Verneuil synthesis. A final note is made of the resurgence of diffusion treated sapphires since early 1990; the trend continued in 1991 and some large ones have been found in important jewellery. Writer advises all sapphire be checked by immersion as the safest way to detect this colour faking. R.K.M.

GEHRMANN, A.L., 1991. Der Granatenkogel (3.304mm). *Mineralien Welt*, 2, 4, 53-6, 9 photos (6 in colour), 1 map.

Crystals of almandine are found on the Granatenkogel in the Otztaler Alps of the Austrian Tirol. Well-formed crystals up to 5cm are reported though most are not of gem quality. M.O'D.

GIL IBARGUCHI, J.I., MENDIA, M., GIRARDEAU, J., 1991. Mg- and Cr-rich staurolite and Cr-rich kyanite in high-pressure ultrabasic rocks (Cabo Ortegal, north western Spain). *American Mineralogist*, **76**, 501-11, 9 figs.

Green pleochroism of staurolite and blue pleochroism of kyanite (in non-gem crystals from the Cabo Ortegal complex in north-western Spain) are attributed to substitution of Al by Cr in octahedral sites. It is suggested that Mg- and Cr-rich staurolite and Cr-rich kyanite were stable through ecologitic composition. Although the Cr contents of kyanite and staurolite could indicate Cr-rich bulk composition the occurrence of small colourless Cr-poor kyanite included in matrix minerals and blue Cr-rich matrix kyanites suggests increasing Cr substitution in kyanite with increasing pressure and temperature. M.O'D.

GRIGG, R.W., BROWN, G., 1991. Tasmanian gem corals. *Australian Gemmologist*, **17**, 10, 399-404, 42 figs.

Several species of bamboo, gold and black varieties of coral have been accidentally trawled off South Tasmania while catching deep water fish known as 'orange roughy'. Morphology, hand-lens characteristics and gemmological properties are given. Trawl-net damage is costly and these finds are not welcomed by fishing fraternity. R.K.M.

HÄNNI, H.A., SCHMETZER, K., 1991. New rubies from the Morogoro area, Tanzania. *Gems & Gemology*, **27**, 3, 156-67, 16 figs.

A new find of red to blue spinels contained about 10% of cabochon quality ruby, a few of which would facet. Treacly swirls and angular zoning were seen and a few stars were cut. Some crystals pseudo-octahedral with angles more acute than in spinel. Twin lamellae and colour planes parallel with the rhombohedral faces, negative crystals, fissures, rutile silk, apatite and spinel inclusions were also found. These stones resemble Burma material in type while earlier Morogoro rubies do not. R.K.M.

HASSAN, I., GRUNDY, H.D., 1991. The crystal structure and thermal expansion of tugtupite $Na[Al_2Be_2Si_8O_{24}]Cl_2$. *Canadian Mineralogist*, **29**, 385-90, 2 figs.

Tugtupite, a sodalite group mineral, has fully ordered framework *T* cations [where *T* represents Al^{3+}, Be^{2+} and Si^{4+}], the order lowering the symmetry from cubic (as in a number of sodalite group minerals) to tetragonal. Large Si-O-Be angles are typical of the structure and these angles are larger than those in helvite group minerals. Thermal expansion is controlled largely by rotations of the TO_4 tetrahedra. The thermal expansion was modelled using the *DLS* program, the crystal structure was obtained by using an automated single crystal four-circle X-ray diffractometer using MoKα radiation. M.O'D.

HENN, U., 1991. Geschliffener Aegirin und Aegirin-augit aus Norwegen. (Cuttable aegirine and aegirineaugite from Norway.) *Zeitschrift der Deutschen Gemmologischen Gesellschaft*, **40**, 1, 69-71, 1 graph, 1 table, bibl.

The material comes from the Langesund fjord in southern Norway and is a mixed mineral between diopside and acmite. Physical properties are given. E.S.

HENN, U., 1991. Burma-type rubies from Vietnam. *Australian Gemmologist*, **17**, 12, 505-9, 10 figs and map.

Another report on the heavily included Burma type rubies found in marble, northwest of Hanoi near the China border. Constants are normal, twinning more common and solid inclusions less so than in Burmese stones. R.K.M.

HENN, U., BANK, H., 1991. Epidot von der Knappenwand im Untersulzbachtal, Österreich. (Epidote from the Knappenwand in the Untersulzbach valley in Austria.) *Zeitschrift der Deutschen Gemmologischen Gesellschaft*, **40**, 1, 1-9, 13 figs, 2 tables, bibl.

The best known source of epidote in Europe is the Knappenwand in the valley of the lower Sulz in Austria. This has been worked for 125 years and from time to time crystals of cuttable quality are found. Some of this material has been examined: n_x = 1.731-1.738, n_y = 1.748-1.753, n_z = 1.761-1.773. DR 0.031-0.036, SG 3.37-3.44. Typical inclusions are byssolite, calcite, apatite as well as liquid inclusions and growth zoning. E.S.

HENN, U., BANK, H., SCHUPP, F.J., 1991. Rubine aus Vietnam. (Rubies from Vietnam.) *Zeitschrift der Deutschen Gemmologischen Gesellschaft*, **40**, 1, 25-8, 8 figs, bibl.

The rubies seem to come from the Huang Lien Son Province, about 250km north-west of Hanoi. The colour of the rough crystals varies from pale red to red, sometimes with a distinct violet hue. Weak pleochroism, red to yellowish-red. Physical data lie within known range of corundum. The colour is caused by Cr^{3}. Inclusions are healing cracks, fluid inclusions, lamellar twinning, hollow tubes, rutile dust, rounded crystal inclusions, cracks and growth lines. E.S.

HLAING, U.T., 1991. A new Myanmar ruby deposit. *Australian Gemmologist,* **17**, 12, 509-10, 1 fig.

The first published report of rubies from Mong Hsu area of Shan State, S.E. Myanmar [Burma]; four stones examined were rather poor. R.K.M.

HODGKINSON, A., 1991. Synthetic red spinel. *Australian Gemmologist,* **17**, 11, 466-8, 1 fig.

Inspired by queries about identifying flawless red spinels, the paper offers answers based on the blue/red crossed filter technique advocated by Anderson to detect chrome fluorescence and now offered in solid filter form by McCrone Instruments. [Many red spinels do not fluoresce and I doubt if this paper necessarily solves the problem of distinguishing them.] R.K.M.

HOLZHEY, G., 1991. Feueropal aus Aleksejewskoje, Kasachische SSR, UdSSR - ein Beitrag zu vergleichenden gemmologisch-mineralogischen Untersuchungen mikrokristalliner SiO_2 Minerale. (Fire opal from Aleksejewskoje, Kazakstan in the USSR - a contribution to comparative gemmological-mineralogical examinations of microcrystalline SiO_2 minerals.) *Zeitschrift der Deutschen Gemmologischen Gesellschaft,* **40**, 1, 11-23, 2 colour photographs 5 photomicrographs, 3 graphs, 1 table bibl.

The Russian fire opals from Aleksejewskoje are compared with those from Zimapan, Mexico. RI (1.448) and SG (2.06) are average. The submicroscopic structure with a system of cracks can be compared with other microcrystalline SiO_2 minerals such as agates and point to a primary gel-like state of silicic acid. The trace elements show a higher content of non-volatile constituents suggesting a granitic host for the fire opals. E.S.

HOOVER, D.B., 1991. Peridot or sinhalite? (Letter). *Australian Gemmologist,* **17**, 12, 524.

On detection of sinhalite by its greater thermal conductivity; further applications of the method are discussed. R.K.M.

HOSAKA, H., 1991. Observations on hydrothermally synthesized massive agate-like crystals. *Australian Gemmologist,* **17**, 12, 503-5, 6 figs.

A diagram suggests that quartz is deposited, rather in the order found in a natural geode, at the hotter end of an autoclave instead of the cooler end; cristobalite was the source powder. R.K.M.

KAMMERLING, R.C., KOIVULA, J.I., 1991. Identifying features of filled diamonds in review. *South African Gemmologist,* 5, 2, 10-16, 7 figs (2 in colour).

Signs of filled diamonds are described and illustrated. M.O'D.

KAMMERLING, R.C., KOIVULA, J.I., 1991. Rough grinding pavilions for intentional light scattering. *South African Gemmologist,* 5, 2, 17-21, 3 figs in colour.

Rough grinding of the base in some synthetic stones causes light scattering and a more natural appearance when stones are examined face up. Ruby and blue synthetic spinel are illustrated. M.O'D.

KAMMERLING, R.C., KOIVULA, J.I., FRITSCH, E., 1991. Characterization of a so-called 'Reconstructed lapis lazuli'. *Australian Gemmologist,* **17**, 11, 450-3, 3 figs.

A convincing new imitation consisting of barium sulphate with pyrite inclusions, bonded in a polymer, was translucent to a powerful light placed behind it. Natural lapis would have been opaque. SG 2.31 is low, while RI 1.55 is too high for true lapis. 'Reconstructed lapis lazuli' is a misnomer. [Darker blue around pyrite inclusions normal to most natural lapis seems to be absent.] R.K.M.

KAMMERLING, R.C., KOIVULA, J.I., FRITSCH, E., 1991. Plastic imitation opals purchased in Thailand. *Australian Gemmologist,* **17**, 12, 498-501.

Bracelets of plastic imitation opals were liberally infested with gas bubbles and owed their colour-play to fragments of film or laminate, they gave broad bands at 560, 608 and 650nm plus a background of fine lines through the whole spectrum. Superficially similar to Slocum Stone. R.K.M.

KAMMERLING, R.C., KOIVULA, J.I., FRYER, C.W., 1991. An unusual imitation jade carving. *Zeitschrift der Deutschen Gemmologischen Gesellschaft,* **40**, 1, 29-32, 3 photographs, 3 photomicrographs, bibl.

The jade carving - a sphere - was bought in the jade market in Kowloon, Hong Kong. It is pierced and carved, weighs 933.50 ct and ranges from 52.0-53.3mm in diameter. It is opaque except in thin edges, where it is semitransparent. Colour varies from dark reddish-brown to medium yellowish-brown to vivid dark yellowish-green. It was found to be a rock consisting of calcite and lesser amounts of serpentine, possibly a serpentine marble called ophicalcite. The sphere had been selectively dyed brown in the calcite areas and green in the serpentine areas, the whole piece being wax or paraffin coated. E.S.

Kammerling, R.C., Koivula, J.I., Kane, R.E., Maddison, P., Shigley, J.E., Fritsch, E., 1991. Fracture filling of emeralds. Opticon and traditional 'oils'. *Gems & Gemology,* 27, 2, 70-85, 17 figs.

Compares the epoxy resin 'Opticon' with Canada balsam and with cedarwood oil when used as fillers for surfacing cracks in emerald. All may be damaged in cleaning by ultra-sound or steam, or by heating in repair of a mount, but Opticon is less prone to damage in cleaning. The epoxy resin is applied by soaking the emerald in hot filler followed by a surface coating of hardener which is removed after ten minutes. The filling is hardened at the surface but remains liquid within the filled crack.

GIA advocate the use of the wording 'Foreign matter is present in some fractures reaching the surface', rather than 'oiling' which does not apply to all treated stones. Filled surface flaws can be expected in stones other than emeralds and colour is sometimes added with the filler. Other substances are also being used as fillers. R.K.M.

Kane, R.E., McClure, S.F., Kammerling, R.C., Khoa, N.D., Mara, C., Repetto, S., Khai, N.D., Koivula, J.I., 1991. Rubies and fancy sapphires from Vietnam. *Gems & Gemology,* 27, 3, 136-55, 32 figs.

An important paper on new sources of ruby and pink sapphire from the Luc Yen and Quy Chau area in Northern Vietnam. Other localities in the south are not yet worked commercially. Aquamarine and colourless topaz have been found near Quy Chau.

Mining is principally by open-pit, with much contrabanding by 'independent' miners, most crystals small. Gemmological constants as expected for corundum; twin laminations; inclusions largely reminiscent of Burmese or Thai rubies plus some unique to this locality. Stones not heated at mine but may be treated later.

Dark blue colour zones common in the rubies and colour is generally patchy, swirled and treacly, bluish clouds, and whitish ones of larger particles also common, and iron stained fractures exceptionally so. Acicular needles thought to be boehmite; crystals of included apatite and calcite were identified while opaque rods proved to be pyrrhotite and not rutile. Less often stones contained orange crystal patches of the rare mineral nordstrandite, new in corundum; phlogopite mica was also seen. Rubies of similar type are found across the border in China and possibly in Laos. Further gem areas are expected and the whole region could become a significant source of ruby. Illustrations on neutral backgrounds seem to depict the colour and quality nicely. R.K.M.

Keeling, J.L., 1991. Review of a new theory on emerald formation in schist deposits. *Australian Gemmologist,* 17, 11, 440-2.

Recent studies of Habachtal (Austria) and Leydsdorp (Transvaal) emeralds by Grundmann and Morteani of Munich University suggest that emerald in biotite mica schists has formed in the course of low-grade regional metamorphosis. [A paper more interesting to petrologists than to the average gemmologist.] R.K.M.

Kirkley, M.B., Gurney, J.J., Levinson, A.A., 1991. Age, origin, and emplacement of diamonds: scientific advances in the last decade. *Gems & Gemology,* 27, 1, 2-25, 20 figs.

A detailed account of basic knowledge of diamond formation arrived at in the 1980s which estimates the probable age range as between 990 and 3200 million years (My) based on age-dating of inclusions of garnet, pyroxenes, etc., by assessment of radio-active residues. These findings have added a great deal to the understanding of diamond origin deep in the earth's mantle and it is now considered likely that they are xenolithic, having formed in eclogite under enormous pressure before being carried some 150km to the surface, in upsurges of kimberlite or lamproite, from a molten zone in the mantle. It is also thought that the carbon source of diamond is either CO_2 or methane, rather than coal [or oil?]. Processes involved are extremely complex and still appear to be far from completely understood despite these advances. An interesting though complex subject well treated here. R.K.M.

Kleyenstuber, A., 1991. Observation of inclusions in a Madagascar emerald and their possible implications. *South African Gemmologist,* 5, 2, 4-9, 6 figs (4 in colour).

An emerald from Madagascar weighing 32.50 ct and cut as an oval cabochon contained black mica flakes and fracture fillings of yellow goethite as well as elongated hollow growth channels, apparently devoid of mineral or liquid filling and a large individual hexagonal crystal with distinct yellow to green pleochroism. This is tentatively identified as apatite or tourmaline.
M.O'D.

KOIVULA, J.I., KAMMERLING, R.C., 1991. Gemological examination of a red taaffeite. *Zeitschrift der Deutschen Gemmologischen Gesellschaft*, **40**, 1, 33-7, 1 fig., bibl.

The stone is a well-proportioned oval modified brilliant-cut of intense, medium-dark, slightly brownish-red colour. The weight was confirmed as 0.58 ct. Measurements 5.21 x 4.43 x 3.51 mm. Said to be the largest and only second reported red taaffeite. Properties were identical to those reported in literature for the only other known taaffeite of this colour. E.S.

KOIVULA, J.I., KAMMERLING, R.C., 1991. Gem news. *Gem & Gemology*, **27**, 1, 46-55, 19 figs.

A general report on this year's Tucson Show:

Diamonds

Coloured diamonds increase in number each year, mostly treated, commonly to blue, yellow and to browns with grey or green overtones; natural colours are declared as such; irradiated stones are not - [a reversal of the required practice!] three Russian synthetic yellow diamonds had no colour zoning.

Coloured stones

Blue-green apatites from Madagascar were there again but heat sensitivity makes faceting difficult; bead materials included a banded dolomite, fluorite and brecciated pyrite; a cat's-eye beryllonite, looking like ulexite, was rare enough to purchase for the GIA permanent collection; a 2.89 ct clinohumite was the largest so far seen; sapphires were available in profusion, mostly heat-treated Montana; also some Brazilian sapphires, again some with colour change; and some so-called padparadschas from Umba region of Tanzania.

Thais are fashioning cubic zirconia and other stones in square and rectangular brilliant styles very effectively; drusy agate, black and pale purple quartz, pyrite-rich lapis lazuli and other gems were shown in carved forms; some small Uralian beryl and light emeralds were examined; Alta Ligonha, Mozambique, is producing pale morganite; white opal from Piaui State and blacks from Boi Morto, Brazil, were also seen, some too porous to take a good polish and some layered in a spectral sequence of colours.

Cultured pearls from Tahiti were the best yet, with many fine strands of large blacks; small peridot from Arizona were plentiful and a 131.89 ct one from Burma was also seen, as were bi-colour amethyst/rock-crystal; cat'seye rose quartz; faceted rhodolite garnet from Orissa, India, and a violet scapolite cat's-eye from Burma with low birefringence.

Tanzanite mines are being worked under Tanzanian Army supervision to stop illegal diggers, plenty of these stones seen at Tucson; Paraiba blue tourmaline again much in evidence; further Vietnam finds of ruby are reported from Luc Yen near Hanoi, and sapphires from the south.

Enhancements

Plasticised Alberta ammonite shell, and dyed and plastic coated Paua shell are reported; coloured Opticon is being used to fill emerald cracks; Sri Lankan rubies heated by blow-pipe; diffusion treated sapphires from Bangkok were plentiful but similarly treated rubies are not successful due to blue chromophores in the material.

Synthetics and Simulants

A light coloured synthetic alexandrite from J.O. Crystals exploits the pleochroism as well as the colour change, bubbles and zoning were seen; Chatham had some 'cleaner' synthetic emeralds, and some extremely large crystals of flux-grown ruby with clean areas, they have no plans to market padparadschah synthetic corundum; Pool emeralds are now offered as Kimberley Created Emeralds; less dense silicon (2.33) is being used to replace heavy hematite (5.20) for bead material although less black in colour; a natural looking imitation lapis lazuli was translucent to intense light and weakly fluorescent to SUV, inert to L W , plastic binder suspected; gold-quartz/white ceramic doublets were seen; Soviet synthetics included the flux-grown purple/ red spinels, flux-grown alexandrite; hydrothermal beryl in a range of colours; synthetic emerald on tumbled aquamarine seeds; much synthetic quartz, advertised as Siberian Blue Quartz; synthetic tanzanite and tourmaline are hinted at but the Russian word for synthetic is the same as for imitation, so these are probably imitations, a similar mistake occurred when they claim large faceted CZ gems to be 'synthetic' diamonds.

R.K.M.

KOIVULA, J.I., KAMMERLING, R.C., 1991. Gem News. *Gems & Gemology*, **27**, 2, 116-25, 19 figs.

Diamonds

Reports on the 273ct heart-shaped Centenary Diamond, reportedly flawless and the largest outside the British Crown Jewels, but with a confusing illustration; on a 'chameleon' greenish-grey diamond which turned brownish yellow when hot; on

Soviet diamond production; on Australian permit to explore Timor Sea for diamonds; a world record price at Sotheby's, Geneva, for a 101.84ct diamond (US$12,760,000); on a pair of 'Star of David' shaped double twinned macles; a bluish-grey boron-rich micro-coating of low-temperature synthetic diamond on colourless diamonds had high electrical conductivity, and could also be detected by an edge fugitive tendency giving a white abraded look under magnification.

Coloured stones

Reports on tourmalines from Namibia, Zambia and Madagascar; on increased ruby output from Tanzania, with better padparadscha from the Umba River region, and on aquamarine from Zimbabwe, amethyst from Afghanistan; ruby in green mica from Northwest Frontier Province, Pakistan; a joint venture to cut and market Uralian emeralds; labradorite from Madagascar carved as cubes, spheres and other shapes; opal with fine greenish body colour from Peru; iridescent green exoskeletons of beetles mounted as jewellery. The first auction of Cook Island black cultured pearls had many silver grey pearls and sold just over half the items offered, mostly to Japan; rich green transparent zoisite is available from the Merelani district of Tanzania, and resembles the fine tourmalines of Paraíba, Brazil.

Enhancements

Buffing settings of aqua aura blued stones can remove the gold coating and spoil the colour; jadeite with cracks filled with epoxy resin is reported; quartzite beads dyed to lavender blue were offered as dyed jadeite, penetration of colour was complete; gems made from fibre optic glass are described and illustrated; backed Mexican opal slices embedded in plastic to simulate black opal are offered as 'opal encapsulado'; plastic imitations of opal containing iridescent films or foil were purchased in Bangkok, multitudinous gas bubbles made the deception obvious; Russian flux-synthetic red spinels seen in recent years have been made from 'defective' natural crystals from the Pamir Mountains so constants approach those of natural spinel.

Instrumentation

A dark-field loupe has been developed by GIA GEM; two new automated and versatile cutting machines have been developed to facet girdle edges of diamonds, one in Belgium, the other in Israel; an Israeli firm offers ROBOGEM, a computerized stone cutting machine which has image-processing technology to provide 'optimum yield' from rough and can be programmed to produce all common shapes, graduated sets, pairs or maximum weight, and can preform girdling in less than a minute.

R.K.M.

Koivula, J.I., Kammerling, R.C., 1991. Gem News. *Gems & Gemology*, 27, 3, 180-90, 16 figs.

Diamonds

Argyle are expanding ore processing at AKI pipe, WA, to keep up with lesser productivity at depth, and are now cutting diamonds in China; Namibia's Elizabeth Bay deposit has been reopened as an open-cast mine by Consolidated Diamond Mines and expects to produce about 2.5 million carats of mainly gem quality stones in the next ten years; there is much organized theft there particularly from the Orangemund mine; a major new Russian diamond field is reported at Baryatskaya near the Mongolian border.

The second European Conference on diamond, diamond-like and allied coatings held in Nice was notable for the number of presentations on diamond-like coatings (extremely hard amorphous carbon of great potential in industry, an inherent colour seems to be a problem with DLC, but the brown of CDV (carbon vapour deposition) films is due to interstitial graphitic deposits and may be improveable.

Maico Diamonds recently introduced their 'Dream-cut' diamonds which have the normal rounded girdle left straight-sided, making the table look larger and utilizing relatively flatter rough. Small modifications of facets help to minimize light leakage normal to shallow stones, with resultant greater weight yield and larger looking stones. [Brilliant, marquise and drop are illustrated but images are too confused to allow one to assess details]. GIA report finding stereoscopic photographs taken at the turn of the Century relating to early diamond mining in S. Africa.

Coloured stones

Colombian emerald exports reached an all time high in 1990, mostly to Japan. A large grey South Sea pearl is reported in Thailand, 42mm long with high lustre, when shaken internal liquid could be heard; Myanmar is to permit export of rough and cut stones to a Thai company in Rangoon; a Myanmar postage stamp illustrates the 496.5ct Nawata ruby rough found at Mogok in 1990 and confiscated the same year as illegally mined; much Thai sapphire is still produced by traditional hand mining and sorting. Attractive pink spinels from Umba River region of Tanzania were seen at the Tucson show, some were velvety with submicroscopic inclusions; the Longido ruby mine, Tanzania, is being worked again producing cabochon grade stones; the Tanzanian government invites tenders for mineral rights in the Merelani tanzanite area.

Large Paraíba blue/green tourmalines are now reported; two African tourmalines were colour-change when seen in combined incandescent and fluorescent light, and fluoresced chalky yellow under SUV; dissimilarity of pleochroism between brown tourmaline and andalusite is noted and a warning given on over-reliance on visual clues to identify; idocrase in purple, green and bi-colour have been found at Jeffery mine in Quebec; an unusual black tanzanite was pleochroic in red, greenish and purple along its principal axes under powerful light [would heat have made this a usable stone?].

Enhancements

There are reports of diamond-film coated stones but GIA are aware of only three diamonds which were experimentally coated with Type IIb blue diamond film; DLC films adhere to a variety of soft stones and sapphire point will not scratch them, they impart anomalous adamantine lustre and a brownish tint to the stone [Do such ultra-thin coatings affect the RI?]. Dry Cottonwood Creek mine, Montana, is producing blue and yellow sapphires which can be heated to deepen the colour, some develop unwanted zoning; experimental diffusion of red colour into corundum has so far been unsuccessful and some stones lose colour from over-polishing.

Synthetics and simulants

A white Gilson type synthetic opal adhered to the tongue and absorbed water readily.

Instrumentation and new techniques

It is pointed out that heat-coating and heat-diffusion are different processes, the former does not affect pleochroism, while this is enhanced by heat diffusion of colour. A new method of setting diamonds in a carbon-based polymer plastic defeats thermal conductivity tests but inclusions are still typical of diamond and the X-ray transparency test still applies; a new and greatly improved colour imaging process is described and so is surgical tape to increase the adhesion of gem tweezers. R.K.M.

Krosch, N.J., Cooper, W., 1991. Queensland Sapphire. *Australian Gemmologist*, **17**, 11, 460-4, 2 maps.

The first instalment of a paper based on a Queensland Govt. Mining Journal report of 1990 dealing with the many sapphire areas of eastern Queensland, only two of which are mined on a commercial scale. These are the Rubyvale, Sapphire and Anakie region in central Queensland and Lava Fields in the north. Sapphire tends to occur in basaltic rocks which are widespread in these areas. R.K.M.

Krosch, N.J., Cooper, W., 1991. Queensland Sapphire: part II. *Australian Gemmologist*, **17**, 12, 511-15.

Deals with surface, shaft and large scale mechanical mining, producers, production, marketing and future potential. Most stones are cut in Thailand. Competition from Nigeria and China anticipated. R.K.M.

Linton, T., Brown, G., 1991. Polaroid 'spectra' system with close-up stand Model 7500. *Australian Gemmologist*, 17, 10, 429-31, 4 figs.

Report on a Polaroid camera adapted for close-up photography of gems and small jewellery says shallow depth of field (<12mm) plus high cost of camera and film makes it less attractive than claimed, while centre definition leaves something to be desired. R.K.M.

Linton, T., Brown, G., 1991. Coral identification kit. *Australian Gemmologist*, **17**, 11, 465.

A collection of 15 different corals, both rough and polished, from deep waters south of Tasmania, including various bamboo corals, black and gold corals, with notes on the main features which identify corals from these seas. Reasonably priced at $A25. R.K.M.

Linton, T., Brown, G., 1991. The Shibuya 150 gemmological refractometer. *Australian Gemmologist*, **17**, 11, 468-9, 2 figs.

A Japanese refractometer with scale range from 1.30 to 1.83, but supplied in this case with 1-bromonaphthalene (RI 1.66) as contact fluid. An in-built yellow interference filter is not quite as accurate as a sodium light source, but the instrument is assessed as high quality. Some difficulties were experienced with spot testing high RI cabochons.

Linton, T., Polita, M., Brown, G., 1991. A new dark-field loupe. *Australian Gemmologist*, 17, 10, 396-7, 2 figs.

A report on an American 10x dark-field lens combined with a focusing Mini-Mag pocket torch. Efficient when batteries are new but restricted for large sizes of stone, and expensive. R.K.M.

McCabe, A.J., 1991. Paua shell and how to work it. *Wahroongai News*, **25**, 7, 4-7.

Advice on working rough paua shell to a satisfactory finish. The rather strange Maori name is pronounced 'pa-wa'. R.K.M.

NIEDERMAYR, G., 1991. Eine Dose aus Bleiberger Muschelmarmor. *Mineralien Welt*, **2**, 4, 49-52, 6 figs (5 in colour).

Examples of fire marble from the Natural History Museum in Vienna are illustrated with notes on their composition and on the places where the material was found. Chief among these is Bleiberg, Carinthia, Austria. M.O'D.

PAULITSCH, P., 1991. Kupfer und Jade aus China. *Aufschluss*, **42**, 207-12, 2 photos in colour, 1 fig.

The history and use of jade in China is briefly described with notes and tables of jade-like minerals. Copper also features in the paper. M.O'D.

REDMANN, M., HENN, U., BANK, H., 1991. SchleifwUrdiger, klar durchsichtiger, farbloser bis blassgelblicher Thaumasit aus, Südafrika. (Cuttable, transparent, colourless to pale yellow thaumasite from South Africa.) *Zeitschrift der Deutschen Gemmologischen Gesellschaft*, **40**, 1, 67-8, bibl.

The colourless to pale yellow gem quality thaumasite from the Black Rock mine in the Kalahari manganese field is described. N_o = 1.505-1.510, n_e = 1.467-1.480, DR 0.030-0.038, SG 1.88-1.91. E.S.

ROBERT, D., 1991. Un simulant de roches mauves. *Revue de Gemmologie*, **107**, 3-6, 3 figs in colour.

Charoite, sugilite and common beryl are reviewed as mauve gem or ornamental materials. M.O'D.

RUFLI, J.-C., 1991. Ny intensiv blå och grön Ädelsten från Brasilien! *Gem Bulletinen*, 1/91, 2-3. A brief note on the deep blue tourmalines recently found in Paraiba, Brazil. Adapted from a paper in Gem News. M.O'D.

SCHLÜTER, J., WEITSCHAT, W., 1991. Bohemian garnet – today. *Gems & Gemology*, **27**, 3, 168-73, 16 figs.

Pyrope has been mined commercially in what is now Czechoslovakia since the 16th century and although now considered exhausted a small mine still operates at Podsedice in the Bohemian Hills. Stones are cut and set in Turnov. The alluvial deposit is from peridotite pipes and the garnet is mostly in small crystals. Other localities are being explored. Mining is open-cast and 320 tonnes of gravel are washed and sieved daily to yield about 45kg of concentrates, which are then hand-sorted to give about 5kg of cuttable crystals yielding rose-cuts from 3 to 5mm in diameter. Weight loss in cutting is said to be only 10%. R.K.M.

SCHMETZER, K., 1991. Lechleitner synthetic emeralds, rubies and sapphires. *Australian Gemmologist*, **17**, 12, 516-23, 18 figs.

Deals in some detail with each type of synthetic produced by Johann Lechleitner, who is now 70, from A to F; type B, natural seed beryl, over-grown with thin plates of chrome-rich synthetic emerald; type D, fully synthetic emerald grown on a central synthetic seed, and type F, flux-grown full synthetic emerald are available commercially. Lechleitner started experimenting with synthetic corundum in 1983 again by over-growth of synthetic ruby on colourless Verneiul cores, and other colours followed, using molybdenum and lead fluxes; following year he produced ruby by coating synthetic ruby onto natural corundum cores. All these are composite or synthetic stones and must be so marketed. R.K.M.

SCHMETZER, K., BERHARDT, H-J. BIEHLER, R., 1991. Emeralds from the Ural Mountains, USSR. *Gems & Gemology*, **27**, 2, 86-99, 14 figs.

Emeralds from the Takovaya River area, north of Sverdlovsk, in eastern Urals, are being found in quantity, as a by-product of beryllium mining, after a lapse of several decades. Qualities vary from pale to dark green and from heavily included to flawless. RIs vary from 1.581p1.575 to 1.590-1.582, SG from 2.72 to 2.75. Three-phase inclusions are less frequent than in Colombian stones and lack the jagged outline of the latter; healed fractures, flat liquid-filled feathers parallel to the basal pinacoid, and phlogopite and other inclusions are common but most are similar to inclusions from other localities. R.K.M.

SCHWARZ, D., 1991. Die chemischen Eidenschaften der Smaragde. II Australien und Norwegen. (The chemical properties of emeralds. II Australian and Norwegian.) *Zeitschrift der Deutschen Gemmologischen Gesellschaft*, **40**, 1, 39-66, 1 photomicrograph, 2 maps, 6 graphs, 5 tables, bibl.

The emeralds from Norway came from Eidsvoll near the Mjosa Lake, the Australian specimens from Pilgangoora, Wodgina, Calvert White Quartz Hill, Warda Warra, Melville and Torrington in Western Australia, Emmaville in New South Wales and from Menzies in West Australia. On average, compared with the Brazilian material, there is less magnesium, sodium and iron content in both the Norwegian and Australian stones, especially the Norwegian and the Emmaville samples have extremely low Na_2O and MgO contents. The Mjosa emeralds have a high vanadium content. E.S.

SCHWARZ, D., 1991. Australian emeralds. *Australian Gemmologist*, **17**, 12, 488-97, 3 figs and a map.

Part of a research on emeralds from main sources world-wide by microprobe, more of interest to the petrologist or mineralogist than to the gemmologist. R.K.M.

SHERRIFF, B.L., GRUNDY, H.D., HARTMAN, J.S., HAWTHORNE, F.C., CERNY, P., 1991. The incorporation of alkalis in beryl: multinuclear MAS NMR and crystal-structure study. *Canadian Mineralogist*, **29**, 271-85, 10 figs.

Stereochemical details of the incorporation of alkali ions into the beryl structure are examined using multi-nuclear MAS NMR spectroscopy and single-crystal structure refinement. M.O'D.

STÖTZEL, N., SCHWEISFURTH, G., HOCHLEITNER, R., 1991. Siegerland-Mineralienland. Die klassischen Mineralstufen aus den Siegerländer Erzgangen. *Lapis*, **16**, 7/8, 27-67, 115 photos (95 in colour), 6 figs.

Fine quality rhodochrosite, malachite and sphalerite are among the minerals found in the German Siegerland mining area. Other minerals are described and illustrated and a complete list for the area is given. M.O'D.

TILLANDER, H., 1991. En kritisk Analys av De Beers Diamantbroschyr. *Gem Bulletinen*, 1/91, 10-16.

Review of a pamphlet on diamond grading issued by De Beers for consideration within the Scandinavian countries in 1989. M.O'D.

TOMBS, G., 1991. Some comparisons between Kenyan, Australian and Sri Lankan sapphires. *Australian Gemmologist*, **17**, 11, 446-9, 6 figs.

Corroded, fragmentary crystals of sapphire from Kenyan sources at Garba Tula, Lodwar and Samburu are compared with Australian (New England) and with Sri Lankan sapphires, and the differences in colour enhancement by heating attributed to the considerable variations in iron content. Repairers are warned to unset sapphires before applying heat to a mount. R.K.M.

URMOS, J., SHARMA, S.K., MACKENZIE, F.T., 1991. Characterization of some biogenic carbonates with Raman spectroscopy. *American Mineralogist*, **76**, 641-6, 3 figs.

Biogenic carbonates from a scleratinian coral (Porites sp.), Corallium reale and C. secundum corals, pink and uncoloured respectively and from natural and cultured pearls are examined by Raman spectroscopy. Aragonitic Porites coral and pearls show Raman bands characteristic of aragonite but bands from the natural pearl are slightly sharper than the corresponding bands from Porites and cultured pearls. Deep-sea precious corals show Raman spectra closely resembling those of magnesian calcite but pink corals show seven additional bands in the region 1020-3759cm^{-1}. The extra bands are attributed to a carotenoid pigment which gives rise to the pink colour of the coral skeleton. M.O'D.

VON BEZING, K.L., DIXON, R.D., POHL, D., CAVALLO, G., 1991. The Kalahari manganese field: an update. *Mineralogical Record*, **22**, 279-97, 38 photos (18 in colour), 1 map.

Gem quality crystals of rhodochrosite and sugilite are among the minerals listed and described in this update. The crystals are small in general. A complete list of minerals discovered so far and a list of references are given. M.O'D.

WELZEL, J., 1991. Glass Art - now and then. *Industrial Diamond Review*, **51**, 141-3, 5 figs (2 in colour), bibl.

In reproducing famous glassware from the classical period and finishing it by fine grinding and engraving, master craftsman J. Welzel is convinced that diamond abrasives were in use from the first to the fourth century AD.

Mr Welzel has reproduced the Lykurgos goblet and the Portland vase. E.S.

ZEIHEN L.G., 1987. The sapphire deposits of Montana. *Bulletin, Montana Bureau of Mines and Geology*, No. 126, 28-39, 5 photos, 2 maps.

The three main sapphire-bearing areas described are the Yogo Creek deposits and those on the Missouri River bars and on Rock Creek. A brief mention is made of other deposits. In general sapphire crystals are small with a wide range of colours. Few finished stones would reach two or more carats but the colours can be very fine in many specimens. M.O'D.

Proceedings of The Gemmological Association and Gem Testing Laboratory of Great Britain and Notices

OBITUARY

Mr R.L. Austen, FGA (D.1937 with Dist.), Chichester, died on 9 December 1991.

Mr Edwin T. Mills, FGA (D.1986), Ely, died on 10 February 1992.

Professor Dr D.H.G. Keuskamp, FGA (D.1981), Streefkerk, Netherlands, died on 12 February 1992.

Mr R.W. Yeo, FGA (D.1929 with Dist.), Instow, died in February 1992. A full obituary will be published in a future issue of *The Journal.*

NEWS OF FELLOWS

Mr Alan Hodgkinson, FGA, represented the Gemmological Association and Gem Testing Laboratory of Great Britain by giving two lectures at the Tucson Gem & Mineral Fair in February 1992.

Following on from last year's theme, this year's heading was 'A further taste of Scottish gemmology', but behind the lighthearted title was a wealth of factual information on gem testing techniques and the latest finds and developments of natural and artificial gemstones.

The diamond/graphite coating on a brilliant-cut cubic zirconia caused such interest that it was displayed on the stand of the Canadian Gemological Association and American Gemological Association via close circuit television from a microscope video. The two 'one-and-a-half hour' lectures lasted five hours in all, and with a standing room only situation the door had to be shut to prevent further entry.

On 3 April 1992 **Dr J.B. Nelson** gave an illustrated talk on 'Gemmological teaching in Hong Kong and China' to the Sussex Mineral and Lapidary Society at Haywards Heath.

MEMBERS' MEETING

London

On 10 March 1992 at the City Conference Centre, Mark Lane, London EC3, Alan Jobbins and Amanda Goode gave illustrated lectures to an audience of more than 150 on the gemstone deposits and trade in Sri Lanka.

Midlands Branch

On 17 January 1992 at Dr Johnson House, Bull Street, Birmingham, a members' practical evening was held.

On 21 February 1992 at Dr Johnson House, Mr Clive Burch gave an illustrated lecture on inclusions in gemstones.

On 20 March 1992 at Dr Johnson House, Mr David Callaghan gave an illustrated lecture on cameos and intaglios entitled 'On the face of it'.

North West Branch

On 15 January 1992 at Church House, Hanover Street, Liverpool 1, Mr David Pelham gave an illustrated lecture entitled 'Small scale gold mining and gem mining'.

On 19 February 1992 at Church House, Helen Fraquet gave a lecture on 'Amber'.

On 18 March 1992 at Church House, Dr Jeff Harris gave an illustrated lecture entitled 'An aspect on diamonds - alluvial diamond deposits'.

MEETINGS OF THE COUNCIL OF MANAGEMENT

At a meeting of the Council of Management held on 18 December 1991 at Chapel House, Hatton Place, London EC1N 8RX, the business transacted included the election to membership of the following:

Fellowship

Anastassiou, Evagelia, Athens, Greece. D. 1991.
Chan, Nga Y., Causeway Bay, Hong Kong. D. 1991.
Chu, Yiu W.T., Kowloon, Hong Kong. D. 1991.
Chudawala, Sucheta, Bombay, India. D. 1991.

FORTHCOMING EVENTS

London

Meetings will be held at the City Conference Centre, 76 Mark Lane, London EC3R 7JN, at a cost per lecture of £5.00 for GAGTL members, £10.00 a member and a guest, and £8.00 for non-members. Further details and tickets from the GAGTL.

Gemstone deposits and the trade associated with them

Tuesday 9 June 1992	South East Asia
Tuesday 24 November 1992	Africa

North West Branch

Meetings to be held at Church House, Hanover Street, Liverpool 1.
Further details from Irene Knight on 051-924 3103.

20 May 1992	Nigel Israel. 'Historical aspects and valuations'
17 June 1992	'Exchange and Mart'. Buying and selling of books, crystals and instruments, plus social evening
16 September 1992	Adrian Klein. 'Emerald'
21 October 1992	Dr Jamie Nelson. 'Optical attributes of a diamond'
18 November 1992	Annual General Meeting

TRADE WORKSHOPS IN JULY

GAGTL staff will be running their popular Trade Workshop again in July. More than a dozen people are already on the waiting list for this Workshop, and if you wish to take part in observing gem materials from the trade point of view, please contact GAGTL Education Office on 071-404 3334 for further details. The Workshop will be held close to Hatton Garden and will cost £60.00 plus VAT.

Chung, Tsz K., Kowloon, Hong Kong. D. 1991.
Doshi, Setu H., Bombay, India. D. 1991.
Ghisi, Maria, London. D. 1991.
Ha, Wai M.C., Kowloon, Hong Kong. D. 1991.
Harrison, Victoria A., Taunton. D. 1991.
Khimji, Priti, London. D. 1991.
Lai, Mui G.M., Hong Kong. D. 1991.
Lau, Mee S.L.M., Kowloon, Hong Kong. D. 1991.
Lee, King T., Kennedy Town, Hong Kong. D. 1991.
Lilley, Elaine, London. D. 1991.
Merchant, Azmet, Bombay, India. D. 1991.
Mourogiannis, Stephanos, Volos, Greece. D. 1991.
Ng, Chee K., Quarry Bay, Hong Kong. D. 1991.
Oo, Thein L., Singapore. D. 1989.
Pang, Shing C., Kowloon, Hong Kong. D. 1991.
Simmons, Charlotte R., Huntingdon, Md., USA. D. 1991.
Vesters, Marco., Hertogenbosch, The Netherlands. D. 1991.
Wong, Hon C., Kowloon, Hong Kong. D. 1991.
Wong, Siu P., Kowloon, Hong Kong. D. 1991.
Yeung, Kit Y.K., Hong Kong. D. 1991.
Zhang, Linxia, Shen Zhen, China. D. 1991.

Ordinary Membership

Allaman, John, Sarasota, Fla., USA.
Beckett, Shona-Maria F., London.
Beltran, Luruenta F.J., Madrid, Spain.
Bevoort-Alwicher, Terrence, GE Nijmegen, The Netherlands.
Bolton, Jane A., London.
Butler, Ian P., High Barnet.
Campbell-Pedersen, Maggie, London.
Chan, Lo M.Y.F.C., Kowloon, Hong Kong.
De Jongh, Laurentia M., The Hague, The Netherlands.
Deshapriya, Sarath B.A.M., Perivale.
Drowley, Brigitte, Haslemere.
Frutos, Carmen, London.
Hertani, Abdul, Lancing.
Huang, Chin T., Taipei, Taiwan.
Humphrey, Mary S., London.
Kinnunen, Kari A., Espoo, Finland.
Makoundoul, Chris M., Solva, Sweden.
Matsumoto, Naoko, Chicago, Ill., USA.
Messer, J. Wayne, Candler, NC., USA.
Packard, Alice V., London.
Rochat-Huguenin, Chantal, Lausanne, Switzerland.
Sarmento, Rodrigo W., Lisboa, Portugal.
Wilkins, Anthony E., Bridgwater.

At a meeting of the Council of Management held on 22 January 1992 at Chapel House, Hatton Place, London EC1N 8RX, the business transacted included the election to membership of the following:

Fellowship

Bakagianni-Sabou, Aristea, London. D. 1991.
Baxendale, Paul D., London. D. 1965.
Dietz, Susanne C., Koenigstein/TS, Germany. D. 1990.
Mehra, Shilpa, Hong Kong. D. 1991.
Nolet, Theresa A., Castlegar, BC, Canada. D. 1991.
Ranabahu, Mallikage K.T.S.N., Ratnapura, Sri Lanka. D. 1982.
Samaranayake, Ravinda, Colombo, Sri Lanka. D. 1991.

Ordinary Membership

Boulton, Brian C., London.
Harper, Jonathan, London.
Hart, Juliana L., Colonel Light Gardens, S. Australia.
Leong, Weng, Maidstone.
Schmetzer, Karl, Peterhausen, Germany.
Speet, Scilla M.A., London.

At a meeting of the Council of Management held on 19 February 1992 at Chapel House, Hatton Place, London EC1N 8RX, the business transacted included the election to membership of the following:

Fellowship

Campomanes Eguiguren, Amalia, Alicante, Spain. D. 1991.
Xue, Qinfang, Hubei, China. D. 1991.
Yang, Mingxing, Hubei, China. D. 1991.
Zhang, Fan, Huei, China. D. 1991.

Ordinary Membership

Arai, Takahiro, Chiba Pref, Japan.
Hasegawa, Tomoko, Tokyo, Japan.
Higo, Kenji, Qsaka, Japan.
Higo, Yoshiko, Osaka, Japan.
Horsfall-Ertz, Priscilla J., London.
Hotta, Shigemitsu, Nara Pref, Japan.
Ikeda, Noriko, Hyogo Pref, Japan.
Kariya, Tomoko, Tokyo, Japan.
Katsuta, Morifumi, Osaka, Japan.
Kiji, Michio, Osaka, Japan.
Kinda, Yumiko, Osaka, Japan.
Klein, Jeffrey L., Southend on Sea.
Liu, Zhao, Hubei, China.
Magara, Yoshiaki, Fukui Pref, Japan.
Mina, Jacqueline, Twickenham.
Mitsuno, Atsushi, Kyoto, Japan.
Miyamoto, Kiyomi, Osaka, Japan.
Morino, Yoshio, Tokyo, Japan.
Mumetani, Miho, Hyogo Pref, Japan.
Murakami, Chie, Osaka, Japan.
Nakamura, Haruji, Kyoto, Japan.
Nakane, Chie, Hyogo Pref, Japan.
Nishimura, Tadahiro, Osaka, Japan.
Noritomi, Hidekazu, Osaka, Japan.
Odawara, Hiroko, Osaka, Japan.
Park, Jung S., Seoul, Korea.
St Clare, Edward, Southport.
Sakaki, Kouki, Ibaraki Pref, Japan.
Sano, Hajime, Tokyo, Japan.
Semi, Saoko, Kanagawa Pref, Japan.
Takai, Reiko, Niigata Pref, Japan.
Tanaka, Kazuhide, Osaka, Japan.
Tanaka, Mariko, Hyogo Pref, Japan.
Taniguchi, Toshiko, Osaka, Japan.
Tateno, Haruyuki, Ibaragi Pref, Japan.
Uchi, Naoko, Hyogo Pref, Japan.
Udagawa, Koichi, Tokyo, Japan.
Warne, William R., Birchington.
Yamagami, Mayumi, Tokyo, Japan.
Yamasuga, Ryoji, Hyogo Pref, Japan.
Yashima, Aiko, Hyogo Pref, Japan.
Zhang, Yabin, Hubei, China.
Zubaida, Albert, London.

F.G.A.

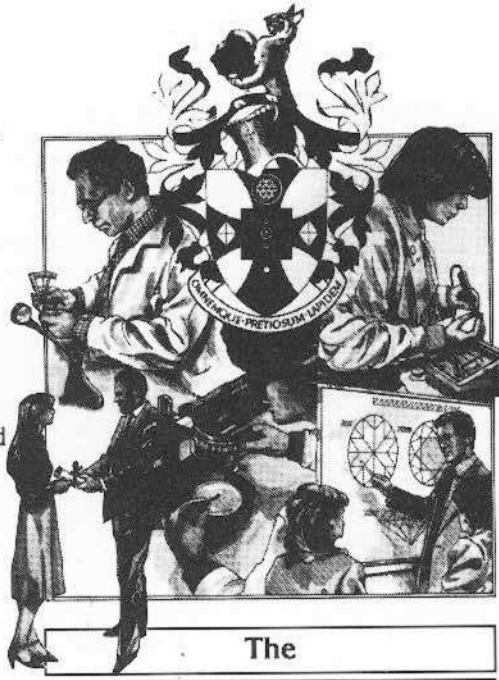
your key to the fascinating

world of Gemmology

The Gemmological Association and Gem Testing Laboratory of Great Britain has been actively involved in the very beginning of Gemmology as an independent science.

Today, the Association takes pride in its international reputation as a learned society dedicated to the promotion of gemmological education and the spread of gemmological knowledge.

The Association's coveted Fellowship is a mark of excellence only bestowed upon individuals who successfully undertake the Association's written and practical examinations covering all aspects of gemmology as a science.



The

Gemmological Association

and Gem Testing Laboratory

Of Great Britain

The Gemmological Association's course has been specially compiled into a series of teaching modules that are both readable and lavishly illustrated.

Together they provide a comprehensive step-by-step guide to the fascinating world of gemmology and an opportunity to earn the coveted initials FGA – Fellow of the Gemmological Association.

To find out more complete the coupon below and we will immediately forward the Association's 1992 prospectus giving full details of this unique course

Please complete and return to the Gemmological Association Training Scheme.
27 Greville Street, London EC1N 8SU England Tel: (071) 404 3334. Fax (071) 404 8843

Name

Position

Company

Address

Telephone

At a meeting of the Council of Management held on 18 March 1992 at Chapel House, Hatton Place, London EC1N 8RX, the business transacted included the election to membership of the following:

Fellowship

Colborne, Janette., Brisbane, Australia. D. 1991.

Van Den Haak, Hester, Krimpen, The Netherlands. D. 1991.

Ordinary Membership

Alteen, Michael L., Nova Scotia, Canada.
Boote, Caroline M.E., London.
Deolia, Damji, Hounslow.
Dillistone, Jason S., Hove.
Dinnis, Simon J., Swadlincote.
Duigan, Ingeborg, Kowloon, Hong Kong.
Hug, Markus E., Schaffhausen, Switzerland.
Page, Tayma F.L., Hong Kong.
Roper, Bebs, Tasmania, Australia.
Yenson, Patrick, London.

MEETING OF THE TRADE LIAISON COMMITTEE

At a meeting of the Trade Liaison Committee held on 13 February 1992 at 100 Hatton Garden, London EC1, the business transacted included the election to membership of the following:

Gold Laboratory Membership

Johnson, Walker & Tolhurst Ltd., 64 Burlington Arcade, London W1V 9AF.

C.A. Rotenberg Ltd., Suite 130, 100 Hatton Garden, London EC1.

Blacklock & Son, 15 Waterloo Place, Sunderland SR1 3HT.

Boodle & Dunthorne, 35 Lord Street, Liverpool, Merseyside.

Manny Gordon Trading Inc., 580 Fifth Ave., Suite 610, New York, NY 10036, USA.

Michael Hager & Sons, Suite 110, 100 Hatton Garden, London EC1N 8NX.

L. & R. Josyfon Ltd., 100 Hatton Garden, London EC1.

Teh Jun Co. Ltd., Room 1206, Lane Crawford House, 70 Queens Road Central, Hong Kong.

S. Muller & Sons NV., Schupstraat 1-7, Bus 6, 2018 Antwerp, Belgium.

C.N. Ross-Field Ltd., 12 Hatton Garden, London EC1N 8AN.

Ordinary Laboratory Membership

Pinkertons the Jewellers, 48 Market Street, Brighton, Sussex BN1 1HH.

Hugh Rice Ltd., 10-14 George Street, Hull, N. Humberside HU1 3AJ.

The Jewellers & Silversmiths, 15 Thames Street, Kingston Upon Thames, Surrey.

REPLICA DIAMONDS

One of the attractions at the Birmingham NEC Jewellery and Giftware Fair in February was the public launch on the GAGTL stand of a new series of cubic zirconia stones cut to imitate famous diamonds. The series also includes sets which show the most popular cuts used for diamonds, the development of the brilliant cut, and a range of round brilliants of different weights. Each of 13 famous diamonds can be bought separately and are available through Gemmological Instruments Ltd., Fax 071-404 8843.

GEM & MINERAL FAIRS 1992

Gem and Mineral Fairs will be organized by the British Lapidary & Mineral Dealers' Association during 1992 as follows:

Leicester 16-17 May 1992. Holiday Inn.
Harrogate 29-31 August 1992. Crown Hotel.
London 17-18 October 1992. Holiday Inn, Swiss Cottage.

Further details from Fair Organizer: John F. Turner, Glenjoy, 19/21 Sun Lane, Wakefield, W. Yorkshire. Telephone 0924 373786.

Letter to the Editor

From A . E. Farn

Dear Sir,

It is unfortunate that letters to the Editor have three months to wait before a reply dealing with the matter can be published. Worse still if a reply is published six months later, by which time the patient reader may well say, 'what are they on about'. Phrases such as 'Storm in a teacup' or 'Much ado about nothing' spring readily to mind. Keith Mitchell and myself are friends of long standing, we both hold the works, researches and memory of Basil Anderson in great admiration. Thus when I used the word, 'treatise' incorrectly in describing Keith Mitchell's work in a book to be published by Eric Bruton it was an enthusiastic attempt on my part to draw attention to and hopefully to spur gemmologists to buy the book when it appears. Thirty five years at the laboratory, most of them in close working contact with Basil Anderson, all of them in friendship with Keith Mitchell, probably promoted 'an enthusiasm too far'— mea culpa.

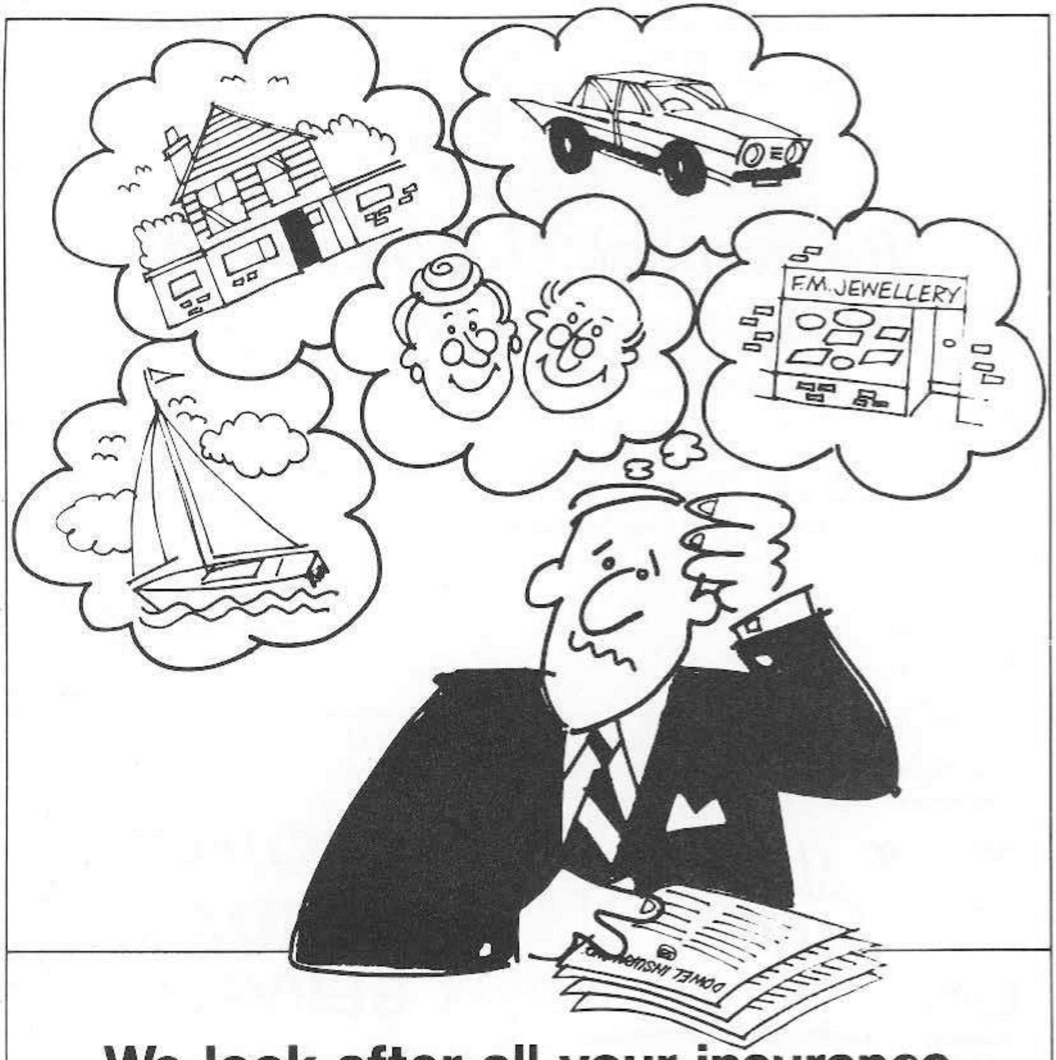
To revert to other contents of the January Journal, on pp 40,41, under the sub-title 'The Crown Jewels', I was particularly interested to read of the Koh-i-Noor. Purely by coincidence I was reading up the details of the Koh-i-Noor for material for a short story, fiction based on facts, the day before the Journal arrived. Since we are informed on page 41 that in 1986 it was decided to compile a detailed account of the collection by staff of the GAGTL I feel hesitant to query the figures quoted for the Koh-i-Noor.

The Journal article on the Koh-i-Noor states: 'The Koh-i-Noor was recut in 1852 from 186.10ct to 105.60ct'. Eric Bruton's '*Diamonds*', p4, states, 'The Koh-i-Noor was recut in *Amsterdam* to 108.93ct'. On page 452 it states that the Koh-i-Noor was recut and polished by two workers from Costers of Amsterdam who came to London to carry out the work at the premises of Messrs. Garrard in Panton Street, London, in 1862.

De Beers, '*Notable diamonds of the world*', states that two workers from Costers of Amsterdam came to London to carry out the work. The result was a weight of 108.93ct. Thus is my confusion confounded by a convergence of data.

Yours sincerely
A.E. Farn
18 February 1992
Seaford, E. Sussex.

The Koh-i-Noor was removed from its setting in 1988 to ascertain exact weight; 105.60ct is the correct figure. Ed.


F.M. JEWELLERY

Notes for Contributors

The Editors are glad to consider original articles shedding new light on subjects of gemmological interest for publication in the *Journal*. Articles are not normally accepted which have already been published elsewhere in English, and an article is accepted only on the understanding that (1) full information as to any previous publication (whether in English or another language) has been given, (2) it is not under consideration for publication elsewhere and (3) it will not be published elsewhere without the consent of the Editors.

Papers should be submitted in duplicate on A4 paper. They should be typed with double line spacing with ample margins of at least 25mm all round. The title should be as brief as is consistent with clear indication of the content of the paper. It should be followed by the names (with initials) of the authors and by their addresses. A short abstract of 50–100 words should be provided. Papers may be of any length, but long papers of more than 10 000 words (unless capable of division into parts or of exceptional importance) are unlikely to be acceptable, whereas a short paper of 400–500 words may achieve early publication.

Twenty five copies of individual papers are provided on request free of charge; additional copies may be supplied, but they must be ordered at first proof stage or earlier.

Volume 23 No. 2. April 1992

The Journal of Gemmology

Contents

Registered Office: Palladium House, 1-4 Argyll Street, London W1V 1AD

ISSN: 0022-1252

Produced by Green Belt Studios: Printed by Quadrant Offset, Hertford, England.