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GEMMOLOGICAL ASSOCIATION
OF GREAT BRITAIN
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ON GEM ELBAITE FROM NEWRY, MAINE, U.S.A.

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IN August of 1972, a very significant find of gem quality elbaite (lithium tourmaline) was made at the Dunton gem mine, Newry, Maine, U.S.A. The narrative of discovery was related by McCrillis (1975) and the description of the elbaite was given by Dunn (1975).

The elbaite occurs in a lenticular pegmatite atop Newry Hill. The pegmatite had long been noted for elbaite and many of the finest examples of New England "watermelon" tourmaline had come from this mine in years gone by, although most of it was not facet-grade. Some gem pockets had been found in recent years, but the yield of gem material was small. This rediscovery at Newry, which has produced a prodigious amount of facet-grade rubellite, is truly one of the most significant tourmaline discoveries of all time.

The elbaite occurs as prismatic, hemimorphic, crystals, from 27 cm in length to very small. The vast bulk of the crystals are broken sections averaging 5 cm in width by 10-15 cm in length. It is apparent from the partially rehealed surfaces of the broken ends that these crystals were broken in past geologic time when mineralizing solutions were still active. The terminations of the crystals are complex and consist of several trigonal pyramids modified by several ditrigonal pyramids.

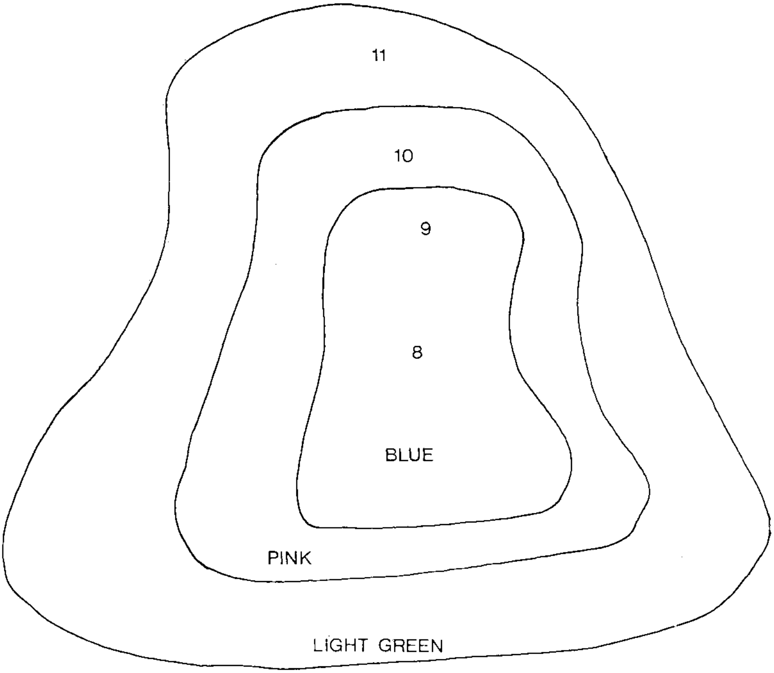

FIGURE 1. Cross-section (40 mm radius) of "watermelon" tourmaline crystal zoned parallel to the prism. Section is parallel to *a* axes. (NMNH #128157).

Much of the new Newry elbaite is zoned, creating the beautiful "watermelon" effect. This type of zoning, parallel to the prism of the crystals, is the most common type at Newry. (See Figures 1 and 4). Most of the crystals are rubellite which has been grown over by a thin layer of green elbaite, which is badly fractured. This fracturing does not continue into the rubellite core, however, and only serves to give the beautiful red gem material a crackled green coat! The thin outer green rind can be easily removed to reveal the frequently flawless rubellite underneath. Those few crystals which exhibit three colours indicate that a dark blue formed first and was then subsequently covered by rubellite and finally by green elbaite. Most samples, however, show only red and green.

Zoning is also noted which is parallel to the pedion $\{000\bar{1}\}$ and has produced a few "bicolour" gems. This zoning is usually sharp and distinct. Many of the crystals have a red core, which is oddly shaped in that the upper surface of the red core is not perpendicular to the prisms but is canted at a non-constant angle.

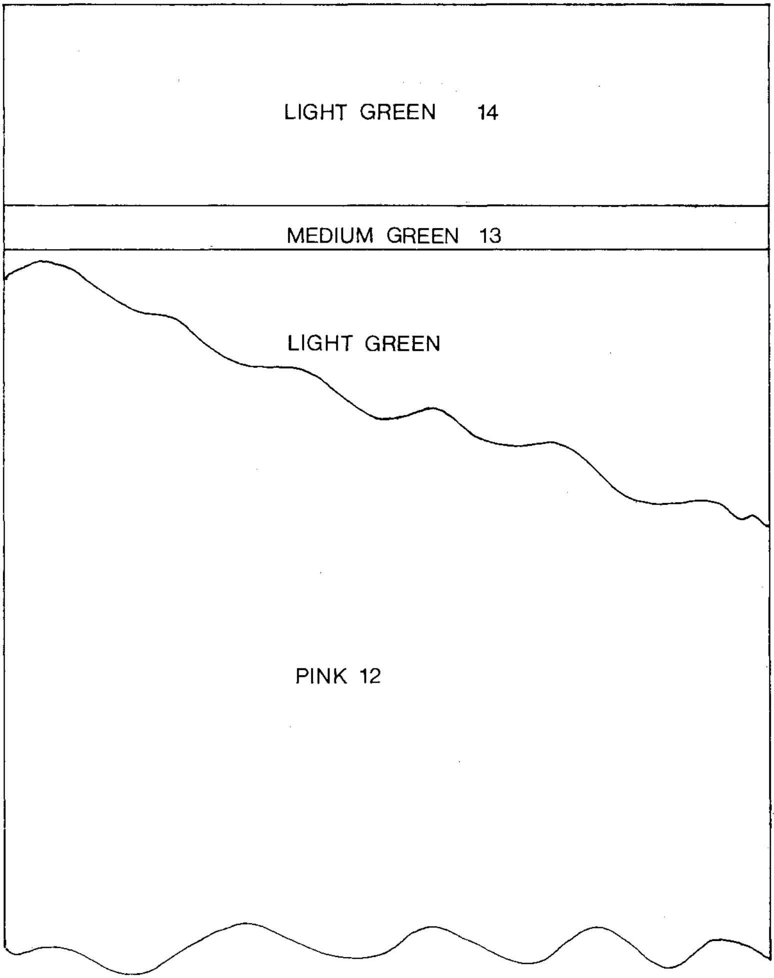

FIGURE 2. Length-section (10 × 18 mm) of a crystal which is zoned parallel to the pedion. Section is parallel to the *c* axis. (NMNH #133814).

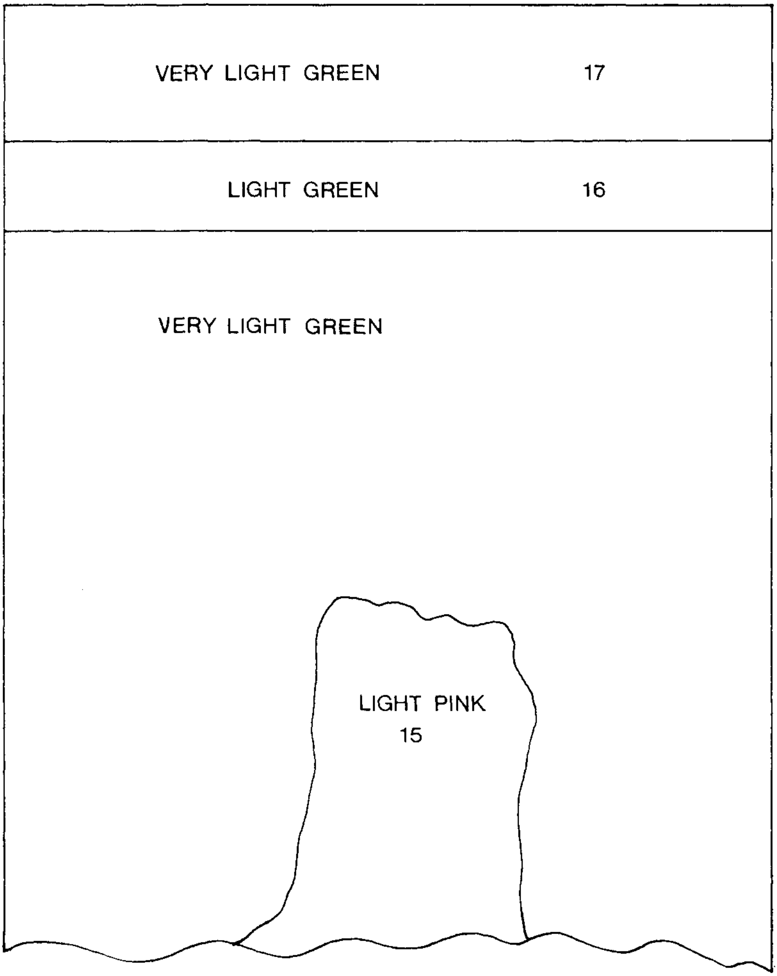

FIGURE 3. Length-section (10 × 8 mm) of a crystal which is zoned parallel to the pedion. Section is parallel to the *c* axis. NMNH #133815).

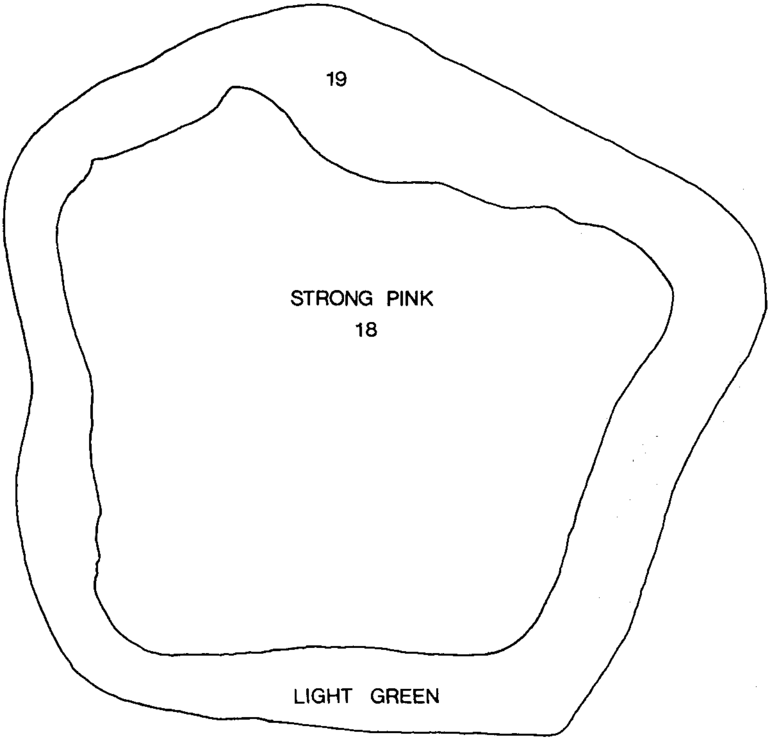

FIGURE 4. Cross-section (7 cm radius) of a "watermelon" tourmaline crystal zoned parallel to the prism. Section is parallel to the *a* axes. (NMNH #133816).

(See Figures 2 and 3). This is likely due to a peculiar resorption of the original rubellite by subsequent mineralizing solutions or by a sudden explosive event which fractured the still-growing crystals. The obvious zoning of the pedial type is seen only in the green material, and is always parallel to the pedion, regardless of the shape of the "termination" of the previously formed rubellite. (See Figure 2).

Many of these pedially zoned crystals have sharp zones of medium green colour, which have been preceded in growth by light green and followed in the deposition sequence by more light green. Because of the sharpness of this medium green zone and the relative thinness of it, few fine-quality bicolour gems have been cut from this material, and most of the gems are cut as mono-coloured stones. Clean stones of 78 carats have been cut from the finest rubellite.

This discovery of gem material is still continuing after two years of semi-continuous operation of the mine. The elbaite is being mined from collapsed gem pockets and an extraordinary amount of gem-quality material has been recovered.

Through the courtesy of Mr Dean McCrillis, of Plumbago Mining Corporation, Rumford, Maine, the author was permitted to examine several hundred faceted stones. This study was initiated because there are very few such opportunities to examine a large number of cut stones from a single locality, where there is absolutely no doubt that all the stones are from one site.

The Newry gem elbaite comes in a wide variety of colours. The most abundant of these, in decreasing order of relative abundance in faceting quality, are noted in Table 1 with their pleochroic colours.

The most beautiful and stunning colour is the rich burgundy rubellite, which grades through all shades of pink to a very light pink. It occurs in sizeable pieces and fine, large brilliant gems have been cut up to 100 ct. Next in terms of visual appeal (author's opinion) is a medium green, which is a pure green, without the yellow component which so frequently diminishes the beauty of green tourmaline. Much of the green material is this good clean green colour, although some yellowish-green is also found, as well as a very beautiful soft blue-green.

An expected consistency in the refractive indices of the pink and green gems was not observed. There was considerable latitude in the variation of the indices (0·014), and the only observed correlation between refractive indices and colour was that the lightest pink stones had the lowest indices and the deepest burgundy-red stones had the highest. Thanks to the foresight of Mr McCrillis, several boxes of stones were available which had all come from the same pocket. The variation in refractive indices of these stones was the same as that of the entire lot. The high, low, and most common refractive indices for each of the major colour-groups are presented in Table 1.

The density of the Newry elbaite varies from 3·04 to 3·09, the stones with darkest colours having the higher densities.

The absorption spectrum of the dark red elbaite has two distinct lines of 4560 and 4650 Å. These lines are also present, although not easily observed, in the pink elbaite.

The pink and red elbaite does fluoresce a weak violet colour under short-wave ultraviolet radiation, although the green material does not fluoresce at all. This observation was first noted by Mr Beesley, of the GIA in New York. Neither the red nor the green material responds to x-radiation.

Table I

OPTICAL DATA FOR NEWRY TOURMALINE

Apparent Colour	Pleochroic Colours	
	ε	ω
Deep burgundy red	Light pink	Deep red
Medium pink	Light pink	Medium pink
Light pink	Colourless	Light pink
Light green	Green	Yellow-green
Greenish-blue	Light green	Blue-green

Colour	Refractive Indices*					
	Highest Indices		Lowest Indices		Most Common Indices	
	ε	ω	ε	ω	ε	ω
Deep red	1·626	1·644	1·617	1·635	1·620	1·638
Medium pink	1·626	1·643	1·612	1·629	1·620	1·638
Light pink	1·621	1·637	1·617	1·635	1·621	1·636
Light green	1·625	1·642	1·616	1·633	1·620	1·638
Blue-green	1·622	1·640	1·617	1·634	1·620	1·638

*Determined in sodium light (± 0·002) on several hundred gems.

CHEMISTRY

Three samples of Newry elbaite were semi-quantitatively analysed by emission spectroscopy to determine the presence and relative concentration of minor and trace elements. The results of these analyses are presented as Table II. These figures represent a single determination on 2·5 mg of sample. They are valid within a range of 50% of the reported value, i.e., a concentration reported as 0·05 per cent might range between 0·025 and 0·075 per cent.

Semi-quantitative comparison was made using the Spex Industries graphite standards and Spex mix.

TABLE II

SPECTROGRAPHIC ANALYSES

ELBAITE, NEWRY, MAINE

	#128157 (BLUE)	#133812 (GREEN)	#133811 (PINK)
Ag	·0001	·0001	·0001
Al	M	M	M
B	> 1·0	> 1·0	> 1·0
Ba	·0005	·0005	·0003
Be	·03	·003	·003
Ca	·007	·005	·005
Cr	·005	·001	·0001
Cu	·03	·03	·03
Fe	> 1·0	·30	·005
Ga	·03	·01	·007
Hg	·003	·001	·003
K	·03	·01	·01
Li	·50	·65	·50
Mg	·007	·003	·0003
Mn	·50	·07	·05
Mo	·003	·0005	·0007
Na	> 1·0	> 1·0	> 1·0
Ni	·01	·001	·0001
P	·07	·05	·05
Pb	·01	·05	·07
Si	M	M	M
Sn	·03	·007	·03
Sr	·0005	·0003	·0003
Ti	·0005	·0005	·0005

Symbols M —Major element
> —Greater than

Samples of all the principal colour-varieties of Newry elbaite were analysed with an ARL Electron Microprobe, using an operating voltage of 15 kV, a sample current of 0·15 Ma, and NMNH microprobe standards of high reliability. Boron, lithium and oxygen cannot be detected with the microprobe and, therefore, the analyses are partial. All specimens are from the collection of the National Museum of Natural History and the sample numbers refer to catalogue numbers in the mineral collection.

The analyses of the elbaite are given in Table III, and notes about each analysed sample are in Table IV. Where pertinent, analysis numbers have been noted on Figures 1, 2, 3, and 4 to indicate the approximate area analysed.

TABLE III

ANALYSES OF NEWRY ELBAITE

NMNH #	Analysis #	SiO_2	Al_2O_3	FeO	MnO	MgO	CaO	K_2O	Na_2O	TiO_2	Cr_2O_3	F
133809	1	37·37	42·96	0·11	1·30	0·03	0·77	0·00	2·00	0·00	0·00	0·84
133810	2	38·21	44·97	0·00	0·04	0·01	0·14	0·00	2·08	0·00	0·00	0·72
133807	3	38·78	n.d.	0·00	0·14	0·04	0·44	0·02	1·92	0·00	0·00	0·67
133811	4	38·56	45·31	0·00	0·24	0·03	0·48	0·02	1·95	0·00	0·00	0·62
133812	5	37·79	43·14	1·18	0·67	0·06	0·35	0·01	2·13	0·00	0·00	0·73
133808	6	38·26	n.d.	0·86	0·22	0·04	0·22	0·05	2·10	0·01	0·00	0·65
133813	7	37·77	44·23	1·21	0·20	0·06	0·20	0·02	2·20	0·00	0·00	0·75
128157	8	37·00	40·42	4·40	0·90	0·03	0·22	0·03	2·80	0·02	0·01	1·08
128157	9	37·25	40·56	4·10	1·05	0·07	0·22	0·05	2·70	0·01	0·00	0·96
128157	10	37·66	45·03	0·00	0·13	0·05	0·21	0·02	1·93	0·00	0·00	0·63
128157	11	37·43	43·28	0·73	0·16	0·06	0·12	0·01	2·00	0·00	0·00	0·57
133814	12	38·43	44·59	0·00	0·13	0·00	0·31	0·00	1·91	0·00	0·00	0·81
133814	13	37·90	42·20	1·70	0·66	0·04	0·30	0·02	2·14	0·00	0·00	0·89
133814	14	38·17	42·50	0·57	0·45	0·02	0·05	0·01	2·03	0·00	0·00	0·69
133815	15	38·03	43·68	0·00	0·47	0·02	0·18	0·02	2·01	0·00	0·01	0·63
133815	16	39·20	39·82	2·03	0·61	0·06	0·25	0·02	2·23	0·00	0·00	0·83
133815	17	37·70	43·44	0·30	0·37	0·02	0·03	0·00	2·16	0·00	0·00	0·46
133816	18	38·38	43·22	0·31	0·09	0·02	0·17	0·02	1·92	0·00	0·00	0·70
133816	19	38·10	44·02	0·91	0·18	0·04	0·16	0·00	2·17	0·00	0·00	0·75

Accuracy of data—± 2% of the amount present

Of special interest to the gemmologist are the relative concentrations of iron and manganese. Many investigators have searched for the cause of the colour in pink and green elbaite, and have generally concluded that Fe^{+2} is primarily responsible for the cause of the green colour, and Mn^{+2} or Mn^{+3} for the cause of the pink colour. For more information on this topic, the reader is referred to the work of Quensel and Gabrielson (1939) who investigated the elbaites of the Varutrask pegmatite, Carobbi and Pieruccini (1947) who examined the Elba tourmaline, and Bradley and Bradley

TABLE IV

LIST OF ANALYSED SAMPLES OF NEWRY ELBAITE

ANALYSIS #	NMNH #	REMARKS
1	133809	Random core fragment—very light pink
2	133810	Random core fragment—brownish pink
3	133807	Random core fragment—strong pink
4	133811	Random core fragment—strong pink
5	133812	Single crystal—light medium green
6	133808	Single crystal—light medium green
7	133813	Single crystal—yellowish-green
8	128157	Crystal section parallel to *a* (Fig. 1)—blue inner core
9	128157	Crystal section parallel to *a* (Fig. 1)—blue outer core
10	128157	Crystal section parallel to *a* (Fig. 1)—pink middle zone
11	128157	Crystal section parallel to *a* (Fig. 1)—light green outer zone
12	133814	Crystal section parallel to *c* (Fig. 2)—inner pink zone
13	133814	Crystal section parallel to *c* (Fig. 2)—medium green thin zone
14	133814	Crystal section parallel to *c* (Fig. 2)—very light green outermost zone
15	133815	Crystal section parallel to *c* (Fig. 3)—light pink core
16	133815	Crystal section parallel to *c* (Fig. 3)—light green thin zone
17	133815	Crystal section parallel to *c* (Fig. 3)—very light green outer zone
18	133816	Crystal section parallel to *a* (Fig. 4)—strong pink core
19	133816	Crystal section parallel to *a* (Fig. 4)—light green outer zone

(1953) who studied Pala, California, elbaite. More recent investigations have indicated that the colour is very likely due to the oxidation state of part or all of the manganese or iron content (Manning (1969); Darragh *et al.* (1967); Voskrensenskaya *et al.* (1967)).

The microprobe cannot determine the oxidation state of elements. The iron and manganese content of the Newry elbaites has been calculated as divalent oxides, but it may actually be in part or all trivalent.

The Newry elbaite analyses indicate that the dark blue elbaite has the highest iron and manganese content, the green elbaite the next highest, and the pink elbaite the lowest. Analysis #1 is anomalous and will be discussed later. The iron content of the green elbaite is proportional to the intensity of the colour, the darker green gems having a higher iron content than the lighter ones. However, the manganese content of the rubellite samples is not proportional to the intensity of the pink colour. Deer, Howie and Zussman (1962) have noted that pink tourmalines have a very low iron content rather than a significant manganese content. This observation has been substantiated by the present study. Most pink elbaite from Newry has no appreciable iron and a relatively small amount of manganese. It is possible, as noted by Bradley *et al.*, that the pink colour is produced by very small amounts of manganese, but is masked when iron is present.

The relatively high manganese content of analysis #1 is somewhat puzzling at first glance, inasmuch as the material is very light pink. However, Bradley *et al.* (1953) have noted a colourless crystal with 1·38% each of Mn0 and Fe0 and suggested that iron content may be adequate to mask the pink colour induced by manganese but insufficient to produce a green colour. It is possible that the crystal in analysis #1 is similarly affected by the iron content, or that the light colour is due to the oxidation of the manganese.

In Table 3, analyses #8-19 are zoned "watermelon" and "bicolour" crystals. Freehand sketches of these zoned crystals are shown in Figures 1, 2, 3, and 4. All four crystals were cut across the direction of colour-zoning, either parallel or perpendicular to *c*. Analyses of the separate zones show that compositional changes, evidenced by colour-change, are abrupt and not gradual. Both light green sections of the crystals shown in Figure 2, although separated by a relatively iron-rich zone, have identical compositions (analysis #14). The outermost green rind of "watermelon" sections is enriched in iron.

Due to the high quality of this elbaite, and the prodigious amounts in which it is being recovered at this date (August 1974), this gem material will undoubtedly be encountered by the practising gemmologist with increasing frequency in coming years.

The author is indebted to Mr Dean McCrillis and Mr John Marshall, of Plumbago Mining Corporation, for their invaluable

assistance during the course of this study, and to George Switzer, Daniel Appleman and John S. White for suggestions for improvement of the manuscript. The spectrographic analysis was obtained from the Conservation Analytical Laboratory of the Smithsonian Institution.

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MAGNESIOAXINITE, A NEW MINERAL FOUND AS A BLUE GEMSTONE FROM TANZANIA*

By E. A. JOBBINS, ANNE E. TRESHAM AND B. R. YOUNG

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A PALE BLUE circular mixed-cut gemstone, weighing 0·1577 grams (0·78 carats), was submitted for detailed examination by Mr R. K. Mitchell, who had received it from Mr C. R. Bridges, a mineral dealer operating in East Africa. The rough

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material had been obtained from a prospector in Tanzania, and there had been no distinct crystal faces or form. The stone did not identify with any of the usual gem minerals and was later shown to be a new member of the axinite group. It was acquired for the Institute collections (registered number MI 34610), and is now on display in the Geological Museum, London.

The cut stone is of brilliant appearance with a vitreous lustre; pale blue in daylight but pale violet under tungsten lighting. The refractive indices, obtained on a Rayner Dialdex refractometer using sodium light, are α 1·656, β 1·660, γ 1·668 (all ±0·001), giving a birefringence of 0·012. In contrast, a specimen of the well-known axinite from Bourg d'Oisans, Dauphiné, France gave values of α 1·672, β 1·679, γ 1·682 (all ±0·001). For a pale coloured stone the pleochroism is notable—from pale blue to pale violet to pale grey. The mineral is optically positive in contrast to most axinites which are biaxial negative; it has not yet been possible to determine 2V or the optical orientation.

The specific gravity of the gemstone is 3·178, whereas that of the Bourg d'Oisans axinite used for analysis and x-ray work is 3·288. The streak (powder) is white and the hardness is greater than 6 but less than 7. Under the binocular microscope very fine cleavage traces were seen in one plane, but no other inclusions were noted.

Under ultra-violet light the stone fluoresces a distinct orange-red by long-wave radiation (3650Å), but appears a duller red by short-wave radiation (2357Å); the Bourg d'Oisans material is inert. The stone appears pink through the Chelsea colour filter. Viewed between crossed filters (of copper sulphate solution and red glass) the stone fluoresces bright red. When viewed through the spectroscope, using the copper sulphate solution as a filter, it shows a faint, broad fluorescent band in the orange-red (5900-6500Å region) but no bright lines. These properties might be taken to indicate the presence of chromium, but possibly only in trace amounts since chromium is known to give similar fluorescent effects in concentrations as low as 100 parts per million. Examination of the absorption spectrum of the stone using white light, did not reveal any chromium lines in the red, but there was a faintly perceptible general absorption of the green, and of the deep violet.

Table 1

OBSERVED AND CALCULATED X-RAY POWDER DIFFRACTION DATA FOR MAGNESIOAXINITE (1) AND FERROAXINITE FROM FRANCE (2).

(1)

I/I_1	d_{obs}	d_{calc}	*hkl*
15	8·95Å	8·935Å	010
25	6·29	6·290 6·278	110 $1\bar{1}0$
4	4·96	4·959	011
8	4·76	4·762	$1\bar{1}1$
2	4·51	4·522	$1\bar{1}\bar{1}$
10	3·97	3·981	$20\bar{1}$
5	3·66	3·659	$1\bar{2}1$
65	3·440	3·441	002
20	3·269	3·270	$1\bar{2}\bar{1}$
65	3·139	3·139	$2\bar{2}0$
8	3·069	3·064 3·064	$0\bar{2}2$ 102
20VB	2·985	3·001 2·978 2·977	012 030 $0\bar{3}1$
20	2·877	2·877	$13\bar{1}$
100	2·796	2·797	$31\bar{1}$
5B	2·753	2·770 2·742	$1\bar{3}1$ 112
5	2·633	2·636	$2\bar{1}\bar{2}$
25	2·556	2·559	$2\bar{1}2$
18	2·429	2·429	311
18	2·415	2·411 2·410	$30\bar{2}$ 131
8	2·352	2·354 2·353	$11\bar{3}$ 212
1	2·305	2·309	$23\bar{2}$
1	2·252	2·253 2·252	$12\bar{3}$ $2\bar{3}\bar{1}$
28	2·176	2·176	$1\bar{4}1$
32	2·150	2.148	103
4	2·121	2·119	$1\bar{1}3$
14	2·048	2·048	$13\bar{3}$
14	2·028	2·0285	$1\bar{3}\bar{2}$

(2)

I/I_1	d_{obs}	d_{calc}	*hkl*
20	6·30Å	6·308Å 6·305	110 $1\bar{1}0$
1	5·85	5·851	$10\bar{1}$
1	5·11	5·116	101
2	4·97	4·976	011
4	4·78	4·787	$1\bar{1}1$
6	4·54	4·535	$1\bar{1}\bar{1}$
4	3·99	3·987	$20\bar{1}$
10	3·68	3·678	$1\bar{2}1$
80	3·451	3·452	002
20	3·277	3·281	$1\bar{2}\bar{1}$
85	3·148	3·154 3·153	220 $2\bar{2}0$
10	3·077	3·077 3·077	$0\bar{2}2$ 102
20VB	3·000	3·011 2·992 2.991	012 030 $0\bar{3}1$
12	2·957	2·961	$1\bar{1}\bar{2}$
4	2·923	2·925	$20\bar{2}$
18	2·886	2·887	$13\bar{1}$
2	2·839	2·834 2·835	$1\bar{3}0$ 130
100	2·799	2·801	$31\bar{1}$
2	2·783	2·784	$1\bar{3}1$
4	2·753	2·752	112
6VB	2·647	2·658 2·642	$3\bar{1}\bar{1}$ $2\bar{1}\bar{2}$
25B	2·562	2·571 2·558	$2\bar{1}2$ 202
2	2·521	2·520	$13\bar{2}$
1	2·477	2·480 2·479	230 $2\bar{3}0$
20	2·440	2·437	311
20	2·416	2·419 2·415	131 $30\bar{2}$
1	2·391	2.393 2·387	$2\bar{2}2$ $1\bar{3}2$
20	2·361	2·362 2·360	$21\bar{2}$ $11\bar{3}$
1	2·319	2·320 2·315	$3\bar{2}\bar{1}$ $23\bar{2}$
3	2·261	2·261 2·260	$2\bar{3}\bar{1}$ $12\bar{3}$
28	2.185	2·188	$1\bar{4}1$
32	2.154	2·156	103
5	2.125	2·125	$1\bar{1}3$
20	2.055	2·055	$13\bar{3}$
14	2·035	2·0356	$1\bar{3}\bar{2}$

The intensities were estimated visually by comparison with an intensity scale.
B = broad, VB = very broad.

1. Magnesioaxinite, Tanzania (Registered No. M.I. 34610). CuKα radiation (λ=1·54178Å) *a* 8·933Å, *b* 9·155Å, *c* 7·121Å, α 102·59°, β 98·28°, γ 88·09° (cell volume 562·4Å^3).
2. Ferroaxinite, Bourg d'Oisans, Dauphiné, France (Registered No. M.I. 34509), CoKα radiation (λ=1·79021Å). *a* 8·953Å, *b* 9·197Å, *c* 7·143Å, α 102·63°, β 98·10°, γ 88·21° (cell volume 568·2Å^3).

Comparison of x-ray powder data (Table 1), obtained from films taken with an 11·46 cm camera, of the gem mineral and axinite from Bourg d'Oisans shows the gem to be an axinite. The powder data were provisionally indexed by comparison with published data and were refined using the least squares program (BA1·0) developed by Dr R. J. Davis, Department of Mineralogy, British Museum (Natural History), for the refinement of cell dimensions and enumeration of all possible d-spacings. This refinement gave cell dimensions *a* 8·933Å, *b* 9·155Å, *c* 7·121Å, α 102·59°, β 98·28°, γ88·09° (cell volume 562·4Å^3) for the Tanzanian axinite and *a* 8·953Å, *b* 9·197Å, *c* 7·143Å, α 102·63°, β 98·10°, γ 88·21° (cell volume 568·2Å^3) for the axinite from Bourg d'Oisans. The Tanzanian axinite gives slightly smaller d-spacings than the French material and gives an additional spacing at 8·95Å which is also given by the manganese-rich axinite known as tinzenite (Milton *et al.*, 1953).

In view of the unusual colour for an axinite and the low physical constants, it was decided to carry out a chemical analysis by electron microprobe (Geoscan microanalyser) despite its limitations on elements with an atomic number below 11 (sodium), and the consequent omission of boron and water from the results. A small fragment of axinite from Bourg d'Oisans was also analysed for comparison. Analyses were made of the various elements using appropriate silicates, oxides, sulphides and pure metals as standards. The analyses were made at an accelerating potential of 20kV and the results have been corrected for x-ray absorption, atomic number effect and secondary fluorescence using the computer program written by Mason, Frost and Reed.

TABLE 2

SHOWING ANALYSES OF MAGNESIOAXINITE (1) MAGNESIUM RICH AXINITE FROM AUSTRALIA (2) AND FERROAXINITE FROM FRANCE (3)

	(1)	(2)	(3)
SiO_2	44·0	42·39	42·2
TiO_2	0·03	—	0·03
B_2O_3	*	5·52	*
Al_2O_3	17·9	17·10	17·5
Cr_2O_3	nt.fd.	—	nt.fd.
V_2O_3	0·13	—	nt.fd.
Fe_2O_3	nt.fd.	1·68	†
FeO	nt.fd.	5·18	6·1†
MnO	0·4	1·38	3·3
MgO	6·9	4·20	1·6
CaO	21·7	20·31	20·1
ZnO	0·06	—	nt.fd.
NiO	nt.fd.	—	nt.fd.
CoO	nt.fd.	—	nt.fd.
Na_2O	nt.fd.	0·06	0·04
K_2O	0·01	0·03	0·02
$H_2O > 105°$	n.d	1·67	n.d
$H_2O < 105°$	n.d	0·31	n.d
	91·13	99·83	90·89

n.d. = not determined, nt.fd. = not found. *The presence of boron was confirmed by chemical tests. †Assuming that all the iron is in the divalent state.

α	1·656	1·659	1·672
β	1·660	1·665	1·679
γ	1·668	1·668	1·682
δ	0·012	0·009	0·010
D	3·178	3·19	3·288

NUMBERS OF IONS ON THE BASIS OF 28(0) (COLUMNS 1, 2a, AND 3), ON THE BASIS OF 32 (O,OH) (COLUMN 2b).

	(1)		(2a)		(2b)		(3)	
B	—		1·772		1·789		—	
Si	8·012		7·885	8·00	7·961	8.00	8·025	
Al^{iv}	—		0·015		0·039		—	
Al^{vi}	3·842	3·87	3·634	3·87	3·746	3.98	3·923	3·93
Fe^{3+}	—		0·235		0·237		—	
Ti	0·004		—		—		0·004	
V	0·019		—		—		—	
Mg	1·872	6·18	1·165	6·27	1·176	6·33	0·454	6·07
Fe^{2+}	—		0·806		0·814		0·970	
Mn	0·061		0·217		0·220		0·531	
Zn	0·008		—		—		—	
Ca	4·234		4·049		4·088		4·095	
Na	—		0·021		4·021		0·015	
K	0·002		0·007		0·007		0·005	
OH	—		2·072		2·092		—	

The number of ions has been given to three places of decimals to avoid rounding up errors.

1. Magnesioaxinite, Tanzania (Registered No. M.I. 34610). Microprobe anal. A. E. Tresham.
2. Magnesium-rich axinite associated with epidote, tremolite and calcite; London Bridge, near Queanbeyan, New South Wales, Australia. Anal. T. G. Vallance.
3. Ferroaxinite, Bourg d'Oisans, Dauphiné, France (Registered No. M.I. 34509). Microprobe anal. A. E. Tresham.

The results of these analyses and that of the magnesium-rich axinite described by Vallance (1966) are shown in Table 2. Since the microprobe analyses do not show B_2O_3 or H_2O we have calculated the number of ions in the unit cell on the basis of 28 oxygens, but the full analysis of Vallance has been calculated on a 32 oxygen basis (column 2b). We also show the Vallance analysis calculated on a 28 (0) basis (column 2a) for direct comparison with the microprobe analyses.

Analyses for chromium using the microprobe are complicated by the overlap of the chromium Kα peak by the vanadium Kβ peak, and it was not possible to make a satisfactory count for chromium. It may be that traces of chromium are the cause of the red fluorescence, but one cannot exclude the possibility that the 0·13% V_2O_3 is responsible. A synthetic corundum simulating alexandrite and coloured by vanadium (probably > 1%V) showed the characteristic sharp line at 4750Å (not seen in the axinite gemstone) through the spectroscope using copper sulphate solution as a filter, but there was no fluoresence in the red part of the spectrum, although the fluorescent effects in UV light and between crossed filters are similar to the gemstone. However, the fluorescent effects of vanadium in axinite do not necessarily follow a precisely similar pattern to that when it is used as a colouring agent in synthetic corundum. The presence of manganese and vanadium interfere with some sensitive microchemical tests for chromium, and we were unable to confirm the presence of the element by this means. Accordingly, we record chromium as 'not found'.

Since boron and water cannot be detected with the microprobe used it was deemed desirable to confirm these constituents of the axinite by other tests. A scraping from the gemstone mixed with potassium bisulphate and fluorite was fused on a platinum wire and the presence of boron was confirmed by the green coloration imparted to the flame. It was hoped to confirm the presence of water by heating in a dried tube and observing the condensation in the cooler part of the tube, but the results were not sufficiently conclusive and further material could not be spared from the gemstone.

The chemical formula of axinite has been given as 2 [$(Ca, Fe^{2+}, Mn, Mg)_3Al_2BSi_4O_{15}OH$] and there is considerable variation in the proportions of Fe and Mn, and also Ca, in different axinites. Sanero and Gottardi (1968) proposed the names ferroaxinite and manganaxinite for the calcium iron (Ca, Fe) and the calcium manganese (Ca, Mn) end members of the series. Vallance (1966) described an axinite from London Bridge, near Queanbeyan, New South Wales containing 4·2% MgO, 5·18% FeO, 1·68% Fe_2O_3 and 1·38% MnO (the only other axinite previously described with such a high Mg content seems to have been that of Steinwachs (1929), which had 4·13% MgO) and with this significant percentage of magnesium it appears that mutual substitution is possible between Fe, Mn and Mg. The refractive indices of the London Bridge material α 1·659 (1·656), β 1·665 (1·660) and γ 1·668 (1·668) approach those of the present gemstone (shown in brackets) and the specific gravity is also reduced 3·19 (3·178). It would seem that the increase in magnesium, at the expense of Fe and Mn, is responsible for the lowering of the physical constants (including the cell dimensions) compared with the Bourg d'Oisans and most other axinites. However, the physical constants of the present axinite (with 6·9% MgO) are not as low as might have been expected compared with those of the Australian material (4·2% MgO).

The composition of the gemstone now described closely approaches the theoretical calcium magnesium (CaMg) end member, with 6·9% MgO and only 0·4% MnO, and we now propose that the name *magnesioaxinite* should be applied to it. Fromme (1909) proposed the name magnesium-axinite for a theoretical end member of the series, but the mineral had not then been found in nature, nor was artificial material known. The name magnesioaxinite (following the style of Sanero and Gottardi) has been submitted for approval to the Commission on New Minerals and Mineral Names of the International Mineralogical Association.

In the course of preparation of this paper the authors have had much constructive discussion with their colleagues in the Petro-

graphical Department of the Institute, and with friends at the Gem Testing Laboratory of the London Chamber of Commerce, Mr R. K. Mitchell and others—their assistance is gratefully acknowledged. We are especially indebted to Dr R. J. Davis and Mr J. G. Francis of the British Museum (Natural History) for their collaboration in making available the computer program for the refinement of the x-ray data. Prof. R. A. Howie kindly allowed us to see the revised typescript for the axinite section of Deer, Howie and Zussman, *Rock Forming Minerals*, 2nd edition.

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INFRA-RED REFLECTION SPECTRA OF TURQUOISE (NATURAL AND SYNTHETIC) AND ITS SUBSTITUTES

By M. ARNOULD and J.-P. POIROT

Abstract: Studies are reported of the 800-1200 cm^{-1} reflection spectra of natural and synthetic turquoise and some of its substitutes. Resulting curves permit an easy identification of the different stones.

Infra-red reflection spectroscopy is a non-destructive method of investigation, which can be applied to gemstones, even if they are

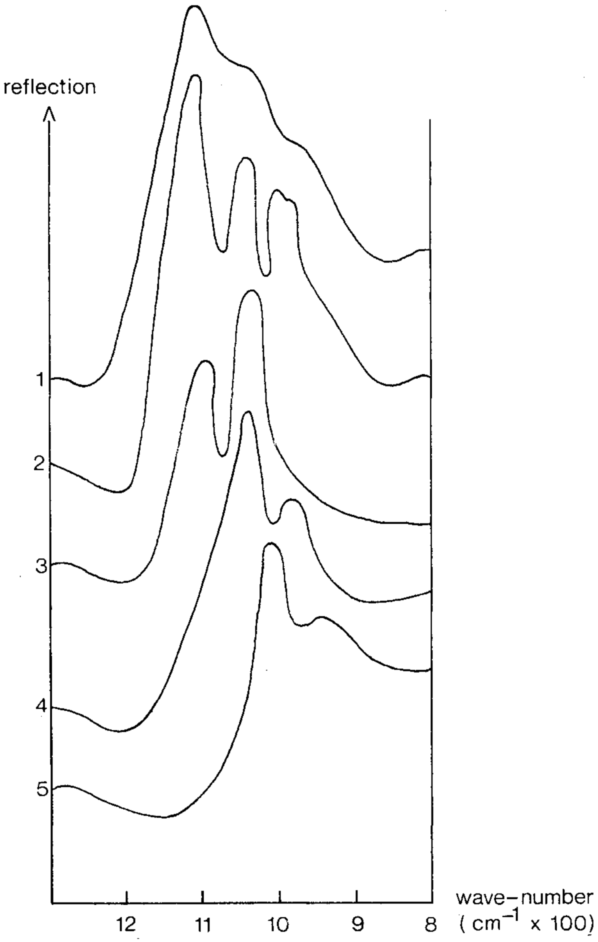

FIGURE 1

Infra-red reflection spectra of turquoise and its substitutes (ordinate origins of the curves are displaced for clarity):

1—Synthetic turquoise
2—Natural turquoise
3—Odontolite
4—Turquoise-imitation "Vienna"
5—Turquoise-imitation "Reese"

in settings, in order to identify them. It seemed interesting to compare some samples by this method:

—natural turquoise, from various localities

—synthetic turquoise, of Gilson manufacture

—several species of stones occasionally used in jewellery as substitutes for turquoise: odontolite, "neolite" and other compressed phosphates.

Turquoise is a complex aluminium-copper-phosphate. Infrared spectroscopy is used to display the transitions of $(PO_4)^{3-}$ radicals, the energy of which depend on their cationic environment in the crystal structure. One of these transitions is characterized by a strong reflection peak in the 1000 cm^{-1} band (10μm). Therefore we have limited the investigation field to the wave-numbers between 800 and 1200 cm^{-1} (approx. 12 to 8μm).

Figure 1 shows some characteristic spectra; the spectrum of natural turquoise is quite constant, for all the samples studied; it should be observed that this sampling includes some stained and some plastic-impregnated stones. Three sharp peaks are obvious, at 950, 1030 and 1120 cm^{-1}. The same energy values, but with wide peaks, are observed on the spectrum of synthetic turquoise: natural and synthetic stones can be easily differentiated from the aspect of the spectrum curve (see Figure 1).

Several phosphates, natural or man-made, can be employed instead of turquoise. We have recorded in Figure 1 three spectra corresponding to such substitutes: odontolite, turquoise-imitation "Vienna", turquoise-imitation "Reese". The difference between them is large, and infra-red reflection spectroscopy can be considered as bringing an additional technique to the identification of various turquoise-looking stones in jewellery.

A REPORT ON THE GEMETER '75

By ROBERT WEBSTER, F.G.A.

THE report published in the *Journal of Gemmology*(1) of the writer's assessment of the earlier type *Gemeter* has, as shown by the personal communications received, aroused a great deal of interest. Indeed much more information was obtained from the observations of other workers who kindly wrote to me.

Before it was published, a copy of my report was sent to Sarasota Instruments Inc., and a kindly reply was received by the Secretary of the Gemmological Association from Mr Wallace L. Minto, the President of the Company(2). In this letter Mr Minto agreed that I was substantially correct in my assessment as to how the instrument operated, and he gave the added information that the wavelength of infra-red radiation used was 0·98 microns (9800Å or 980·0 nm). Mr Minto also agreed that several of my comments were valid and said that these were expected to be overcome in later models.

Much information was sent to the writer by Dr E. Gübelin(3), in which he described his own findings on the behaviour of the *Gemeter*, and these tended to confirm my own findings. Dr Gübelin also mentioned that Dr Godehard Lenzen was to speak on the instrument at the German Gemmological Conference at Idar-Oberstein. It is understood that this talk was given, but no written report seems to have been published as yet.

A letter from Herr M. Eickhorst, of Hamburg,(4) added to the knowledge of the working of the *Gemeter* by the information that the "sensor" consists of a combination of a LED (light emitting diode) and a photo-transistor placed adjacent to each other at an angle of 30°. Such a piece of equipment is said to be well known to electricians and is mainly used as a light barrier and for scanning perforated cards. Figure 1 shows a photo-print enclosed in the letter received from Herr Eickhorst, which shows the sensor unit and path of the rays.

The writer is indebted to Mr P. E. Paulin, of Sweden,(5) for the mass of results he has recorded using the *Gemeter*, and, further, his experiments with the power-supply to such an instrument. This worker found that the major fault seemed to lie with the power-supply and removed the battery and connected the instrument to a

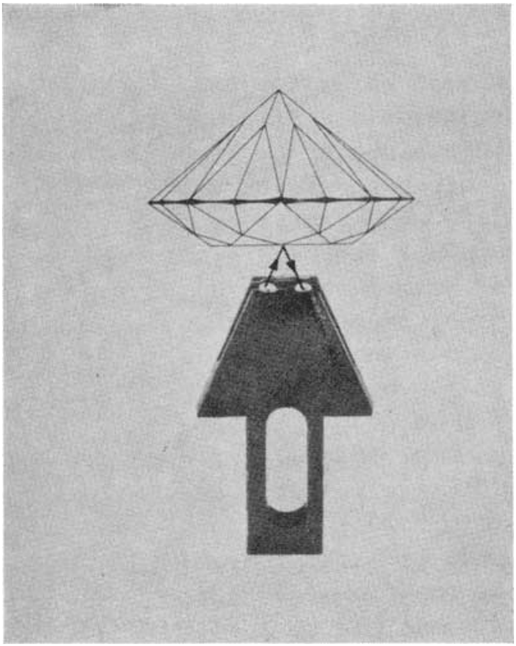

Fig. 1. The sensor as described by Herr Eickhorst.

stabilized direct-current supply at 1·45 volts. This increased the constancy of the readings, and further experiments confirmed that differences in readings occurred when the voltage is altered by only 0·05 volt. This tends to confirm the writer's own findings that constant use drains the battery and thus leads to inaccuracies. Mr Paulin also had the sight of a similar type of instrument produced by another maker. This is the RE-DEX and is powered by a 9 volt cell. From accounts received, this instrument apparently gives more stable readings.

The writer must appear to the reader to have digressed from the original title, but it was felt necessary to give some information on the experiments known to have been carried out by other workers and to correlate their findings so as to complete the picture.

The "*Gemeter* '75" is housed in a fawn-coloured plastic case of a completely new design (Fig. 2). On a horizontal platform is placed the press-button switch, the adjustment screw and the examination disc: the meter is conveniently placed on an inclined panel behind the horizontal platform and has a clear scale marked from 1·4 to 2·7, with, as in the old instrument, the more important stones marked by letters. The alkaline dry battery fixes in clips in a recess in the base plate, which itself is secured by screws through rubber grummets which provide "feet" for the instrument. The press-button switch is of much better construction and is more positive in action. It does not "slip" like the switch used in the earlier model.

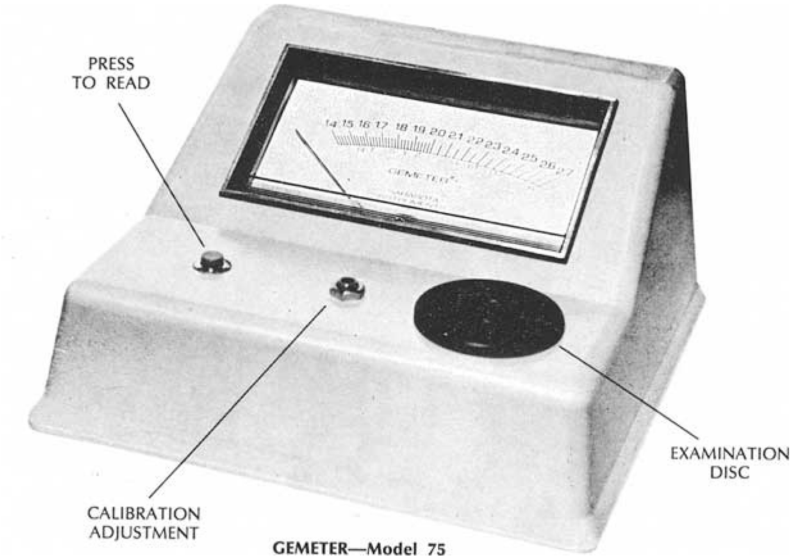

FIG. 2. The Gemeter '75.

The examination disc is similar to the one used in the original model except that it has radial bars at 45° marked on it as well as the concentric circles. The "nipple" is still present and is, if anything, of a smaller diameter than the "nipple" on the original instrument. To set a stone correctly is therefore much less easy, especially if it be a long trap-cut or a pendeloque stone of any size. With a stone set off-centre in a piece of jewellery the balancing feat necessary would call for some ingenuity. Mr Minto's view that the "nipple" allows a stone to be tested where the setting is "proud" of the stone, while a valid answer, seems to the writer to be using a minority case and ignoring the general run of normal tests. Give me a flat working surface every time.

Testing out the new model showed the performance to be superior to that shown by the earlier instrument examined: even so, the repeatability does not appear to be all that could be desired. For the general test the instrument was calibrated on synthetic spinel at 1·73: unknown to each other, Mr Paulin and the writer both used synthetic spinel as a calibration point. With the *Gemeter* so set, the values recorded were, in general, not unduly out. This is especially so with the lower ranges below 1·80. The value of the instrument must undoubtedly lie in the range over 1·80 where the normal optical refractometer does not readily function. In this higher range the instrument was found to be useful but not always reliable, for the readings, often quite good, were at times widely off the mark, even with the same stone. One could reasonably understand low readings and attribute them to bad surface polish, unclean stone or extraneous dirt, but quite often the readings obtained were exceptionally high, a diamond or a stone of lower refractive index indicating in the range of rutile.

The reason for these high readings is puzzling and the writer can offer no solution. Other workers too have found this effect and have so far provided no answer. It is this defect which nullifies the suggestion that even a counter-hand can use the instrument, for, unless he was a competent gemmologist who could spot such errors, misidentification could easily occur and this, in England with its present consumer protection legislation would be dangerous.

With all the experimental work now being carried out on this type of instrument something satisfactory must eventually be evolved, but the Fresnel stipulation that a well-polished surface is essential must prevail. This limits the accuracy of this type of instrument, which can never surpass the performance of the optical refractometer in the range below 1·80. Above this the *Gemeter* does have a distinct value, if handled by a knowledgeable person.

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PEARLS

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

(being the substance of a talk given to the Gemmological Association of Great Britain at Goldsmiths' Hall, London, on 19th March, 1975.)

IT was a happy coincidence, when I was asked to give a talk to the Gemmological Association in London at the Goldsmiths' Hall, that the subject should be Pearls. This year is the golden jubilee of the laboratory of the London Chamber of Commerce, which was founded solely as a pearl testing station in 1925. Pearl testing to combat the very serious threat of Japanese cultured pearls was undertaken by B. W. Anderson, B.Sc., who was later joined by fellow graduate of King's College, C. J. Payne, B.Sc. Pearl testing by early lucidoscope and eventually the endoscope soon proved a fast and efficient method of testing drilled pearls, and Anderson and Payne became extremely proficient workers.

Unfortunately for many traders the world slump of *circa* 1931 caused a cessation in trading and virtual collapse of the pearl market. Fortunately for gemmologists time was available and opportunity for research presented itself to Anderson and Payne. We are fortunate that we had these two young men of education and intelligence gifted with probing minds. Data for gemmologists flowed from their work and today's gemmologists and instructors alike owe much to the work of these two pearl testers. Had it not been for the cultured pearl threat we would not have had Anderson and Payne. Without these two gemmology would not have achieved its present standard in this country. I confess we owe it all to the Japanese (albeit indirectly)! So then I come to gemmologists of today, who possibly consider gemmology to be about gemstones when in fact it really owes much to pearls. My idea was to talk about x-rays and results seen when jewellery such as pearl-set pieces were under test and the various results and reactions seen. However, it seems appropriate in this our fiftieth year to deal with pearls and x-rays.

The first use of x-rays was to check thin-shelled oysters for possible pearls and avoid opening masses of oysters and leaving the rotting flesh to decompose under a hot sun. Raphael Dubois(1) first mooted this method to detect (not to test) pearls in 1901and it was put into practice in 1906: it was not very successful since labour was cheap and plentiful. Dauvillier in 1924 found upon investigation that nacre (mother-of-pearl) gave a six-spot hexagonal or ring-structure when penetrated by x-rays normal to the mother-of-pearl layer and a four-spot pattern at right angles to it: he published his paper in 1926.(2)

Shaxby (1924)(3) followed Dauvillier and proved that the thin-layered structures of nacre in the concentric structure of pearl were platelets of aragonite whose *C* axis was normal to the plane of the layers. These calculations were agreed by Prof. W. L. Bragg (later to become President of the Gemmological Association).

Galibourg and Ryziger (1926–1927)(4) followed and put to use the lauegram method of testing. It follows that if a beam of x-rays is passed through a real pearl a six-spot pattern will result and that if the pearl is turned through 90° a second six-spot pattern will be obtained—proving emphatically a natural pearl. A mother-of-pearl nucleus in a cultured pearl will give a six-spot pattern through the pearl skin and layers of mother of pearl and a four-spot pattern at 90° when the beam of x-rays travels along the layers of mother-of-pearl. If a first x-ray diffraction picture shows a four-spot pattern no further testing is necessary. The pearl is cultured.

The knowledge of the concentric and radial structure of natural pearls is utilized in the endoscope method of testing. In this method a beam of concentrated light (usually from a carbon arc source) is focused through a hollow platinum needle which has one end of the tube polished at 45° as a miniature mirror and a short distance away a second mirror is placed inversely at 45°. The pearl is threaded upon the needle to a position such that its centre is poised mid-way between the two mirrors. Light from the carbon arc source impinges upon the second mirror, shoots up into the pearl, travels round concentrically until (through an aperture) it meets the end mirror and is emitted through an eyepiece (which is the end-scope!) Cultured pearls so tested allow the light to travel along a mother-of-pearl layer and escape through to the exterior surface of the cultured pearl.

This knowledge, gained by testing tens of thousands of pearls and consequent examination of their interiors via drill holes, enabled a speeding up of the use of x-rays in radiographs of pearl necklaces. Dog-leg drill holes, thin skins and conchiolin gaps were very easily recognized signs of a cultured pearl. With natural pearls a radiograph serves to indicate very accurately the nature of the pearls and subsequent optical examination lends speed to expertise. No anomalies are allowed—any doubtful cases are again x-rayed and fluoresced. We think we have the best of both methods, both endoscope and radiographs. The mother-of-pearl used for bead nuclei comes from the Mississipi River mussel: it contains traces of manganese, which fluoresces under x-ray excitation. It is a cold candle-wax colour when viewed down the drill hole, whereas most natural pearls have a warm light-yellow to honey colour and a ringed structure when so viewed. Cultured pearls generally have larger drill holes than natural pearls: this is because natural pearls are sold by weight and cultured pearls by size (small holes conserve weight).

Following mother-of-pearl-nucleated cultured pearls from sea-water oysters, the Japanese now grow cultured pearls without a nucleus in fresh water mussels. In Lake Biwa, the largest freshwater inland lake in Japan, they dredge the mussel *hyriopsis-schlegeli* which grows to 9 inches in length and lives for 13 years. The mussel has no room internally to accept a bead nucleus. It is opened up and 10 slits are cut into each side of its body and pieces of tissue are inserted into each incision. The mussel is then lowered in a cage from rafts as in normal cultivation routine. In three years the mussels produced 60% successfully, i.e. 20 baroque pearls to each mussel, very regularly irregular, having a soft white waxy brilliance akin to river pearls. The mussels are not discarded but are returned to the lake and produce a second crop without further insertion of tissue nuclei. The pearls of this second crop are rounded and buttony in shape—a step further than the first baroques. Sometimes a third crop is formed which is flatter in shape. Radiographs of first-crop non-nucleated cultured pearls show a distinctive pattern of slight wispy nature likened by a former and young colleague to potato crisps, which when viewed from a side elevation do have this vague thin structure. When a whole necklace of pearls shows such a structure—nebulous it may be—it is further proved by the very typical strong white/greenish fluorescence and distinct phosphorescence seen under x-ray excitation. The last figures of production I received of non-nucleated cultured pearls was approximately 2 million momme annually: one momme = 3·75 grammes. 70% of the production was sold to Beirut.

In Australian waters much larger sea-water oysters are found: this is *pinctada maxima*, which can produce (and does) pearls naturally. Japanese workers and methods are used to insert much larger spherical mother of pearl nuclei for cultivation. After three months the seeded oysters are checked and it is found that 50% of the oysters have failed to accept the nucleus and in fact the mother of pearl lustrous lining of the very large oyster has become erupted and made useless for its normal commercial use. Since the seeding and consequent spoiling of large oysters is expensive, a method is used to recoup at least the cost of the spoiled oysters. A half-sphere shape or slightly less (usually steatite) is inserted and this it seems is "acceptable". The oyster isolates the hemisphere by attaching it to the inner wall of its shell and coating it with nacre. This cultured pearl blister is subsequently sawn off as a disc from the shell proper and sent to Japan to be worked. The nucleus is removed, the pearl is bleached and cleaned, the hollow interior filled with resin and a mother of pearl cap or disc seals the base of the now termed "mabe cultured blister pearl".

In the Japanese language "mabe" is synonymous with half-pearl. Half a million "mabe pearls" are produced annually and are sold principally to Spain, Mexico and Hong Kong. Now the Japanese or their colleagues are cultivating the large *pinctada maxima* with tissue inserts as in non-nucleated cultured Biwa fresh-water mussels. These produce large baroque natural-looking cultured pearls. Since sea-water oyster products such as these do not fluoresce under x-ray excitation radiography is an absolute essential.

I am grateful to my friend and colleague, Robert Webster, for use of some of his work and references in "X-ray Focus", an Ilford production, Vol. 7, No. 1, 1966.

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RED DRAVITE FROM KENYA

By PETE J. DUNN, M.A., F.G.A., JOEL E. AREM, Ph.D. and JOHN SAUL, Ph.D.

OCCASIONALLY it will happen that gemmologists in diverse parts of the world will be investigating the same problem, each unaware of the other's efforts. Such was the case in the matter of a red tourmaline recently described by H. Bank (1974). A parallel effort was under way at the Smithsonian Institution, and the following short paper is offered as it contributes further knowledge to the understanding of this uncommon material.

A dark red tourmaline was discovered several years ago by one of the authors (J.S.) at Osarara, Narok District, Kenya. The deposit is located at 1° 34′ S, 35° 46′ E, in the heart of Masailand. Saul's field notes follow:

> "In a high sloping meadow I found small outcrops of massive-bedded iron-stained quartzites of the Basement System (part of the Mozambique Belt of Eastern Africa) which in places contained dark tourmaline. In a position that appeared to be stratigraphically between two such outcroppings was found red tourmaline float. Digging at this point through the black soil which covered much of the hillside exposed a friable, weathered quartz muscovite schist (also of the Basement System) with tourmalines which were distinctly smaller, redder, gemmier, and more numerous than the tourmalines seen in either quartzite. Despite appearances, it would be imprudent to make any assertions concerning the stratigraphic relationships, since several pieces of quartzite float found on the hillside exhibited slickensides."

This tourmaline (NMNH # 126030) occurs as euhedral, equant, hemimorphic crystals from 3 to 25 mm in size. The crystals are lustrous and partially transparent. The forms present, in order of decreasing dominance, are the trigonal prism {1120}, modified by the hexagonal prism {1010}, and another trigonal prism {0110}. The crystals are terminated by the pedion {0001}, and the trigonal pyramids $\{h0\bar{h}\bar{l}\}$, $\{0h\bar{h}\bar{l}\}$, and $\{h0\bar{h}l\}$.

A partial analysis of this tourmaline indicates that it is a dravite with a high iron content. This analysis is presented as Table 1. The oxidation state of the iron was not determined. The ratio of Mg : Fe is 4 : 1. The material is probably a ferrous dravite as the aluminium content is too high to allow any extensive substitution of Fe^{+3} for Al^{+3}, such as was noted by Frondel *et al.* (1966). This dravite has some gem potential, and it is dark red, of a hue similar to good quality almandine. The specific gravity, determined by use of a Berman balance and employing a temperature correction factor, varies from 3·07 to 3·08.

The refractive indices, determined in sodium light on a Rayner Dialdex refractometer, vary from $\varepsilon = 1{\cdot}623$, $\omega = 1{\cdot}654$ to $\varepsilon = 1{\cdot}626$, $\omega = 1{\cdot}657$. Attempts to lighten the colour of the material by irradiation with CuKα x-radiation and ultraviolet radiation were unsuccessful. Heat treatments of eight hours duration at 200°, 400°, and 600° C also were non-productive in terms of lightening the colour of the material.

The authors are indebted to Mr Richard Johnson for the preparation of polished samples, and to Gail L. Dunn for assistance in the heat-treatment of this material.

TABLE 1

PARTIAL ANALYSIS OF KENYAN DRAVITE

K_2O	0·06%
Na_2O	2·7 %
CaO	0·06%
MgO	9·4 %
MnO	0·03%
FeO	4·4 %
TiO_2	0·3 %
SiO_2	37·9 %
Al_2O_3	31·1 %

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Bank, H. (1974). *Rote Turmaline mit hoher Licht- und Doppelbrechung aus Kenya.* Z. Dt. Gemmol. Ges., **23**, 2, 89-92.

Frondel, C., Bield, A., Ito, J. (1966). *New Type of Ferric Iron Tourmaline.* Am. Miner. **51**, 1501-1505.

Gemmological Abstracts

Addamiano (Arrigo). *Silicon carbide—artificial and natural.* Lapidary Journal, 1975, 29, 3, 674-678.

An informative account with a useful bibliography. M.O'D.

Akizuki (Mizuhiko). *Opal, history and science, Part 2.* Journal of the Gemmological Society of Japan, 1975, 2, 1, 11-24.

Three types of lamellae of silica spheres have been identified with the electron microscope; those with no voids, those with a unit layer without voids and with three voids encircling spheres of silica and those with a unit layer and six or three voids. Illustrations of opal from the various fields are included. There is a discussion of the formation of opal in igneous and sedimentary environments. M.O'D.

Amthauer (G.). *Zur Kristallchemie und Farbe grüner und brauner Grossulare aus Tansania.* (Crystal chemistry and colour of green and brown grossularites from Tanzania). Z. Dt. Gemmol. Ges., 1975, 24, 2, 61-72.

Detailed article with 3 tables, 4 graphs and bibliography of 25 items. Green and brown garnets from Tanzania are nearly pure grossularites with small contents of transition elements. The colour of the green grossularites is mainly due to absorption bands of Cr^{3+} and V^{3+} in octahedral position, the colour of the brown grossularites to absorption bands of Fe^{3+} in octahedral and Mn^{2+} in the garnet structure. E.S.

Bank (H.). Z. Dt. Gemmol. Ges., 1975, 24, 2, 88-93.

Three short articles by Dr Bank:

(1) Transparent colourless to yellow cuttable augelite from the White Mountains in California. Description of the first specimen of augelite from California seen by the author. The double refraction was measured and found to be 0·020 which is higher than previously mentioned as 0·014.

(2) Transparent green gahnite from Brazil. The author described the rare example of gahnite or zinc spinel from Brazil.

(3) A short discussion on the value for determination of specimen by publishing exact data of up-to-then unknown values for R.I. and double refraction, density, lattice constants, spectra. The value of publishing details of trace elements and descriptions of inclusions is mentioned. E.S.

Beesley (C. R.). *Dunton mine tourmaline: an analysis.* Gems & Gemology, 1975, XV, 1, 19-24. 4 illus; 2 Tables.

A survey of the tourmalines found at the newly re-opened Dunton mine at Newry, Maine. This mine has intermittently produced small amounts of tourmaline since the turn of the century, but it was not until 1972 that a group of amateurs stumbled on a rich find of tourmaline in this mine. This find has been exploited and the mine re-opened. Two of the features of the tourmalines found at this mine are said to be the exceptional brilliance of the stones, said to be due to a trace of caesium, and the wide range of colours produced: these vary from pink to red and light yellowish green to dark blue, and there is a "water-melon" type. The constants of these Dunton mine tourmalines are recorded, together with the fact that they tend to fluoresce under short-wave ultra-violet light, and something is told of the inclusions seen in these stones. R.W.

BERAN (K.). *Das Absorptionspektrum des Benitoits im nahen Ultrarot.* (The infra-red absorption spectrum of benitoite). Tschermaks Min. Petr. Mitteilungen, 1974, 21, 47-51.

In colourless benitoite crystals a broad pleochroic band is found at 3030 cm^{-1}. It disappears on heating the crystal to 400°C and is thought to indicate the presence of H_2O molecules. M.O'D.

BUURMAN (P.). *Wood opals from Yakuplu, Turkey: their properties and genesis.* Scripta Geologica, 1975, 30, 1-19. 15 figs. Price Dfl 6·50.

Lignitic to opaline fossil driftwood occurs in Late Miocene gravel near Yakuplu, west of Istanbul. Opalization took place at various stages of decay; the stage of decay and admixture of detrital clay influenced the crystallinity and dehydration characteristics of the opals. X-ray diffraction, DTA, TG, and XRF investigations are reported. Opalization was probably the result of the weathering of volcanic ash in the overlying strata. The geological setting is comparable to that of some Hungarian wood opals. R.A.H.

CARREL (R.-P.). *Les pierres precieuses du Pakistan.* (The precious stones of Pakistan). Bulletin de l'Association Française de Gemmologie, 1974, 41, 7.

Aquamarine, garnet and tourmaline are mentioned and a further note promised on emerald. M.O'D.

COHEN (A. J.) and HASSAN (F.). *Ferrous and ferric iron in synthetic α-quartz and natural amethyst.* American Mineralogist, 1974, 59, 719-728.

Positive rhombohedral growth regions of synthetic α-quartz containing Fe^{3+} is related to the generation of the amethyst colour on treatment with ionizing radiation. It is thought that interstitial Fe^{3+} ions in voids perpendicular to positive rhombohedral faces give charge compensation for substitutional Fe^{3+} ions.

M.O'D.

CROWNINGSHIELD (R.). *Developments and highlights at GIA's lab in New York.* Gems & Gemology, 1974/75, XIV, 12, 362-366; 1975, XV, 1, 12-18. 29 illus.

A new imitation opal is discussed. These objects have a density which varies from 2·41 to 2·50 and have a refractive index of 1·50 to 1·52 and the hardness is about 5 on Mohs's scale. Some comparison is made of these fake opals with the Gilson synthetic opals. An opal doublet consisting of a white opal top cemented to an ironstone base by a thick layer of epoxy resin and ground-up particles of ironstone, and a similar composite stone with a top of carved white opal and mounted in a brooch are also mentioned. A carved nephrite horse weighing

180 lb, a hololith bangle in calcite which had areas selectively dyed green, a brooch with three crackled synthetic rubies and a dark blue lazulite of 0·48 carat, which was negative biaxial with refractive indices of 1·616-1·646 showing an absorption spectrum resembling that of turquoise, are some of the items seen in the New York laboratory. A hololith ring with white and yellow metal insets was found to be made of what was probably water-buffalo horn. Serious damage to a tanzanite by overheating during repair and damage to peridots probably by an acid cleaning bath are reported. The articles conclude with mention of a true canary coloured diamond and that flux grown synthetic rubies are now more frequently seen.

R.W.

DRYSDALE (D. J.). *Hydrothermal synthesis of various spodumenes.* American Mineralogist, 1975, 60, 105-110.

Elements substituting for aluminium include iron, chromium, vanadium, indium and scandium. Cell dimensions are given. α-spodumene has not yet been successfully synthesized. M.O'D.

GÜBELIN (E.) and Weibel (M.). *Vanadium-Grossular von Lualenyi bei Voi, Kenya.* (Vanadium–grossular from Lualenyi, near Voi, Kenya). Neues Jahrb. Min., Abhdl., 1975, 123, 194-197, 1 fig., 1 coloured map. (Also a more extensive version in English under the title *Green vanadium grossular garnet from Lualenyi, near Voi, Kenya.* Lapidary Journal, 1975, 29, 2, 402-426.)

A dark green vanadian grossular of gem quality is discovered in a clinopyroxene rock in Lualenyi, Mgama Hills, Taita District, Kenya, with nearly 10% graphite and nearly 30% of different alteration products of unknown origin. The green grossular forms porphyroblasts or sometimes idiomorphic crystals; it is always surrounded by a kelyphitic alteration shell consisting of fine-grained epidote and scapolite. For Na-light, *n* 1·739-1·744, increasing with increasing V content; the typically green variety has 1·743 ± 0·001; sp. gr. 3·57-3·65, mean 3·61; *a* 11·863 Å. Composition CaO 35·1, $Na_2O + MgO + MnO + FeO$ 1·4, Al_2O_3 20·9, V_2O_3 3·3, Cr_2O_3 0·19, TiO_2 0·25, SiO_2 38·7, = 99·84. I.Kb.

HUBER (M. V.). *Pink copper-bearing prehnite from Isle Royale National Park, Michigan.* Lapidary Journal, 1975, 29, 3, 666-673.

Prehnite occurs as amygdales in Keweenawan lava floors and has frequently been mistaken for thomsonite. The pink colour arises from reflections from disseminated inclusions of native copper. M.O'D.

LAGERWEY (A. A. F.). *Detection of structural varieties of red gem spinels from Ratnapura, Sabaragamuwa province of Sri Lanka.* Scripta geologica, 1974, 27, 1-27, 1 pl. (in pocket). Price Dfl 10·50.

A new instrumental method for the spectrographic detection of particularities of crystal fields around optically active ions, e.g. Cr^{3+}, was applied to a study of red spinels from the Ratnapura gem gravels and other sources. The method analyses the luminescence spectra in the red and near-IR ranges excited by concentrated flux of blue radiation. The spectrograms reveal multiplet structures and the intensity distributions of component lines. Systematic study of these red spinels revealed one grain (0·45 carats) of an unknown variety here termed a spineloid: this is "mallow purple" with sp. gr. 3·61, *a* 8·082 Å; it shows cracks on

{111} and is practically isotropic. Although the spineloid shows the same wavelenght pattern in the 6500-7600 Å range, it gives a completely different intensity distribution of the spectral lines, and in particular a very intense broad luminescent band at 6876 Å. From various models, it is concluded that the spineloid is a near-stoichiometric spinel ($MgO.Al_2O_3$) in which Cr^{3+} ions appear in pairs in regular polyhedral configuration; the spectrum is modified by the presence of Mn ions of different valencies. R.A.H.

LEHMANN (G.). *On the color centers of iron in amethyst and synthetic quartz: a discussion.* American Mineralogist, 1975, 60, 335-337.

The band at 5·6eV (46000cm^{-1}) is concluded to arise from Fe^{3+} on lattice sites in quartz. The absorption spectrum of Fe^{2+} in green synthetic quartz proved that the iron occupies interstitial sites of distorted octahedral symmetry. A band at 6·2eV (51000cm^{-1}) is found in iron-doped synthetic quartz with a shoulder near 41000cm^{-1} and these are consistent with Fe^{3+} in interstitial sites of distorted tetrahedral symmetry. The visible coloration of amethyst is dominated by Fe^{4+}. The biaxial nature seen in amethyst is thought to be due to unequal substitution of the three lattice sites by Fe^{3+} M.O'D.

LIDDICOAT (R. T.). *Developments and Highlights at GIA's Lab in Los Angeles.* Gems & Gemology, 1974/75, XIV, 12, 367-371; 1975, XV, 1, 26-30. 19 illus.

Report of a new synthetic alexandrite grown by the Czochralski "pulling" technique. The colour of the stones is more reminiscent of the well-known synthetic "alexandrite colour" sapphire than of natural alexandrite. These stones have a refractive index of 1·740-1·749 ± 0·005. The fluorescence was strong red under long- and short-wave ultra-violet light and under x-rays. Transparency tests to both long- and short-wave ultra-violet light gave interesting results. These experiments showed that the "pulled" alexandrite was much more transparent to both long- and short-wave ultra-violet rays than the natural or the flux-grown alexandrites. A blue coral which was found to be calcareous and not, as is the black coral, composed of conchiolin is described and a black coral which showed a sub-surface sheen is mentioned. The strange case of a supposedly Australian white opal which after twelve months became non-transparent in the centre, and which was to some extent corrected when immersed in hot water was finally considered to be a porous type of Mexican opal. Mention is made of the rare case of a natural blue sapphire so devoid of iron that it fluoresced blue under short-wave ultra-violet light as does the synthetic sapphire. Other interesting items seen in this laboratory were a cabochon of rock material consisting of grains of red ruby and green tourmaline; a glass of "metajade" type which showed a jadeite spectrum; a nephrite bangle which fluoresced orange under ultra-violet light and two carved rubies in zoisite matrix. Helical inclusions in an emerald and a variscite with the high refractive index of 1·60 are mentioned. A Montana blue sapphire mounted in a ring produced an unexplained problem, for over twelve months wear the stone gradually lost its polish. R.W.

MARSHALL (M.) and RUNCIMAN (W. A.). *The absorption spectrum of rhodonite.* American Mineralogist, 1975, 60, 88-97.

The specimen tested was rich in calcium and iron. A table of the bands pertaining to both high- and low-iron rhodonite is given; most non-vibrational bands can be assigned to Fe or Mn. M.O'D.

NAESER (C. W.) and SAUL (J. M.). *Fission track dating of tanzanite.* American Mineralogist, 1974, 59, 613-614.

The average fission track age established from 7 crystals from the Ally and d'Souza mines, Tanzania, was 585 ± 28 million years. M.O'D.

NASSAU (K.). *The origins of color in gems and minerals.* Gems & Gemology. 1974/5, XIV, 12, 354-361; 1975, XV, 1, 2-11. 7 illus. 5 Tables.

These are the first two instalments of a three-part article on the causes of colour in gemstones. In the introduction the general mineralogical aspect of colour in gemstones is briefly discussed, i.e. idiochromatism, allochromatism and pseudochromatism, the latter originating from physical causes such as the diffraction grating effect in opal. Although twelve different types of colour-causing mechanisms are to be described, only four distinct theories cover the whole range of colours in gemstones. These are the "crystal field theory", "molecular orbital theory", "band theory" and "physical optics theory". A short explanation is given of each of these. A section on "light, energy, and quantum considerations" deals with colour as a wavelength of light, and energy as electron volts. The colour and fluorescence of ruby and emerald are explained by reference to paired and unpaired electrons and energy levels. Pleochroism is discussed as well as the twelve specific causes of colour. In part two there is a discussion of idiochromatic and allochromatic colorations which are caused by transition metals. Colour centres are described as a defect in a crystal in which an electron can be "trapped", or a "hole" which is explained as the absence of one electron from a pair leaving behind an unpaired electron which then may cause colour. These colorations by colour centres are discussed and the instability of the colour in the case of irradiated stones is mentioned. This second part concludes with a discussion of molecular orbital causes of colour and some information is given on the treatments, such as heat and radiation, used to alter the colour of gemstones. Part three of this series, which must not be missed, is to follow in the next issue of this American journal. R.W.

PETROV (I.) and BERDESINSKI (W.). *Thermolumineszenz als Untersuchungsmethode der Farbursachen von Topasen.* (The use of thermoluminescence in examining the causes of colour in topazes.) Z. Dt. Gemmol. Ges., 1975, 24, 2, 73-80.

Various tables; bibliography of 18 items. The article describes the thermoluminescence method as a possibility in examining the causes of colour in minerals, especially in topazes. Besides an introduction to the theory of luminescence, there is a discussion over possible colour-centres and chromophores found in topazes. The results of these thermoluminescent measurements in colourless, pink and blue topazes are discussed. E.S.

PIAT (D.). *Le rubis himalayen d'Hunza.* (Himalayan ruby from Hunza.) Bulletin de l'Association Française de Gemmologie, 1974, 41, 5.

Hunza Province is in the north of Pakistan; rubies are found in calcite.

M.O'D.

RAO (K. M.). *The first Indian cultured pearl.* Gem World, 1975, 2, 5, 31-34. 2 illus.

This article appears to be based on a group discussion at the Central Marine Fisheries Research Institute (India) at which Dr K. Alagarswami gave a description of the first experiments to produce cultured pearls in Indian waters. It was suggested that both the Gujarat coast which lies just south of Pakistan and the coast of Tamil Nadu in the Gulf of Manaar would be suitable sites for pearl cultivation. Neither the name Tamil Nadu nor Veppalodai, which is named as the location for the Pearl Culture Laboratory of the Central Marine Fisheries Research Institute, could be found on the map in the abstracter's possession (Times Atlas 1968) and it can only be assumed to be the coastline around Tuticorin. It is said that the oysters are grown for about six months in the sea and then brought to the laboratory for conditioning after which they are anaesthetized using chemicals. Nucleus insertion operations are then performed using dice of mantle and bead nuclei of either imported or indigenously produced shell beads of 3 to 6mm diameter. Both the bead nucleus and the graft tissue are manipulated to obtain the correct orientation. They are then returned to the sea water to allow recovery from the operation and then kept in a running water system in the laboratory for a week. They are then returned to the rafts on the oyster farm. The first experiments were carried out during May to August 1973 and the first cultured pearl was produced on the 25th of July 1973, just 43 days after the date of the operation. Much is made of this quick growth and it is compared with the three years necessary with Japanese culture. It would have been expected that with this quick growth commercialization would have gone ahead, but there seems to be no report of these objects coming on the market. Indeed Dr Alagarswami's talk was not made until early this year, so that there may well have been "snags" which have delayed things. It will be interesting to see what comes out of this endeavour. R.W.

SANTOS MUNSURI (A.). *Koh-i-Noor.* Boletin del Instituto Gemológico Español, 1975, 11, 27-33.

A historical account of the celebrated diamond forming part of the British Crown jewels. M.O'D.

SANTOS MUNSURI (A.). *Tabaqueras de rapé chinas.* (Chinese snuff-bottles). Boletin del Instituto Gemológico Español, 1975, 11, 19-26.

An account, illustrated in colour, of the snuff-bottles used in pre-1912 China, often including gemstones as ornamentation or as the stopper. M.O'D.

SCHMETZER (K.), BERDESINSKI (W.) and BANK (H.). *Farbveränderungen von Edelsteinen der Beryllgruppe.* (Colour-changes of various gems in the beryl group). Z. Dt. Gemmol. Ges. 1975, 24, 2, 81-87.

Apart from three graphs and a bibliography of 6 items, the article contains a table showing the colour-changes in variously coloured beryls with and without iron, with chromium, with vanadium, with iron and chromium, with manganese and various other types of beryls. These stones are listed and their colour-changes described after first irradiation with x-rays, γ-rays and electrons and then heat treatment, and also after heat treatment and with following irradiation. E.S.

SHAUB (BENJAMIN M.). *Dunton gem mine and its remarkable tourmalines.* Mineral Digest, 1975, 6, 20-28.

An account with high-quality illustrations in colour of the occurrence of tourmaline at Dunton, Maine, U.S.A. M.O'D.

STEYN (EDDIE). *South African agates.* The Guilder, 1975, 1, 5, 11-14.

An account of the formation of agates and their occurrence in the Vaal River and other areas associated with diamond digging. M.O'D.

SWINDLE (LEWIS J.). *Digging for pegmatite pockets in the Pikes Peak region of Colorado.* Lapidary Journal, 1975, 29, 3, 682-702.

The author found topaz, goethite, quartz, feldspar, epidote, fluorite and other minerals. M.O'D.

TAKENOUCHI (SUKUNE). *Basic knowledge on studies of fluid inclusions in minerals. Pt. 1.* Journal of the Gemmological Society of Japan, 1975, 2, 1, 25-33.

Inclusions are grouped for the purposes of discussion into gaseous, liquid, multi-phase fluid, CO_2 fluid and petroleum-bearing fluid. Microphotographs illustrate some typical forms. M.O'D.

WADA (KOJI). *Biomineralogy and pearl culture. Part 2.* Journal of the Gemmological Society of Japan. 1975, 1, 3-10.

Discusses the mineralization of pearl and the chemical composition of mollusc secretions. M.O'D.

WEBSTER (R.). *The London Gem Testing Laboratory.* Lapidary Journal, 1975, 29, 3, 646-651.

A short history of the laboratory from its inception in 1925, illustrated with photographs of the various premises and types of equipment used. M.O'D.

WOODS (G. S.) and LANG (A. R.). *Cathodoluminescence, optical absorption and x-ray topographic studies of synthetic diamonds.* Journal of Crystal Growth, 1975, 28, 215-226.

Under cathodoluminescence polished sections of synthetic diamonds show distribution of growth sectors belonging to the forms $\{100\}$, $\{111\}$, $\{110\}$ and $\{113\}$. These sections can be distinguished by their colour and the brightness of their cathodoluminescence. Crystals tested had diameters in the range 0·75-1mm; others were larger. M.O'D.

WYART (J.) and BARIAND (P.). *Lapis-lazuli: le gisement de Sar-e-Sang couche, Badakhchan, Afghanistan.* (Lapis-lazuli: the Sar-e-Sang bed, Badakhchan, Afghanistan.) Bulletin de l'Association Française de Gemmologie, 1974, 41, 2-4.

An account with a coloured illustration of the classic locality for lapis-lazuli. M.O'D.

Cutting soft stones. Rocks & Minerals, 1974, 49, 62-63.

Notes on the cutting of variscite, obsidian, malachite, lazurite, serpentine and ulexite. M.O'D.

Short gemmological notes. Z. Dt. Gemmol. Ges., 1975, 24, 2, 94-98.

K. Schmetzer and J. Brezina publish physical constants of emeralds from Ghana. H. Bank and W. Berdesinski describe a kornerupine occurrence in Tanzania, H. Bank also an occurrence of ruby in Kenya. A contact liquid with $n = 1{\cdot}84$ produced by R. P. Laboratories in Cedar Grove, U.S.A., is mentioned by H. Bank. M. Schulz describes an adaption to the new carat scales 430CM by Sauter to make density determination even simpler. There is also an article dealing with 40 years education in gemmology in Idar-Oberstein, comparing courses then and now. E.S.

BOOK REVIEWS

ASSCHER (S.). *Diamant, wonderlijk Kristal.* (Diamond, crystal extraordinary.) Fibula-van Dishoeck, Bussum, 1975. pp. 164. Dfl 37·50.

An account by a member of one of the most famous Dutch diamond firms of the commercial aspects of the diamond trade. It provides interesting historical notes on the Dutch diamond scene and there are lucid descriptions of the current systems of grading. There is a short bibliography. M.O'D.

BAWDEN (Sharman N.). *Australian gemstones.* Golden Press, Gladesville, N.S.W., Australia, 1972. pp. 109 Illustrated in colour. Price on application.

A simple but well-written guide to the commoner Australian gem materials, this pocket-sized book deserves wide circulation. Each illustration is faced by the appropriate text and an outline map of the continent with localities pin-pointed. Simple tables and a bibliography would have been useful. M.O'D.

BÜHLER (H. -P.). *Antike Gefässe aus Edelsteinnen.* (Antique fashioning of gemstones). Verlag Philipp von Zabern, Mainz, 1973. pp. vii, 85. Illustrated in black-and-white and in colour. DM 98.

An account of the use of ornamental materials in the manufacture of artefacts in classical and later periods, concentrating particularly on the quartz family. References to classical sources are given in separate tables and there is a bibliography. The standard of illustration is high. M.O'D.

COLAHAN (John). *Australian opal safari.* White Lion Publishers, London, 1975. pp. 127. Illustrated in black-and-white and in colour. £4·50.

A well-illustrated guide to the Australian opal fields, this book makes pleasant reading and contains some useful information. M.O'D.

DEL CALDO (Ambrogio) and others. *Minerale bestimmen.* (Identifying minerals). Franckh'sche Verlagshandlung, Stuttgart, 1974. pp. 152. Illustrated in colour. DM 24·00.

A beautifully illustrated pocket-sized guide to minerals, this book includes simple field identification methods, tables and examples of storage methods as well as an account of the better-known minerals. There is a short bibliography. M.O'D.

FIRSOFF (V.A.) and (G.I.). *The Rockhound's Handbook.* David & Charles, Newton Abbot, 1975. pp. 210. £4·95.

Although the conception of the book is good its usefulness is vitiated by numerous erros which could have been avoided by someone more familiar with mineralogy. The section on spinel contains, apart from the inevitable old names (and some new—sapphire spinel) which seem essential in books of this class, a strange typographical arrangement which suggests that zeolites are members of the spinel group; chrysotile and chrysolite have been confused; no mention is made of the cleavage of topaz; the important Mexican locations for sphene are omitted. All these are the type of error we have come to expect from this hurriedly produced area of mineralogical literature. There are better books and it is to be hoped that they are the ones which will sell. The abbreviations used in the text and in the tables can only be described as ludicrous. M.O'D.

GARBE (Richard). *Die indischen Mineralien, ihre Namen und die ihnen zugeschriebenen Kräfte.* (Indian minerals; their names and the art of writing on them.). Verlag Dr H. A. Gerstenberg, Hildesheim, Germany, 1974. pp. x, 104. DM 19·00.

A reprint of a work first published in Leipzig in 1882, this book is a translation from the Sanskrit of Narahari's Râĝanighantu Varga XIII. One of the four sections deals with the occurrence and working of gems. M.O'D.

HARTIG (Herbert). *Edle Steine Schleifen.* (Cutting gemstones). Verlag Frech, Stuttgart, 1974. pp. 120. Illustrated in black-and-white. Price on application.

A revised and enlarged edition of *Mineralien und Edlesteine selbst schleifen.* M.O'D.

HARTMANN (K.). *Edelsteine.* (Gemstones). Franckh'sche Verlagshandlung, Stuttgart, 1975. pp. 71. Illustrated in colour. DM 8·80.

A good short guide to gemstones, beautifully illustrated in colour and including the better-known species. M.O'D.

KIPFER (A.). *Ein neues Hobby: Kleinmineralien.* (A new hobby: micromounts). Franchk'sche Verlagshandlung, Stuttgart, 1974. pp. 64. Illustrated in colour. DM 5·80.

Introduces micromounts with many excellent illustrations and a discussion of storage methods. M.O'D.

LIEBER (W.). *Leuchtende Kristalle.* (Fluorescent crystals). Vetter K. G., Wiesloch, 1974. pp. 48. Illustrated in black-and-white and in colour. About 60p.

A short guide to commoner fluorescent minerals with notes on some light sources currently available. There is a short bibliography, and many helpful references are contained in the text. M.O'D.

LUZZATTO-BILITZ (Oscar). *Antike Jaden.* (Archaic Jades). Schuler Verlagsgesellschaft, Munich, 1974. pp. 160. Illustrated in colour. DM 14·80.

Originally published in 1966, this is a well-illustrated short guide to the archaic jades of China, America and New Zealand. M.O'D.

PETER (Mary). *Collecting Victorian Jewellery.* Macgibbon & Kee, London, 1970. pp. 100. Illustrated in black-and-white. £2·00.

This short book is directed at the collector who specializes in small pieces which may be found in out-of-the-way places. Most forms are discussed and designers such as Giuliano and Castellani are mentioned. There is no bibliography. M.O'D.

ROGERS (C.). *Forming a mineral collection.* Lapidary Publications, Broadstairs, 1975. pp. 48. 60p.

A well-written and illustrated booklet on mineral collecting aimed at the beginner, this praiseworthy set of articles avoids serious error and should be most useful. The price is very reasonable for today. M.O'D.

ROGERS (C.). *More of Britain's gems.* Lapidary Publications, Broadstairs, 1975. Not paginated. 60p.

Intended as a companion to the author's earlier *Finding Britain's Gems*, this pocket-sized book contains chapters by a number of authors. The common theme is the occurrence of minerals (gems in the title is something of a misnomer) in the British Isles; the material included is reasonable and most if not all of the items listed should be found. M.O'D.

STEINBACH (Kurt P.). *Ein Strauss Edler Steine.* (A bouquet of gemstones). Alles Brillant, Friedrichsdorf, 1969. pp. 148. Illustrated in colour. DM 19·80.

A beautifully-illustrated introduction to gemstones printed with an elegant type-face on a brown paper. Constants of the stones are quoted on the verso of the plates and there is a short bibliography. M.O'D.

TINDALL (James R.) and THORNHILL (R.). *The Blandford rock and mineral guide.* Blandford Press, London, 1975. pp. 256. Illustrated in colour. £6·95.

Designed for the collector of rocks and minerals, this book is written in a simple style and has well-chosen and balanced illustrations. The quality of these is less good, and one purporting to depict zircon looks more like peridot. In the discussion of mineral classes, silicates are given a disproportionate amount of room; some of the other classes yield collectable specimens. Tables are reproduced from Deeson *et al.*, *The collectors' Encyclopaedia of Rocks and Minerals*—not a recommendation. The habits in these tables are reduced to one word or phrase, which hardly reflects the true state of affairs. The bibliography is inadequate for so large a book. M.O'D.

WAGNER (P. A.). *The Diamond Fields of Southern Africa.* C. Struik (Pty), Cape Town, 1971. pp. 355. Illustrated in black-and-white. R12·50.

This large and interesting book is a re-issue of a work first published in 1914. Its pull-out maps and other illustrations, as well as an informative text, make it well worth buying. M.O'D.

Crystal Growth 1974. Proceedings of the fourth International Conference on Crystal Growth, Tokyo, Japan, 24-29 March 1974. Edited by K. A. Jackson, N. Kato and J. B. Mullin. North-Holland Publishing Co., Amsterdam, 1974. pp. xvi, 707. £56·00.

The original publication of *Crystal Growth 1974* formed a special issue of the *Journal of Crystal Growth* (24/25, 1974). In this very large and expensive hard-cover book there are a number of articles of interest to the scientific gemmologist. One paper, by A. R. Lang, of the University of Bristol, deals with the growth of natural diamonds. Whereas most diamonds grow with concentric octahedral growth layers, some show stacking faults and some coated stones show a sharp transition between normal and fibrous growth modes. Other papers deal with the synthesis of chrysoberyl single crystals, the synthesis of serpentine minerals and the perfection of flux-grown crystals. A variety of topics with the rare-earth garnets are included. M.O'D.

ASSOCIATION NOTICES

NEW BRANCH

It is proposed to start a branch of the Association for Merseyside and the North West, taking in the Manchester area. An inaugural meeting is being held on Monday, 27th October, 1975, at 6.30 p.m. in the premises of Pyke & Sons Ltd., 30 Exchange Street, Liverpool. Anyone who is interested and wishes to attend should communicate with Mr John G. Roach—telephone 051-647 7444 (business) or 051-652 3458 (home).

All Fellows and Members of the Association in the area are eligible to become a member of the branch without payment of any extra subscription.

OBITUARY

Mr H. Cecil Diss, M.B.E., F.B.H.I., died in his 88th year. Mr Diss was one of the six successful candidates in the first Gemmological Examination held in 1913.

Mr Fred E. Ullmann, London, who gained the Association's Diploma with Distinction in 1938, died on the 20th August, 1975.

Notice has been received of the death of Mrs Martha J. (Jean) La Due, of Jensen, Kentucky, U.S.A., a Fellow of the Association who attained her Diploma with Distinction in 1972. Mrs La Due died on 9th March, 1975.

MEMBERS' MEETINGS

Midlands Branch

The Annual General Meeting of the Midlands Branch was held on the 11th June, 1975.

Mr John Marshall was re-elected Chairman and Mr C. Hundy elected Secretary.

Nottingham Branch

At the Annual General Meeting of the Nottingham Branch, held on the 17th February, 1975, Mr D. T. K. Lewis and Mrs B. Crutchley Smith were re-elected Chairman and Secretary respectively.

SOME ASPECTS OF THE SCIENCE OF GEMS AND MINERALS

The Harrow College of Technology and Art, Northwick Park, Harrow, Middlesex, started a course on 30th September, 1975, entitled "Some Aspects of the Science of Gems and Minerals". The Course tutor is Mr Frederick A. Fryer, B.Sc., F.G.A., A.R.I.C., Lecturer in Inorganic Chemistry, Harrow College of Technology and Art, Faculty of Science and Engineering, Northwick Park, Harrow, HA1 3TP, from whom further details can be obtained.

GIFTS TO THE ASSOCIATION

The Council of the Association is indebted to Mr R. H. Outerbridge, India, for a sphene weighing 1·49ct, which shows quadrupling of back facets.

EXAMINATIONS 1976

Examinations next year will be held as follows:

Preliminary (Theory only)—Tuesday, 29th June
Diploma (Theory only)—Wednesday, 30th June
Diploma (Practical) —London—1st and 2nd July.
Other U.K. Centres and Overseas as arranged.
The Diploma (*theory*) examination must be taken on the 30th June.

Please note *final* date for receipt of completed examination entry form is 1st March, 1976.

ACCREDITED GEMOLOGISTS ASSOCIATION

First official meeting held January 31, 1975

Formation of Accredited Gemologists Association

Intent: Endeavour to keep up with new developments in gemmology (new gemstones, new finds, meetings of interest, etc.) and for purposes of open discussions of new equipment and procedures in gemtesting; new books; advancements in educational matters; get to know other American FF.G.A. who may just be neighbours.

Meetings will be held quarterly—January, April, July and October.

Membership will be composed of Fellows of the Gemmological Association of Great Britain and Accredited Gemologists of the Gemological Institute of America. Anyone who is interested in membership of this new organization should communicate with the *Acting Secretary:* Mrs Sonja S. Schwartzman, F.G.A., 8717 Bradmoor Drive, Bethesda, Maryland 20034, U.S.A.

INSTRUCTORS

At the meeting of the Council held on 5th February, 1975, the appointment of G. Pratt, F.G.A. and J. Edwards, F.G.A., as instructors was approved.

EXAMINERS

At the meeting of the Council held on 6th October, 1975, Dr G. H. Jones, B.Sc. Ph.D., F.G.A., was appointed as an examiner in gemmology.

LETTER TO THE EDITOR

Dear Sir,

The late Dr E. H. Rutland

Mrs Jill Rutland has pointed out to me that in the obituary notice of Ernest Rutland published in your April issue* I was incorrectly informed on two points.

Firstly, Rutland's Ph.D. thesis was not concerned with statistics but was entitled "The Decentralization of Industry and Population from London", and secondly, though he was a trained statistician and used statistics in some of his work, his true bent lay in the field of sociology.

I hope that this note will help to keep the record straight.

Yours sincerely,
Basil W. Anderson

22nd July, 1975.

CORRIGENDA

On page 183 *ante* in line 19 for "The Natural Collection of Gems" read "The National Collection of Gems".

On page 341 *ante* in lines 11–13 from the bottom of the page for "Cerro Rico de Posito" read "Cerro Rico de Potosi".

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*J. Gemm., 1975, XIV, 6, 301 – 303. —Ed.

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Names of authors are printed in small capitals, pages of abstracts and book reviews in italics.

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