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MINERALOGICAL NOTES: No. I.—TOPAZ, BERYL, VESUVIANITE, TOURMALINE, AND WOLFRAMITE.

By C. Anderson, M.A., B.Sc., Mineralogist.

(Plates xxxix.-xli.)

TOPAZ.

Topaz from New South Wales has been previously described by Hahn[1], but I am unable to refer to his paper, and, as I am ignorant as to the localities and development of his specimens, it may be that this paper simply duplicates or falls short of his work. Nevertheless it is hoped that, besides being a description of specimens actually on view in the Australian Museum, the present paper will perhaps be useful to Australian Mineralogists to whom, as to the writer, the earlier work may not be available.

Emmaville, New South Wales.

The collection of minerals lately purchased by the Trustees from Mr. D. A. Porter contains a large assortment of topaz, mainly small crystals, from an emerald mine at this well-known locality, which may be given more exactly as Glen Creek, seven miles N. by E. from Emmaville. It is associated with tinstone, beryl, and fluorspar in pegmatite, the occurrence having been already described by various observers[2]. The crystals are almost invariably clear and colourless, but do not seem to attain a large size, six of the better developed specimens averaging 7 mm. × 6 mm. × 5 mm. Two larger, doubly-terminated crystals, measured 13 mm. × 10 mm. × 8 mm., and 18 mm. × 9 mm. × 7 mm. respectively. The larger specimens are much less perfectly developed but show a greater proportion of doubly terminated crystals, which are rarely found in this species. Thus a collection of nineteen crystals specially picked on account of their suitability for goniometric measurement contained only one doubly terminated specimen, while no less than twelve were found in a collection of forty-four larger and less perfect crystals. The base, which is a constant feature in all the crystals I have examined though sometimes very small, is often pitted and dull. The faces in the prismatic zone are sometimes striated, but usually give good reflections; the unit prism, *m*

[1] Hahn—Zeits. Kryst., xxi., 1893, p. 337 (quoted 1st Appendix to the sixth edition of Dana's System of Mineralogy, 1899, p. 69).

[2] David—Ann. Rep. Dept. Mines for N.S. Wales for 1891 (1892), pp. 229-234; Curran—Journ. Roy. Soc. N.S. Wales, xxx., 1897, pp. 244-247, pl. xiv.

(110) generally predominates. One crystal showed a well-developed brachypinacoid (010), which on two others appeared as a very narrow plane. The rare macropinacoid (100) was not recognised. The brachydome *f* (021) seems to be invariably present. In all fifteen forms were identified :—*b* (010), *c* (001) ; *m* (110), *M* (230), *l* (120), *π* (250), *g* (130) ; *d* (201), *h* (203), *f* (021), *y* (041) ; *o* (221), *u* (111), *i* (223), *x* (243) (in this as in the other species the lettering and axial ratios are according to Dana.) ; Pl. xxxix., fig. 3 shows all the forms except *b*. Five of the best and most typical crystals were measured on the Goldschmidt two-circle goniometer at the University of Sydney.

Crystal I.—(Pl. xxxix., fig. 1.) This crystal measures 9 mm. × 6 mm. × 5 mm. and may be described shortly as stout prismatic. The five forms in the prismatic zone are present in their full complement of four faces, excepting *π* which has only two. The prism *m* is the largest but the others are also well developed The brachydome *f* is large, *y* is absent. The two faces of the macrodome *d* are present as small planes giving poor reflections. The base, relatively small owing to the large size of the brachydome, is rough and almost non-reflecting. Of the pyramids *o* and *u* have the full quota of faces, while *i* has only two.

The appended table shows the mean co-ordinate angles obtained, the crystal being placed in the conventional position with the zone-circle [021,001] as " prime meridian."

Form.		Measured.				Calculated.				Error.	
		ϕ		ρ		ϕ		ρ		ϕ	ρ
		°	′	°	′	°	′	°	′	′	′
c	001	—	—	—	—	—	—	—	—	—	—
m	110	62	6½	90	2	62	8	90	0	1½	2
M	230	51	34	90	2	51	35	90	0	1	2
l	120	43	24	90	0	43	25	90	0	1	0
π	250	37	10	89	58	37	7	90	0	3	2
g	130	32	14	90	½	32	14	90	0	0	½
d	201	89	6	60	1	90	0	61	0	54	59
f	021		3½	43	37	0	0	43	39	3½	2
o	221	62	12	63	50	62	8	63	54	4	4
u	111	62	12	45	41	62	8	45	35	4	6
i	223	62	10	34	8	62	8	34	14	2	6

Crystal II.—(Pl. xxxix., fig. 2).—This specimen illustrates another common type. The dimensions of the crystal are 5 mm. × 7 mm. × 6 mm. Only three prisms are represented *m* (110) *M* 230) and *l* (120), of which *m* and *l* are the largest. The two brachydomes *f* and *y* are small as are the three pyramids, and the basal pinacoid is proportionately large. The brachypinacoid *b* (010) is present as a very small plane. There are also indications of one, or perhaps two, macrodomes, but they do not give images. The faces as a rule give good reflections, and the measured angles agree well with the calculated values.

Crystal III.—(Pl. xxxix, fig. 3).—This is the best crystal in the Museum collection, and shows a somewhat different habit. It measures 7 mm. × 4 mm. × 2½ mm. Fourteen forms were recognised. Of the prisms *m* (110) greatly predominates, and it has two parallel faces much larger than the others, so that the crystal might be described as tabular on these faces. The domes *f* and *y* are about equally developed and small, while the base, which is unusually smooth and brilliant, is large. The pyramids *o*, *u*, and *i* are comparatively narrow, while in addition there are two small faces of the brachypyramid *x* (243). The macrodomes *d* and *h* are very small, and are each represented by one plane.

Crystal III. and another of similar habit were selected for the determination of the refractive indices and optic axial angle; as the values obtained were practically equal for the two, the results from both are combined in order to find the means. The indices γ and β were measured on a Fuess vertical axis goniometer, using the faces of *m* as a refracting prism, and fitting the telescope with a nicol prism. By viewing the signal successively through *m* and *m'*, and *m''* and *m'''*, making several determinations, and taking the mean of the best results, values which are at least reasonably correct were obtained. The three indices were also determined by the method of total reflection; sodium light was employed in all cases.

The optic axial angle for sodium light was measured in the usual apparatus on the universal stand carrying the vertical axis goniometer. The mean values of the indices having been found, a liquid was prepared consisting of cinnamic aldehyde, index 1·619, and bromoform, index 1·600, in such proportions as to have a refractive index equal to the value found for β. The crystals were immersed in this in a small glass tank with parallel walls. In this way the acute and abtuse angles $2V_a$ and $2V_o$ could be successively measured. In order to correct errors of observation and adjustment, successive readings were taken by revolving the crystal several times in one direction, and determining the position of axial emergence from each end, and both sides of the cyrstal. The temperature was 17°-20° C. Subsequently the refractive index of the liquid was re-determined and found to be the same as before. The result for refractive indices and axial angles are combined in the table below

Refractive Indices.			Axial Angles.	
α	β	γ	$2V_a$	$2V_o$
			° ′	° ′
1·6125	1·6163	1·6244	63 37	116 21
1·6143	1·6146	1·6212	63 33	116 29
1·6137	1·6166	1·6227	63 29	116 31
	1·6163	1·6229	63 22	116 27
		1·6229	63 32	116 38
Mean 1·6135	1·6160	1·6228	63° 30′	116° 29′

Thus the birefringence is ·0093.

From the mean refractive indices found the value of $2V_a$ was calculated by the usual formula. The calculated value is found to be 62° 42′ which agrees tolerably with the measured angle.

Oban, New South Wales.[3]

At Oban topaz usually occurs as waterworn pebbles of rather large size ; they are generally colourless but some have a bluish tint and when cut make handsome gems. When crystals are found, the faces are seldom good, being worn and dull ; they sometimes show natural etch-figures, and what seem to be prerosion faces are occasionally developed. The basal plane is apparently rare, so that the crystals have either pointed terminations, or the large brachydomes meet in an edge.

Crystal I.—(Pl. xxxix., fig. 4).—The drawing shows the crystal in approximately its natural development ; this is the best crystal from Oban in the Museum collection. Its colour is faintly bluish. The prism *l* is much larger than *m*, as can be seen on the unbroken side. There are indications of another prism between *m* and *l*, probably *M*, but, owing to striation, the measurement was unsatisfactory and the form is not figured. The dimensions

[3] Porter—Journ. Roy. Soc. N.S. Wales, xviii., 1885, p. 77 ; Curran —*Loc. cit.*, p. 245, pl. xiii., figs. 1, 2, 3.

are: 3 cm. × 3 cm. × 2½ cm. approximately. The brachydome *y*, which is only seen on one side, is very small; *f* is large, and its two faces meet in a long edge. The three pyramids *o*, *u*, and *i* are present, *u* being the largest. Etch-figures are well seen especially on the domes. They seem to take the form on the dome faces of little rounded ridges, with a blunt termination towards the apex of the crystal, and tapering off, towards the other end. The forms were identified by the contact goniometer, the angles determined being as under:—

Angle.		Measured.		Calculated.		Error.	
		°	′	°	′	°	′
$m \wedge m'''$	$110 \wedge 1\bar{1}0$	56	30	55	43		47
$l \wedge l'''$	$120 \wedge 1\bar{2}0$	92	0	93	10	1	10
$f \wedge f'$	$021 \wedge 0\bar{2}1$	86	0	87	18	1	18
$f \wedge y$	$021 \wedge 041$	18	0	18	41		41
$m \wedge o$	$110 \wedge 221$	27	0	26	6		54
$m \wedge u$	$110 \wedge 111$	45	0	44	25		35
$m \wedge i$	$110 \wedge 223$	57	0	55	46	1	14

Crystal II.—(Pl. xxxix, fig. 5.).—It measures 4 cm. × 4 cm. × 3½ cm. and is essentially similar to Crystal I. save that it is of a more pronounced bluish tint, and wants *y*, *o*, and *i*. The etch-figures are similar to those of the first.

Dr. A. S. Eakle refers to an Australian crystal of topaz in the collection of the U.S. National Museum which from his description probably came from Oban[4].

BERYL.

The occurrence of beryl and emerald at Emmaville has been known since 1890,[5] and considerable quantities have been cut and polished as gems. A large proportion of the stones is rather green beryl than emerald, the colour not being sufficiently deep. The crystals are comparatively simple, that shown in Pl. xl., fig. 1 being the most complex that has come under my observation. It is 2 mm. long by 1¼ mm. in diameter, and the

4 Eakle—Proc. U.S. Nat. Mus., xxi., 1899, p. 364.

5 David—Ann. Rep. Dept. Mines N.S. Wales for 1891 (1892), pp. 229-234; Curran—Jour. Roy. Soc. N.S. Wales, xxx., 1897, pp. 238-244, pl. xv., fig. 1.

faces are developed in almost ideal symmetry, their relative sizes being approximately as represented in the figure. It is a combination of the unit prism *m* ($10\bar{1}0$) with the unit pyramid *p* ($10\bar{1}1$) and the diagonal pyramid *s* ($11\bar{2}1$), truncated by the base. The co-ordinate angles obtained by measurement and the calculated values are as follows :—

Form.		Measured.				Calculated.				Error.	
		ϕ		ρ		ϕ		ρ		ϕ	ρ
		°	′	°	′	°	′	°	′	′	′
m	$10\bar{1}0$	0	1	90	2	0		90	0	1	2
p	$10\bar{1}1$	0	7	29	55	0	0	29	57	7	2
s	$11\bar{2}1$	29	59	44	51	30	0	44	56	1	5

Three crystals of slightly larger size from Glen Creek, Emmaville,[6] show the unit prism, a fairly large basal plane, a well developed diagonal pyramid, and only one small triangular face of *p* ($10\bar{1}1$); so that, apparently, the usual form is a combination of the prism *m*, the base, and the diagonal pyramid, and, less commonly, the unit pyramid.

VESUVIANITE.

Small but brilliant crystals of vesuvianite are found at Bowling Alley Point, Nundle, New South Wales, lining cavities in veins of massive garnet traversing serpentine.[7] A few crystals were carefully detached from the matrix and examined under a lens. They are remarkably uniform in development, all showing apparently the same combination, which is represented in ideal symmetry in Pl. xl., fig. 2. Owing to the small size of the faces it is impossible to do more than indicate their relative dimensions. The specimens may be generally described as long prismatic in habit, and yellowish green in colour. The forms present are the prism of the first order, *m* (110), the prism of the second order, *a* (100), with the unit pyramid *p* (111), the pyramid *t* (331), and the ditetragonal pyramid *s* (311). Save

[6] Porter—Journ. Roy. Soc, N.S. Wales, xxii., 1889, p. 82, pl. i., figs. 8 and 9.

[7] Porter—*Loc. cit.*, xviii., 1885, p. 80; Liversidge—Minerals N.S. Wales, 1888, p. 204.

that it wants the basal plane the habit is essentially similar to that of the crystal from Zermatt figured by Dana after Penfield.[8]

Below are the co-ordinate angles obtained :—

Form.		Measured.				Calculated.				Error.	
		ϕ		ρ		ϕ		ρ		ϕ	ρ
		°	′	°	′	°	′	°	′	′	′
m	110	89	50	90	1	90	0	90	0	10	1
a	100	44	56	90	2	45	0	90	0	4	2
p	111	45	10	37	25	45	0	37	14	10	11
t	331	45	0	66	15	45	0	66	19	0	4
s	311	18	38	59	30	18	26	59	32	12	2

TOURMALINE.

Tourmaline of gem quality has recently been discovered in the Hundred of Dudley, Kangaroo Island, South Australia. Mr. H. Y. L. Brown, Government Geologist, South Australia, says[9] :—" The stones are remarkable for their size and beauty, and after passing through the lapidary's hands form very handsome gems. The prevailing color is green in various shades, although some of the crystals have centres of a delicate pink color. Sales made show that the stones have commercial value in the rough, aud the discovery bids fair to be of importance."

By the kindness of Mr. E. F. Pittman, Under-Secretary for Mines and Agriculture, New South Wales, and the good offices of Mr. G. W. Card, Curator and Mineralogist to the Geological Survey, I have been enabled to examine and measure some crystals of tourmaline from this locality on view in the Mining and Geological Museum, Sydney.

The six crystals examined in detail had been attached by one end, consequently show only one termination. Apparently they are of the usual columnar habit. The colour varies from practically opaque black at the apex, to transparent green towards the broken end, but there is no definite line of demarcation in the tint as is sometimes observed in tourmaline.[10] The faces in the

[8] Dana—System of Mineralogy, 6th Ed., 1892, p. 479, fig. 10,

[9] Brown—A Short Review of Mining Operations in the State of South Australia during the year 1903 (1904), p. 12.

[10] Bowman—Min. Mag., xiii., 1903, pp. 108-9.

prismatic zone are as usual rounded and striated, and in the figured specimens only the forms which were definitely recognised are taken account of. The commonest termination is evidently a combination of *r* and *o* simply, *o* predominating.

Crystal I.—(Pl. xl., fig. 3.).—It measures 7 mm. x 3 mm. Only one prism was clearly identified, namely the diagonal prism *a* (11$\bar{2}$0). The crystal is terminated by *r* (10$\bar{1}$1) and *o* (02$\bar{2}$1). The latter in large, roughly triangular faces predominates, *r* being represented by narrow planes. All the forms are present in the full complement of faces.

Form.		Measured.				Calculated.				Error.	
		ϕ		ρ		ϕ		ρ		ϕ	ρ
		°	′	°	′	°	′	°	′	′	′
a	11$\bar{2}$0	30	1	90	1	30	0	90	0	1	1
r	10$\bar{1}$0		2	27	30	0	0	27	20	2	10
o	02$\bar{2}$1	60	1	45	51	60	0	45	57	1	6

Crystal II.—(Pl. xl., figs. 4 and 5.)—This specimen, which is approximately of the same size as the last, is somewhat more complicated. It shows the two trigonal prisms *m* (10$\bar{1}$0) and *m* (01$\bar{1}$0), the diagonal prism *a* (11$\bar{2}$0) the positive rhombohedron (trigonal pyramid) *r* (10$\bar{1}$1), the negative rhombohedron *o* (02$\bar{2}$1), and the scalenohedron *u* (3$\bar{2}$51). The two rhombohedra are about equally developed while *u* is small.

An apparatus was improvised to test the crystals for pyro-electricity by Kundt's method. The result was to prove that in all six crystals the end with terminations becomes positively electrified on cooling. Hence the terminated end is the antilogous pole. On examining the crystals for pleochroism, it was found that the ordinary ray, vibrating perpendicular to the vertical axis, is almost completely absorbed, while the extraordinary ray, vibrating parallel to the axis, has a tint of apple to glaucous-green.

WOLFRAMITE.

Wolframite is of common occurrence in New South Wales, but it is almost invariably massive. In fact crystallised specimens are, so far as I am aware, obtained only at the Wild Kate

Mine, near Deepwater. Mr. C. A. Süssmilch, Lecturer in Geology, Technical College, Sydney, was good enough to lend three crystals for description, and, from the Mining and Geological Museum four others were kindly given on loan for the same purpose. In Pl. xli, figs. 2 and 4 are drawn from the Geological Survey specimens, the original of fig. 3 belongs to Mr. Süssmilch; fig. 1 represents a crystal from the Museum collection.

The forms identified are :—*a* (100) *c* (001), *l* (210) *m* (110,) *t* (102) *y* ($\bar{1}$02) *f* (011) *ω* (111) *o* ($\bar{1}$11) *σ* (121) *s* ($\bar{1}$21).

Crystal I.—(Pl. xli., fig. 1.).—This crystal measures 3½ cm. x 2¾ cm. x 1 cm. It is developed in almost ideal symmetry and is so represented in the figure. The orthopinacoid *a* (100) is large, the two prisms *l* and *m* are approximately equal in size. The *σ* and *s* faces are well developed while *f* is comparatively small. The faces were measured with the contact goniometer, values being obtained as under :—

Angles.		Measured.		Calculated.		Error.
		°	′	°	′	′
l ∧ *l*′′′	210 ∧ 2$\bar{1}$0	46	0	45	4½	55½
m ∧ *m*′′′	110 ∧ 1$\bar{1}$0	79	0	79	23	23
f ∧ *f*′	011 ∧ 0$\bar{1}$1	82	0	81	54	6
σ ∧ *σ*′	121 ∧ 1$\bar{2}$1	99	30	100	3	33
s ∧ *s*′	$\bar{1}$21 ∧ $\bar{1}\bar{2}$1	100	0	100	41	41

The other crystals are drawn as nearly as possible according to their natural development, and call for no particular verbal description.

Crystal II.—(Pl. xli., fig. 2.) measures 5 cm. x 3 cm. x 1¼ cm. It is the only specimen with the two orthodomes *t* and *y* present. The crystal is much broken and the prism faces striated.

Crystal III.—(Pl. xli., fig. 4.) is cleaved and *m* is absent. On the left side of the drawing is a large cleavage plane parallel to *b*. Behind, it shows only *a* (100).

Crystal IV.—(Pl. xli., fig. 3.).—The dimensions are 2 cm. x 3 cm. x 1¼ cm. It has the base present and is broken irregularly at both ends of the ortho-axis.

In conclusion, I desire to express my indebtedness to Mr. H. Stanley Jevons, M.A., B.Sc., F.G.S., Lecturer in Mineralogy and Petrology, in the University, Sydney, for much cordial assistance and advice.

Note—Since the above was written I have been able to obtain the paper on New South Wales Topaz, by Hahn, previously referred to. No locality is given, save New South Wales, but if the crystals are all from the same place, that place is probably Emmaville. Hahn recognised all the forms I have enumerated on Topaz from this locality, except the base and the pyramid *x*, but his combinations were evidently much simpler. Two crystals are figured, one showing the faces *m*, *l*, *f*, *y*, *o*, *u*, *i*, the other, the forms *m*, *l*, *f*, *y*, *d*, *h*, *o*, *u*, *i*.

2 E was determined on a cleavage plate in sodium light, and found to be 113° 18′.

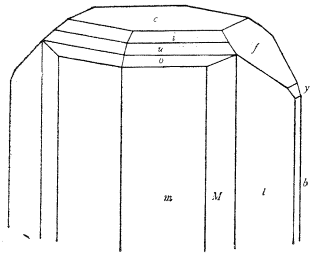
EXPLANATION OF PLATE XXXIX.

TOPAZ.

Figs. 1, 2, 3. Emmaville, New South Wales.

Figs. 4, 5. Oban, New South Wales.

Faces:—*b* (010), *c* (001), *m* (110), *M* (230), *l* (120), *π* (250), *g* (130), *d* (201), *h* (203), *f* (021), *y* (041), *o* (221), *u* (111), *i* (223), *x* (243).



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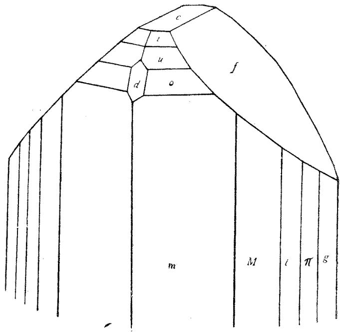

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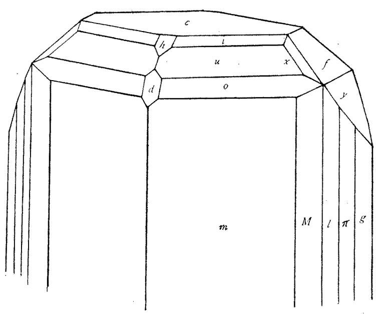

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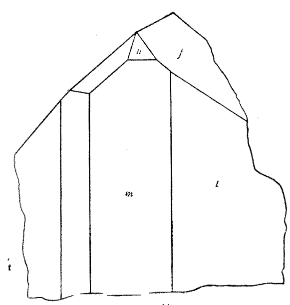

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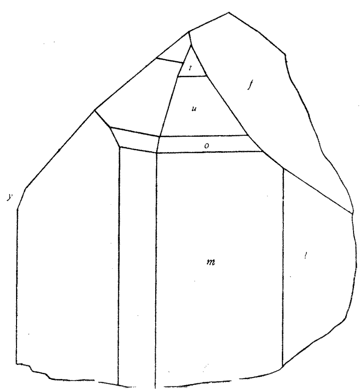

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EXPLANATION OF PLATE XL.

BERYL.

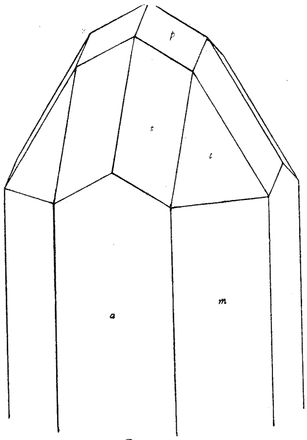
Fig. 1. Emmaville, New South Wales. Faces:—*c* (0001), *m* (10$\bar{1}$0), *p* (10$\bar{1}$1), *s* (11$\bar{2}$1).

VESUVIANITE.

Fig. 2. Bowling Alley Point, Nundle, New South Wales. Faces:—*m* (110), *a* (100), *p* (111), *t* (331), *s* (311).

TOURMALINE.

Figs. 3, 4. Kangaroo Island, South Australia. Faces:—*m* (10$\bar{1}$0), *m* 01$\bar{1}$0), *a* (11$\bar{2}$0) *r* (10$\bar{1}$1), *o* (02$\bar{2}$1), *u* (32$\bar{5}$1).



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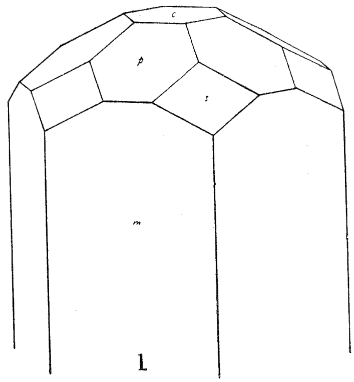

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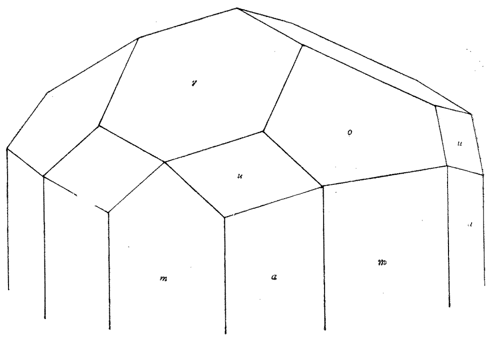

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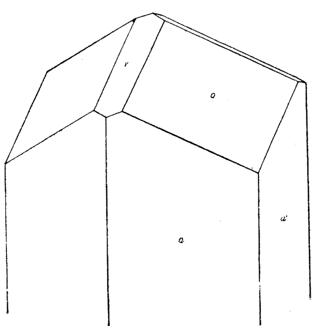

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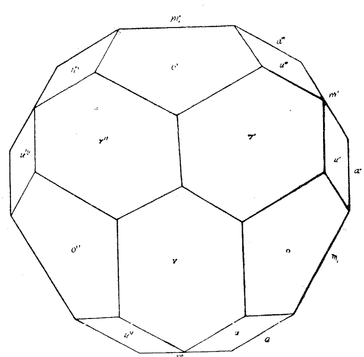

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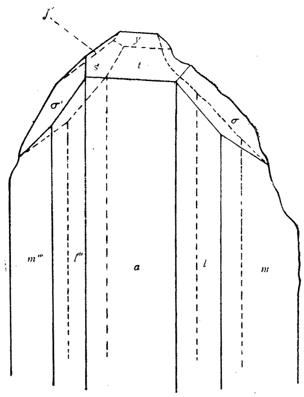
EXPLANATION OF PLATE XLI.

WOLFRAMITE.

Figs. 1, 2, 3, 4. Wild Kate Mine, near Deepwater, New South Wales. Faces :—*a* (100), *c* (001), *l* (210), *m* (110), *t* (102), *y* ($\bar{1}$02), *f* (011), *ω* (111), *o* ($\bar{1}$11), *σ* (121), *s* ($\bar{1}$21),



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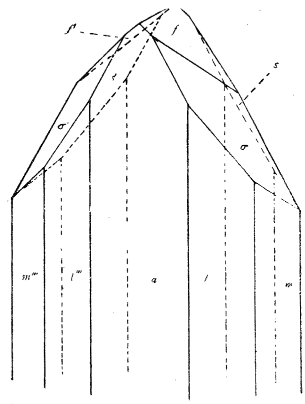
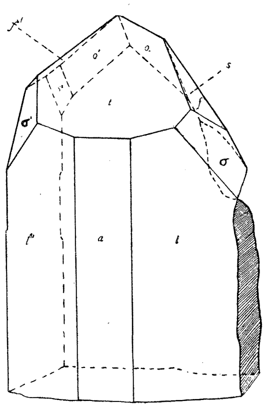


1



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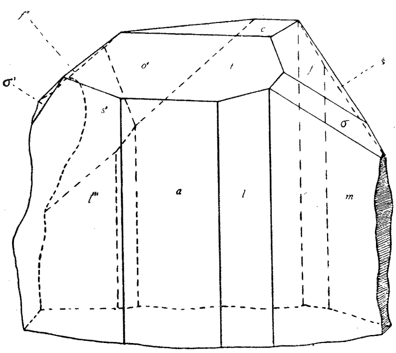

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C. ANDERSON, del.,
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Electric Photo-Engr. Co., Ltd.,
Sydney.

[The following corrections were published in Volume 5 Issue 6 and are to be read with the appropriate paper dated 18 August, 1905.—Sub-Editor, August, 2009]

CORRECTIONS.

Page 58—for *Prosoplismus recurvirostris*, read *Pentaceropsis recurvirostris:* (see Ann. Mag. Nat. Hist. (7), xii., 1903, p. 288.)

,, 170—further investigation, in conjunction with Mr. McCulloch, shows that examples recorded under the name *Glyphisodon antjerius*, and *G. brownriggii* are the young of *Parma polylepis*, specimens recorded from the mainland under these names are the young of *Parma squammipinnis, Parma microlepis,* the tenable name of the species, being the half-grown stage.

,, 171—for D. xiii. 9; read D. xiii. 19.

,, 190 No. 9—for figure none, read Kner, Reise Novara, Fische, 1867, pl. xiii., fig. 2.

,, 195 No. 33—for p. 148, read 481.

,, 206 No. 81 *Figure*—for 1869, read 1865.

,, 209 No. 94—delete in favour of No. 92, and see note p. 170 above.

,, 219 No. 147—read 147 TROPIDICHTHYS CAUDOFASCIATUS, Günther. *Tetrodon caudofasciatus*, Günther Cat. Fish. Brit. Mus., viii., 1870, p. 304, of which *T. callisternus* is a synonym.

,, 234—for *Tropidostethus rhothophilus*, read *Iso rhothophilus.*

,, 247—at third line from bottom for "elytra ·24" read "elytra 2·4."

,, 298—line 4 from bottom, for abtuse read obtuse.

,, 303—line 20 for m $(01\bar{1}0)$ read $m_{,}$ $(01\bar{1}0)$.

,, 304—line 10 ,, y (102) ,, y $(\bar{1}02)$.

,, 318—line 9, for "Inserte," read "Incertæ"

EXPLANATION OF PLATE XIV.

For fig. 10 read fig. 9.

SCAPHITES ERUCIFORMIS, *Eth. fil.*

Fig. 10. Back of limonite cast showing sutures and sculpture.—×2.

EXPLANATION OF PLATE XL.

First and second line from bottom, for m $01\bar{1}0$ read $m_{,}$ $(01\bar{1}0)$.

And add Fig. 5, Plan of Fig. 4.