THE

MINERALOGY OF SCOTLAND


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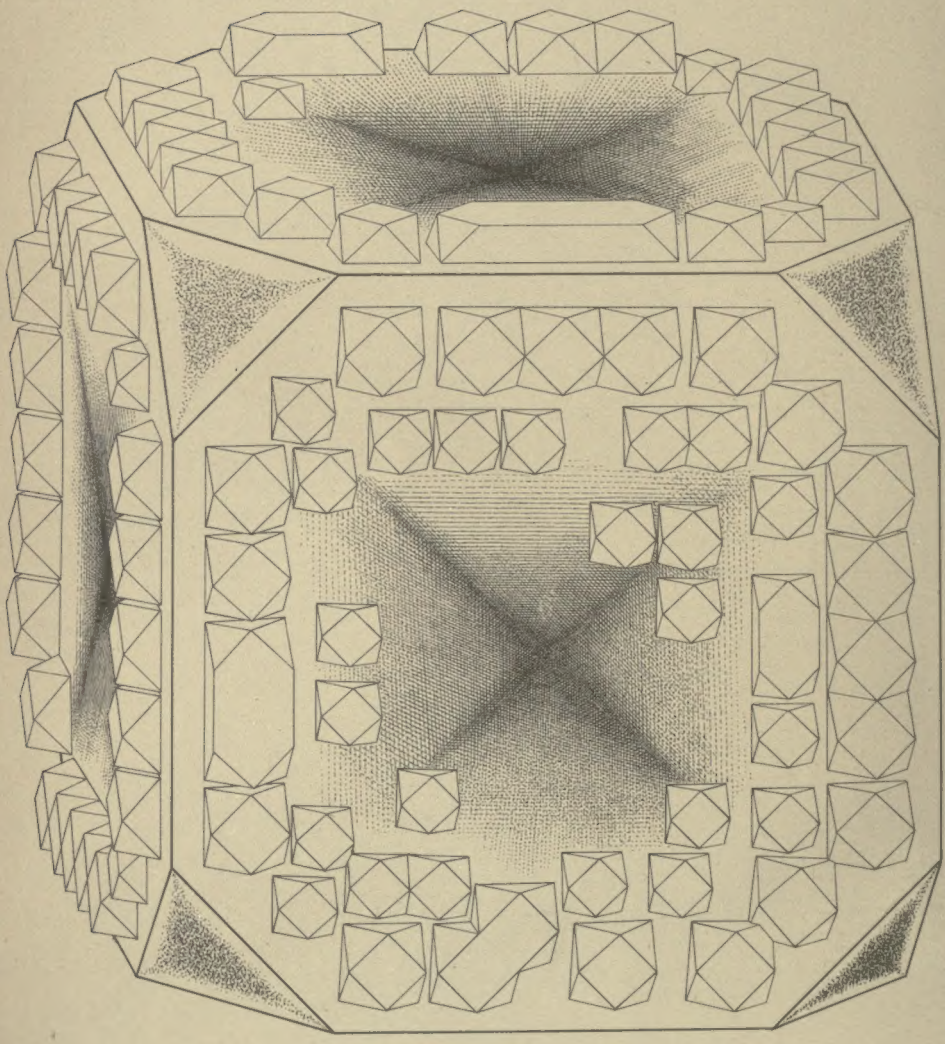
Coronetted Pyrites.

Drawn by Dr Heddle.



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THE MINERALOGY OF SCOTLAND

BY THE LATE

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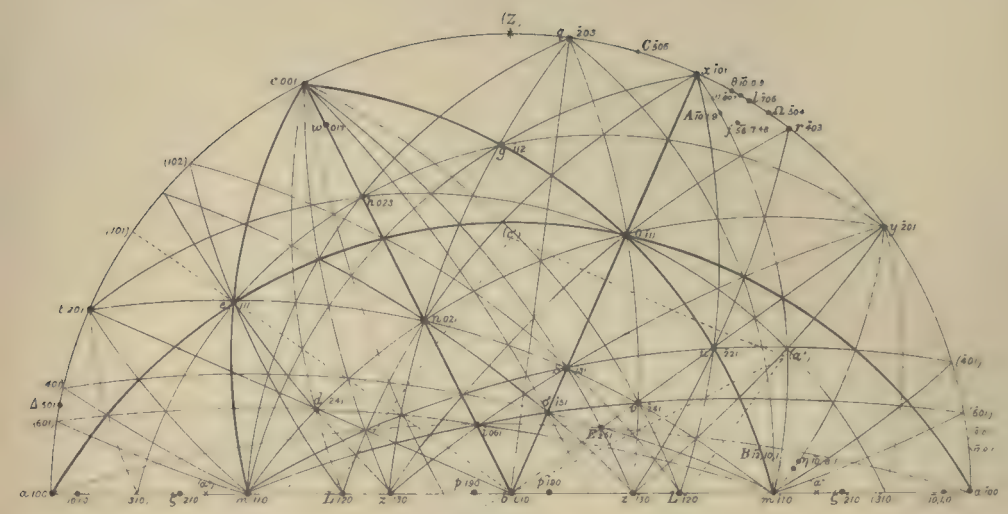
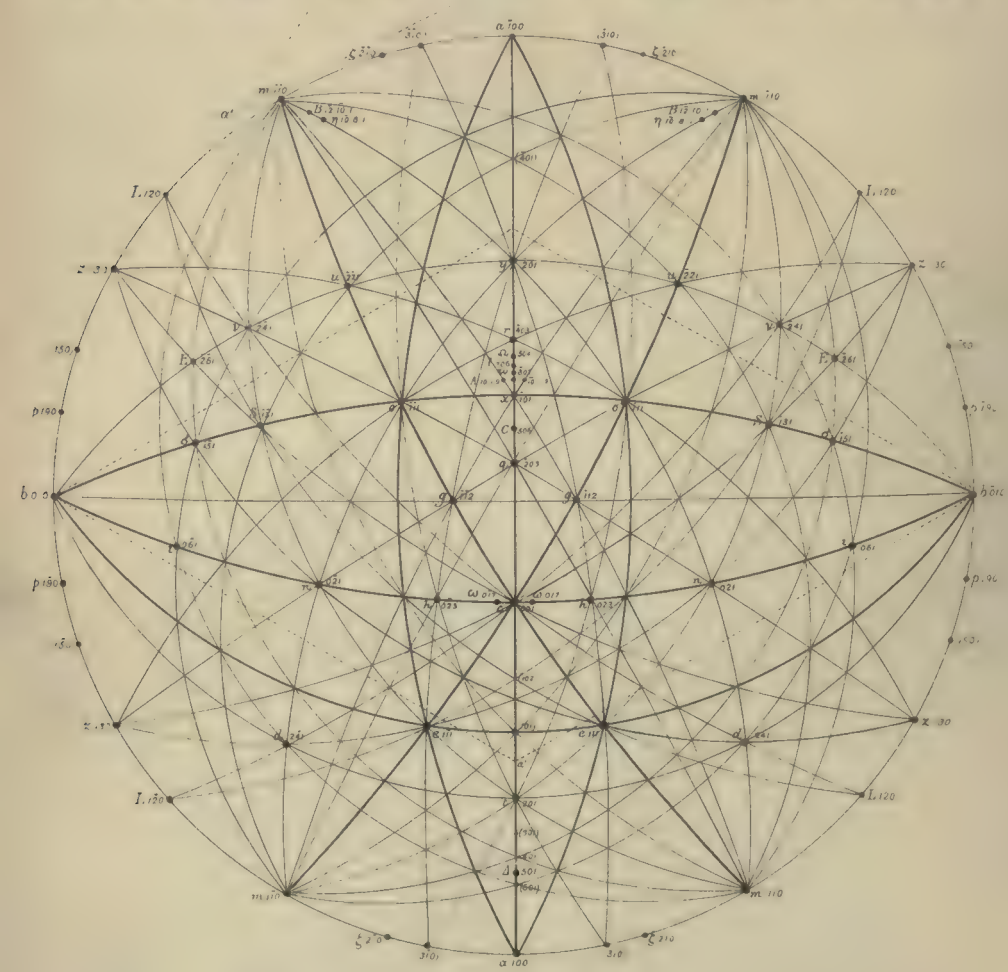
Orthoclase.

G. Goldschmidt





M. Kurtzbauer & Brauneis, Edit.

THE
MINERALOGY OF SCOTLAND.

VOL II.

OXYGEN SALTS.

II. SILICATES.

A. Anhydrous Silicates.

1. Disilicates.

Feldspar Group—a. Monoclinic Section.

78. **Orthoclase (313).** $KAlSi_3O_8$.

Monoclinic. [*a*, 100 ; *b*, 010 ; *c*, 001 ; *m*, 110 ; *x*, 101 ; *z*, 130 ; *y*, $\bar{2}01$; *o*, (*e*), 111 ; (*o*), $1\bar{1}1$; *t*, 201 ; *n*, 021 ; *h*, 023 ; *g*, $\bar{1}12$.]

Pyr., etc. B.B. fuses at 5 of Kobell's scale ; varieties containing much soda are more fusible. Not acted upon by acids.

Typical Sanidines exhibit numberless fractures with characteristic rents, which constantly alter their direction. They also frequently display, upon their cleavages, a striation somewhat resembling a pseudo-twinning.

1. Heddle, *Min. Mag.*, p. 135 ; 2. Heddle, *Trans. Roy. Soc. Edin.*, xxviii. p. 216 ; 3. Heddle, *Trans. Roy. Soc. Edin.*, xxviii. p. 223 ; 4, Heddle, *Trans. Roy. Soc. Edin.*, xxviii. p. 220 ; 5. Heddle, *Trans. Roy. Soc. Edin.*, xxviii. p. 221 ; 6. Heddle, *ibid.*, p. 214 ; 7. Heddle, *Min. Mag.*, iv. 217.

Sanidine :—1 and 2. Heddle, *Trans. Roy. Soc. Edin.*, xxviii. pp. 222-3. Erythrite :— 10. Thomson, *Phil. Mag.* (1843), 22, 188.

Analyses:—

Locality	Colour	Cleav. ang.	S.G.	SiO_2	Al_2O_3	Fe_2O_3	MnO	MgO	CaO	K_2O	Na_2O	H_2O	Total.
1. Point of Ness, Stromness, .	cream	..	..	60·77	18·87	1·32	..	·23	3·75	12·69	1·95	·86	100·44
2. Cnoc Dubh, Lairg	buff	89°·59′	2·555	62·62	19·63	·06	..	·64	·6	13·72	2·92	·13	100.32
3. Canisp, Sutherland, . .	brick-red	..	2·545	63·54	17·36	1·87	·38	..	1·33	12·93	1·69	1·12	100·22
4. Struy Bridge, .	blue	89°·50′	2·545	64·19	17·39	1·2	·46	..	·69	13·31	1·96	·56	99·76
5. Balvraid, Gleann Beag, . .	blue	89°·58′	2·558	63·04	19·31	..	..	·21	·97	14·63	1·02	·56	99·74
6. Clattering Bridge	brown	..	..	64·03	19·17	·30	·22	·94	1·40	11·84	1·37	·57	99·84
7. Beinn Spionnaidh	..	..	..	64·15	19·07	1·32	·54	·38	·95	11·17	1·75	·71	100·04
	Sanidine.	Ratio of Soda to Potash, two-thirds to one to two to one.											
8. Kinkell, Fife, .	yellow	89°·50	2·609	63·07	18·69	2·47	·06	..	2·2	6·62	5·5	1·39	99·99
9. Corriegills, Arran, . .	colourless	..	..	66·85	17·24	·42	..	·06	1·22	9·2	4·32	·86	100·17
10. Erythrite, .	..	..	..	67·90	18·00	2·7	..	3·25	1·0	7·5	..	1	100·35

Shetland. Unst, at Lamba Ness and Skaw, in pink crystals porphyritically imbedded in epidotic "syenite" (Greg). Mainland, at Bixter Voe, similarly to the above (Dudgeon and H.).

Orkney. Mainland, at the point of Ness, Stromness. From granitic veins in gneiss. Cream coloured—Anal. 1.

Sutherland. Ben Hope, at Meallan Liath, with Hornblende, in hornblendic gneiss. In a quarry north-west of Ribigill, with Albite, Sphene, and actinolitic Hornblende, *m x c* (Plate LII., fig. 1); *m x c* (Plate LII., fig. 2). At Jibigall, Melvich, in porphyritic crystals, with a zonal structure, with Albite, in granitite. Lairg, at Cnoc Dubh, in veins in "syenite," of a pink colour, with Oligoclase, Sphene, Allanite, and Haughtonite—Anal. 2. At The Ord, bright red, in veins in gneiss. Beinn Spionnaidh, on the north-west slopes, granular, pink, with Uralite and Sphene—Anal. 7. Canisp, near the summit, on the east side, sometimes with a sheath of Albite, in red porphyry in quartzite, *m c b z o y* and *m c b o g* (Plate LII., fig. 3); *m c b n z a o y*, *m c b o y n - - z* (Currie); *m b c o g*, hemihedral; twins of fig. 3 with interstitial Oligoclase twins (Plate LII., fig. 6) and simple twins of fig. 3 (Plate LII., fig. 6).

Ross-shire. West of Struay Bridge, granular, and pink; with blue Microcline, Beryl, Garnet, yellow Muscovite, and Tourmaline —Anal. 4. In the red porphyry associated with the Torridonians and the Cambrian Quartzite of Canisp. Loose crystals of brick-red colour may be gathered in quantity from bare scalps on both sides of the summit of this hill. These are in simple crystals of the form *m c v z o y* and *m c b o g*.

Inverness-shire. Glenelg; Gleann Beag, above Balvraid. Pale blue, with a waxy lustre (Necronite) in limestone, with Balvraidite, hydrous Labradorite, and dark grey-blue Malacolite—Anal. 5 (Dudgeon and H.).

Banffshire. Near Tomintoul. Three miles above the junction of the Ailnack and the Avon, on the west bank of the former stream, with Rutile and Chlorite, *m c* (Plate LII., fig. 7); *m c b x* (Plate LII., fig. 8); *m c n x*.

Aberdeenshire. Bennachie, on the summit ridge, crystals with zonal Albite, in porphyritic granite. Eslie, in limestone (Nicol and H.).

Kincardineshire. Banchory, at Cairnton. On the summit of Mount Shade, fawn coloured crystals, in red porphyry. At Clattering Bridge, colourless crystals, with zonal Albite, in porphyry dyke—Anal. 6.

Hebrides. Harris, on the south shore of West Loch Tarbert, of a deep red, in hornblendic gneiss.

Argyllshire. At Strontian, porphyritic crystals, purple-red, with a zonal coat of white, in granite, with Sphene and Haughtonite. Campbeltown, at Isle Davarr, in porphyry.

Sanidine or Glassy Fissured Felspar.

Hebrides. Eigg, in the pitchstone of the Scuir, etc. (Greg). In the pitchstone of Oigh-sgeir, south west of Canna.

Fifeshire. Kinkell, in tufa, in hemitropes, with a singular internal structure—Anal. 8. Elie, in dykes of basalt east of the Summer Tower [and in the agglomerate filling volcanic necks on the shore between Elie and St. Monans]. Also in the tufa of the Kincraig. Bin Hill, Burntisland, in a dyke of basalt. West of Elie. [These remarkable occurrences of Orthoclase may be due to derivation from some felspar-bearing rock, similar in lithological character to the trachytes of the Garleton Hills, through which these trappean rocks have made their way. See also under "Hornblende," *infra*, and the Appendix.]

Linlithgow. [?] Hillhouse quarry, in a dyke of columnar basalt.

Midlothian. [?] Blackford Hill, with black Augite, in large crystals.

Arran. At Corriegills, in "pitchstone porphyry," along with plagioclase (Allport). Glen Iorsa, in the same kind of rock (Jameson)—Anal. 8. Drumadoon, in opaque crystals in claystone porphyry (MacCulloch).

Roxburgh. Peniel Heugh, Crailing parish; at Ancrum House, "large crystals in porphyritic greenstone" (Nicol). Wooden Hill, Eckford, "large splendent crystals in a dark rock." Near Ancrum, at Bellsbutts, in large crystals, in a light green matrix.

Erythrite, or Zeolitic Orthoclase, of flesh-red colour, underlies zeolites in cavities. It occurs pseudomorphous after Stilbite, Heulandite, and perhaps Prehnite. It is specially associated with Analcime, Prehnite, and Thomsonite, *c m h n y*. It occurs at Bowling (Anal. 10) in Dumbartonshire; at Boyleston, near Barrhead, at the Gryfe tunnel, near Greenock; and at Berry Glen, in Ayrshire. [Some varieties of Erythrite have been placed by Dr. Heddle with Albite.]

Felspar Group—β. Triclinic Section.

79. **Microcline (315).** $KAlSi_3O_8$.

Triclinic. [*c*, 001; *a*, 100; *b*, 010; *m*, 110; *m′* (*M*), $1\bar{1}0$; *o′* (*o*), $\bar{1}\bar{1}1$; *x*, 101; *y*, $20\bar{1}$; *z*, $1\bar{3}0$; *o* (*p*), $\bar{1}11$; *q*, $\bar{2}03$; *n* (*e*), 021; *n′* (*n*), $0\bar{2}1$.]

1. Heddle, *Min. Mag.*, p. 134; 2. Heddle, *Trans. Roy. Soc. Edin.*, xxviii. p. 216; 3. Heddle, *Min. Mag.*, p. 284; 4. Heddle, *Trans. Roy. Soc. Edin.*, xxviii. p. 220; 5. Haughton; 6. Heddle, *Trans. Roy. Soc. Edin.*, xxviii., p. 209; 7. Heddle, *Trans. Roy. Soc. Edin.*, xxviii. p. 210; 8 and 9. Heddle, *Trans. Roy. Soc. Edin.*, xxviii. p. 213; 11. Heddle, *Trans. Roy. Soc. Edin.*, xxviii. p. 215; 12. Haughton; 13. Haughton; 14. Haughton; 15. Heddle, *Trans. Roy. Soc. Edin.*, xxviii. p. 219; 16. Heddle, *Trans. Roy. Soc. Edin.*, xxviii. p. 210; 17. Tait, *Bryce's Arran* (4th ed.), p. 160; 18. Heddle, *Min. Mag.*, v. 96.

Analyses :—

Locality.	Colour	Cleav. ang.	S.G.	SiO_2	Al_2O_3	Fe_2O_3	MnO	MgO	CaO	K_2O	Na_2O	H_2O	Total
1. Yeskenaby,	cream	89°·56	2·549	66·67	18·52	·88	tr.	·31	·73	13·54	1·8	·87	100·31
2. Ben Bhreac, Suth.,	green	89°·43′	2·569	64·2	18·40	·45	·15	·03	·73	12·75	2·95	·51	100·22
3. Loch Uamh, Gheadha,	flesh	..	2·554	63·85	18·47	1·32	·12	·77	·43	13·02	·92	3·91	99·8
4. Struay, Rossshire,	pink	..	2·543	65	17·03	1·43	·69	..	·73	13·82	1·0	·51	100·20
5. Callernish,	..	..	..	64·48	20	..	..	..	·78	12·10	2·19	·08	99·63
6. Chaipaval Harris,	blue	89°·50′	2·565	64·86	18·47	67	..	·71	..	12·98	1·89	·51	100·08
7. Stromay „	grey	89°·55′	2·574	65·35	17·68	·92	..	·25	·68	13·13	2·51	·18	100·70
8. Cowhythe, 3rd vein,	flesh	..	2·561	64·74	18·3	1·99	..	·04	·97	9·87	3·34	·17	99·42
9. Cowhythe, 4th vein,	flesh	89°·40′	2·559	66·0	18·3	2·03	..	..	1·0	10·02	3·19	·16	100·70
11. Rubislaw, Aberdeen,	flesh	89°·58′	2·554	64·54	18·36	·32	..	·09	·36	13·05	2·58	·09	99·39
12. „ „	..	..	..	64·44	18·64	·80	..	tr.	·66	12·15	2·73	·80	100·22
13. Peterculter, „	..	..	..	64·48	20·0	..	..	tr.	1·01	12·81	1·72	·64	100·66
14. Sterling Hill, „	..	..	..	65·40	19·04	tr.	..	tr.	·22	11·26	3·63	·20	99·75
15. Blairydryne, Kincardine,	white	89°·41′	2·551	63·59	19·58	1·09	..	·08	·68	12·53	2·76	·42	100·73
16. Glen Fernait, Perthshire,	pink	90°	2·525	63·99	17·06	2·47	..	·07	·52	14·85	·53	·65	100·14
17. Arran, Castles,	white	..	..	63·70	20·02	1·28	..	tr.	·89	12·33	1·71	..	99·93
18. Shiness,	white	..	2·560	64·23	18·68	1·32	..	·38	·69	12·38	1·26	·70	99·64
19. Banchory,	white	..	2·542	63·11	18·98	·98	..	·57	·88	13·06	2·34	·34	100·26
20. Forester Hill,	cream	89°·58	2·548	63·31	18·16	·85	..	..	1·05	13·27	2·06	·81	99·51

Pyr. B.B. fuses at 5 of Kobell's scale. Varieties containing much soda are more fusible. Not acted upon by acids.

Microcline is in Scotland of much more frequent occurrence than is Orthoclase. It may be said to be the essential constituent of many granites and of most acidic gneisses and pegmatites. It exhibits the Microclinic structure in very varying development, and, generally, this is more apparent in the Microcline of those remarkable bands of granitoid rock [pegmatite] which traverse, in parallel courses, so many of the older metamorphic areas of Scotland.

Shetland—Mainland. Hillswickness, at North Quin Geo, brick-red, in veins, with Epidote, in gneiss.

Orkney—Mainland. At Inga Ness, Yeskenaby, in nodules in gneiss near granite—Anal. 1.

Sutherland. Near Tongue, in a vein in the "syenitic" boulder on Ben Bhreac; pale brown, passing to *Amazonstone*—Anal. 2. Crystals of two types occur. Those found near the sides of the vein are simple and twin-crystals of the Carlsbad type. The crystals are sometimes much distorted. $c\,m\,m'\,b\,y$ (Plate LIII., fig. 1); $c\,m\,m'\,b\,y\,x\,o\,o'$ (Plate LIII., fig. 2); $c\,z\,z'\,b\,y\,x\,o\,o'$ (Plate LIII., fig. 3); $c\,m\,m'\,b\,z\,z'\,y\,o\,o'$ (Plate LIII., figs. 4 and 5); $c\,m\,m'\,b\,z\,z'\,y$ (Plate LIII., fig. 6); $c\,m\,m\,b\,z\,z'\,y\,x\,o\,o'$ (Plate LIII., figs. 7 and 8); $c\,m\,m'\,b\,z\,z'\,y\,x$ (Plate LIV., fig. 9); twins $c\,m\,m'\,b\,z\,z'\,y\,x\,o\,o'$ (Plate LIV., figs. 10 and 11), with the axis of revolution vertical, c and x nearly coinciding, and showing the composition by sutures which show the two halves of the twin mutually to interpenetrate. These crystals are associated with Radiated Cleavelandite Fluor, Orangite, Thorite, Magnetite, Babingtonite, Sphene, Ilmenite, and Zircon. Towards the centre of the vein crystals of the Manebach type occur. Two crystals of huge size were found, one 15½ inches along b and c, 10 inches over b, 8 inches over c; the other 12½ inches along b and c, 8 inches over b, and 6 inches over c. The simple crystals are $c\,b\,x$ (Plate LIV., fig. 12); $c\,b\,m\,m'\,z\,z'\,x\,y$ (Plate LIV., fig. 13); $c\,b\,m\,m'\,z\,z'\,x\,y\,o\,o'$ (Plate LIV., fig. 14), and twins of the last (Plate LV., figs. 15 and 16); of $c\,b\,z\,z'\,m\,m'\,x\,y\,o\,o'$ (Plate LV., fig. 17); $c\,b\,m\,m'\,x\,y\,o$ (Plate LV., fig. 18), sometimes with the face o alternately hemihedral; $c\,b\,z\,z'\,m\,m'\,o\,o'\,x$ (Plate LV., fig. 19), with the faces z and o alternately hemihedral; and $c\,b\,z\,z'\,m\,m'\,o\,o'\,x\,y$ (Plate LV., fig. 20). These deeper-seated crystals are associated with Ilmenite, Specular Iron, radiated Strontianite, and Quartz. The plagioclase felspar, which forms the corded structure of the above Microcline, appears from the analysis to be Oligoclase. It is itself striated parallel to the cleavages of the Amazonstone crystal. The angle of the latter is 89°·43.

Beinn Laoghal. In veins in "syenite," in the cliff Sgor a' Chonais-

aite, in bright green crystals of about an inch in size, of the Carlsbad type associated with Topaz, Tourmaline, Thorite, and Magnetite. In veins in gneiss, a little north-west of Collabol, Loch Shin, with Epidote and Actinolite.

Strathy. On the west side of the mouth of the Halladale river, with crystallised Albite and Haughtonite, in veins in gneiss.

Loch Eireboll, in a vein on the north shore of Rispond harbour, graphic quartz being imbedded with Oligoclase, Haughtonite, and Magnetite (D. and H.). Also at Loch Uamh Gheadha, on the west side of the loch, with a flesh-red colour and waxy lustre, with Agalmatolite (D. and H.)—Anal. 3.

Cape Wrath, red, in veins with Quartz (Geikie and H.). Geodha na Seamraig, deep red, in veins with Oligoclase ; sp. gr. 2·563.

On the west slopes of Foinne Bheinn, with Oligoclase and Haughtonite, the Microcline structure is very large in the pattern; sp. gr. 2·565.

At Shiness, on Loch Shin, in the gneiss, near limestone, with Lepidomelane (D. and *H.*) Anal. 18. Amazonstone, ¼ mile south of Badnabay, Loch Laxford, in a vein (Clough).

Ross-shire. In the banks of the Black Water, south of its exit from Loch Garve, with green mica and Garnet near Kincardine (T. Bell).

West of Struay Bridge. Massive, blue, with yellow Muscovite, Tourmaline, Garnet, Beryl, and Orthoclase, pink in colour, and granular in structure—Anal. 4.

Blen Logan. Deep red, in brecciated gneiss, with Fluor and Epidosite.

Inverness-shire. Speyside, at Newtonmore, in veins in gneiss, pure white. Sgòr na Ciche, Loch Nevis, near the summit, deep red. In Arisaig (MacCulloch), Creag Mhòr, Cluny Castle.

Hebrides. North Rona, at the summit of the west horn ; in large, rude, highly-lustrous, salmon-coloured crystals, in a pegmatite vein, with black Quartz (MacCulloch).

Sula Sgeir. In granular pink bands, in pale gneiss.

Taransay. In veins at the south end (MacGillwray), in rude Baveno twins.

Lewis. In the granite of Callernish (Haughton) –Anal. 5.

Harris. In the great vein of Chaipaval, white, lustrous, in graphic granite ; also, rarely, blue (Anal. 6), with green Muscovite, Garnet, rose Quartz, and Haughtonite (D. and H.). In the dyke opposite Stromay, grey, in graphic granite, with Moonstone (Albite) and Haughtonite (D. and H).—Anal. 7. In veins in gneiss south-east of Scara Ruadh, of Loch Langabhat, milk-white (D. and H.). Similarly in veins on the east face of Roneval, with Haughtonite (MacCulloch).

Stromay. In large, lustrous, crude crystals, a foot or two across, of a pale brown colour, in white graphic granite.

Shillay. In the south cliffs, bright red, lustrous, with Haughtonite and Topaz.

Mingulay. In veins in Macphee's Hill, lustrous.

In Coll (MacCulloch).

Tiree. In veins west of Creagan Mòra, of a purple colour, with Augite and Lepidomelane (MacCulloch).

Rona, of a brownish-pink colour (MacCulloch).

Eriskay and Fuday, purple-brown (MacCulloch).

Nairnshire. In Kinsteary Quarry, grey and cherry-red, in both Carlsbad and Baveno-twins, and both zoned by a tesselated arrangement of crystals of Albite.

Banffshire. Portsoy, in the first granite vein east of the town, white, with silvery mica. In the second vein, bright red. In the third, at Cowhythe Head, flesh-red, with Tourmaline, Muscovite, Apatite, and graphic Garnet —Anal. 8. In the fourth vein, pale red, *m m′ c x v* (Plate LV., fig. 21), with Garnet Anal. 9. In the sixth vein, in repeated interlacing crystals, forming brick-shaped masses. In the seventh vein, with plumose mica. Ben Bynac, at the Barns, rarely, *a m m′ b c x o o′* (Plate LV., fig., 22), with Cairngorm (Anderson). Cairngorm, *m m′ b c y* (Plate LVI., fig. 23), with smoky Quartz.

Aberdeenshire. It occurs abundantly, but seldom crystallised, in the *red* granite. In small quantity in the mass, but largely and often crystallised in exfiltration veins in the *grey* granite. Of a skim-milk colour, with a fatty or waxy lustre, in veins in gneiss near limestone.

At Murdoch Head quarry, in twins, *m m′ b c x* (Plate LVI., fig. 24), with crystals of Albite disposited on *m m′* in parallel arrangement. In Rubislaw quarry, in the veins (Anal. 11 and 12), in flesh-red crystals of the Carlsbad type, simple and twins of *m m′ c b y n n′ z z′* ; these crystals are sometimes 8 inches across. The associates are Muscovite, Beryl, Apatite, Tourmaline, and Garnet. Also in grey crystals of the Manebach type, with Oligoclase and Haughtonite. Also in veins in many others of the grey granite quarries near Aberdeen ; as at †Gelatly, with Oligoclase ; at Anguston, in twins, *o o′ b c x y m m′* (Plate LVI., fig. 25), with Oligoclase, Allanite, Ilmenite, and Haughtonite ; at Craigton, Hill of Fare, Peterculter (Anal. 13). Monymusk, at Henly's quarry, Pitfichie, *c m m′ b*, *c m m′ b y*, *c m m′ b y n n′ z z′* (Sowerby). Here sometimes in huge crystals imbedded in Quartz. Dyce Quarry, micrographic.

In the bed of the Garchary, opposite Cairn Toul, deep red. Geallaig Hill, Crathie.

The Pass of Ballater, at its eastern extremity, in unusually finely-modelled crystals, combinations, *c m m′ b y*, *c m m′ b a*, *c m m′ b y x*, *c m m′ b y z*, *c m m′ b y x z z′ o o′*, *c m m′ b y x a z z′ o o′*, and ? *e* (Thoms). Its ordinary associates are Zinnwaldite and brown Quartz, rarely twinned Albite and also Beryl.

In the red granite it occurs near Peterhead, at Sterling Hill quarry (Anal. 14), with Quartz and Muscovite, *m m′ b c y z z′* (Plate LVI., fig. 26). At Blackhill quarry.

The waxy-lustred variety occurs near Old Meldrum, half a mile south of Forester Hill, as the matrix of crystals of Hornblende, with Sphene and Ilmenite—Anal. 20. At Brathans, near Banchory, and near the limestone quarries of Eslie, and of Midstrath, etc., with Haughtonite. Creag Mhòr, near Inver inn, at Rinachat.

In gneiss it occurs, in Buchan, at †Cairn Polly point, by Midsummoner flesh-coloured (Wilson). At the Brindey Hill, near Leslie, with Amethyst and Fluor. At the Cabrach at Leids Hill, red. At the Burn of the Cairn in graphic granite.

Kincardinshire. At Girdle Ness, in veins of gneiss, with Epidote and Chlorite, deep red (Plate LVI., fig. 23). At Cove, with Haughtonite. Near Finzean, in granite in twins, with an outside layer of Oligoclase (Nicol). One mile north of Blairydryne, with Haughtonite and Apatite (Nicol)—Anal. 15. At Toll House, north of Cairnmonearn, deep red. Opposite the Hasman Rocks, deep red, in veins in gneiss.

Perthshire. On Carn Liath, 2 miles N.E. of Blair-Athol, white, in granite veins in mica schist, crystallised. Gleann Fearnach, pink, in veins in schist, 2½ miles from the foot of the glen, with grey avanturine Quartz—Anal. 16.

Argyllshire. Near Loch Eil, with crystallised Muscovite. In Ardgower. At the summit of Ben Resipol, white, with Garnet. At Barrs quarry, Loch Etive, in veins in granite. On Fraochaidh, Loch Creran, on the south side of Stob Coire Ruadh, grey. North of Kingshouse, Moor of Rannoch, on the east side of the summit of Meall Bhalach, in gneiss, with Epidote.

Bute. In Arran, on the south-east side of Goatfell (Murchisonite), with smoky Quartz, in triplets of Baveno twins, *c m m′ x y z z′ o o′* (Plate LVI., fig. 27) (Dudgeon). On the Castles—Anal. 17. Near Loch Ranza, *m m′ b c x y a* (Plate LVI., fig. 28). At Glen Catacol, *c a b x m m′* (Currie).

Graphic Granite.

This consists in all cases of a nearly simultaneous intergrowth of Microcline, or, rather, of cross-hatched felspar, with Quartz, the corded structure of Albite or Oligoclase being generally absent.

The Quartz crystals have their main axes parallel to the faces *c* and *b* of the felspar, as if imbedded in parallel growth in a simple crystal of the Baveno type.

The Quartz, through dominance of crystallising power, preserves the angles of its faces ; but as there has been a deficiency of material for the formation of solid forms of Quartz, hollow crystals result.

The structure is also deficient as regards several of the faces of the prism, but hollow summits of the crystals are successively formed, the one within the other, as the compound structure is built up.

As the deficient faces of the Quartz crystals are on one or other side which faces *b* of the felspar crystal, sections of the felspar parallel to *c* show an imbedded system of crystals of Quartz, which resemble fish-hooks of more or less regularly increasing size (and common polarity linked one within the other, the hook being turned towards *b*.

Again, sections parallel to *a* of the Microcline, which sections cut the Quartz crystals at right angles to their main axis, show more or less numerous angular sections thereof, according as the deficient prism or the hollow summit of the crystals happens to be cut across.

In all cases in Scotland where graphic granite is found *in situ*, it occurs in granite [=pegmatite] veins, the material of which has solidified from the sides towards the centre. Almost all such veins show this graphic structure when sectioned parallel to the sides of the vein, and the structure is most minute at the sides.

It is only very rarely that the Quartz protrudes from the terminations of the crystals of felspar.

The whole circumstances seem to point to the silica which has crystallised having been that portion which has been present in excess of the quantity necessary for the formation of the felspar.

In such rocks as exhibit this structure on a micrographic scale, a radiation of the Quartz from many solidifying points has taken place. In some of the huge veins in which it is found in Scotland, the Quartz crystals hold a parallel position over large spaces ; while in others in which the felspar has concreted in huge rude crystals, there is a radiation of the Quartz, generally from a single point in each crystal. The great vein in Chaipaval, Harris, and those in and opposite to the islet of Stromay,

in the Sound of Harris, are examples of the first; the red vein near Cowhythe Head, in Banffshire, is an example of the second.

Sutherland. Rispond, Loch Eireboll, in a vein in Hebridean Gneiss on the north side of the harbour. The Microcline is deep flesh-red, the Quartz greyish-white. The structure is small throughout, and uniform in size. The associates are Oligoclase and Magnetite in imbedded lumps, and Haughtonite in large, dark green plates (D. and H.). L. Glencoul, at Liath Bhad: the Microcline pale yellow, the Quartz white, structure large, in overslid Hebridean Gneiss (Huddleston and H.). At Freasgeal Burn, Loch Eireboll, near its mouth.

Inverness-shire. At Phopachy, red (Anderson). Inverfarigaig, in a vein in a limestone quarry, of two varieties. In the one the Microcline is pink and the Quartz pale grey; is associated with Epidote, and the Quartz letterings are in fissured specimens coated with Abriachanite. In the second variety the Microcline is pinkish-grey and the Quartz is deep red. The structure is large (Aitken and H.). In the railway cutting a mile west of Inverlair station, in veins in mica gneiss (Thomson and H.).

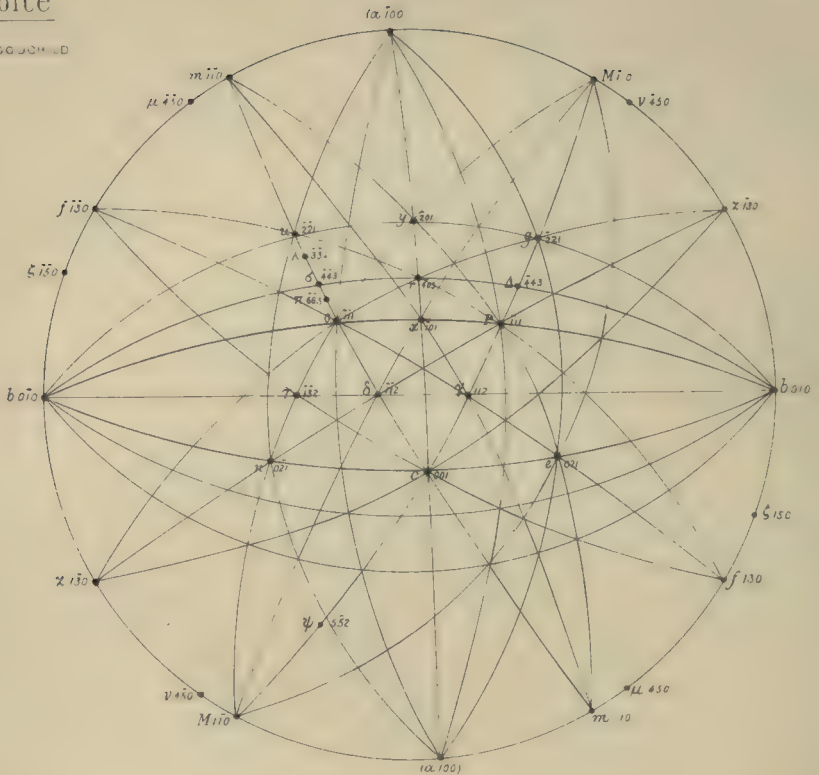
Hebrides. North Rona, in a granite vein at the summit of the West Horn. The Microcline is pink or salmon coloured, the Quartz deep brown and white, with imbedded crystals of lustrous Microcline; structure large (MacCulloch). Flannan Islands (MacCulloch).

Harris. East Loch Tarbert, near the pier. Pale flesh coloured, Quartz grey (James Thomson). North shore of East Loch Tarbert, Microcline deep red, Quartz colourless; with veins of Epidote and crystals of Allanite and Haughtonite. Great vein of Chaipaval, Microcline cream coloured, Quartz grey; in large masses, with rose Quartz and green Muscovite (Neill). In a vein opposite the rock of Stromay, Sound of Harris, Microcline white, pearly lustre, Quartz colourless, with Moonstone (Albite) (D. and H.). Rock of Stromay, in a vertical vein about 16 feet wide: the Microcline is pale cream coloured, the Quartz pale brown; contains imbedded fan-shaped crystals of Haughtonite, with lumps of Magnetite, and a vein of striated Albite. The large vein is fissured parallel to its sides throughout at distances of from 3 to 8 inches. It yielded, however, a solid mass, which was over a foot in thickness, and weighed over 8 cwt. This was cut into four table tops, 3 feet by 1 foot 9 inches in size. The crystals of Quartz ran almost continuously from side to side of the vein. The structure is small. Roneval, in granite veins (MacCulloch).

North Uist. Port nan Long, north-west point of the east shore, opposite Berneray. Microcline pale yellow, Quartz grey; structure large. With Haughtonite and Oligoclase.

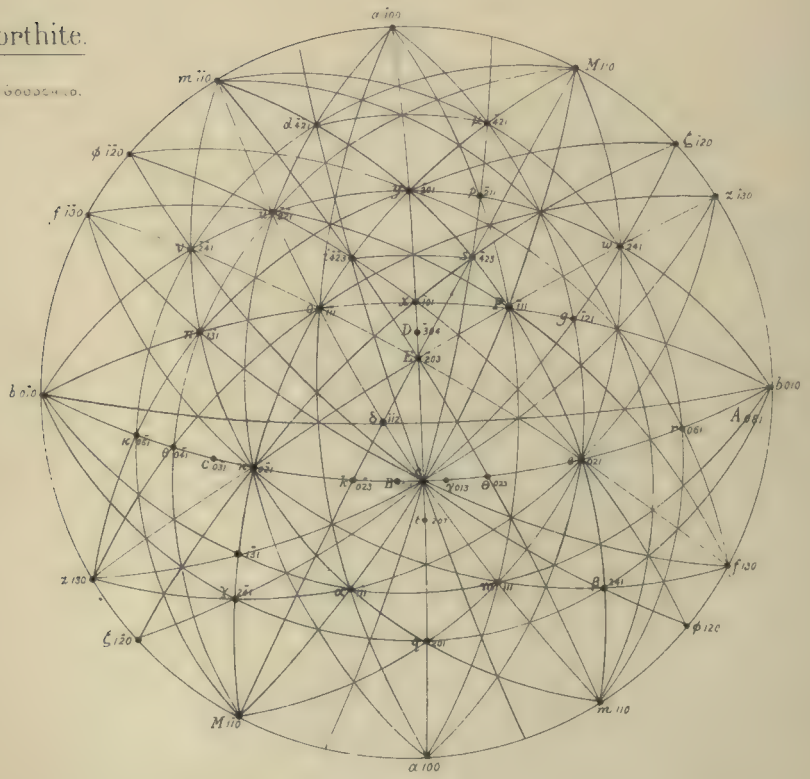
Albite

J. G. Goodchild



Anorthite.

J. G. Goodchild.



McFarlane & Erasmus, Edin.

Rum. Orval: the granitoid rock is micrographic in structure, with many centres of radiation.

Banffshire. Parish of Deskford; loose Microcline blocks, white and opaque, the Quartz very dark; structure both large and small. Fifth granite vein east of Portsoy, near Cowhythe Head. Microcline in huge, rude, flesh-coloured crystals. Quartz, colourless to pinkish, radiates from the corners of the masses of Microcline, and so is almost micrographic at the base, and very large in structure at the sides. With plumose Muscovite and with Tourmaline (Basil Hall). Sixth vein. Microcline flesh coloured, in interlacing parallel crystals, Quartz of the same colour; structure micrographic.

Aberdeenshire. Aberdour, in the cliffs on the east side of Dundarg Castle. In Murdoch Head quarry, Peterhead, microcrystalline, in divergent groups, in narrow veins, over Haughtonite. At Monymusk (? Pitfichie) (Sowerby). "Old Deer parish, near the base approach to the ruins of the old Abbey of Deer." Kildrummy, at Thief's Slack, Hill of John's Cairn; structure unique. The base is a fawn coloured Microcline; the Quartz is dark brown; the hollow summit of each crystal incloses a patch of white Albite. Glen Kindie, loose, very pale pink. Lumsden, north Clova glen, rarely, in veins of crystalline granite, with roots of graphic granite. Cabrach, Burn of Gauch, in magnificent loose specimens, rarely. The Microcline is flesh coloured; the Quartz, which is dark, is arranged in a series of ripple-like undulating lines of lettering. The associates are graphic garnet and Carnelian, which cements brecciated fragments. Other specimens have a lustrous peristerite Microcline. Leids Hill quarry, Microcline scarlet-red, Quartz white or colourless; structure large. Mount of Haddoch, east side of, half a mile from Three Burn Heads; root of crystallised granite vein.

Kincardineshire. Banchory, at Waulkmill, Tilquhillie Castle, structure fine. Mount Battock, south slopes, and near the burn (Imrie).

Kirkcudbrightshire. Five miles north-east of Newton Stewart, near the summit of Blairbuies Hill, cream coloured, in pegmatitic veins, in white granite (Gardiner).

80. **Albite (316).** $NaAlSi_3O_8$.

$a:b:c=0{\cdot}63347:1:0{\cdot}55771$; $a=94°{\cdot}3'$, $\beta=116°{\cdot}28\frac{5}{6}'$, $\gamma=88°{\cdot}8\frac{2}{3}'$.

Triclinic. [m (b), 010; r p (c), 001; t (M), $1\bar{1}0$; l (m), 110; z, $1\bar{3}0$; f, 130; g, o, 111; s (p), 111; g (γ), $\bar{1}12$; k (δ), $\bar{1}\bar{1}2$; n, 021; e, $02\bar{1}$; y, $20\bar{1}$; x, $\bar{1}01$; u, $22\bar{1}$; v, (p), $\bar{1}\bar{1}1$.]

Crystalline, massive, and in radiating plates. Clv., basal and brachydiagonal, almost equally perfect. Fracture conchoidal or uneven. H., 6 to 6·5; G., 2·6 to 2·67. Rarely transparent. Lustre vitreous, pearly

on the cleavage faces. Colourless, but generally white, sometimes grey, green, red, or yellow. Streak, white.

Pyr., etc. B.B. fuses at 4 of Kobell's scale to a colourless or white glass, imparting an intense sodium yellow to the flame. Not acted upon by acids. Comp., 68·6 Silica, 19·6 Alumina, 11·8 Soda, with, in some specimens, from ·1 to 1 Iron Peroxide, ·3 to 4 Lime, 0 to 2·5 Potash.

Analyses :—

1 and 2. Heddle, *Trans. Roy. Soc. Edin.*, xxviii. pp. 238, 239 ; 3. Heddle, *Trans. Roy. Soc. Edin.*, xxviii., p. 239 ; 4 and 5. Heddle, *Min. Mag.*, v. 141, rep. 369 ; 6. Heddle, *Trans. Roy. Soc. Edin.*, xxviii. p. 235 ; 7. Haughton, *Phil. Mag.*, 1870, 40, p. 61 ; 8. Heddle, *Trans. Roy. Soc. Edin.*, xxviii. p. 236. 9. Heddle, *Greg and Lettsom, Brit. Min.*

	Colour	Cleav. ang.	S.G.	SiO_2	Al_2O_3	FeO	MgO	CaO	K_2O	Na_2O	H_2O	Total.
1. Colla Firth Voe (near the pier),	white	86°·45′	2·61	66·84	16·73	2·42	·37	·94	·73	10·76	·89	99·68
2. ,, ,, ,,	white	..	2·62	66·80	17·83	1·13	·14	1·5	·92	11·52	·48	100·32
3. Banks of Niddister,	pink	86°·32′	2·62	66·71	19·81	·90	·09	1·38	1·26	9·23	·54	99·92
4. Meall a' Bhràghaid (matrix)	blue	..	..	66·85	20·11	1·43*	·31	1·03	·44	9·7	·33	100·20
5. ,, ,, (crystals),	cream	..	..	66·62	17·56	1·87*	·38	·73	1·83	10·09	·73	99·81
6. Stromay (opposite), Harris,	grey	86°·21′	2·63	66·97	19·46	·60	·21	2·04	1·23	9·54	·31	100·36
7. Sterling Hill, *Clearelandite*—	white	..	..	68·00	20·00	..	tr.	·35	·68	10·88	..	99·91
8. Beinn Bhreac, Tongue,	white	..	2·622	67·8	18·76	1·43*	..	·52	·76	10·49	·16	99·99
9. *Cluthalite* - Pseudo-Laumontite,	..	..	..	68·57	20·42	1·06	†	..	1·06	9·57	·54	100·38

Albite is a somewhat rare felspar in Scotland, being, for the most part, confined to the red granite of Aberdeenshire—the so-called Peterhead granite, wherein it occurs as a dominant constituent of the rock. In Shetland it occurs as one of the essential constituents also of the gneisses.

Shetland. Unst, at the Bridge of Balliasta, with Chlorite in gneiss. Mainland, at Colla Firth Voe, on the south shore, near the pier, pure white, in a vein with massive Quartz (D. and H.) – Anal. 1. At the south-west corner of the Voe in two narrow tilted beds, of a granular structure, forming, with Hornblende, the " Beautiful Rock " of Hibbert—Anal. 2. At Hillswick, at the Banks of Niddister, pink, with platy Hornblende (Anal. 3) ; and snow-white, with Actinolite (D. and H.). Bixter Voe, at the south-west end, in crystals imbedded in milk-white Orthoclase, which forms a vein with a pegmatitic structure (D. and H.). In porphyry, at the Grind of the Navir, and at the Cannon (D. and H.). Fitful Head, in chlorite slate, in twins, *m p t f z o x*, *m p t f l z n o x s g* (Greg, H., and Thomas).

* Fe_2O_3 also. † Lithia, 1·6.

Sutherland. Tongue, in a quarry north-west of Ribigill, *m p* [*r*] *y t l g x* (Plate LVI., fig. 1), with Sphene and Actinolite in hornblendic gneiss. Beinn Laoghal, Sgor a' Chonais aite, in granitic veins in "syenite," *m e x y t l n f z r* (*c*) (Plate LVI., fig. 2), with Amazonstone, Topaz, Thorite, and Tourmaline. Halladale River, on the west side of its mouth, in crystals an inch in length, of a cream colour, with red Microcline. Meall a' Bhràghaid, of Breabag, on its south-east shoulder, as porphyry, forming both the matrix (Anal. 4) and the imbedded porphyritic crystals—Anal. 5.

Hebrides. Harris, in a granite vein opposite the rock of Stromay, in nodules in graphic Microcline, with Haughtonite; of a white colour and a dove blue, moonstone lustre (D. and H.) – Anal. 6. Rock of Stromay, in a milk-white vein, nearly a foot wide, composed of huge twin crystals. The vein is imbedded in a parallel position in one of graphic Microcline. The Albite has a moonstone lustre and a Peristerite structure.

Aberdeenshire. North-west of Kinnairds Head lighthouse, in a vein penetrating Microcline, with Haughtonite (Wilson and H.). Sterling Hill quarry, with Orthoclase and Quartz (Haughton)—Anal. 7. Murdoch Head quarry, colourless crystals, with black Mica, Microcline, Quartz, and Fluor. At Craigton quarry, Hill of Fare, with Muscovite. Pass of Ballater, with Microcline, Zinnwaldite and Beryl (Thoms).

Perthshire. Glen Tilt, in porphyry (Phillips) ?.

Bute. In Arran, on Goatfell, with Microcline and Quartz, *p t l z m y* (MacCulloch).

Probably is the white felspar of the granite of Foula, Fair Isle, and Tiree.

As "Radiated Cleavelandite," underlying and penetrating crystals of Amazonstone, in the boulder on Beinn Bhreac, Tongue, Sutherland (D. and H.)—Anal. 8 (Plate LVI., fig. 3). As "Perthite," with Orthoclase and Rubinglimmer, in Glen Livet, Banffshire (Ross). As Zeolitic Albite ("Weissigite"), of a brick-red colour, in pseudomorphs after Stilbite, Heulandite, and Laumontite, with Zeolites, at Bowling quarry, Dumbartonshire; Boyleston quarry, Renfrewshire; and at Berry Glen, Ayrshire.

Note.—The reddish substance which occurs in pseudomorphs after Heulandite, Laumontite, Analcime, and, possibly, Calcite, at Bowling and Lang Crag, in Dumbartonshire, and at the Calton Hill, Edinburgh, and hitherto considered to be either Analcime or Cluthalite, has been shown by the author to be Albite—see Analysis No. 9.

81. **Oligoclase (317).** $n\mathrm{NaAlSi_3O_8}m\mathrm{CaAl_2Si_2O_8}$.

Triclinic. [The letters denoting the crystal faces of Oligoclase have the same meaning as those employed in the description of Albite.]

Comp., 63 Silica, 23·4 Alumina, 9·4 Soda, and 4·2 Lime; thus nearly = 3 Albite and 1 Anorthite.

1. Heddle, *Trans. Roy. Soc. Edin.*, xxviii. p. 245; 2. Heddle, *Trans. Roy. Soc. Edin.*, xxviii. p. 241; 3. Heddle, *Trans. Roy. Soc. Edin.*, xxviii. p. 246; 4. Heddle, *Trans. Roy. Soc. Edin.*, xxviii. p. 244; 5. Heddle, *Trans. Roy. Soc. Edin.*, xxviii. p. 243; 6. Heddle, *Trans. Roy. Soc. Edin.*, xxviii. p. 245; 7. Heddle, *Trans. Roy. Soc. Edin.*, xxviii. p. 243; 8. Heddle, *Trans. Roy. Soc. Edin.*, xxviii. p. 242; 9. Heddle, *Trans. Roy. Soc. Edin.*, xxviii. p. 241.

Analysis :—

Locality.	Colour.	Cleav. ang.	S.G.	SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	MgO	CaO	K_2O	Na_2O	H_2O	Total.
1. Lairg, Cnoc	colourless	86·15	2·62	62·83	22·92	·16	..	..	·08	4·25	·84	8·53	·29	99·90
1a. " Dubh,	colourless	86·10	..	62·05	22·44	·35	..	..	·14	4·20	·86	9·22	·36	99·62
2. Rispond,	white	86·14	2·64	61·85	21·7	3·37	..	·20	·09	4·13	1·63	6·95	·38	100·30
3. Canisp,	cream	..	..	64·44	20·47	·88	..	·38	..	1·33	1·14	9·96	1·46	100·06
4. Rubislaw,	bluish-white	86·15	2·64	62·53	23·52	1·28	..	..	·37	4·97	1·32	6·19	·60	100·78
5. Sclattie,	white	..	..	59·53	21·05	1·81	..	..	·88	3·63	4·73	7·23	1·88	100·74
6. Craigiebuckler,	white	86·14	2·62	61·58	22·00	1·24	..	..	·32	4·19	1·53	8·27	·54	99·66
7. Dyce, Aberdeen,	white	86·15	..	64·85	23·20	..	..	..	·20	·96	3·77	8·13	·01	101·12
8. Barra Hill,	milk-white	86·8	2·83	64·67	22·18	1·44	..	..	·02	1·89	1·54	7·64	·15	99·53
9. Coyle Hills,	cream	86·32	2·63	63·54	21·45	1·86	..	..	·23	3·88	1·07	7·64	·44	100·11

B.B. melts more easily than Orthoclase or Albite to a clear glass; not affected by acids.

In its habits in Scotland Oligoclase presents itself as the very frequent associate of the corded felspar in granitic veins—only in one locality (Coyle) is it found in another association; the evidence as regards it is perfectly definite. It also constitutes the bulk of the grey granite of Aberdeen; this I find to consist of a great deal of Oligoclase, little Orthoclase, little Quartz, very small quantities of Muscovite, and a good deal of Haughtonite, such a compound as G. Rose calls *granitite*. The hornblendic gneiss of the Cape Wrath district frequently consists almost solely of a granular mixture of Oligoclase and Hornblende. No one who has become familiar with the ever-recurring exfiltration veins—called *Crocus* by the quarrymen—which lace the grey granite of Aberdeenshire, will hesitate in considering the well defined crystals of the white felspar of these veins to be as thoroughly good a species as the accompanying flesh-coloured Microcline.

A similar association with Microcline is also to be seen in the veins—whether intrusive or exfiltration—which occur in hornblendic gneiss, as at Rispond and Geodha na Seamraig.

Orkney. In the Skerry of Stack and Skerry west of Hoy, in belts in the Caledonian gneiss, with sericitic gneiss.

Sutherland. Lairg, Cnoc Dubh, in veins in "mica syenite," in imbedded crystals, 1 to 2 inches in size, cream coloured. With Orthoclase, Sphene, Allanite, Hornblende, and black Mica (Haughtonite)—Anal. 1. Rispond, in the graphic granite vein, imbedded in lumps, with Haughtonite, Magnetite, and Microcline (D. and H.)—Anal. 2. Calgach, Ceannabeinne in finely striated white crystals in granite veins in the Hebridean Gneiss (Peyton). Tongue, in the great bolder on Beinn Bhreac, crystallised on the terminal faces of Amazonstone; *m p t l f z n x o* (Plate LVII., figs. 1 and 2). Cape Wrath, in veins on the south-east side of Geodha na Seamraig, slightly altered, with a bright red felspar. One and a half miles south of Cape Wrath, in veins with Haughtonite (Geikie and H.). Foinne Bheinn, 700 feet up the west spur, in veins with jet-black Haughtonite and pink Microcline. Canisp, on the north-east side, near the summit, in red porphyry, with red Orthoclase; *p m y t l*, in pairs of simple crystals, also in Carlsbad twins of that combination (Plate LVII., figs. 4 and 3), *p m y z l t*, hemitropes (Plate LVII., fig. 5); *p m t l y o* [*g*] *x s* Plate LVII., fig. 6) (Anal. 3); *m p t l y - - f - - z - - s z* (Currie). Rhiconich, Loch Inchard (Haughton).

Inverness-shire. Glen Urquhart, in a roadside quarry north of the main road to Millton, about half a mile north-west of Drumnadrochit inn; massive, white, the matrix of Actinolite.

Hebrides. Lewis, at Loch na Muilne, north of Loch Roag, in veins in gneiss. with Orthoclase and Haughtonite. Colour pale blue (D. and H.).

North Uist. Loch Maddy, half a mile north of the pier, in granite veins with blue quartz. Port nan Long, on the east side, with Haughtonite and graphic granite. At Hornish, two miles further west, in white crystals, several inches in size, with Haughtonite.

Tiree, on the road from Crossapoll to the Island House, pink, colourless, and pomegranate coloured, with green Quartz, Haughtonite, and Microcline. The Oligoclase here is a sonnenstein (Sunstone).

In West Monach Island, in layers of hornblendic gneiss. These layers carry Ilmenite, Epidote, Apatite, and Sphene.

Aberdeenshire. At Rubislaw quarry, in the deep and smaller veins, white, and finely striated; with Microcline, Muscovite, Haughtonite, Apatite, Tourmaline, and Garnet—Anal. 4. Sclattie quarry, near Buxburn, with flesh-coloured Microcline—Anal. 5. Craigiebuckler, similar to Sclattie (Nicol and H.)—Anal. 6. Dyce quarry, in veins in Granite, with Muscovite and Quartz—Anal. 7. At Anguston, with Microcline, Ilmenite, Sphene, Haughtonite, and Allanite. At Dobson quarry, near Inverurie, with Epidote. At Barra Hill, on the south-west

flank, with or near Labradorite and Wollastonite—Anal. 8. At the Coyle Hills, in Meall Dubh, in veins in Actinolite schist—Anal. 9.

82. **Andesine (318).** $m CaAl_2Si_3O_8 n NaAlSi_3O_8$.

Triclinic. [The letters denoting the crystal faces of Andesine have the same meaning as those employed in the description of Albite.]

Crystals similar in general form to those of Albite and Anorthite. Twin face *M*. Polysynthetic twinning common. G., 2·67 to 2·7. Other physical properties like those of Albite; but the present species is more easily fusible to a porous white glass. Hydrochloric acid sometimes dissolves out the alternate laminæ of the compound crystals. Comp., 59·7 Silica, 25·6 Alumina, 7·7 Soda, 7 Lime; and thus is nearly equivalent to a mixture of one part of Albite and one of Anorthite. In Scotland is typical of the limestones of the Highland Metamorphic Series, and of some of the eruptive rocks which are intimately associated with these limestones.

Analyses, by Heddle:—1 to 6. *Trans. Roy. Soc. Edin.*, xxviii. p. 251.

	Colour	Cleav. ang.	S.G.	SiO_2	Al_2O_3	Fe_2O_3	MnO	MgO	CaO	K_2O	Na_2O	H_2O	Total.
1. Glen Urquhart,	white	86°·28′	2·672	58·38	22·5	2·12	·15	tr.	5·34	3·2	5·21	3·41	100·31
2. ,, ,, .	..	..	2·697	57·38	23·48	·94	·153	·23	6·46	·44	9·09	1·99	100·16
3. Glen Gairn, .	blue	86°·21′	2·705	57·18	24·04	1·12	..	·12	6·11	2·83	7·13	1·6	100·13
4. ,, ,, .	white	..	2·689	56·96	23·81	·94	..	·09	7·98	2·56	6·85	1·62	100·81
5. Crathie, .	white	86°·24′	2·677	56·3	25·71	·97	tr.	..	9·35	1·49	4·72	1·82	100·36
6. Portsoy, .	white	..	2·692	58·36	23·34	·24	..	·5	8·24	1·15	7·84	·53	100·20
7. Laggan, Dulnan Br., .	..	..	2·624	60·53	23·68	·32	·53	·1	4·601	·82	9·64	·66	100·88

Sutherland. In the Shiness limestone quarry, very rarely, in pale dove-blue or grey crystals in cavities of crystallised Sahlite, with Sphene and Pyrrhotite, *p m t l x y s o* (Plate LVII., fig. 1); *p m t l x s z o*, twin (Plate LVII., fig. 2); *p m t l x z o n y*, twin (Plate LVII., fig. 3) (D. and H.). These crystals are striated, and when placed in weak acid the alternate plates are soluble therein. This indicates that the crystals are made up of reversed layers of Albite and Anorthite.

Inverness-shire. Glen Urquhart, in one of the Millton limestone quarries, very rarely, in large crystals, in the centre of crystals of Zoisite—Anals. 1 and 2. This quarry had, in addition, only Quartz and pale green Actinolite; but adjacent quarries afforded massive white opaque Andesine, with Sphene, Edenite, Allanite, Actinolite, and Apatite.

Strathspey. In Dulnanbridge limestone quarry in imbedded striated lumps, with Zoisite, Sahlite, and Tremolite—Anal. 7.

BANFFSHIRE. Portsoy, on the east side of the Bay of Durn, in a thin, tortuous vein in schist, near limestone, of a radiating or plumose structure, with Sphene and Babingtonite—Anal. 6.

ABERDEENSHIRE—Glengairn. Dalnabo, in bands of rock near limestone, passing into pseudo-Prehnite. Of two varieties—bluish-white and cleavable, in large unstriated simple twins (Anal. 3); and opaque cream coloured, with Coccolite—Anal. 4.

Crathie limestone quarry, similar to the above, with Wollastonite and Coccolite—Anal. 5. At Leac Ghorm, in a granitic belt in limestone.

At Boultshoch, in a granitic belt in limestone.

At Muir and Midstrath limestone quarries, in a massive vertical vein. At Forester Hill, near limestone, massive granular, in small quantity, with Sphene. Biotite, Pyrrhotite, and other limestone [contact] minerals.

[**Bytownite,** Ab_2An_3 to Ab_2An_6, is said to occur as a rock constituent.]

83. **Labradorite (319).** $n NaAlSi_3O_8$, $m CaAl_2Si_3O_8$.

Triclinic. [The letters denoting the crystal faces of Labradorite have the same meaning as those employed in the description of Albite.]

Comp., 52·9 Silica, 30·3 Alumina, 12·3 Lime, 4·5 Soda (Ab_1An_1 to Ab_1An_2).

1, 2. Lehunt, *Edin. New Phil. Jour.* (1832), 86; 5*a*. Haughton, *Dublin Quart. Jour. Sci.*, v. p. 93; Heddle, 3 to 13. *Trans. Roy. Soc. Edin.*, xxviii. p. 259; 14 Holland, *Min. Mag.*, viii. 154, 1889.

Analyses :—

Locality.	Colour	Cleav. ang.	S.G.	SiO_2	Al_2O_3	Fe_2O_3	MnO	MgO	CaO	K_2O	Na_2O	H_2O	Total.
1. Campsie,	..	..	..	54·67	27·89	0·31	..	0·18	10·60	0·49	5·05	..	99·19
2. Milngavie,	..	..	..	52·34	29·97	0·87	..	..	12·10	0·30	3·97	..	99·55
3. Portsoy, massive	white	..	2·672	53·03	29·85	0·13	..	0·61	11·44	0·64	4·21	0·42	100·33
4. Harta-Corrie,	white	..	..	49·15	29·62	1·15	..	0·91	15·31	0·69	2·91	0·73	100·47
5. Loch Scavaig,	grey	86°·42′	2·715	50·81	29·48	0·25	..	0·12	12·69	0·55	3·92	2·48	100·30
5*a*. " "	..	..	..	53·60	29·88	0·20	..	0·07	11·02	0·80	4·92	0·48	100·97
6. Glen Bucket.	white	..	2·674	50·59	28·33	3·05	..	0·59	11·17	2·18	2·56	1·42	99·89
7. Balta, Shetland,	lavender	..	2·95	52·21	29·64	0·48	..	0·26	12·43	0·44	4·00	0·11	99·57
8. " "	white	..	2·954	53·14	29·99	0·25	..	0·21	12·3	0·47	3·86	0·21	100·43
9. Portsoy, crystals,	grey	86°·42′	2·83	52·41	28·96	0·15	0·91	0·54	10·85	1·61	3·48	0·93	99·84
10. Kildrummy,	cream	..	2·674	51·31	26·76	1·82	0·76	0·41	10·14	2·11	6·43	0·68	100·42
11. Kinneff,	colourless	86°·40′	..	53·19	26·43	2·85	tr.	0·92	·68	1·51	4·59	0·73	99·90
12. Balvraid granular	wax	..	2·708	47·44	28·02	0·34	..	0·41	11·03	3·51	4·61	5·2	100·56
13. Balvraid, fibrous,	wax	86°·40′	2·705	49·33	26·7	0·25	..	0·07	11·02	2·59	5·25	4·84	100·05
14. Ardnacross, Mull,	..	..	2·72	50·80	31·54	..	..	..	12·83	tr.	3·96	0·52	99·65

Shetland—Unst. Balta island, at "Brough Geo," in a vein with Hornblende, lavender-blue; structure fine granular—Anal. 7. In an adjacent vein with Diallage, milk-white, massive (D. and H.)—Anal. 8 The microscope shows that both of the above contain a little Anorthite.

Fair Isle. Grey, of pavonine lustre; also clove-brown (Thomas).

Inverness-shire. Glen Elg, at Balvraid in Glen Beg, with Necronite, Biotite, and Balvraidite (D. and H.). Anal. 12, of granular, saccharoid, blue variety; Anal. 13, of flat, fibrous variety; both hydrated.

Hebrides. Skye, in veins at the head of Loch Scavaig, in large twin crystals with Diallage, grey and striated (Grieve and H.)—Anal. 5 and 5a. Druim nan Ramh, with Augite, Biotite, and Magnetite (D. and H.). Harta Corrie, granular, with Pyroxene and Magnetite (Forbes)—Anal. 4. Coire na Creiche (Grieve). South slopes of Sgùrr nan Gillean, pavonine, with Biotite and Augite (Dudgeon). Blaven, large crystals (MacCulloch). Talisker, north side of the Bay, in long, imbedded twins.

Rum. Allival, on the north cliffs and slopes of the summit, in crystals over an inch in each direction, of glassy lustre, and finely striated; with Olivine and glassy Augite. Askival, among the east precipices, more rarely, but in still finer crystals. On the west side of both of these hills, in a massive granular belt, with very little imbedded Olivine (in troctolite).

Canna. Near a cave on the south-west shore in dolerite, in lustrous twin crystals with Chlorophæite.

Shiant Islands. Eilean Mhuire, in a cave on the north-west side of the narrow neck, at the south end; in large striated crystals, with Magnetite, Pyrites, Nepheline, Saponite, and Augite.

Mull. Between Aros Castle and Tobermory, near Ardnacross, in crystals nearly 2 inches in length (Judd)—Anal. 14.

Raasay. Pure white, in a ground of dark blue (MacCulloch).

Elginshire [?]. "At Eaglesham, in a whinstone quarry, crystallised on purple quartz."

Banffshire. At Portsoy, west of the Old Battery, striated and crystallised with actinolitic Hornblende and Iserine; grey in colour. Behind a store south of the Battery, in granular massive vein, with imbedded large crystals of Enstatite. In a bed 15 feet wide between quartzite and limestone, massive, and containing porphyritic twin crystals of apparently the same felspar, pure white. Rarely containing crystals of pale green Talc, together with Sphene.

Craigbuirach. A course-grained vein or belt of the norite rock of this district stretches towards Retanach. This contains Labradorite of a grey colour, in rude crystals, sometimes associated with Paulite, Enstatite, and a paulitic Diallage, and also with Iserine, Pyrites, and Leucoxene, more

rarely with Olivine passing into Serpentine. Very rarely the rock contains masses, the size of the fist, of snow-white glassy Labradorite, like a white pitchstone.

Aberdeenshire. Tillypronie, near the summit level of the road between Logie-Coldstone and Donside, in a vein on the west side of the road, in grey crystals with Hornblende, Biotite, Iserine, Allanite, and Sphene. At Badnagoach, near the Deskry, in a vein with Hornblende, Iserine, and Sphene. Glenbucket, in a huge vein, south of Creag an Innean, near Tullocharroch, of a granular crystalline structure, and snow-white to pink colour; with gigantic crystals of Hornblende, also Iserine, Biotite, Apatite, and Sphene (Peyton and H.)—Anals. 6 and 9. Clova, at Clashnarae Hill, Kildrummy, within veins in mica gneiss, of a pure white colour, Andalusite, Fibrolite, Sapphire, and Biotite (Morgan and H.)—Anal. 10.

Forfarshire. North of the church of Kinneff, in grey twin crystals in the interbedded traps of the Old Red Sandstone. The druses at this spot carry red Stilbite and Heulandite, with radiated zeolitic Quartz, and sap-green or chocolate-coloured Saponite—Anal. 11.

Fifeshire. In a dyke in the Bin, Burntisland, in glassy crystals.

Stirlingshire. Strathblane, "a little south of, in the basaltic columns of a wooded hill." Near † Altmarry turnpike road from Glasgow to Drymen, in the black basalt of the horizontal columns. In the columnar basalt of the Kilpatrick and Campsie Hills—Anal. 1. Two miles west of Milngavie, in large yellow crystals; also in small colourless crystals (Greg)—Anal. 2.

Edinburgh. In [?] Blackford Hill, in large, glassy, white crystals, with black Augite. On Corstorphine Hill, with glassy Augite, Prehnite, and Chalcopyrites, in pale yellow twins of *m p y l t* (Plate LVIII., fig. 1).

Linlithgowshire. At Hillhouse, Linlithgow, in glassy crystals, in columnar basalt.

Roxburghshire. Kelso, about a mile from Yetholm, east of the road, near a stream; in greenish crystals. At Peniel Heugh, Ancrum, north of Teviot, in large crystals in porphyritic "diabase."

Dumbartonshire. In Auchentorlie Glen, west of Bowling, in dolerite.

Buteshire. In the Great Cumbray, in "basanite," in the Deil's Dyke, on the east side, in composite twins (Blackwood). Similarly in many of the dykes on the west shore of Bute.

Ayrshire. In the dykes near Fairlie, opposite Cumbray. South-east of Howrat Toll, in lustrous, striated crystals, in dolerite (Blackwood and H.).

84. **Anorthite (320).** $CaAl_2Si_2O_8$.

Comp., 43 Silica, 36·9 Alumina, 20·1 Lime, sometimes with Magnesia and Soda.

Pyr., etc. B.B. fuses to a clear glass. Soluble without gelatinising in concentrated hydrochloric acid.

Anorthite, in Scotland, seems to replace Oligoclase in the Diorite of Fetlar, and in portions of the Gabbro of Ayrshire.

Analyses :—1, 2, and 3. Heddle, *Proc. Roy. Soc. Edin.*, xxviii. p. 261 ; **Latrobite** :—4 and 5. Heddle, *Proc. Roy. Soc. Edin.*, xxviii. p. 263.

Locality.	Colour	Cleav. ang.	S.G.	SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	MgO	CaO	K_2O	Na_2O	H_2O	Total.
1. Fetlar, .	cream	..	3·1	46·92	30·77	..	..	tr.	·09	16·34	1·5	3·07	1·54	100·24
2. Glengairn,	green	..	2·958	46·42	21·86	..	5·92	·69	2·92	18·38	1·26	1·69	1·08	100·23
3. Lendalfoot	greyish	86°·42′	2·761	44·22	31·44	1·95	..	..	1	14·18	1·48	1·63	3·69	99·59

Latrobite—

Locality.	Colour	S.G.	SiO_2	Al_2O_3	Fe_2O_3	MnO	MgO	CaO	K_2O	Na_2O	H_2O	Total.
4. Glengairn,	rose	2·749	45·2	31·04	3·43	·68	1·2	5·21	7·12	·49	5·7	100·07
5. ,,	..	..	46·85	29·31	2·31[1]	1·15	1·38	6·46	7·31	·83	4·49	100·20

Shetland. Fetlar, at east side of head of the Wick of Tresta, cream coloured, massive granular, with jet-black lustrous Hornblende – Anal. 1.

Sutherland. Durness, granular massive, pink ; forming the matrix of crystals of Diallage.

Aberdeenshire. Glen Gairn, Dalnabo limestone quarry, in a massive granular vein, with Coccolite and Latrobite—Anal. 2.

Ayrshire. From the Diallage rock, about one mile north of Lendalfoot, in coarsely-striated crystals about half an inch in size. Rare associates are Native Copper and Pectolite (Grieve and H.)—Anal. 3.

84*a*. Latrobite.

Many authorities regard Latrobite as being a species distinct from Anorthite ; others place them together. This is certainly ill-advised. Anorthite is a lime felspar, with only a trace of potash ; Latrobite is a potash-lime felspar.

The classification of the felspars is essentially an *alkaline* one– every consideration should make it so. Dana unites this with Anorthite from the quantity of its *acid* ; but it is doubtful if that quantity is the same as in Anorthite.

Latrobite has different angles, and has much inferior hardness.

The specimens I have were found at Dalnabo, in metamorphic limestone associated with Anorthite. There was very little of the mineral ;

[1] FeO, ·11.

from the appearance and hardness being the same as those of Rhodonite, it was taken for that species until the specific gravity was determined.

The colour was pale rose-red, the structure fine granular, the lustre feeble, the hardness 5, the specific gravity 2·749.

Two specimens from different parts of the quarry were analysed; the first was pure, the second might not have been totally separated from Coccolite.

Only one other locality of this mineral is known.

2. Metasilicates. $RSiO_3$.

Pyroxene Group—a. Orthorhombic Section.

85. **Enstatite (323).** $MgSiO_3$.

[Orthorhombic. *a*, 100; *b*, 010; *c*, 001; *m*, 110; *o*, 111; *n*, 120; *k*, 012; *q*, 023; ϕ, 016; τ, 223; *e*, 212; *i*, 211; *u*, 232; *d*, 350; *h*, 014; *z*, 210.]

Usually occurs imbedded, or in indistinctly granular masses. Clv., macrodiagonal very perfect, prismatic distinct, brachydiagonal imperfect. H., 5·5; G., 3·1 to 3·3. Translucent throughout, or only on the edges. Lustre vitreous or pearly on the more perfect cleavage planes. Colourless, greyish, or greenish-white, yellowish, or brown. Not affected by acids. B.B. almost infusible. Comp., 60 Silica, 40 Magnesia, 6 to 10 Iron Protoxide, 1 to 2 Alumina, 1 to 2 Water.

Shetland. Unst, at Swinna Ness, in lustrous pea-green crystals imbedded in Serpentine, in association, occasionally, with grey fibrous Hornblende, or interlaminated with the fibres of the same. These imbedded crystals are over half an inch in size. Balta, at the Great Geo, with Anorthite and Diallage. Mainland, at Fethaland, above Cleber Geo, in lustrous sap-green crystals.

Banffshire. Portsoy, behind the old battery, in a Labradorite vein, in so-called "diorite," in large lustrous crystals. North of the old battery, in a vein close to limestone, in association with Edenite and Labradorite. Occasionally in the great mass of "diorite" west of the harbour, with Diallage, Augite, Sphene, and Labradorite. In a vein between veins of aplite, on the west side of the bay east of Portsoy, with Labradorite, a Diallagic Paulite, and a Diallagic Hornblende. Cowhythe Head, in small crystals, in olivine norite. Craigbuirach, and near Retanach, with Paulite, Labradorite and Iserine. At the last three localities it passes into Paulite.

Aberdeenshire. On the south-west side of the Hill of Milleath, near Huntly, rarely, near Serpentine, in large dark-green crystals, over an inch. At Barra Hill, with Paulite, and an "eozoic"-like serpentine. Rarely, with Paulite and Labradorite at Belhelvie.

HEBRIDES. Rum, on Allival, with Labradorite.

AYRSHIRE. Lendalfoot, in serpentine, in lustrous crystals over half an inch. At Whilk, in a rock like lherzolite, with Anorthite, Diallage, and Olivine. South of Pinbain Point, in a diallagic rock, in crystals several inches in dimensions, along with Diallage, Anorthite, and Pectolite. The crystals frequently show brilliant reflections from an arborescent structure, in two directions, at an angle of about 15° from one another. The microscope discloses that such parts have assumed a fibrous structure.

The altered variety of Enstatite, termed *bronzite*, occurs in :—

SHETLAND. Island of Noss, east side, in nodules of serpentine, imbedded in volcanic breccia.

HEBRIDES. In scattered flecks in the serpentine of Scuir Ruadh, Harris ; Diaclasite.

BANFFSHIRE. Portsoy, on the west shore of the Bay of Durn, with Augite, Sphene, and Anorthite, forming a vein. In serpentine, on Tombhreac.

ABERDEENSHIRE. In euphotide, between Dobston and Middleton of Balquhain. In serpentine in Glen Kindie, and in the Red Craig near Rhynie [?].

FORFARSHIRE. In serpentine, at Cortachy Bridge, on the Esk.

AYRSHIRE. In serpentine, at Knockdaw Hill, Lendalfoot. and Byne Hill, Girvan. In Ailsa Craig, at the north-east end, in a vein of serpentine.

STIRLINGSHIRE. In serpentine, near Balmaha, Loch Lomond (Murdoch).

The crystals above noted as occurring in serpentine, though all more or less bronzy in lustre, may all be Bastite.

It is said also to occur [in the Lower Carboniferous Volcanic Rocks] at Wester Craiglockhart Hill, near Edinburgh ; and also at Roseneath on the Clyde (Connell).

85*a*. **Bastite, Schiller Spar (323a).** $(Mg,Fe)SiO_3$.

[Usually regarded now as an altered form of Enstatite.]

Comp., $(MgO,FeO)SiO_2$=43 Silica, 26 Magnesia, 2·7 Lime, 7·4 Iron Protoxide, 3·3 Iron Peroxide, 2·4 Chrome Oxide, 1·7 Alumina, 12·4 Water.

Analysis—Heddle, see *infra*, p. 29.

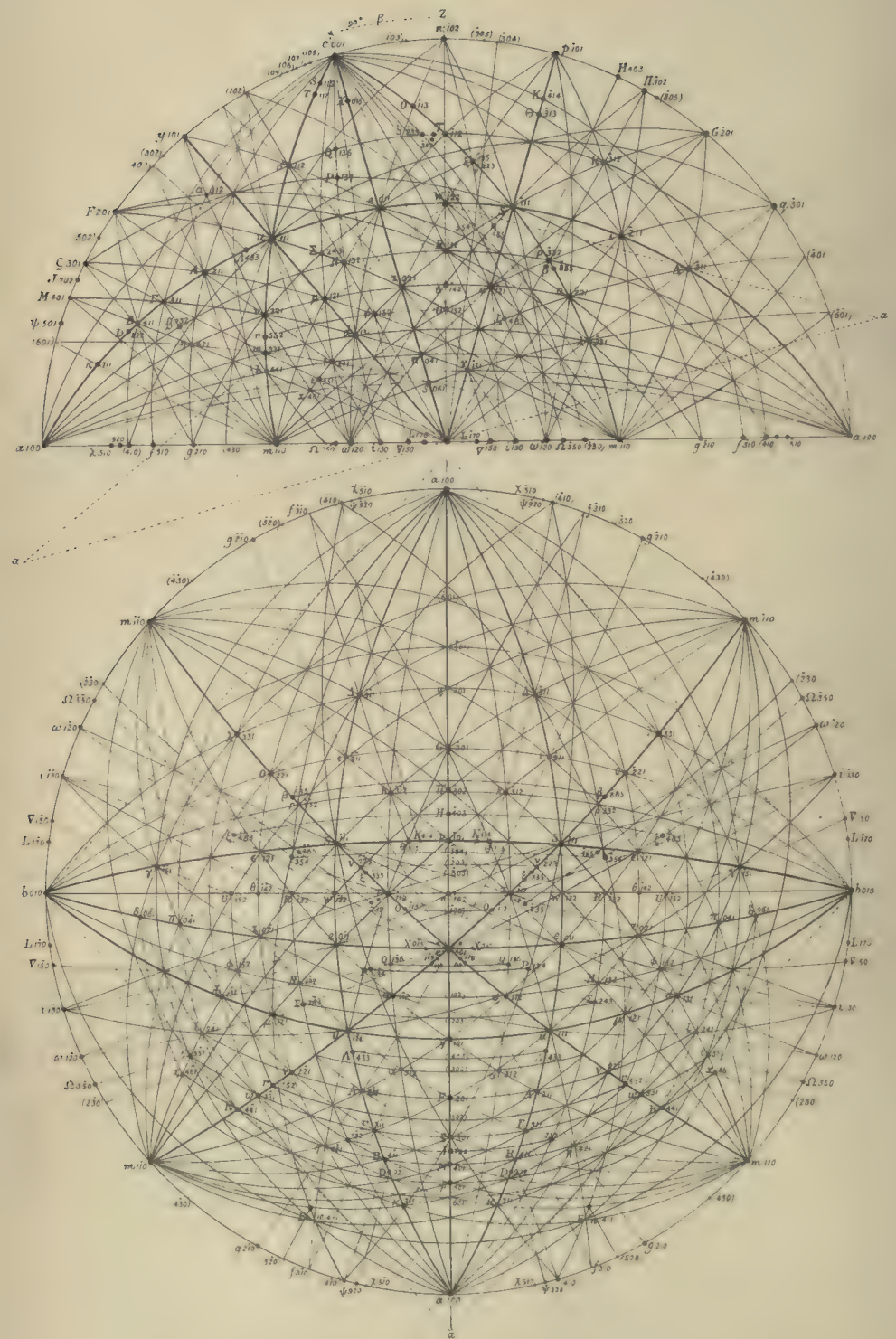
ABERDEENSHIRE. Belhelvie, in a quarry near Broomhillock, in large crystals in Serpentine, pea-green. In a quarry near Whitecairns, in Serpentine, with plumose Pyrites, in bronzy crystals. In boulders of black Serpentine, at the Black Dog Rock, in very large crystals—Anal. 8.

BANFFSHIRE. Near Rothiemay, in Serpentine.

AYRSHIRE. Balhamie Hill, near Colmonell, in leek-green crystals, imbedded in black Serpentine (J. Geikie)—Anal. 3, p. 29.

Augite.

C. S. Goodchild



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86. **Paulite, or Hypersthene (324).** $(Fe,Mg)SiO_3$.

Orthorhombic. (The letters denoting the several crystal faces are the same as those given under Enstatite.)

Granular or disseminated. Clv., brachydiagonal very perfect, prismatic distinct, macrodiagonal very imperfect. H., 6; G., 3·3 to 3·4. Opaque or translucent only on thin edges; lustre vitreous or resinous, but metallic-pearly on the cleavage planes, of which one is copper coloured to violet or silvery. Colour pitch-black and greyish-black; streak, greenish-grey or pinch-beck-brown, inclining to copper-red. Not affected by acids. B.B. melts more or less easily to a greenish-black glass, often magnetic. Comp., generally 46 to 58 silica, 0 to 4 alumina, 11 to 26 magnesia, 1 to 5 lime, 13 to 34 iron protoxide, 0 to 6 manganese protoxide. Chemically, Enstatite and Paulite pass into one another.

Analyses :—

1. Heddle, *Min. Mag.*, vol v. p. 10 (1880); 2 Heddle, *Trans. Roy. Soc. Edin.*, xxviii. p. 466 (1878).

Locality.	S.G.	SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	K_2O	Na_2O	H_2O	Total.
1. Craigbuirach, Portsoy, Banffshire,	3·32	51·461	..	4·022	12·673	·692	5·299	24·230	·252	·741	·519	99·889
2. Retanach, Banffshire,	3·28	50·307	4·479	3·924	5·763	·307	17·575	16·615	·188	·899	·378	100·435

Banffshire. Portsoy, in hyperitic norite, at the south-west corner of the Bay of Durn, with Biotite and Diallage. Craigbuirach and Retanach, in the outcrop of a vein, in crystals an inch in length, with Enstatite, Labradorite, Iserine, Olivine, and Pyrites (Peyton). Sillyearn Hill, near Knock, on the east side, in small purple crystals in norite.

Aberdeenshire. At Barra Hill, on its north side, in norite, with Labradorite, Diallage, Pyrites, and Iserine. Belhelvie, rarely, in Serpentine.

Buteshire, Arran. Said to occur at Struey Rocks, Bennan Head (Bryce).

β. Monoclinic Section.

87. **Augite (325).** $(Ca,Mg,Fe)(SiO_3)_2$.

[a,100; b, 010; c, 001; m, 110; p, 101; t (e), 011; δ (s), 111; u, 111; o, $\bar{2}21$; g, 210; v, 221; f, 310; i, 130; z, 021; λ, 331; ζ, $\bar{4}83$; ϕ, 152; y, 101; n, 102; q, $\bar{3}01$; d, 131; x, 461; μ, 120; ξ (ϵ), $\bar{1}21$.]

(*a*) Magnesia Augite—Silica, 56·22 ; Lime, 25·54 ; Magnesia. 18·24 ; Iron.

(*b*) Magnesia-Iron Augite—Silica, 52·72 ; Lime, 23·81 ; Magnesia, 8·50 ; Iron, 14·97.

(*c*) Iron Augite—Silica, 49·06 ; Lime, 22·29 ; Magnesia, 10·0 ; Iron, 28·65.

Analyses :—

1 to 14 inclusive, 15 to 18, 22, 23. Heddle, *Trans. Roy. Soc. Edin.*, xxviii. pp. 453 to 491 (1878) ; 14*a*, 20. Haughton, *Dublin Quart. Jour. Sci.* (1865), 5, p. 95 ; 21. v. Rath.

Locality.	S.G.	SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	K_2O	Na_2O	H_2O	Total.
Malacolite—												
1. Shiness, white,	3·15	53·06	·19	1·77	·47	·15	23·63	19·30	..	..	1·55	100·12
2. Totag, blue,	3·2	50·69	·03	·93	..	·07	25·78	18·09	·5	1·43	2·62	100·14
3. Beinn a' Chuirn, white,	3·16	51·58	·11	·33	..	..	22·01	19·59	·49	1·01	4·64	99·76
4. Glen Tilt, white,	3·16	53·24	..	2·71	..	·13	22·77	18·86	..	..	2·17	99·88
5. Glen Muick, blue,	3·18	51	..	1·37	1·59	·38	26·36	17·08	·63	1·12	·26	99·89
Sahlite—												
6. Beinn a' Chuirn,	..	54·48	..	..	3·13	·24	22·82	17·58	·44	·79	·42	99·91
7. Tiree,	3·14	50·54	4·69	4·14	·04	·69	23·59	14·4	·31	·63	1·48	100·51
8. Eslie,	..	49·5	1·96	..	11·06	·40	24·08	10·81	·57	·8	·69	99·86
Coccolite—												
9. Gruagach,	3·05	49·04	6·09	1·39	2·94	·46	23·34	15·12	·82	·79	·17	100·16
Diallage—												
10. Balta,	2·96	50·23	5·85	..	5·22	..	11·23	21·59	1·2	·58	4·17	100·07
11. Pinbain,	3·25	51·77	2·1	..	2·95	·31	22·1	18·46	·63	·58	1·08	99·98
Augite—												
12. Glen Elg,	3·24	54·22	·17	..	6·72	·40	19·57	16·97	·5	·45	·96	99·96
13. Allival, Rum,	3·48	50·54	3·35	1·34	4·42	·23	21·42	17·05	·25	·53	·71	99·84
14. Craigbuirach,	3·28	50·31	4·48	3·92	5·76	·31	17·57	16·62	·19	·90	·38	100·44
14*a*. Rum,	..	50·80	3·00	..	9·61	1·08	19·35	15·06	..	0·66	·60	100·16
Pseudo-Hypersthene—												
15. Corrie - na - Creiche, green,	3·33	53·05	4·82	..	11·39	·08	19·81	11·58	..	..	·63	101·36
16. Harta Corrie, bronzy,	3·33	51·36	1·66	..	8·97	·33	20·84	16·47	..	..	·54	100·17
17. Druim-nan-Ramh,	3·34	51·94	1·32	..	13·9	·25	19·36	13·85	..	Ti·38	·2	101·22
18. Loch Scavaig,	3·32	49·27	·22	2·17	12·15	·38	20·26	14·81	..	..	·72	99·98
19. Cuillins (Muir),	3·34	51·35	..	..	33·92	..	1·84	11·09	..	..	·5	98·70
20. Skye (Haughton),	..	50·8	3	..	9·61	1·08	19·35	15·06	..	·66	·6	100·16
21. Cuillins (v. Rath),	3·34	51·30	·76	..	13·92	·25	20·15	14·85	..	..	·21	101·44
Augitic Glass—												
22. Elie,	3·33	49·04	9·71	1·25	5·16	·31	16·25	16·88	·31	·79	·3	100·01
23. John o' Groats,	3·36	46·98	11·39	..	7·92	·46	16·07	15·65	·82	1·06	·38	99·83

AMIANTHIFORM AUGITE. Silky, pure white.

SUTHERLAND. Shiness, in limestone, uniting the disjointed portions of large crystals of Malacolite. The crystals are dislocated along the face of union *c* to the extent of one-fourth of an inch ; the interspace is filled with Quartz, in which the amianthiform fibres lie parallel with the long axis of the Malacolite crystals (D. and H.).

ROSS-SHIRE. North side of Loch Duich, at the bridge of An Leth Allt, with Sahlite and Biotite. Totag, one-fourth of a mile south-west of, with Malacolite, in limestone (D. and H.), east of the Pier (Currie).

MALACOLITE. White, or nearly so ; massive, and crystalline.

SUTHERLAND. Shiness, limestone, in white crystals, sometimes sixteen inches in length by one and a half inches in width. Often disrupted into segments two or three inches in length along the face *c*. Also fan-shaped—Anal. 1. The associates are Sahlite, Pyrrhotite, Sphene, Molybdenite, Tremolite, and Talc.

ROSS-SHIRE. Totag, at the pier, crystallised, *m a i v o* (Plate LVIII., fig. 1). with white Biotite, Magnetite, and Serpentine in dolomite. 200 yards south-west of this, dove-blue, massive—Anal. 2. (D. and H.). Beinn a Chuirn south-west of Loch Duich, in limestone, with Serpentine.

HEBRIDES. Harris, at Rodil, in limestone, with Coccolite. Tiree, east of Ballyphetrish, in white marble, with Sphene (Jameson).

ABERDEENSHIRE. Deeside, at Muir, Midstrath, and Leac Ghorm limestone quarries, rarely, with Sahlite, etc. At Corntulloch, with Wollastonite, Pyrrhotite, Graphite, and Sphene. Coyle Hills, at Allt-cailleach, blue, massive, with Biotite—Anal. 5. South of Loch Callater, crystallised, with Actinolite (L. Lindsay).

PERTHSHIRE. Glen Tilt, in the marble quarry, near Forest Lodge, white and lustrous (Anal. 4), with Tremolite, Serpentine, and Margarodite. At Morenish, north-west of Loch Tay, in limestone.

FORFARSHIRE. Glen Mark, near [?] Bankhead, in limestone.

SAHLITE. Light green, massive, foliated, and crystalline.

SHETLAND. Fetlar, at Uriesetter (Webster).

SUTHERLAND. At Shiness, sap-green in large and small crystals, *a m b p s c e* (Plate LVIII., fig. 2) ; *a m b p s c u* (Plate LVIII., fig. 3) ; *a m b o s c* (Plate LVIII., fig. 4) ; *a m b o p λ ζ c e u* (Plate LVIII., fig. 5) ; *m g a b c o u s t* (Plate LIX., figs. 6, 7). with Sphene, Molybdenite, and Funkite (D. and H.). At Arscaig, south shore of Loch Shin, with Pyrrhotite ; also in large, elongated, *m a b c* (Plate LIX., figs. 8, 9) ; *m i a b* (Plate

LIX., figs. 10, 11) (D. and H.). North-west of Ledbeg, in Dolomite, *m a o λ z c* (Plate LIX., fig. 12); *m i b a f o u* (Plate LIX., fig. 13); with Margarodite and Magnetite, pale yellow; also, *m a c o z*; *m a o v*; *m a o v i*; *m a o u f b*; *m a u o f b i*.

Ross-shire. Near Glenelg, on Beinn a' Chuirn, north side, in radiating crystalline nodules in limestone, pale green (Jameson)—Anal. 6. At Loch Duich, north shore, at the bridge over An Leth Allt, with Biotite.

Hebrides. North Rona, at the mouth of the Tunnel Cave, sap-green, in the centre of crystalline masses of dark green Hornblende. Tiree in a vein on the shore, near Creagan Mòra, in rude crystals, nearly one foot in length by four inches in width, with purple Orthoclase and brown mica. Ballyphetrish, in rounded crystals, dark green, light green, and grey—Anal. 7. The *c* face is disclosed in these crystals in repeated sequence of pale or white bands (MacCulloch). Skye, valley of Beal, translucent crystals like Augite, called Diopside.

Aberdeenshire. In the Crathie limestone. Glen Gairn, in pale green crystals, with the minerals which are its usual associates in limestones along their contact zones adjoining intrusive rocks.

Kincardineshire. Eslie, in bright green crystals, in limestone. These crystals sometimes have a crystal of Hornblende in their centre. The associates are Pyrrhotite, Funkite, Talc, and Andesine.

Perthshire. Rannoch, pale green (MacCulloch).

Coccolite. Granular Sahlite.

Ross-shire. Loch Ailsh, at † Gruagach Cliff (Joass)—Anal. 9.

Hebrides. Tiree, near Creagan Mòra, very fine, rare.

Aberdeenshire. Glen Gairn, with Sphene. Crathie and Boultshoch, with Garnet and Idocrase.

Funkite. Applegreen.

Shetland. Colla Firth (D. and H.).

Sutherland. Shiness, rarely, with Pyrites (Joass). Armadale, near the mouth of the stream east of Creag Gharbh, with Scapolite and Sphene (Macconochie).

Ross-shire. On the south shoulder of Sgurr na Lapaich, near the summit.

Inverness-shire. Gleann Beag, Glenelg, south side of the river, three miles from its mouth (D. and H.). Diallagic appearance—Anal. 12.

Aberdeenshire. At Dalnabo, Glen Gairn, and at Eslie.

Banffshire. Portsoy.

Augite.

Shetland. Brough Geo; Cleft Geo; Hunie Island; above Cleber Geo.

Orkney. Rousay, at Scabra Head, in crystals, *a m b s*, in a dyke cutting Old Red Sandstone.

Hebrides. Lewis, at Loch Maaruig, Seaforth. Scalpa, at Eilean Glas, in translucent greyish crystals, with Quartz and Calcite. Rum, on the higher slopes of Allival and Askival (Anals. 13, 14), in pellucid gem-like crystals, which have no evident cleavage, but the *c* partings, with Labradorite, Olivine, and Biotite (Jameson). [In basic eruptive rocks of all ages, *passim*.]

Inverness. South of Loch Laggan, in the col between Aonach Beag and Ben Eibhinn, diallagic.

Banffshire. West of Greenloan, in the north bank of the Blackwater, in imbedded crystals.

Fifeshire. Raith, at Foulford quarry, in acicular crystals of a black colour. [In basic eruptive rocks, *passim*.]

Crystals, recognisable as such with the lens, occur in the [basic] eruptive rocks of numerous localities, *e.g.* :—Skye, at Talisker; Dunsappie Hill, and the Lion's Haunch, on Arthur's Seat; Inchkeith, in basalt, etc.

Diallagic Augite. Probably from repeated twinning, or juxtaposition of crystals on face *c*.

Inverness-shire. Grantown, at Achnagonalin, in crude crystals in limestone, with Cinnamonstone. Dulnanbridge limestone quarry.

Hebrides. Skye, Cuillin Hills generally (Anals. 20, 21); specially large masses in segregation veins. Occasionally somewhat bronzy, or pseudo-hypersthenic, but from surface weathering only, as at head of Loch Scavaig (Anal. 19), with large crystals of Labradorite. Druim nan Ramh, bronzy on surface—Anal. 18. Harta Corrie, bronzy, with pale green Labradorite, and with Magnetite. Corrie na Creiche, grey-green—Anal. 16.

Banffshire. Portsoy, in veins, in the Bay of Durn, with Paulite, Andesine, Labradorite, Biotite, Iserine, Pyrites, and Pyrrhotite. At Craigbuirach, with Labradorite, Paulite, Iserine, Pyrites, and Pyrrhotite —Anal. 15. At both of the last two localities the Augite is diallagic, with interlaminated Enstatite.

Argyllshire. At Ardnamurchan. Beinn Bhreac, with Actinolite (Peyton and H.).

Aberdeenshire. At the Crook of Deveron (Peyton and H.).

Ayrshire. Pinbain, with Anorthite, Pectolite, and native copper—Anal. 11.

HUDSONITE. Black, highly ferruginous.

HEBRIDES. St. Kilda, Conagher (?Coignahan), with Labradorite and Serpentine. Skye, near † Loch Einort.

ARGYLLSHIRE. Near Taynuilt.

EDINBURGH. [?] Blackford Hill, velvet black, with [?] Sanidine.

AUGITIC GLASS.

CAITHNESS. East of John o' Groats House, in agglomerate, filling a neck in Old Red Sandstone, dark green, vitreous—Anal. 23 (Geikie).

FIFESHIRE. Elie, in a dyke in tuff, west of the Summer House, dark green, brittle; associated with Pyrope—Anal. 22.

AYRSHIRE. Near Fairlie (Geikie).

Many substances occur in Scotland, which, from their mode of occurrence, their situation, their appearance, that is, a gradation in their outward change, and from a corroborative alteration in their constitution when analysed, give rise to the conclusion that they have been formed by what may be termed a gradually-increasing serpentinous change from other minerals, of which Enstatite, Augite, Hornblende, and Olivine may be taken as the types. Those who wish to consider the details of such transmutation may consult a chapter on the subject in the *Trans. Roy. Soc. Edin.*, xxviii (1878). It is here merely necessary that, through their immediate relationship to Augite, the following analyses be given:—

1 to 9 inclusive, Heddle, *Trans. Roy. Soc. Edin.*, xxviii. pt. 2, pp. 491-501 (1878).

	S.G.	SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	K_2O	Na_2O	H_2O	Total.
1. *Typical Sahlite*, .	..	53·70	..	..	8·00	..	24·9	13·4	..	..	..	100·
Hydration—loss of CaO, and SiO_2—peroxidation partial—												
2. Pseudo Augite, Portsoy,	..	37·33	1·13	4·36	4·05	·38	1·2	36·71	·88	·73	13·37	100·14
3. Pseudo-Enstatite (?) Balhamie, .	..	37·78	2·12	5·07	2·09	·08	..	37·01	tr.	tr.	16·07	100·22
Hydration—loss of CaO and SiO_2—total peroxidation—												
4. Pseudo-Diallage, Portsoy	2·62	34·54	1·16	15·2	·33	·28	..	36·38	..	..	12·2	100·09
5. Pseudo-Enstatite (?), Greenhill, .	2·16	37·41	..	13·54	·06	·24	·2	34·76	..	..	13·59	99·78
6. Totaigite, yellow, Totag,	..	37·22	·76	..	1·05	·23	5·24	44·97	..	..	10·64	100·11
7. „ black, „	2·87	36·19	·26	·29	2·96	·45	3·27	45·57	·25	·42	10·2	99·96
Hydration—no peroxidation—												
8. Schiller Spar, Black Dog Rock, .	2·65	38·19	2·18	·03	8·48	·51	2·91	32·42	1·4	·06	14·03	100·49
9. *Typical Serpentine*, .	..	44·14	..	..	..	..	..	42·97	..	..	12·89	100·00

Monoclinic. Crystals long, often acute-pointed ; prisms longitudinally striated. Cleavage like that of Augite. H., 5·5 to 6·5 ; G., 3·4 to 3·6. Nearly opaque ; lustre vitreous ; colour brownish or greenish-black. Streak greenish-grey. Imperfectly soluble in acids. B.B. fuses easily.

[88. **Aegirine (326).** $NaFe(SiO_2)_2$.

Occurs in Scotland as a rock constituent, and is there usually only recognisable with the aid of the microscope. Dr. Heddle's Collection in the Edinburgh Museum of Science and Art includes one specimen of Pegmatite from Glen Clunie, which he has named " Aegirine Porphyry."]

89. **Spodumene (327).** $Li_2O,Al_2O_3,4SiO_2$.

Monoclinic. Cleavage, *m* (110), perfect. Chiefly occurs massive or lamellar. H., 6·5 to 7 ; G., 3·1 to 3·2. Translucent ; lustre vitreous or pearly. Colour pale greenish-grey or white, ranging to apple green. Streak white. B.B. intumesces slightly, tinging the flame momentarily purplish-red, and then fuses easily to a colourless glass, not affected by acids. c.c. 65 silica, 28·7 alumina, 6·3 lithia.

[This species is stated by Brook and Miller in *Phillips' Mineralogy* (1852), p. 363, to have been found at Peterhead in granite. Dr. Heddle left no statement confirming this record.]

90. **Wollastonite (329).** $CaSiO_3$.

Monoclinic. Rarely crystallised, mostly broad-prismatic or lamellar. Frequently fibrous. Clv., parallel to the Orthopinacoid, *a*, and the Basal Plane, *c*, perfect ; but the planes are uneven, or rough. H., 4·5 to 5 ; G., 2·8 to 2·9. Translucent. Lustre vitreous, or pearly on the cleavage-planes. Colour usually white, but sometimes inclining to grey, yellow, red, or brown. Streak, white. Comp., Calcium Metasilicate=51·7 Silica, 48·3 Lime, but with 0 to 2 Magnesia, and 0 to 2 Iron Protoxide.

Analyses :—Heddle.

	SiO_2	Al_2O_3	Fe_2O_3	CaO	K_2O	Na_2O	H_2O	Total.
1, Millton, .	49·142	·617	tr.	43·7	·634	2·957	3·027	100·08
2, ,, .	49·065	·601	...	43·01	1·008	2·728	3·098	99·51
3, Crathie, .	50·111	·297	1·321	45·729	·614	·152	1·79	100·01

Inverness-shire. Glen Urquhart, near the Free Church of Millton, in a vein in edenitic rock. Colour, bluish-white, solid, with fibrous structure—Anals. 1 and 2. With Zoisite and Staurolite in close association ; sp. gr., 2·715.

Hebrides. Skye, in Coire Nuadh, of Beinn na Caillich, at the bridge over the Allt Ghoiridh, opposite Scalpa, in rifts of limestone, stellate fibrous.

Banffshire. East of Cowhythe Head, in limestone, in light brown tuffs and acicular groups of crystals. At Retanach, on Labradorite, in silky, fibrous groups, rarely. Portsoy, in a tilted bed of grey limestone, north of the Old Battery, with Sahlite and Idocrase.

Aberdeenshire. At Barra Hill, near Bourtie, on its south-west side, in radiating groups of white fibres, on granular Labradorite, in Serpentine. Deeside, at Cairn Tullich (Corntully [or Corntulloch]), in a mass of matted interlacing white fibres, forming a bed two feet thick, in limestone. Graphite scales and crystals of Sphene are imbedded in the fibrous crystals. Hornblendic gneiss caps the limestone. In the limestone at Dalnabo, Glen Gairn, in pale brown fibrous brushes, with Cinnamonstone, Epidote, Sahlite, and Prehnite. With limestone at Bankhead. In Crathie limestone quarry (Anal. 3), in cream-coloured, fibrous brushes, with Idocrase and Garnet. In matted white fibres inclosing Garnet, at Tirebagger.

Edinburghshire. At Barnton railway cutting, in dull yellow tufts, with Datholite, etc.

Arran. In Glen Shiant, with Aplome Garnet (Necker).

91. **Pectolite (330).** $HNaCa_2(SiO_3)_3$.

c (a), 100 ; r (e), 001 ; n, $\bar{3}22$; i (h), $\bar{5}40$; h (q), 340 ; w (o), $\bar{1}40$; u (v), 101.

Monoclinic. Rarely occurs in distinct crystals. Usually in close aggregations of acicular crystals, forming spheroidal masses with a radiating fibrous structure. Clv., Orthopinacoid, a, and Basal Plane (c) perfect; fracture uneven. Exceedingly tough. H., 5 ; G., 2·74 to 2·88. Translucent ; lustre of crystals pearly ; that of a fractured surface of the fibres, silky. Colour, white, tending to pale green, or to yellowish. Soluble in h. acid, leaving a gelatinous residue of silica [whence the name of the species, according to Sterry Hunt]. Comp., 54·2 Silica, 33·7 Lime, 9·4 Soda, and 2·7 Water.

Walkerite is a variety, of columnar form, and differing slightly from normal Pectolite in composition. H., 4·5 ; G., 2·7. Flesh-coloured ; lustre, pearly to greasy. It occurs in veins in Dolerite at Corstorphine Hill, two miles west of Edinburgh, and at Burntisland, Fife.

[In Scotland Pectolite usually occurs as a secondary product, filling vapour cavities, or fissures, in eruptive rocks, generally in those of basic composition. Its modes of occurrence, as well as its genesis, resemble those of the Zeolites, properly so-called.]

Analyses :—1, 10-16. Heddle ; 3, 5, 7. Stuart Thomson ; 8, 9. J. Thomson ; 6. C. Robinson ; 2. Scott ; 15*a*. Walker ; 17. Kennedy ; 1, 10,

11, 16, 17. *Phil. Mag.*, ix. 248 ; 2. *Edin. N. Phil. Jour.*, liii. 277 ; 15*a*. *ibid.*, xv., 386 ; 8, 9. " *Mineralogy* " ; 3, 5, 7. *Trans. Geol. Soc. Glasgow*, 1892, 14, 15, *Min. Mag.*, iv. 121.

Locality.	SiO_2	Al_2O_3	CaO	MgO	K_2O	Na_2O	H_2O	Total.
1. Talisker, Skye,	53·82	2·42	29·88	·31	..	9·55	3·76	99·74
2. Prince Charlie's Cave,	52·01	1·82	32·85	·39	..	7·67	5·06	98·80
3. Dearg Sgeir, Mull,	53·74	·82	31·19	..	..	9·94	3·38	99·07
4. " " "	53·41	1·76	31·69	..	2·42	8·11	3·66	101·05
5. " " "	52·95	1·71	31·48	..	2·42	8·04	4·07	100·67
6. " " "	53·39	..	33·41	..	..	8·80	4·46	100·00
7. Manor House, Oban,	54·63	4·56	26·68	..	..	10·69	3·92	100·48
8. Kilsyth,	52·74	0·67	31·68	1·52	..	9·60	2·6	99·41
9. Bishopton,	52·07	4·20	32·08	..	·35	9·60	2·0	100·67
10. Lendalfoot, Girvan,	53·48	·41	34·38	..	..	9·87	3·26	101·40
11. Bougang quarry,	53·24	1·0	32·24	..	..	9·57	3·6	..
12. Ratho (fibrous),	52·53	·38	32·79	..	..	8·96	2·37	99·65
13. " (crystalline),	52·58	1·46	33·75	..	..	9·26	2·8	99·85
14. Corstorphine Hill,	54·0	1·18	30·79	2·59	..	5·55	5·43	98·36
15. " (Walkerite),	52·20	..	28·64	5·12	·85	6·50	5·28	99·92
15*a*. " "	54·00	..	30·80	..	..	5·55	5·43	98·38
16. Edinburgh Castle,	53·06	·46	33·48	..	..	10·27	3·13	100·40
17. " "	51·50	1·00	32·00	..	..	8·50	5·00	98·00

HEBRIDES. Talisker Bay, Skye, in cavities in Tertiary basalt-lavas —Anal. 1. Prince Charlie's Cave, Skye—Anal. 2. Dearg Sgeir, Loch Scridain, Mull, in vapour cavities in basic lavas and dykes of Tertiary age. It occurs in two forms. One of these is in acicular divergent and rosette groups, such as Scolecite and Mesolite assume, and with rough and opaque crystalline terminations—Anal. 3. The appearance of the other was precisely that which might be expected in a massive Gyrolite. Large folia, of pearly lustre, and of a distinct sea-green colour, passed from all sides to the centre. Generally these folia were flat ; but here and there they were twisted and interwoven. But the toughness of the specimen threw doubt upon the mineral being Gyrolite, and the analysis, No. 4, left no doubt that the mineral in question was simply an exceptional form of Pectolite (Heddle, *Trans. Geol. Soc. Glasgow*, 1892, pp. 241-255). See also Analyses 5 and 6. A mineral doubtfully referred to Pectolite occurs in the north-west cliff of Askival, Rum.

ARGYLLSHIRE. Manor House, Oban, " in a rent in a trap dyke, lustrous, and cream-coloured " (Nicol)—Anal. 7. Sp. gr., 2·734.

STIRLINGSHIRE. Auchinstarry quarry, Kilsyth (Anal. 8), with Apophyllite, in dolerite, intrusive in rocks of Lower Carboniferous age. With radiated Delessite, at Mugdock.

RENFREWSHIRE. Bishopton, compact and fibrous, in " greenstone "—Anal. 9.

AYRSHIRE. Lendalfoot, coast south of Girvan, in cavities and veins in basic eruptive rocks, chiefly of Arenig age, in which it occurs in white,

fibro-crystalline aggregations, some of which are nearly three feet in length, and are excessively tough—Anal. 10. At Bougang quairy, Knockdolian, near Ballantrae, in white, closely-fibrous aggregations, as well as in small acicular crystals—Anal. 11.

Edinburghshire. Ratho, where Pectolite occurs filling what were originally large vapour cavaties in a great sheet of Dolerite. It is of a pale greenish-grey in colour, with a silky lustre, and is excessively tough. Some of the cavities are not quite filled by the Pectolite ; hence the free ends of the aggregations sometimes assume a distinct crystalline form (Plate LX., fig. 1) which serves to show the isomorphism of the present species with Wollastonite. Analysis 12 was made from the ordinary fibrous variety, and Analysis 13 from the crystalline form. Pectolite occasionally occurs at Ratho also as an interesting pseudomorph after Analcime. In the Dolerite quarries of Corstorphine it is not uncommon, and is compact and fibrous, and of a pale greenish-grey colour—Anals. 14, 15*a*. It occurs, rarely, also in the basalt of the Castle Rock of Edinburgh, in nodular masses, with a diverging structure, translucent, and crystalline, of a pale yellowish colour, and associated with Prehnite—Anals. 16, 17. It is said to have occurred, in a weathered state, at Lochend, on the east side of Edinburgh ; also at Salisbury Crags (Taylor).

[The foregoing description has been compiled chiefly from Dr. Heddle's published works, and partly from the specimens in the Scottish Mineral Collection.]

γ. *Triclinic Section.*

92. **Babingtonite (336).** $(Ca,Fe,Mn)SiO_3.Fe_2(SiO_3)_3$.

Triclinic, generally massive or granular. Clv., basal (*c*) very perfect, also along *b*. H., 5·5 to 6 ; G., 3·3 to 3·4. Thin laminæ translucent. Lustre splendent vitreous. Colour black. Not affected by acids. B.B. fuses easily, with effervescence, to a black magnetic bead. Comp., 50·7 Silica, 11 Iron Peroxide, 10·3 Iron Protoxide, 7·7 Manganese Protoxide, and 20·3 Lime.

Analysis—Heddle, *Min. Mag.*, v. 147-8, pp. 375-6, of the Geognosy of Scotland (1884).

	S.G.	SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	K_2O	Na_2O	H_2O	Total.
Ben Bhreac,	3·3	50·845	1·402	9·56	8·307	1·153	17·661	5·538	1·072	2.914	1·485	99·937

Sutherland—Tongue. Occurs in the great "syenite" boulder, which lay upon the west slopes of Beinn Bhreac, in rude crystals an inch or two in length by a fourth of an inch in thickness. The colour is dark green. The crystals are much fissured in all directions. They were imbedded

in the "syenite" where it passed into a granitic vein which carried Amazonstone, Quartz, Thorite, Fluor, Strontianite, etc.—Anal. It also occurred in recognisable amount in masses carrying Amazonstone, Topaz, Quartz, and Thorite, which fell from the north precipice of Beinn Laoghal.

Banffshire.—East shore of the Bay of Durn in norite, very rarely. [It is stated by Allan, *Mineralogy*, p. 145 (1834), to occur in Shetland in Quartz.]

Amphibole Group.—a. Orthorhombic Section.

93. **Anthophyllite (337).** $(Mg,Fe)SiO_3$.

Orthorhombic. Clv., macrodiagonal perfect. Colour clove-brown to purplish-brown, and leek-green. Translucent; radiating, and foliated. Lustre pearly on the cleavage plane. H., 5·5; G., 3·2. Comp., Silica, 55·5; Protoxide of Iron, 16·7; Magnesia, 27·8. B.B. very difficultly fusible.

Analysis: Heddle, *Min. Mag.* iii. p. 21; p. 102, *Geognosy of Scotland.*

	SiO_2	Al_2O_3	FeO	MnO	MgO	CaO	H_2O	Total.
Banks of the Niddister,	56·86	4·49	8·13	·87	25·87	1·09	3·36	100·67

Shetland. Hillswick, at the southern extremity of the "Banks of the Nethista" [or Niddister. This is the locality whence the potstone is obtained; and it is not the banks of the stream, but the shores near its mouth. The mineral occurs] in a tilted bed, [near to, but not directly associated] with, clove-coloured Steatite, Actinolite, and Precious Serpentine. Angle of crystal, $m\,m'$, 125°·23—Anal. In the Fair Isle; Sp. Gr. 3·068 (Thomas).

β. Monoclinic Section.

94. **Hornblende (338).**

Monoclinic. $a : b : c = 0{\cdot}55108 : 1 : 0{\cdot}29376$.

[Forms:—a, 100; x,= (b), 010; c, 001; p, 101; l (r), 011; m, 110; e, 130; z, 121; t, 101; i, 031.]

Distinct cleavage in several directions perfectly parallel to the unit prism m, less perfect parallel to the ortho-diagonal and the clino-diagonal. H., ranging from 4 (generally 5) to 6; G., 2·5 to 4; but mostly the higher. Pellucid in all degrees; lustre vitreous, but sometimes pearly or silky. Occasionally colourless or white, but usually some shade of grey, yellow, green, brown, or black. B.B. fuses, generally intumescing to a grey, green, or black glass. Those varieties containing most Iron are the most fusible, and these are also partially soluble in h. acid which scarcely affects the others.

In part, a normal metasilicate of Calcium and Magnesium, usually with Iron, and also with some Manganese, and Lime.

Average Composition :—with $4SiO_2$, + 2MgO, + 1CaO + 1FeO = 53·6 Silica, 17·8 Magnesia, 12·5 Lime, 16·1 Iron Protoxide.

Analyses—1-7, and 9-18, Heddle, *Trans. Roy. Soc. Edin.*, xxviii. pp. 502-524 (1878) ; 7*a* Haughton, Dublin *Q.J.Sc.*, v. 93.

	S.G.	SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	K_2O	Na_2O	Fl	H_2O	Total.
Amianthus—													
1. Balta,	2·95	56·15	1·54	·39	3·11	·77	11·72	22·46	·19	·69	..	2·50	99·52
Asbestus—													
2. Shiness,	..	56·86	·23	·48	2·12	·23	12·54	23·92	·44	·53	tr.	2·52	99·87
3. Portsoy,	2·99	56·31	·77	·53	2·32	·15	12·58	23·31	·44	·63	tr.	2·94	99·98
Nephrite—													
4. Balta,	2·96	55·74	·05	..	5·2	·01	13·24	22·7	·14	1·12	..	2·44	100·62
5. Leegarth, Fetlar,	2·95	56·92	·22	..	4·65	·08	12·32	22·08	tr.	tr.	..	3·4	99·67
Tremolite—													
6. Shiness,	2·96	56·15	·86	1·62	·72	·07	13·31	24·14	·44	·21	tr.	2·5	100·01
7. Glen Urquhart,	..	57·31	6·68	1·08	3·23	·31	12·36	16·61	..	.	tr.	2·5	100·08
7*a*. Iona,	..	59·00	·64	..	..	..	12·44	27·01	..	..	..	..	99·09
Actinolite—													
8. Hillswick,	2·99	55	1·51	·99	3·46	·31	10·38	23·31	1·12	1·1	..	2·9	100·08
Edenite—													
9. Urquhart, green,	..	50·31	8·54	·12	2·76	·08	11·63	20·77	·5	1·16	none	4·13	99·99
10. ,, black,	..	51·31	2·21	·16	7·66	·49	11·17	20·87	2·2	·46	..	2·12	99·65
Byssolite—													
11. Erins,	..	52·69	2·56	4·09	9·77	·23	11·42	15·77	·57	·69	..	2·13	99·92
Hornblende—													
12. Balta,	3·11	45·87	8·78	..	14·15	·13	9·82	14·40	·82	1·43	..	2·30	97·7
13. Fetlar,	3·09	41·63	11·63	1·85	8·95	·31	9·25	18·51	·63	1·22	..	5·40	99·38
14. Portsoy,	3·25	52·07	2·57	..	9·72	tr.	19·05	14·41	·75	·57	..	·85	99·99
15. Glenbucket,	3·22	45·00	9·41	1·55	16·76	·33	11·24	11·19	1·36	1·66	..	1·35	99·85
16. Durness,	..	51·46	2·97	2·45	9·66	1·08	20·07	10·46	·68	1·31	..	·68	100·82
17. Elie,	3·37	40·38	19·01	2·12	7·28	·46	11·54	17·50	..	..	..	1·17	99·46

Non-Aluminous Subdivision.

1. Tremolite, $CaMg_3(SiO_3)_4$. Magnesia-Lime Amphibole.

White, grey, or greenish-grey. Usually in long prismatic crystals, which are often striated longitudinally. Lustre pearly or silky ; semi-transparent or translucent. B.B. fuses readily to a white, or to a nearly colourless, glass. H., 5 to 6·5 ; G., 2·9 to 3·1.

Shetland. Unst, Norwick Bay, in quartz veins, near the junction of Serpentine with Schist (Traill). Fetlar. Leegarth, matted, white, pearly lustre—Anal. 13.

Stellate Groups of Actinolite Crystals,
Ord Ban, Loch an Eilean (M'Tier).

[*To face* p. 35.

Sutherland. Shiness, in magnificent specimens, colourless, and silvery lustre, in limestone (Joass)—Anal. 6.

Perthshire. Dunkeld, in clay slate. In tufted aggregates in limestone, one mile west of west end of Lochan Fada (Macconochie). Glen Tilt, in the quarry at Marble Lodge, in fine specimens, plumose and radiating in perfect circles, also in single imbedded crystals (MacCulloch). Flat bladed, radiated, Carn Liath (MacCulloch).

Hebrides. Tiree, in large, independent, and reticulated, crystals in limestone (MacCulloch). Iona, in marble (Haughton) Anal. 7ª.

2. Magnesia-Iron-Lime Amphibole : *Actinolite.*

Colours, bright green, pale green, greyish-green. Crystals usually long-bladed to acicular. Frequently breaks across the prism, showing an acute lozenge-shaped section. The variety in long bright green crystals is called *glassy Actinolite.* G., 3 to 3·2. Seldom more than 6 per cent. of Iron Oxide.

Shetland. Unst, at Herma Ness (Thomas). Near Baliasta Bridge, Loch of Cliff, in granular, pale yellow Talc, in lanceolate crystals (D. and H.). Mainland. Fethaland, Cleber Geo, and passing into Picrolite at Pundy Geo (D. and H.). Colla Firth, south shore, splendent green, with Biotite and Albite (Copeland). Hillswick, at the Banks of Niddister, glassy Actinolite, crystallised, with Talc (Hibbert). Similarly at Baa Taing, at the edge of the cliff. Papa Stour (Hibbert) ; Foula (Jameson).

Sutherland. Ceannabeinne, and near Caligaig, in interlacing groups of bright green crystals, with Pyrites and Grastite (D. and H.). Similarly, but less fine, at Loch Meadaidh, Durness, leek-green (Peach). Ben Hope, at Leitir Mhuiseal, lanceolate, with Garnet, and white, granular Quartz, *m l* (Plate LX., fig. 1) (D. and H.). West side of summit of Creag na Fearna, 2 miles S. of Cape Wrath, with Epidosite.

Inverness-shire. Glen Urquhart, half a mile north west of Urquhart Hotel, with Albite, *m x l* (Plate LX., fig. 2). Millton, in the limestone quarries, in thick yellow crsytals, with Graphite, and Margarodite (Plate LX., fig. 4)—Anal. 7. Glenelg, south of Ellan Reoch : asbestiform, fibrous, either continuously straight, or undulated, also schistose, *m e l p* (Plate LX., fig. 3), *m e x l* (Plate XL., fig. 4) (MacCulloch). Strathspey, at Ordban, near Loch an Eilein, rarely, in magnificent clusters of stellate groups (M'Tier) and plumose groupings.

Hebrides. Scalpay, at Eilean Glas, with Magnetite. Islet south-east of Isle of Ornsay in Skye (MacCulloch). Ensay island, Sound of Harris, in concretions in Hornblende rock. These have a radiating crystalline

structure, with green and yellow colour disposed in concentric bands (Joass).

ABERDEENSHIRE. In Crathie, Glen Gairn, and Foresterhill quarries. In limestone at the balloch between Glen Bucket and Glen Nochty, with Pyrrhotite, Pyrites, and Margarodite.

KINCARDINESHIRE. At Eslie limestone quarry, fine crystals imbedded in Sahlite with Sphene, Pyrrhotite, and other limestone minerals.

PERTHSHIRE. Asbestiform. Glen Tilt, 50 yards below Gow's Bridge, with "greenstone porphyry" along with Chlorite, Talc, Hornblende, Steatite, and Serpentine (MacCulloch). At a small lake half-way between Kenmore and Loch Freuchie, light green. At the summit of Beinn Heasgarnich, in arrow-head combinations, with Margarodite; also reticulated, with Margarodite and Rutile, near Blairgowrie (Peyton).

ARGYLLSHIRE. Glencoe, near the junction of the Coe with * * in long radiating crystals with Andalusite. Knapdale, at the copper mine west of Erins, plicated, fibrous, and of a fine green.

KIRKCUDBRIGHTSHIRE. In acicular crystals in grey felspar-porphyry.

Non-aluminous varieties of Amphibole tend to pass into fibrous varieties. The fibres of Tremolite are sometimes very long, and so loosely attached as to be separable by the fingers. When such fibres are flexible they are termed *Amianthus*; when rigid, but tough, *Asbestus*; and when rigid, isolated, transparent, and brittle, *Byssolite*. When these fibres become matted and entangled they form a fissile or schistose stone of great toughness termed *Nephrite*, being one of the stones used for the manufacture of axe-heads. Similar arrangements of crystals of Actinolite form *actinolite schist*, which sometimes occurs in quantity entitling it to be regarded as a rock-mass.

[Most of the Scottish Actinolite is associated with rocks that have been deformed by earth-movements.]

3. AMIANTHUS. Flexible Asbestus.

SHETLAND. Balta, Doo's Geo, with Nephrite; silky, flexible—Anal. 1. In a vein on the west side, opposite Balta Sound. Unst, Swinna Ness, grey, rare. Mainland, Fethaland, at Cleber Geo (Hibbert).

ABERDEENSHIRE. Tombreck (pronounced Towanrieff), near Rhynie; at Peddie's Hill, the western summit, with Mountain Wood. Deeside, Coyle Hills, in a vein in Serpentine, in a cliff facing south, near the summit. Parish of Kennethmont, at Leith Hall, formerly, greenish, with grey blotches, with Serpentine. Made into snuff-boxes, etc.

INVERNESS-SHIRE. At † Benmore, white. Glenelg, south of Ellan Reoch (MacCulloch).

Fife. Inchcolm, at south end, in "greenstone," with Steatite. [Chrysotile.]

Lothian. North Berwick, with veins of Calcite, imbedded in amygdaloidal "greenstone." One mile south of Dunbar. (The last three are probably Pilolite.)

4. Asbestus. Rigid Asbestus.

Shetland. Unst, at Swinna Ness, dark green; Fetlar, matted.

Sutherland. At Shiness, in limestone, rare (Joass)—Anal. 2.

Hebrides. Scalpa. Eilean Glas, in the Dolomite vein. Harris, in the Serpentine, which lies between the granite and the gneiss, and stretches from Scara Ruadh upon the south-east end of Loch Langavat, to the Dùn of Borve upon the west. Rigid and flexible, with asbestiform and ordinary Actinolite; with Hornblende, dark green mica, green Steatite, and Potstone (Jameson). In Berneray (Walker).

Banffshire. In a quarry west of Portsoy. In the augitic serpentine vein, near the sea, grey—Anal. 3. In a quarry of Nephrite north of the Bin of Huntly, passing into Picrolite.

Aberdeenshire. Deeside, in the bed of the River Muick, at the base of the Coyle Hills. In the parishes of Leslie and Towie, and at Tirebagger in Dolomite (Greg).

Forfarshire. At Balloch Carity, with Magnetite.

Perthshire. Aberfeldy, in a quarry above Bolfracks, in chlorite schist.

In *Mountain Wood* Asbestus fibres are imitative of decayed wood. It occurs at Peddie's Hill, Tombreck, and in the quarry north of the Bin of Huntly. Also at Swinna Ness, Unst, Shetland.

5. Byssolite. Bright green, ferruginous.

Inverness-shire. In Glencoe, 2 miles above Loch Triochatan, in a purple porphyry, in cavities, with Epidote and Chlorite, rare.

Argyllshire. Knapdale, 3 miles west of Erins, near Tarbert, with Chalcopyrite and Grastite—Anal. 12.

6. Nephrite.

Shetland—Unst. Balta, at Doo's Geo, with Amianthus, fissile and antigoritic, cross fracturing at angles about 122°, pale green—Anal. 4. At Leegarth, Fetlar, a similar mineral, but schistose—Anal. 5.

Hebrides. Iona, near Port na Curaich, forming a thin, antigoritic vein, adherent to white marble (Somerville). Berneray, forming a light green, soft rock. S.G., 2·984 (Thomson).

Aberdeenshire. In a road-metal quarry, north of the Bin of Huntly.

Banffshire. East of Boyne Castle, a matted, fibrous Actinolite.

Argyllshire. North-east of Melford, at * * waterfall, a similar rock.

7. Actinolite and Actinolite Schist.

Shetland. With quartz veins at junction of Serpentine with schist Nor. Wick, Unst (Traill). Mainland, Fethaland, at Cleber Geo (D. and H.). Hillswick, " banks " of the Niddister, Actinolite slate.

In a skerry north of Bailencille House, and, radiated, one and a half miles south of Loch Meadaidh, Sutherland.

Aberdeen. Plicated, at the hill of Milleath, west of Huntly.

Sutherland. At Leitir Muiseal, Ben Hope (D. and H.). South bank of River Inver, a mile from its mouth.

Argyllshire. South slopes of Meall Garbh, Loch Tulla. Near Melford, matted, crystalline, passing into Nephrite. North Uist, in a skerry off the north-west shore. Plicated, at Erins, Knapdale.

Banffshire. Portsoy, west of the great bed of Serpentine, inclosing Actinolite rock, in angular masses.

2. *Aluminous.*

8. Actinolitic Hornblende.

Sutherland. Tongue, in a quarry north-west of Ribigill, with Sphene, Albite, &c., *m e b r.* Ben hope, among the fallen masses at Carn a Mhadaidh, and at Meallan Liath. Assynt, at Stronechrubie, in porphyry, in [the Durness] Limestone, at Cnoc an Droighinn, in prophyry. Breabag and elsewhere. On Foinne Bheinn, and near Loch Inver.

Inverness-shire. Glen Shiel, near Clunie Bridge Inn, in red porphyry, in the col between Garbh-leac and Sgùrr nan Ceathramhan, with Epidote.

9. Edenite. Aluminous Magnesia-Lime Amphibole.

Inverness-shire. Glen Urquhart, at the Free Church, Millton, in large, lustrous, leek-green crystals, with Xantholite, Garnet, and Biotite, white and brown.

Fasciculitic, in sheaf-like groupings, or plumose tufts. In the limestone quarries one mile north of Millton, with Pyrrhotite, Calcite, and Sphene, pale olive-green, fibres curved (Anal. 9); also blue-black—Anal. 10.

Perthshire. At the summit of Beinn Heasgarnich, Glen Lochay, brown, straight, fibrous, in brushes of clustered crystals.

There is a singular variety of tufted Actinolitic Hornblende, in which the crystals are of recognisable size. They have a black or slate-grey colour, with an internal structure somewhat like Chiastolite. This occurs

in " talcose clay slate " at the upper fork of the burn of Boharm, in Banffshire (Sowerby and MacCulloch). Similarly, in the Burn of Aldernie, At Soundmoor, north of Boharm (Grant Wilson). In the banks of the stream which joins the Avon opposite Gaulrig, with masses of Epidote (Cunningham). An Actinolitic Hornblende of grass-green colour, with a central lozenge-shaped core of white Albite (?), occurs in Diorite, in Glen Creran, Argyllshire, in † Corry na Peigh, of Fraochaidh; Actinolitic Hornblende also occurs in the banks of Niddister, and at Glen Nevis.

10. Hornblende Proper. Aluminous Magnesia-Lime-Iron Amphibole.

Shetland. Balta, at Brough Geo, in a vein in diallagic rock—Anal. 12. Fetlar, east of the Wick of Tresta, in large, black, lustrous crystals, in massive Anorthite—Anal. 13. In Diorite, between Uriesetter and Crossbister. Mainland, Colla Firth, south shore, actinolitic, in large plumose masses (Hibbert). Hillswick, banks of Niddister, in foliated crystals, and glossy, jet-black, fibrous arrangements.

Aberdeenshire. Glen Bucket, on the flanks of Craig an Innean, in black crystals, some as much as 21½ inches in length by 2 inches in width, [in Hornblende pegmatite], with Labradorite, Sphene, Biotite, and Iserine—Anal. 15. In a diorite vein south of Colquhony, at the Bridge of Strathdon. At Shenwell, on the Upper Black Water, in a diorite vein, near Serpentine. On the Tillypronie road, east of Craig Glas, with Labradorite, Sphene, Biotite, Allanite, and Iserine. In Boultshoch quarry. At Forester Hill, in Microcline.

Hebrides. In Coll, crystallised (MacCulloch).

Fifeshire. At Elieness [and the volcanic necks between there and St. Monans, as ejected crystals, rounded by attrition. They are dark green or black in colour, and exhibit very perfect and lustrous cleavage planes]—Anal. 17.

Perthshire. Head of Glen Lochay, between Creag Mhòr and Stob nan Clach, at the south end of the summit of the ridge, in lanceolate dark green crystals, in clay slate [phyllite], with Andalusite. Cam Chreag.

Berwickshire. Hill of Pogbie, near Fala, in a ravine. In acicular crystals of a light green colour, in veins of yellowish-red compact felspar.

Roxburgh. [?] Stichill, near Kelso, in glossy black crystals in basalt [with Olivine], and with Bitumen, Opal [and Agate].

Selkirkshire. On Thirlstone Hill, in Ettrick, crystallised, in trap (Nicol).

Kirkcudbright. West side of the Bay of Kirkcudbright, on the shore near Burnfoot, green, in " claystone," at the base of a conglomerate which touches " greenstone." [In all the Galloway Granites, associated with Oligoclase, Sphene, Allanite, &c.]

11. Hornblende Slate [Schist].

Shetland. Fissile arrangements of interlacing Hornblende crystals forming sometimes independent rock strata, and found at Colla Firth and Niddister, Hillswick, jet black, minute, scaly, and dark green, foliated or fibrous. Stellated, entangled, at Fethaland (D. and H.).

Sutherland, on the west side of Durness Bay (Murchison).

Ross-shire, forming great part of Beinn Airidh a' Char.

Inverness-shire, "highly schistose, fibrous, and laminar," at Ellan Reoch, Glenelg (MacCulloch).

Hebrides, south end of Taransay.

Large, flat, foliated, interlacing, or interpenetrating, rock-forming Hornblende, constituting bands, or granular, nodular, concretions, in gneissic, and, more rarely, in granitic rocks, are found commonly throughout the gneisses of the north and west of Scotland, as in Shetland, at Hillswick; Sutherland, at Loch Inver, Creag a' Mhail, near Scourie (D. and H.), dark green, with Ripidolite, 2 miles south of Cape Wrath (Geikie and H.). One and a half miles south of that spot, light green, with Ripidolite, and Steatite. Hebrides, North Rono, nodular, rarely, with intermingled Sahlite, west of the Tunnel Cave, on the north-west side, also at the north extremity, in schistose gneiss. Lewis, at Loch Thamanabhaidh. Harris, north-west of Loch Langavat (D. and H.). Coll, at Ben Foill (MacCulloch). With Epidosite, at Tiree. Iona, at the south end, and in Dun I. Also in Colonsay.

Alteration Products.

Hydrous-Anthophyllite. Parallel, or divergent, fibrous, sphæroradiating, interlacing, or matted. Lustre, greasy to somewhat pearly.

Sutherland. One and a half miles south of Cape Wrath, in greenish-brown tufts, with Steatite, Ripidolite, and Moss Jasp-Agate (Geikie and H.). Creag a' Mhail, near Scourie, pea-green, matted fibres, with Talc and Actinolite; in folds of the Hebridean Gneiss. Soft as cream when first quarried (Dudgeon and H.).—Anal. 2.

Inverness-shire. Glen Urquhart, near the Free Church of Milton, brown, glimmering, parallel fibres (Jameson)—Anal. 9.

Hebrides. Harris, at Scarp (Thomas).

Perthshire. South of Loch Tay, near a small loch at the summit of the col above * *, in talc schist.

Ayrshire. Between Girvan and Pinbain. Fibro-columnar and radiating masses of grey-brown colour (Doran)—Anal. 12.

Analyses :—1 to 14 inclusive, Heddle, *Trans. Roy. Soc. Edin.*, xxviii. pp. 524-536 (1878).

Localities.	S.G.	SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	K_2O	Na_2O	H_2O	Total.
Hydration—Loss of Ca—Peroxidation—												
1. Hydrated Hornblende, Green Hill, Strathdon .	3·01	50·92	1·89	9·43	2·09	·31	8·64	21·58	·34	·43	4·54	100·17
2. Hydrous Anthophyllite Scourie . . .	2·92	45·51	6·39	..	14·29	..	4·44	22·14	tr.	tr.	6·72	99·49
3. Mountain Cork, Portsoy	..	51·43	7·52	2·06	2·49	1·3	·58	9·35	..	..	25·04	99·76
4. ,, Leadhills,	..	51·45	7·98	·97	3·29	1·49	1·97	10·15	..	..	21·70	99·00
5. Mountain Leather, Tod Head, . . .	..	52·48	6.33	·6	2·11	2·88	1·34	11·95	..	..	21·70	99·39
5a. ,, Strontian,	..	51·65	9·51	..	5·80	tr.	10·01	2·06	..	..	21·70	100·73
6. Mountain Silk, Tayport,	2·11	54·37	11·27	·21	1·09	·33	·98	9·49	..	..	22·41	100·15
Hydration—Loss of Ca and Bases—Passage into Serpentine—												
7. Picrolite, Balta, . .	2·69	50·19	2·1	..	4·39	·01	5·07	29·23	..	·74	8·5	100·23
8. ,, serpentinous, Balta, . . .	2·63	50·08	1·88	..	6·09	·23	·86	31·57	..	·34	9·3	100·34
Hydration with Removal of, Silica—												
9. Hydrous Anthophyllite, Urquhart, . . .	2·81	47·72	3·84	·18	5·74	·16	5·64	28·75	·19	·26	7·65	100·13
10. Hydrous Asbestos, Portsoy, ...	2·39	46·92	·63	·01	1·67	·77	9·91	25·85	·57	·58	12·84	99·75
11. Picrolite, Fethaland, ..	2·65	42·93	1·85	5·10	..	·42	·80	36·19	·81	·37	11·50	99·97
12. Hydrous Anthophyllite, Ayrshire, . . .	2·81	39·75	·49	5·30	4·11	·23	6·27	26·25	·76	·11	16·83	100·10
13. Baltimorite, Killin, .	2·63	41·47	..	4·01	4·83	·26	..	37·13	..	..	12·50	100·20
14. Chrysotile, Fetlar, .	..	39·73	·10	..	2·92	..	..	41·61	..	..	15·66	100·02

95. **Riebeckite (340).** $2NaFe(SiO_3)_2.FeSiO_3$.

A. Sauer, *Zs. g. Ges.* (1888), 40, 138, fr. Socotra ; (Ailsite), J. Blackwood, private communication ; (Chloritoid) J. W. Judd, *Q.J.G.S.* (1886), xlii. 428, &c. ; J. J. H. Teall, *Min. Mag.* (1892), ix. 219 ; J. W. Sollas, *Proc. Roy. I.A.* (1895), 3rd ser., iii. 516 ; J. J. H. Teall, *Q.J.G.S.* (1894), 50, 219 ; Heddle, *Trans. Edin. Geol. Soc.* (1897), vii. 265 (Map by Currie).

Monoclinic. Axes : $a : b : c = 0{\cdot}54748 : 1 : 0{\cdot}29246$; $\beta = 76° 10'$, Sollas.

Observed forms : *a*, 100 ; *b*, 010 ; *c*, 001 ; *m*, 110 ; *e*, 130 ; *x*, 150 ; *r*, 011 ; *i*, 031 ; *p*, 101 ; *t*, 101 ; *z*, 121 ; *o*, 121. *b*,*m*,*r*,*p*,*t*,*z* were observed by both Sollas and Heddle ; *x* by Sollas alone ; and *a*,*c*,*e*,*i*,*o* by Heddle alone.

Crystals prismatic, terminated by the clinodome *r*, which is frequently pitted.

Cleavage, *m* highly perfect, brilliant. Fracture uneven, with brilliant lustre. Brittle. Lustre, vitreous to splendent. Colour, dark green, approaching black.

Pleochroism intense ; *a* and *b* deep blue ; *c* greenish-brown, for the Ailsa Craig and Meall Dearg mineral (Teall).

The composition of the Socotra mineral shows that Riebeckite is the equivalent in the Amphibole Group to Ægirine among the Pyroxenes.

Analyses—1, Sauer ; 2. Sollas :—

Locality.	SiO_2	Fe_2O_3	FeO	Al_2O_3	Na_2O	K_2O	MnO	CaO	MgO	Total.
1. Socotra, . .	50·01	28·30	9·87	..	8·79	·72	·63	1·32	·34	99·9
2. Portrane, . .	42·69	(	41·71	)	10·00	·86	..	..	..	..

Anal. 2 is an incomplete analysis of specimens from the Drift of the North of Ireland, in all probability ice-carried from Ailsa Craig.

Originally observed by Professor Bonney in the granite of Socotra, but first described as a new species by Sauer. Occurs in granite [and rocks allied thereto].

Ayrshire. Ailsa Craig, in the grey ailsite or Ailsa hone, in minute ophitic patches, dark green, almost black, or of a rich brown. Also, very rarely, on the south-east side in crystals $\frac{1}{16}$th to $\frac{1}{8}$th of an inch. Combinations : *m b r t p z* (Sollas) ; *m b r t p a* (Plate LX., fig. 1) ; *m b r t p a i* (Plate LX., fig. 2) ; *m b a i c* (Plate LXI., fig., 3) ; *m b r t p i* (Plate LXI., fig., 4) ; *m b r t* (Plate LXI., fig. 5) ; *m b r t z e* (Plate LXI., fig. 6) ; *m b r t z e o* (Currie and H.).

In the granophyric rock of Meall Dearg, in Skye, in an ophitic form (Teall).

It has also been stated by Barron to occur in the trachytic rock of the Eildon Hills ; these latter occurrences, however, are only microscopic in the dimensions of the crystals.

[96. **Crocidolite (341)**. $NaFe(SiO_3)_2.FeSiO_3$.

Usually occurs in a fibrous and asbestus-like form, in which the fibres are delicate, easily separable, but tough. Translucent ; lustre silky. Colour, indigo-blue ; streak, lavender. B.B. fuses easily to a black, magnetic glass. Comp., Silica, 50·3 ; Iron Protoxide, 35 ; Magnesia, 2·2 ; Soda, 6·7 ; Water, 5·8. Regarded by some as a variety of Riebeckite.

The Scottish form is earthy and amorphous, and occurs coating the joint faces and other divisional planes of metamorphic and other rocks,

chiefly in the Abriachan district in Inverness-shire, whence the name *Abriachanite* for this variety.]

Analyses—1, 2, Heddle, *Min. Mag.*, iii. 61 ; 3, Jolly and Cameron, *Q.J.G.S.*, xxxvi. 109.

	SiO_2	Fe_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	H_2O	Total.
1.	51·15	14·92	9·80	0·30	10·80	1·12	6·52	0·63	4·77	100·01
2.	52·40	9·34	15·17	0·40	10·50	1·17	7·11	0·61	2·97	100·68
3.	55·02	19·03	3·83	..	12·95	2·53	1·74	..	1·45	100·25

Inverness-shire. In the district which lies between Loch Ness and the Beauly Firth, as far westward as a line drawn from Abriachan to Kirkhill (Aitken).

In "Syenitic" granite at Abriachan, rarely, with Fluor and Epidote In granitic veins, which cut gneiss, at Dochfour Burn, with Pyrites. In gneiss at the Reelick Burn, immediately below the mansion-house of Reelick. At the Allt Cuaig, a little west of Lochend inn.

In a breccia of the Old Red Sandstone, in the approach to Dochfour House, chiefly in clay-like masses, but also in veins, with a fibrous structure, Sp. Gr., 2·33—Anal. 1, 2 ; South Clunes Farm (Jolly)—Anal. 3.

In limestone, near Reelick, with reddle.

On the south shore of Loch Ness in a pink graphic granite vein which cuts limestone in a quarry midway between Inverfarigaig and Foyers ; disposed only upon the letterings of quartz (Aitken and H.).

[*γ. Triclinic Section*].

97. **Ænigmatite (343)**. $Na_4Fe_6(AlFe)_2(SiTi)_{12}O_{38}$.

A titano-silicate of ferrous iron and sodium. Dr. Heddle regarded some minute crystals, of a dark colour, and prismatic habit, which occur imbedded in the outer part of the Pectolite aggregations from Ratho, as Ænigmatite ; but he does not appear to have left any notes regarding the mineral in question. Several specimens of the supposed Ænigmatite are exhibited in the Scottish Mineral Collection.]

Beryl Group.—Hexagonal.

98. **Beryl (344)**. $Be_3Al_2(SiO_3)_6$.

[Hexagonal. (Forms chiefly from Schrauf, Kokscharow, and Dana.) *a*, *M*, (*m*), $2\bar{1}\bar{1}$, $10\bar{1}1$; *b* and *n* (*a*), 011, $11\bar{2}0$; *c*, 111, 0001 ; *p*, 100, $10\bar{1}1$; *r*, 251, $30\bar{3}2$; *u*, $13\bar{1}$, $20\bar{2}1$; *x*, 2.7.13, 15.0.$1\bar{5}$.2 ; *u*, *s*, 100, 131, $11\bar{2}1$; *o*,

$52\bar{1}$, $11\bar{2}2$; *i*, $31\bar{2}$, $21\bar{3}0$; *v*, 041, $21\bar{3}1$; *k*, $42\bar{6}1 = 6P\frac{3}{2}$; *w*, 032, $71\bar{8}1$; Σ, $13.3.\bar{1}1$, $16.8.\bar{2}4.1 = 24\ P\frac{3}{2}$; - = a face in the zone *i k c*, but still lower ; *A*, in Plate LXI., fig. 3 (which resembles the form given by Kokscharow, *Min. Russlands*. Beryll. Tav. xvi. fig. 38, and by Schrauf, *Crystall-formen des Mineralreiches*, Beryll, Taf. 33, fig. 14), is given by Schrauf, *op. cit.*, as Miller's {2.3 m+2.2–3 m}.

Crystals generally prismatic in habit, and striated vertically. Clv., basal (*c*), rather perfect ; *a*, imperfect. H., 7·5 to 8 ; G., 2·6 to 2·8. Transparent or translucent ; lustre vitreous. Sometimes colourless, but usually green ; sometimes very brilliant ; occasionally yellowish, or even smalt-blue. B.B. melts with difficulty in the edges of an obscure vesicular glass. Not affected by acids. Comp., 67·5 Silica, 18·7 Alumina, and 13·8 Glucina, with 0·3 to 3 Iron Peroxide, and 0·3 to ·5 Chrome Oxide in the rich green Emerald.

Analyses—1, Heddle, *Phil. Mag.*, xii. 386 (1856) ; 2, Plattner, Breithaupt, *Min.*, 691 (1847).

SiO_2	Al_2O_3v	Fe_2O_3	BeO	H_2O	Total.
67·70	15·64	0·25	12·52	0·16	99·37
66·10	14·58	0·52	13·02	0·80	96·18

Inverness-shire.—At Struy Bridge quarry, in pale yellow-green crystals, sometimes nearly three inches in thickness. The crystals are sometimes transversely barred with layers of Quartz (Plate LXI., fig. 1), sometimes have hexagonal sheathings of Quartz alternating with Beryl (Plate LXI., fig. 2). The matrix is a granite vein in gneiss, and the associated minerals are—Garnet, Tourmaline, yellow Muscovite, and granular, pink, and cleavable, blue Orthoclase.

Hebrides. Harris, in the great vein of Chaipaval, white, and opaque ; with green Muscovite, blue Orthoclase, rose Quartz, and graphic granite.

Banffshire. Cairngorm, on the east slopes. Formerly found in corrugated crystals, and in masses of a blue-green colour. Also apple-green and transparent. Rarely, peridote-green, with imbedded Rutile. Loch Avon, rarely, imbedded in crystals of Cairngorm, in minute crystals, *a k p A* (Plate LXI., fig. 3) ; *a i k v u o* (Plate LXI., fig. 4) ; *a* - Σ *s c* (Plate LXII., fig. 5) ; *a b c s v u x* (Plate LXII., fig. 6) ; *a* - Σ *k s c p r u x* (Plate LXII., fig. 7) [8 and 9 ?]. The Cairngorm Beryl is sometimes colourless or banded transversley in the following arrangement—pink, white, pale green, colourless.

Aberdeenshire. In Rubislaw quarry, in course, yellow, opaque crystals (" Davidsonite " of Thomson), sometimes over a foot in length (Longman) (Anal. 1 and 2), with Apatite, Tourmaline, Garnet, Oligo-

clase, Microcline, and Muscovite. Pitfoddels quarry, pale emerald-green, transparent, *M n m* (Mitchell). Pass of Ballater, in small, yellow crystals, with Muscovite, Zinnwaldite and Microcline (Thoms).

In a rock near the Black Dog Rock, near Belhelvie, with white Biotite, nearly colourless (Bonney). In a similar, if not identical, rock near Keig Bridge. In gneiss, in the railway cutting between Ellon and Old Deer (Teall).

Kincardineshire. Torry, opposite Aberdeen, on the shore, in rough yellow crystals, with Tourmaline, Pinite, and Margarodite (Fleming). Mount Battock, diverging crystals, in granite (Imrie). Near the burn, at the † Green Burn, near the North Esk, hexagonal.

Perthshire. At Kinloch Rannoch (Greig).

Arran. Near Brodick, of a blue colour, in crystals up to one inch in length, in fine-grained granite (Jameson). In Glen Shant, in crystalline granite, with Topaz, *a o* (Necker).

Intermediate Silicates.

Iolite Group.

99. **Iolite** or **Cordierite (353)**. $H_2(MgFe)_4Al_8Si_{10}O_{37}$.

Orthorhombic. Habit, short-prismatic. Clv., *b* (010) distinct, *a* (100) and *c* (001) less so. Fracture conchoidal or uneven. H., 7 to 7·5; G., 2·5 to 2·7. Transparent or translucent; lustre vitreous, inclining to resinous. Colourless, but usually dark blue or violet; sometimes violet, green, brown, yellow, or grey. Often with a distinct trichroism, on *m* (110) blue, on *a* grey, and on *b* yellowish. B.B. fuses with difficulty to a clear glass. Only slightly affected by acids. Comp., 48 to 51 Silica, 29 to 33 Alumina, 8 to 13 Magnesia, 1 to 12 Iron Protoxide.

Shetland. Ness of Hillswick, at Vannlip, rarely, in blue specks, imbedded in Kyanite.

[Cordierite has been detected by the officers of the Geological Survey in various highly-metamorphosed rocks in the Central and Southern Highlands of Scotland, and especially in those of Perthshire and Forfarshire. See also Chlorophyllite, *infra.*]

Orthosilicates. R_2SiO_4.

Nephelite Group.

100. **Nepheline (357)**. $K_2Na_6Al_8Si_9O_{24}$.

Rhombohedral. Crystals usually imbedded. Fracture conchoidal or uneven. H., 5·5 to 6; G., 2·58 to 2·64. Transparent, or translucent; lustre vitreous and resinous. Colourless or white, but occasionally green,

red, or brown. B.B. melts with difficulty in the case of normal Nepheline, but more easily, with effervescence, in the variety Elæolite, into a vesicular glass. Soluble in h. acid with gelatinisation. Comp., 41·2 Silica, 35·3 Alumina, 17 Soda, 6·5 Potash.

Hebrides. Shiant Isles, Eilean Mhuire, in a sea cavern above the neck at the east end of the island, in hexagonal crystals, associated with Labradorite and octahedral Magnetite [in a course dolerite of Tertiary Age. Nepheline has been recognised as a constituent of Scottish rocks also, by Hatch and others, in the Lower Carboniferous phonolites of Haddingtonshire, as at Traprain Law, etc. ; and by Barron in the Eildon Hills].

Garnet Group. $3RO.R_2O_3.3SiO_2$.

101. **Garnet (370).**

Cubic. [*a*, 100 ; *d*, 110 ; *o*, 111 ; *n*, 211 ; *s*, 321 ; *e*, 210 ; *k*, 052.]

Clv., *d* ; fracture conchoidal or splintery. H., 6·5 to 7·5 ; G., 3·5 to 4·3. Pellucid ; lustre vitreous to resinous. Colour generally red, brown, black, green, or yellow, rarely colourless. B.B. in general fuses to a glass which is black or grey in those containing much iron, green or brown otherwise, and is often magnetic. Imperfectly soluble in h. acid. Comp., variable, but generally forming two series, according as R_2O_3 is chiefly alumina or chiefly iron peroxide ; and these again are divided according as RO is more especially lime, iron protoxide, magnesia, or a similar base.

(1) *Lime-Alumina Garnet*, with 40 Silica, 23 Alumina, and 37 Lime.

To this subdivision belong :—

(*a*) *Water Garnet.*—Colourless to white. Creag Mhòr, Aberdeenshire.

(*b*) *Grossular.*—Olive to gooseberry-green. Creag Mhòr, Aberdeenshire [and the Burn of Boharm, Banffshire].

(*c*) *Cinnamonstone.*—Hyacinth-red to orange-yellow. Ord Ban, Achnagonalin, Inverness-shire, and Glen Gairn, Aberdeenshire.

(4) *Magnesia-Iron-Lime-Alumina Garnet, Pyrope.*—Colour, port wine to purplish-red. Elie, Fife.

(5) *Iron-Alumina Garnet, Almandine, Noble Garnet.*—Columbine-red inclining to violet, blood-red, and reddish-brown. Common in mica schist, gneiss, and granite. Shetland, Ross, Aberdeen.

Analyses :—Nos. 1 to 3 and 6 to 15 inclusive, Heddle, *Trans. Roy. Soc. Edin.*, xxviii. pp. 299-319 (1878) ; 4, Connell, *Jameson's Journal*, xxxix. (1845), p. 209 ; 5, Heddle, *Min. Mag.*, v. (1882), p. 71.

	S.G.	SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	H_2O	Total.
Grossular—										
1. Creag Mhòr, . .	3·545	39·83	9·74	15·07	·11	·35	33·57	1·01	·04	99·72
Cinnamonstone—										
2. Glen Gairn, . .	..	39·27	21·98	1·49	3·93	·33	31·88	·6	·18	99·66
Pyrope—										
3. Elie, . . .	4·124	40·92	22·45	5·16	8·11	·46	5·04	17·85	·10	100·39
4. ,, (Connell), .	..	41·80	28·65	..	8·85	·25	4·78	10·67	..	96·46
Common Garnet—										
5. Leitir Mhuiseal Ben Hope, . .	4·127	35	21·539	2·822	26·537	4·461	7·107	2·307	·143	99·916
6. Burra Voe, Yell, .	3·997	37·3	21·1	7·47	24·02	2·14	4·43	3·53	..	99·98
7. Killiecrankie, .	3·688	37·59	13·66	3·66	32·31	4·47	4·12	3·46	·32	99·59
8. Meall Luaidhe, .	..	37·66	14·80	4·56	32·97	2·37	5·89	1·81	..	100·06
9. Knock Hill, .	4·166	37·11	14·9	10·12	32·41	1·21	2·17	2·93	..	100·85
Almandite—										
10. Clach an Eòin, .	..	39·92	19·81	13·69	13·29	1	9·13	3·31	..	100·15
Precious Garnet—										
11. Glensgaich (red), .	4·125	35·99	16·22	8·64	23·27	15·24	·4	·47	·25	100·48
12. ,, (brown) .	..	36·08	18·96	7·03	21·56	13·62	1·77	·9	·33	100·29
13. Loch Garve, . .	4·122	36·15	21·94	15·15	15·09	7·85	2·07	1·62	·31	100·16
14. Struy Bridge, .	..	35·66	15·8	13·12	22·21	11·43	1·12	..	·06	99·39
15. Ben Resipol, .	..	36·85	21·24	7·38	18·38	14·46	·78	·85	..	99·92

The following varieties of Garnet occur in Scotland :—

1. Calcium-Aluminum Garnet. Water Garnet. Colourless Garnet.

Aberdeenshire. Creag Mhòr, opposite to Balmoral. Colourless, *d* (Plate LXII., fig. 1), with Idocrase, Grossular, and Epidote, in granular limestone. These contained no iron, either ferric or ferrous oxide.

Banffshire. The Burn of Boharm (J. S. G. Wilson).

2. Calcium-Aluminum-Iron Garnet. Grossular.

Aberdeenshire. Occured with the above in crusts of pale pea-green crystals of the form *d*. These crystals passed frequently into a massive granular variety. The crystals are of the size of peas—Anal. 1. Crathie, in the limestone quarry, very rarely.

3. Calcium-Iron-Aluminum Garnet Essonite. Cinnamonstone.

Ross-shire. Near Kincardine (Jameson).

Inverness-shire. At Achnagonalin limestone quarry, east of Grantown, *d*, associated with Zoisite, Pyrrhotite, and Sahlite. At Ord Bain, near Loch an Eilein, *d*; in crystals nearly two inches in diameter, associated with radiated Actinolite (M^{c}Tier).

Banffshire. At Portsoy, north-east of the Old Battery, it forms a vein and is associated with Sahlite and Scorza (Peyton).

Aberdeenshire. In Glengairn, at Dalnabo limestone quarry, *n* distorted *d n* (Plate LXII., fig. 2), twins of *d* (Plate LXIII., fig. 4), with Idocrase, Coccolite, Prehnite, Epidote, Sphene, and Wollastonite (Cunningham) Anal. 2. In the quarry upon the opposite side of the valley, with Sahlite. In Deeside, at Leac Ghorm, near Balmoral, in limestone, associated with Idocrase and Malacolite. At Crathie quarry, with Idocrase and Sphene. At Boultshoch, associated with Idocrase and Coccolite.

4. Calcium-Magnesia-Iron-Aluminum Garnet. Pyrope.

Fifeshire. Near Elie, at Elie Ness, in imbedded fragments in agglomerate, also in crystals *d* in a vein of greasy Quartz (Sowerby)—Anals. 3 (H.) and 4 (Connell). In two basaltic dykes which cut tuff, about a mile east of Elie Ness, associated with Iserine, Saponite, and Sanidine. At Ruddons Point, a mile west of the Kincraig, Elie, in columnar basalt, with large crystals of Olivine and also with Iserine.

5. Iron-Aluminum Garnet. Common Garnet.

Shetland. Unst, on the hill east of Woodwick, in gneiss, with Staurolite, Kyanite, and Muscovite (D. and H.). Valdafield, Herma Ness, in mica schist (Hibbert). Yell [Hamna Voe], 2 miles north-west of Burra Voe, *n* (Plate LXII., fig. 3), with Epidote, in gneiss, pinkish-red—Anal. 5, Near the Noups of Graveland, in large brown imbedded isolated crystals (Aitken). At Colvister, North Yell, sheathed in a zone of Quartz, in mica schist, *n*, *d n* (Plate LXIII., fig. 5) (John M. Aitken). Mainland, Hillswick, at Grevasand, of a brown colour, and often passing into Chlorite with Muscovite and Chloritoid, in mica schist. Foula, at Sheepie Geo, with green Actinolite, in hornblende schist.

Orkney. Near Stromness, in micaceous schist, *d s o* (Plate LXIII., fig. 5) (Jameson).

Sutherland. In the hills between Kirkiboll and the Bettyhill of Farr, in hornblende schist (D. and H.). Ben Hope, at Leitir Mhuiseal, with Actinolite, in mica slate, form *d*, zoned with quartz (Plate LXIII., figs. 6 and 7) (D. and H.) —Anal. 5. Beinn Laoghal, at Meallan Liath, to the north, in hornblende schist, and also in foliaceous Ripidolite. At Camas nam Bùth, north-west of Badcall Bay, there is a rock which is composed almost entirely of huge rough crystals of garnet, many of which

measure over a cubic foot. These garnets are probably of this variety (Macconnochie).

Ross-shire. Loch Mullardoch. Biddean an Eoin Deirg, red, above Loch Mhuilich, and also at the summit. Sgùrr Choinnich, at the summit. Soc Anach, between it and An Riabhachan. On the south-west slopes of Sail Riabhach of Bidean a' Choire Sheasgaich, and near the summit of that hill. Sceuir nan Ceathreamhnan, on the west summit. In the railway cutting at Gleann Sgaich, west of the Raven's Rock, Strathpeffer, the garnets contain layers of white Quartz, arranged in a concentric manner parallel to the sides of the leucitoidal crystals (Plate LXIII., fig. 8), and are associated with mica, Tourmaline, Zircon. Apatite, etc. Also, *d n s* (Plate LXIII., fig. 9).

Inverness-shire. Sgòr na Ciche, Loch Nevis, on the south side of the summit, with red Orthoclase and also with Lepidomelane. Glen Fintaig and Glen Roy, in mica schist.

Hebrides. North Rona, at the south-west end of the island, and also at the north side of the east horn, large granular Garnets, in Hornblende, in belts, sometimes with Actinolite, Hornblende, and Magnetite. Harris, in the great vein of Chaipaval, associated with rose Quartz, graphic granite, green Muscovite, etc. Glen of Rodil, Coire of Roneval, and Skarastavore, in crystals up to four inches (MacCulloch). Chaipaval, on the north side, associated with Kyanite (D. and H.). Hacklett, near Obe, nearly massive, with some Actinolite (Dudgeon).

Argyllshire. In Ardgour, in granite and gneiss (MacCulloch).

Banffshire. At east and north-east foot of Knock Hill, in diorite, in striated crystals, of a port-wine colour, *d k* (Plate LXIII., fig. 10)—Anal. 9. East of Logie Head, in plicated mica schist. Near Findlater Castle, both red and brown in colour and associated with Chlorite and Ilmenite. On the east foot of Sillyearn Hill near Anderson's Wards, pink. In the granite vein east of Portsoy, at one of the points of Cowhythe Head, on large crystals, *d*, with included graphic Quartz, forming a perfect Graphic Garnet, associated with Tourmaline (Plate LXIII., fig. 11).

Aberdeenshire. In Rubislaw quarry, in granite, brown, *n*; associated with Muscovite, Quartz, and Oligoclase. At Tirebagger, with Apatite. At Ardonald, between Keith and Huntly, in phyllite (Greg). In the Bin of Huntly, dark red and translucent, with a white falsitic sheath. At Gingomyres, north of the Hill of Milleath, 4 miles north-west of Huntly, *d*, *n*, *d n*, *n e*, *n s*, in mica schist. At Bogforth, to the south of the Hill of Milleath, in large crystals, *d*, imbedded in Chlorite (Horne and H.). At Glen Bucket, in mica schist (Greg). Cabrach, at the farm of the Buck, *n*.

At Gaugh Burn, Cabrach, in graphic granite, with included graphic Quartz. At the west end of Mar Forest, in a Quartz vein, near the Dee, compressed between layers of the stone, with pink Quartz (MacCulloch).

PERTHSHIRE. At †Garth, near Dunkeld, in mica schist. Ben Vrackie, on the south-west shoulder, associated with lanceolate Hornblende, in granular Quartz. Killiecrankie, in a paste of mica—Anal. 7. Meall Luaidhe, north-west of Ben Lawers—Anal. 8. At Logierait, in mica schist, with Apatite (Greg). Strath Ardle, about one mile above the entrance to Glen Derby, on the north side of the glen, *d*. Ben Vorlich, Loch Earn, on the north-west slopes, associated with Pyrites. Beinn nan Clach, Glen Dochart, Beinn Chaluim, in immense quantities on the south-east slopes, *d*. Glen Falloch, in the col between Beinn Chabhair and Beixn a' Chaistel. At Blair Athol; at Ballechin, in mica schist (Greg). In Gleann Fearnach, on the south-east of Braig Feith Chuibhsachain and the south slopes of Càrn nan Sionnach, in contorted black mica gneiss, dodecahedral, cinnamon-coloured, crystals with quartzose envelopes (Peyton).

KIRKCUDBRIGHTSHIRE. Near New Galloway.

6. IRON-ALUMINUM-IRON GARNET. Almandite.

SUTHERLAND. Clach an Eòin, Betty Hill of Farr, between the mouths of the Borgie and the Naver, associated with Haughtonite, Ilmenite, Chlorite, and Rutile (D. and H.)—Anal. 10.

INVERNESS-SHIRE. Glen Urquhart, near the Free Church of Milton, associated with Biotite, and inclosing Zircon.

HEBRIDES. Tiree, on the south shore of Gott Bay, in Lepidomelane gneiss, inclosing Zircon (Duke of Argyll).

7. IRON-MANGANESE-ALUMINIUM-IRON GARNET. Precious Garnet.

ROSS-SHIRE. Strathpeffer, from the railway cutting near to Glensgaich, in Quartz, and sometimes including Zircon, *n*, *d n*. *n d s* (Plate LXIII., fig. 12), associated with Muscovite, Tourmaline, Zircon, and Apatite. Colours, pink (Anal. 11) and brown (Anal. 12). One crystal of the brown colour measured nearly five inches. Loch Garve, from granite veins near the Black Water, on its south bank; brown, *d*; associated with green Muscovite—Anal. 13. On the north side of Loch Garve, of a brilliant red; *n*, with Agalmatolite, and Muscovite (Cadell). In a quarry half a mile north of Achnasheen, associated with Zircon (Glass). Of a pink colour in the following hills north of Clunie inn, in micaceous gneiss:—

Tigh Mòr, Sàil Chaoruinn, A' Chioch Sgùrr nan Ceathramhan, north-west slopes of Garbh-leac, south slopes of Ciste Dhubh, Sgùrr a' Bhac Caolas. To the south of Clunie inn, this Garnet occurs in the following hills of Maol Chean Dearg :- Sgùrr Beag, with Lepidomelane, Sgùrr an Doire Leathain, and Sgùrr Coire na Feinne, where it is pink and of the form *d*.

INVERNESS-SHIRE. Struy Bridge, from a granite belt in gneiss, red, form *n*, associated with Tourmaline, Beryl, green Muscovite, and pink Orthoclase—Anal. 14.

ARGYLLSHIRE. Near the summit of Ben Resipol, near Strontian, on the north-east side, associated with Orthoclase and Muscovite, *n*, transparent and of a lively red (Rose)—Anal. 15.

Chrysolite Group. R_2SiO_4.

[102. **Forsterite (375).** Mg_2SiO_4.

This mineral has lately been detected by the officers of the Geological Survey in some of the rocks of the Scottish Highlands. Oct. 1898.]

103. **Olivine** or **Chrysolite (376).** $(Mg,Fe)_2SiO_4$.

Orthorhombic. [*a* (*b*), 010 ; *b* (*a*), 100 ; *c*, 001 ; *d*, 101 ; *e*, 111 ; *n* (*s*), 120 ; *u* (*m*), 110.] Clv., brachydiagonal, perfect ; fracture conchoidal. H., 6·5 to 7 ; G., 3·3 to 3·5. Transparent, lustre vitreous. Colour olive-green, yellowish-green, occasionally brown, or even colourless. B.B. infusible. Soluble, with gelatinisation, in acids. Comp., 47 magnesia, 12 protoxide of iron, 40 silica.

Analyses, by Dr. Heddle :—

	SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	K_2O	Na_2O	H_2O
1. Kincraig, Elie, .	42·615	3·154	2·965	6·261	·23	4·436	36·692	1·07	1·483	1·164
2. Allival, . .	38·0	·286	2·933	18·703	·1	·36	38·0	..	..	1·587
3. Lairg (Pseudo-Olivine), .	44·3	·585	7·165	..	·7	1·4	45·91	..	..	·131

HEBRIDES—SKYE. Loch Bracadale, at Rudha nan Clach, in fine large crystals, one to two inches in length, imbedded in basalt ; brownish-yellow in colour ; and associated with zeolites and Calcite. When the crystals are small they have a hyalosiderite tarnish. Talisker, on the north side of the bay, imbedded, *a d b c* (Plate LXIV., fig. 1). Occasionally in rough, granular, or fissured crystals, several inches in size (Peyton and H.). At An Leth Allt, Loch Brittle, in green crystals in wackenitic trap. [In most of the basic eruptive rocks.]

Canna. Near the cave on the south-west side, in basalt, associated with Labradorite, Chlorophæite, and Fuller's Earth. In the Inner Oighsgeir, associated with Chalcedony, in pitchstone.

Rum. On the north-west slopes of Allival, and also on the north-east and the west crags of Askival, in lustrous, dark green, rough crystals, imbedded in gabbro, and associated with Labradorite, Enstatite, Augite, and chromiferous Magnetite, and also, rarely, with Pectolite. These crystals have rents which inclose skeleton pseud-endomorphs (Jameson and H.). Also at both of the above localities, and in Barkeval, in orange-coloured granules, resembling Chondrodite Anal. 2.

Mull. At Aoineadh Mòr (Sowerby). At the Carsaig Arches, rarely, in large isolated crystals imbedded in wackenitic tuff.

Stirlingshire. From Mugdock Tunnel.

Renfrewshire. Barrhead, at Boyleston quarry, associated with Native Copper, in the rock, which carries the zeolites, dark green in colour and glassy, but, rarely, crystallised, *a n b e* (Plate LXIV., fig. 2); *a b u n e* (Plate LXIV., fig. 3) (Young). In the Fereneze Hills, Barrhead, passing into Ferrite, *a b c d e* (Plate LXIV., fig. 4).

Fifeshire. In the agglomerates of Kincraig and Elie Ness. In the basalt which faces Ruddons Point, near Kincraig, and also in the basalt of that place itself, in large crystals, *e* (Plate LXIV., fig. 5), of a Peridote-green colour, associated with Pyrope and Iserine—Anal. 1. In the porphyritic basalt of Newburgh.

Haddingtonshire. Dunbar, in basalt, of a red colour, from decomposition, and associated with red Diallage. [In dykes and other intrusive masses on the shore east of North Berwick.]

Edinburghshire. In all the basalt lavas of Arthur's Seat, and especially in the basalt on the south east shoulder of the hill [the Lion's Haunch]. Also in the basalt lavas of Craiglockhart Hill.

Roxburghshire. Bonchester Hill, in trap, associated with Labradorite (Nicol). Near Stichill, crystallised, and associated with Labradorite, in basalt (Nicol).

Bute. Great Cumbray, south-west of Millport, at the point opposite to the Lesser Cumbray, in basalt, in masses several inches in dimensions, lustrous, and of a lime-yellow colour.

Scapolite Group.

104. **Scapolite** or **Wernerite** (387).

Tetragonal. Clv., *a* (100) and *m* (110) rather distinct, but interrupted. H., 5 to 5·5; G., 2·6 to 2·8. Transparent or translucent. Lustre

vitreous to pearly or resinous. B.B. melts with effervescence to a vesicular glass; in the closed tube may show traces of fluorine; with solution of cobalt becomes blue. Soluble in h. acid. Comp., 49 Silica, 28 Alumina (with Iron Peroxide), and 23 Lime (with Soda).

SUTHERLANDSHIRE. At the mouth of a stream in the bay east of Creag Gharbh, one mile W.N.W. of Armadale, associated with Sphene and Pyroxene, near limestone (Macconnochie). Cnoc na h' Ula (Clough).

INVERNESS-SHIRE. In the limestone of Gortally quarries, imbedded in Zoisite, and of a grey colour—Anal.

HEBRIDES. Tiree, in the pink limestone of Ballyphetrish, very rarely, left in small quantities after solution of the limestone in weak acid. It occurs in small crystals with the forms *a*, 100; *m*, 110; *r*, 111. It is associated with Sahlite and white Biotite, and is almost pure white. Its analyses gave:—

SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	K_2O	Na_2O	H_2O	
48·923	22·098	3·159	1·508	·538	7·753	2·769	6·058	1·679	5·694	Heddle

Vesuvianite Group.

105. **Idocrase** or **Vesuvianite (393)**. $H_4Ca_{12}(Al,Fe)\ Si_{10}O_{43}$?.

Tetragonal. [M (*a*), 100; *d* (*m*), 110; P (*c*), 001; *f*, 210; *h*, 310; *z*, 211; *t*, 331; *o* (*e*), 101; *i* (*ι*), 112; *s*, 311; *r*, 614; $u=\xi$. 302; ξ in the figures represents a low face in the zone *d* (*m*) P (*c*), ? 118; ϵ ?; β (*i*) 312; ξ (*x*), 313; $c=u$ (*p*), 111; *n* ? η, 114.]

Crystals prismatic in habit, striated; also granular. Fracture uneven. H., 6·5; G., 3·35 to 4. Pellucid; lustre vitreous to resinous. Colour, brown, greenish, yellow; streak white. B.B. fuses easily, with intumescence, to a green or brown glass. Partially soluble in h. acid, and totally so after fusion, and then gelatinising. Comp., Alumina, 16; Peroxide of Iron, 7; Lime, 34; Silica, 38.

Analysis, by Dr. Heddle: 1. *Min. Mag.*, v. p. 12 (1882):—

	SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	K_2O	Na_2O	H_2O
1. Glengairn. .	36·251	18·626	·932	5·036	·844	33·935	1·574	·568	·529	1·78

HEBRIDES. Skye, one and a half miles south of Broadford, on the road to Kilbride, at the junction of a trap dyke with the calcareous rock which it traverses.

Banffshire. Portsoy, in a tilted grey limestone bed, north-east of the Old Battery, granular and foliated, associated with Sahlite, Edenite, and Wollastonite.

Aberdeenshire. At Monaltrie, brown and yellowish-green. At Crathie quarry, associated with Wollastonite, Garnet, and Pyrrhotite. In the quarries on Creag Mhòr, with Garnet, Grossular, and Epidote. In Boultshoch quarry, associated with Garnet and Coccolite. At Leac Ghorm, with Garnet, Malacolite, and Pyrrhotite. Glen Gairn, in the limestone quarry at Dalnabo, lustrous, rich brown, and, very rarely, apple-green, associated with Epidote, Cinnamonstone, Prehnite, Greenovite, Sahlite, etc. Sometimes it occurs here in crystals $5\frac{1}{2}$ inches by $\frac{3}{4}$ of an inch. Combs., M *d* P, M *d p f s*, M *d f t c i* P *s* (Plate LXIV., figs. 1 and 2); M *d f t c i* P *s r* (Plate LXIV., fig. 3); M *d f h t c i* γ P (Plate LXIV., fig. 4); *h f d t c i n* (Plate LXV., fig. 8); M *d h f c i* P *u s r* (Plate LXV., fig. 6); M *d f c i* P *s* β ξ *z* (Plate LXV., fig. 7); *h f d t c i n* (Plate LXV., fig. 5); *h f d c i* P *u o* (Plate LXV., fig. 9); M *d t c* P *u o* (Plate LXV., fig. 10); — Anal. 1. In Mammie Hill, associated with Sahlite and Cinnamonstone.

Lanarkshire. "Tintock (Tinto), in the south-west re-entering angle in claystone, minute portions of a crystallised matter like Vesuvian or Garnet" (Macknight).

Zircon Group.

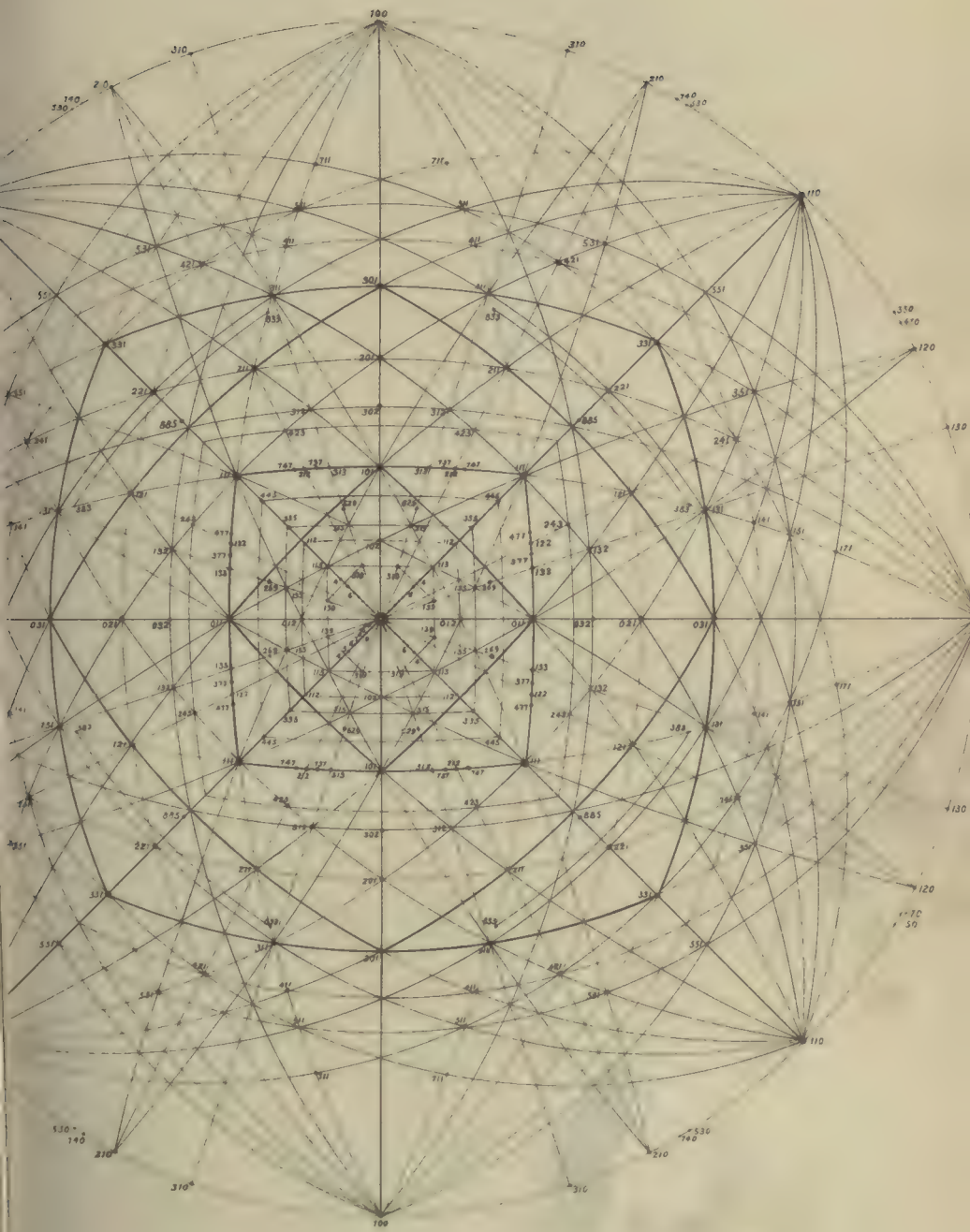
106. **Zircon (394).** $ZrSiO_4$.

Tetragonal. [*m*, 110; *a*, 100; *p*, 111; *v*, 221; *x*, 311; *e*, 101; *y*, 411; *f* ?; *l* ?.]

When crystallised, chiefly prismatic or pyramidal in habit, but often occurs as rounded grains. Transparent to opaque. Lustre vitreous to adamantine. Rarely white, but grey, yellow, or green, more frequently red or brownish-red. B.B. loses its colour, but is infusible. Not affected by any acid except concentrated sulphuric acid; and by that only after long digestion. Comp., 66·3 Zirconia and 33·7 Silica, with 0 to 2 per cent. of iron peroxide as colouring matter.

Sutherland. Beinn Laoghal, in granitic veins on quartz, very rarely, associated with Amazonstone, Topaz, and Tourmaline, colour dark brown, *a p*. Ben Hope, east of An Gorm-loch, in granular quartz schist, associated with rose mica. The Zircon is perfectly transparent, and is of a ruby-red colour, *a p*. Conamheall, within quartz grains, *a p*.

Ross-shire. At the head of the Allt Graad, Kiltearn, Loch Glass, *m a p* (Plate LXV., fig. 1), in granite blocks, along with Garnet and Muscovite. In a granite belt which cuts gneiss in Glensgaich, associated



M'Farlane & Erskine Edin'

with Muscovite, Garnet, Apatite, and Tourmaline. Sometimes imbedded in Quartz, *a m x p* (Plate LXVI., fig. 3), but usually in the very centre of crystals of garnet, *a p x e* (Plate LXV., fig. 2). Achnasheen, imbedded in garnets, in gneiss, in a quarry half a mile north of the hotel. Mam Ratagan, Loch Duich, in very minute colourless crystals, *a p*, in red "syenite."

Hebrides. Lewis, in a granitic belt at †Brann a' Bharra, half a mile north of Balallan; in delicate pink, transparent and adamantine crystals associated with Polymignite (?) in blue Albite, *m a p x v* (Plate LXVI., fig. 4) and *m a p x v y f l* (Plate LXVI., fig. 5). Island of Scalpay at Eilean Glas, imbedded in Chlorite, underlying gneiss, and associated with Serpentine, Talc, Steatite, and Magnetite. Crystals clove-brown, shining. S.G., 4·409 (Turner). (Neill) *m a x* (Plate LXVI., fig. 6); *p x m* (Plate LXVI., fig. 7). Tiree, at Hynish, *m p*. Gott Bay, on the south shore, in minute, black, opaque, distorted crystals, imbedded in Garnets. Rarely on Ceann-a'-bharra.

Inverness-shire. Glen Urquhart, Millton, near the Free Church, in minute blue-black crystals, *s P*, with pavonine tarnish, imbedded in garnets, which are lodged in Edenite and white Biotite. Loch a' Bhruthaich, *a p x*. Struy Bridge, in felspar.

Argyllshire. Loch Sunart, Strontian, in "syenite," with Sphene (Jameson) (Plate LXVI., fig. 8).

Fifeshire. Elie Ness, imbedded in agglomerate, yellowish-brown, very rare (Traill).

Kirkcudbrightshire. In the Burn of Palnure, west of Cairnsmuir, in granite boulders (Jameson). ? Sphene.

107. **Thorite** or **Orangite (395)**. $ThSiO_4$.

Tetragonal. [*a*, 100; *p*, 111; *m*, 110; ? 210 (on fig. 2); *x*, 311.]

Generally massive. H., 4·5 to 5; G., 5 to 5·4. Lustre brilliant-vitreous when fresh, but resinous when weathered. Fracture conchoidal when fresh, splintery when weathered. Colour, brownish-black to clove-brown. Comp., essentially 18 Silica, 73 Thoria, 9 Water.

Orangite and Thorite are thrown together because there is no question of their being one and the same substance: that which is called Thorite being merely Orangite in a state of greater hydration. Differences of colour may be seen to pass into one another with the greatest abruptness in the same crystal, and that so precipitately, that the passage may be termed immediate. There are several localities at which there are more or less grounds for suspecting the occurrence of this mineral, but it has been definitely determined only at two. The first is the great boulder at Tongue, where it is found in lumps up to the size of beans, both rich

orange-yellow and black, rarely showing crystallisation. When definitely crystallised there, the form is that shown in Plate LXVII., fig 1. Its associated minerals here are so numerous that a list, arranged in the order of their occurrence from the outside of the vein which carries them inwards to its centre, may be given. These are Babingtonite, Fluor, Sphene, Allanite, the Thorite, Magnetite, Lepidomelane, radiated Cleavelandite, Ilmenite, Amazonstone, Oligoclase, Quartz, Specular Iron, Bhreckite.

This occurrence, seeing that this is a huge erratic, though almost unquestionably from Beinn Laoghal, cannot be regarded as other than unsatisfactory.

The second locality where it occurs is in rude veins which protrude from the face of the great cliff of Beinn Laoghal, Sgor a' Chonais-aite. Here it occurs in crystals showing four different forms. Two of these show only pyramidal faces, in which the angle of the pyramid seems to depart so little from that of the regular octahedron that it cannot be the primary *p* face which is here disclosed. The second form is the square prism terminated by the pyramid as shown in Plate LXVII., fig. 1 ; next, and this crystal is the most common, in the form depicted in Plate LXVII., fig. 2 ; and lastly, there are two distinct octahedra, about half the size of peas, which, as before mentioned, seem to be the regular octahedron. The following difficulties stand in the way of the definite determination here. There is, firstly, the objection to the destruction of the specimen, and, secondly, the fact that the surfaces of both crystals are much pitted, and so dull that they would afford no reflection. But the fracture, both of the pyramidal and of the octahedral crystals, is conchoidal, the lustre pitchy, and the colour deep brown. In addition to their being non-magnetic, there is no risk of here mistaking Magnetite for whatever mineral these octahedra may be, as the Magnetite here is blue-black, with distinct cleavage, and hackly fracture. And, again, the internal structure of the crystals which occur in these two irreconcilable forms is no more like that of a pseudomorph in the one case than it is in the other. The octahedral crystals do not resemble Pyrochlore. The pyramidal mineral is soluble in hydrochloric acid, with separation of silica ; and the orange-coloured solution gives a copious ruddy precipitate with ammonia, which, taken along with the form, is sufficient to determine the tetragonal mineral as Thorite.

At its second locality the mineral is, next to Amazonstone and greasy-looking Quartz, the most frequently occurring substance in the veins, but it is usually in particles too small to be broken with advantage for collecting it. The associated minerals at this second locality are Babingtonite, Topaz, Rubinglimmer, Galena in small specks, and Sphene.

Danburite-Topaz Group.

108. **Topaz (397).** $(Al(O,F_2))AlSiO_4$.

Orthorhombic. [In figs. 1 to 5, *a* (*b*), 010; *b* (*a*), 100; *c*, 001; *m*, 110; *i* (*d*), 201; *d* (*h*), 213; *w*, 081; *y*, 401; *n* (*f*), 021; *e* (β), 110; *z* (*M*), 230; *l*, 120; *u* (*g*), 130; *k* (*o*), 221; *o* (*u*), 111; *s* (*i*), 223; figs. 6 to 8, *r*, 241; *x* (*v*), 121; *t*, 265; *f* (ϵ), 112; *q*, 423; ϵ (*Y*), 211; *a* (*H*), 023.]

Crystals always prismatic, often hemimorphic. Clv., basal, perfect, fracture conchoidal. H., 8; G., 3·4 to 3·6. Transparent, vitreous Colourless, honey-yellow, amber, pink, asparagus-green, blue. Becomes electric by heat or friction, and the yellow colours become pink. B.B. infusible. Not affected by h. acid; by digestion in s. acid gives traces of Fluorine.

Sutherland. Beinn Laoghal, near the foot of the precipice of Sgor a' Chonais-aite, in granitic [pegmatitic] veins in "Syenite," *a b l m c n i d s x* (Plate LXVII., fig. 1); *a b m u n y w i o* - - - - - -, (Plate LXVII., fig. 2); *m l c n y d o k* (Plate LXVII., fig. 3); *m l u ϵ n d i o* (Plate LXVII., fig. 4). The associates are small crystals of bright green Amazonstone, with Albite, Tourmaline, and Magnetite.

Banffshire. In the cliff above Loch Avon, on its east side, in druses in granite, associated with brown and black Cairngorm. Loose in an old stream course of the Avon, of a fine blue colour, and in a mass nearly the size of one's fist (Stuart)—Anal. 1. Also found near there in masses three to four inches in diameter and of a pale blue colour (Greg). Rolled Cairngorms of wine-yellow or brown colours, Orthoclase and Beryl are the associates.

Analysis of Blue Topaz :—Heddle.

	SiO_2	Al_2O_3	Fl	Total.
Tornahaish, north side of Ben Avon, . .	33·24	56·43	18·58	108·25

Aberdeenshire. Beinn a' Bhuird, from masses of rock which have fallen from the east cliff near the south of the small cairn, have been obtained, at various times, and amongst other crystals, those in the following list :—

1.	1 lb. 3 oz. 8 dwt. 8½ grs., S.G. 3·548	(*Wernerian Transactions*).
2.	7 „ 3 „ 18½ „ „ 3·57	(Imrie, 1803).
3.	7 „ 2 „ 12 „ „ 3·56	(Imrie, 1810).
4.	9 „ 18 „ 12 „ . .	(Imrie, 1810).
5.	19 „	(Jameson and Nicol).
6.	8 lbs., conjectured from fragments, .	(MacCulloch).
7.	. . . . .	(Allan).
8.	. . . . .	(Whites).

From this locality the crystals are usually colourless, passing from that through pale blue to pale brown or wine yellow at the brachypinacoid. Rock crystal is the only associate of the Topaz at this side of the granite range.

Forms :—*m c l n o y* ; *m c a l e n y k o s i* (Plate LXVII., fig. 5) ; *m c l n k i o d e* (Plate LXVII., fig. 6) ; *m l c n r x d o ϵ* (Plate LXVIII., fig. 7) ; *m l c a d o t q u* (Plate LXVIII., fig. 8).

Argyllshire. Machrihanish Bay, Kintyre, in loose granite blocks [boulders], seen by Mr. Milne Home, in which they occurred as small colourless crystals, *m l a c n o i*.

Bute. Arran, in the coarse crystalline granite of Glen Shant, in colourless crystals (Necker). On the shore of Brodick Bay, in loose blocks of fine-grained granite, colourless, and honey-yellow, with blue Beryl (Necker).

Greg mentions the south side of Lochnagar, and also Harris, as other localities for Topaz, but these have not been corroborated.

109. **Andalusite (398).** $(AlO)AlSiO_4$.

Orthorhombic. [*c*, 001 ; *m*, 110 ; *r*, 011 ; *s*, 101 ; *k* (*z*), 120.] Also columnar. Clv., *m*, fracture splintery. H., 7 to 7·5 ; G.. 3·1 to 3·2. Pellucid, vitreous. Colour, green, red, or blue. B.B. infusible. Not affected by acids. Comp., Alumina, 63·1 ; Silica, 36·9. The variety Chiastolite encloses carbonaceous matter.

Analyses, by Dr. Heddle :—1. *T.R.S.E.*, xxxix. 346 ; 2. *Min. Mag.*, v. p. 13 :—

	S.G.	SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	(Alkalies)	H_2O	Total.
1. Maernoch,	..	52·538	39·314	1·094	3·267	·461	·861	·84ϵ	tr.	1·11	99·491
2. Auchindoir,	3·121	36·712	59·678	2·302	..	·23	·860	tr.	..	·456	100·238

Sutherland. In a dell about one mile south of Cape Wrath and near the coast, in interbedded patches in a dark green rock, which also contains * *

Banffshire. On the shore, a quarter of a mile east of Whitehills, in quartzose bands in gneiss of a yellow colour, and associated with pink pseudomorphs of the same mineral in Steatite, Muscovite, and Fibrolite. Marnoch, in the banks of the stream, near the mill of Auchintoul, Kinnairdy Castle, in grey crystals in phyllite, associated with Staurolite (Peyton and H.)—Anal. 1. Near Banff and Macduff, yellowish-white, in fissile schist. At Botriphnie.

Aberdeenshire. Monymusk, on the north-west slopes of Pitfechie, grey, in schist. On the coast near Aberlour, in Muscovite schist. Auchindoir, Clashnarae Hill, in North Clova glen, very rarely, white crystals in veins of graphic granite. In the flagstone quarries of the Correen Hills, rarely, in pink and grey crystals in the quartz veins which cut the slate, and associated with mica, *m c s* (Plate LXVIII., fig 1). Commonly in greyish-blue crystals dispersed throughout the slate. Clova, on the south-east and the north-west slopes of Peat Hill, of a pink colour, and several inches in length, associated with Labradorite, Fibrolite, and Biotite, in quartzose bands in gneiss. Similarly on the west and the south sides of Clashnarae Hill, Clova, *m c a k r s* (Plate LXVIII., figs. 2 and 3), with Graphite and Tourmaline (Morgan and H.)—Anal. 2. Probably under moss, at Mount Meddin and Hill of Snowy Slack. Glen Nochty, white, in granite, associated with Tourmaline. Between Auchnagatt and Methlick, and also in the Skilmanae and Belnagoak Hill, in loose crystals (Cruickshank). Aberlour Bay, in phyllite.

Perthshire. Creag Mhòr, Glen Lochay, in blue phyllite on the north-west side of Stob nan Clach, at a height of 3185 feet.

Argyllshire. Glen Coe, in the banks of Gleann Leac na Muidhe, half a mile south-west of Clachaig, yellowish-white, imbedded in yellow Muscovite on white Quartz bands, in gneiss, and associated with lanceolate crystals of Actinolite. Glen Creran, at the col between Fraochaidh and Coire na Baich, north of (? Elleric). In phyllite, in the neighbourhood of Ballachulish, rarely.

Kirkcudbrightshire. Near New Galloway, on the north-east slopes of Knocknairling Hill, in Silurian grits, near granite veins, in grey crystals, with a chiastolite structure (Miss Gardiner).

Knotenschiefer, which has been regarded as containing incipent Andalusite, occurs in a belt of rock which passes from the Correen Hills north-eastward towards Macduff; also at Coire na Paich, at the north-west end of Glen Creran. It occurs also in Glen Nevis, and at Cuil Bay in Appin.

110. **Sillimanite** or **Fibrolite** (**399**). Al_2SiO_5.

Orthorhombic. Crystals fibrous, columnar, and radiating. Clv., *b*, (010) very perfect. H., 7; G., 3·2 to 3·26. Translucent; lustre resinous, but vitreous on the cleavage planes. Colour, greenish, clove-brown, or hair-brown. One of the trimorphous modifications of Al_2SiO_5; Silica 36·8; Alumina, 63·2.

Analyses—Heddle, 1 and 2, *Min. Mag.*, v. p. 2 :—

	SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	K_2O	Na_2O	H_2O	Total.
1. Pressendye Hill,	39·68	58·822	..	·038	1·1	·36	tr.	·32	
2. Clashnarae Hill,	38·41	61·426	·215	0	·114	..	..	·23	

Banffshire. On the shore, a quarter of a mile east of Whitehills, in quartz belts in gneiss. It occurs quite independently of the Andalusite of the same locality.

Aberdeenshire. About three hundred yards below the north-west side of the summit of Pressendye Hill, near Tarland, in thin veins in gneiss—Anal. 1. Clova, in quartzose belts in gneiss on Clashnarae Hill, the fibres being parallel to crystals of red Andalusite, colourless, and of brilliant lustre Anal. 2. Badenshore of Glenlaff Hill, in veins between the crystals of red Andalusite, the fibres being transverse to the veins, and passing into an appearance like Okenite—Anal. . Apparently in a granite boulder lying on Achindown Hill, near Cawdor, associated with black mica (Aitken). Apparently Margarodite [Muscovite] on edge. Black Dog Rock (Bonney). Ardonald quarry.

[Of common occurrence, also, in the thermo-metamorphosed rocks of Perthshire, Forfarshire, and Kincardineshire (Barrow).]

111. **Kyanite (400).** Al_2SiO_5.

Triclinic. *m* (*a*) 100 ; *p* (*c*) 001 ; *t* (*b*), 010 ; *k* (M), 110 ; *i* (*m*), 110 ; *e*, 210. Hemitropes common, united by *m* (*a*). Also occurs in radiated groups. Clv., *m* (*a*) perfect ; brittle. H., 7 but on the cleavage planes, 5 ; G., 3·5 to 3·7. Pellucid ; lustre vitreous except on the cleavage planes, where it is pearly. Colourless, red, yellow, green, grey, more commonly blue. B.B. infusible. Not affected by acids. One of the trimorphous modifications of Al_2SiO_5.

Analyses—Heddle. 1, *Min. Mag.*, iii. p. 18 :—

	S.G.	SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	K_2O	Na_2O	H_2O	Total.
1. Vannlip,	..	38·153	56·979	1·867	..	·153	·301	..	..	..	2·646	100·099
2. Millden,	3·466 to 3·538	36·384	58·296	1·609	1·123	..	·861	..	·252	·423	1·445	100·393
3. Millton,	3·016	37·53	58·105	2·089	..	..	·129	·076	·252	·741	1·198	100·12

Shetland. Unst, east of the Dale Burn, grey, in Quartz. Nor Wick, blue-grey, in Quartz. In the hill north-east of the bay of Wood Wick, associated with Staurolite (D. and H.). Mainland, at Cunningsburgh,

in mica schist, blue ; sp. gr., 3·62 (Jameson). In large brushes of radiating and plumose groupings of tile-red crystals, in massive Quartz. [At Vannlip] in interlacing bunches of white and red radiating crystals, associated with Ripidolite Anal. 1. In parallel arrangements of long blue crystals in Quartz, *p m t i* (Plate LXVIII., [?] fig. 1) (Hibbert). At Grevasand, rarely (D. and H.). Near Levenwick, at the east side of the Ward of Skousburgh, also at the south-east end associated with Ilmenite, and in colour both white and grey. At Colla Firth (Hibbert).

Inverness-shire. In Glen Urquhart, above Millton, on the east side of the road to the limestone quarries, in large isolated crystals, and also in sheaf-like aggregates, in gneiss—Anal. 3. Strathspey, near Dulnanbridge, to the south-west of the limestone quarry, and in gneiss. Near Achnagonalin, Grantown. Sgùrr a' Choire-bheithe, L. Nevis.

Hebrides. Harris, at the foot of Hacklett, north-east of Obe, in garnet-rock (D). Also in granular felspar (D. and H.). North part of Chaipaval, in belts of granular felspar, blue, with garnet (D. and H.).

Perthshire. Ben Vannoch, at the summit, in quartz belts, with garnet, in mica gneiss.

Banffshire. Sandend Bay, at Garron Point, in a quartz vein, in biotite schist, with Hornblende and Muscovite. Portsoy, in quartz veins in Muscovite schist, between two serpentine bands, and of a white colour. West of Portsoy, in the second bed of phyllite, and with a tesselated structure resembling that of Chiastolite. Also in crystals of a green colour, in nodules of morion quartz in the same bed, but below high-water mark. At Forgie, in the parish of Engie, at the bridge over the Little Dramlach, with ? Damourite (Wallace). At Allt Beag, Glen Rinnes (Wilson). Corryhabbie, on the west side, and in broad blue sheaves in quartz (Peyton). Near Mulben (Nicol). In the railway cutting between Mulben and the Spey. At Botriphnie, with Muscovite, in a quartz vein, in broad, deep blue crystals (Saussure). In the Burn of Boharm, at two spots about two miles south of Auchlunkart House, in quartz seams, and associated with Actinolite, Staurolite, and Garnet, At one locality the colour is pearl-grey ; at the other, the upper part of the burn, it is blue. One extremity of the crystals invariably penetrates the phyllite, the other being imbedded in the quartz (MacCulloch). In the Burn of Alderine, north of Dufftown, black in colour, and associated with Staurolite, in phyllite. Also at Mortlach. One mile north of Loch Builg, in limestone on the east side of the stream, associated with Garnet, Sphene, Staurolite, Chlorite, and Rock Crystal.

Aberdeenshire. At Ardonald quarry, between Keith and Huntly, in quartz concretions in phyllite, near limestone, and associated with

Staurolite and Muscovite (Cunningham). Loch Etchachan, far up in the burn flowing from the east into Glen Derry, and of a grey colour (Peyton).

KINCARDINESHIRE. Banchory (Greg).

PERTHSHIRE. Carn Liath, on the west side (MacCulloch). Glen Tilt, in a quartz vein (MacCulloch). In quartz veins near the summit of Beinn a' Ghlo, the crystals being generally dissolved out. Moor of Rannoch, at the south-west corner; on the west slopes of Meall Buidhe, associated with Ilmenite and Chlorite. In the corrie of Beinn Creachan, on its east side, associated with Ilmenite, Chlorite, and crystals of Orthoclase (Peyton and H.). Cruach Ardran, loose, on the south slopes.

FORFARSHIRE. In outliers near Millden, west of Turret, south of Mount Battock, in large foliated masses of blue and yellow crystals (Imrie). Tarffside, Garlet Hill, on its west side, *p m t k e i* (Plate LXVIII., fig. 2), associated with crystallised Chlorite (Murray). [Glen Clova, on the hill slopes below Loch Brandy, in highly-metamorphosed rocks, and associated with Quartz, Muscovite, and Tourmaline (Goodchild).]

Datolite Group.

112. **Datolite (401).** $HCaBSiO_5$.

Monoclinic. [*a* (*c*), 001; *b*, 010; *c* (*a*), 100; *o*, 120; *r*, 230; *d* (*m*), 110; *s*, 302; ϕ, 101; *f*, 304; *x*, 102; *v*, 103; *u*, 104; *t*, 013; *g*, 012; *m* (*m**), 011; *n*, 111; (ν), 111; π ? 104; *k* (*s*), 115; *l* (*W*), 114; *y*, 144; *e* (Λ), 112; *q* (β), 121; (*L*), 113; ζ (δ), 221; λ, 113; II, 101; ϵ, 112; β ?; *L* ?.]

Fracture uneven, or conchoidal. H., 5 to 5·5; G., 2·9 to 3. Transparent or translucent; lustre vitreous. Colourless, or tinted greenish, yellowish, or pink. In the closed tube yields water. B.B. intumesces, and melts easily to a clear glass, colouring the flame green. The powder gelatinises in h. acid. Comp., 38·1 Silica, 21·6 Boracic Acid, 34·7 Lime, and 5·6 Water.

PERTHSHIRE. Glen Farg, in a cutting on the Great North Road [in andesitic lavas of Devonian age], of a pale green colour, and associated with Analcime. The faces *d g k* are dominant. Forms: *a g m d n e* (Plate LXVIII., fig. 1); *a g m d n c p l k e* (Plate LXIX., fig. 2); *a g m d n e p β o l k*. In cutting the north tunnel of the railway the combination *c m* was dominant, associated with Prehnite and "Konilite," also combinations of the forms *c m a d o n l g p* [? π] ϵ (Plate LXIX., fig. 4); *c m a* ϵ.

FIFESHIRE. In making the south Glen Farg cutting, Datolite was found in snow-white crystals of the comb. *c m a d o* π ϵ *n l*, on bright green Prehnite, and associated with Native Copper and Chrysocolla. It occurs also in the Isle of May, where it is found on the west cliff, in small crystals

of the combination *m n e d i*, *m p* (*c*) *n d* (Plate LXIX., fig. 3), in Prehnite and associated with Scolecite (Fleming).

EDINBURGHSHIRE. Corstorphine Hill, in the east quarry, associated with Prehnite, in colourless to white crystals of the comb. *c a m x L g n o* (Plate LXIX., ? fig. 5); also in the north quarry. Salisbury Crags, on the north side of the south quarry, in a vein which inclined to the east at a high angle. The Datolite was associated with Analcime and yellow Prehnite. The crystals from this locality are generally minute and colourless, but in the Earl of Cathcart's Collection there is a specimen from the quarry referred to on which the crystals of Datolite are pale greenish-yellow, and are three-quarters of an inch in length. It occurs also in the cutting on the Barnton railway in Barnton Park, just west of the station, coating fissures in picrite, in fine crystals, generally, *per se*, but closely associated with Prehnite, Pectolite, Analcime, and Natrolite (Goodchild and H.).

DUMBARTONSHIRE. Bowling quarry, in isolated crystals, in a vein which cuts the eruptive rock.

RENFREWSHIRE. In the Bishopton railway tunnel, in magnificent groups of large snow-white crystals, engaged in spherical brushes of green Prehnite.

Some of the Thomson's "Konilite" seems to be the granular Datolite of Glen Farg, which occurs, especially in the north tunnel, along with Prehnite and crystallised Datolite, at its southern mouth, and also in lumps *per se* at its northern mouth.

113. **Zoisite (406).** $Ca_2(AlOH)Al_2(SiO_4)_3$.

Orthorhombic. [*a*, 100; *b*, 010; *m*, 110; *f*, 011; *o*, 111.] Clv.' brachydiagonal perfect. H., 6; G., 3·2 to 3·4. White, brownish-grey, and dark green. B.B. intumesces, and forms a white or yellow porous mass, and, on the edges, fuses to a clear glass. Comp., 29·8 Alumina, 24·35 Lime, 2·8 Oxide of Iron, 40·3 Silica, and 2·1 Water.

Analyses—Heddle, *Trans. Roy. Soc. Edin.*, xxix. 2:—6. Macadam, *Min. Mag.*, v.:—

	S.G.	SiO_2	Al_2O_3	Fe_2O_3	FOe	MnO	CaO	MgO	KO	Na_2O	H_2O	Total.
1. Loch Garve .	3·268	40·07	30·83	1·58	·48	·22	23·66	·48	·50	·42	2·10	100·35
2. Glen Urquhart,	3 to 3·111	39·60	31·08	..	2·07	·08	23·34	tr.	·57	1·06	2·41	100·20
3. ,, .	3·014	41·56	29·90	..	3·21	..	22·14	·33	·34	·68	2·19	100·36
4. ,, .	3·317	39·51	30·83	..	2·52	·08	22·81	..	·68	·9	2·50	99·83
5. Laggan.	3·438	38·75	28·14	6·55	..	·92	22·03	41	..	..	3·33	100·13
6. Loch Garve,	..	43·00	27·73	2·47	..	..	24·16	1·40	·87	..	..	99·63

Ross-shire and Cromartyshire. In Contin parish, at Fannich, on the west slopes of Meallan Rairigidh, yellowish-white, in garnetiferous schist. On the south-east slopes of Sgùrr Mòr, near the summit. On the east side of Carn na Criche, resembling Tremolite, but hard and lustrous, and occurs in crystals 2 inches in length. In the fault north of the Raven's Rock, Strathpeffer, in lustrous brown crystals. On the south side of Loch Garve, about a quarter of a mile east of the inn, in a quartz vein, in pale brown crystals (Bell)—Anals. 1 and 6.

Inverness-shire. Glen Urquhart, in the centre of the limestone quarries, near Gortally, nearly white in colour, and imbedded in Calcite and associated with Quartz, fibres of Actinolite, and, very rarely, with Scapolite—Anals. 2-4 (Plate LXIX., fig. 1). Near the Free Church of Millton, rarely, in large green crystals, associated with Biotite, and, rarely, with Wollastonite. In boulders in the Asylum grounds at Inverness (Aitken). At Grantown, in the limestone quarry of Achnagonalin, in green crystals, associated with Cinnamonstone. At Laggan, Dulnanbridge, in the upper limestone quarry, in Quartz, in pale brown, lustrous crystals, associated with Chlorite, Sahlite, and Biotite (Geikie)—Anal. 5.

Argyllshire. Glen Creran, on Sgòr na h Ulaidh, associated with Hornblende, Garnet, and Chlorite. Glen Coe, in the banks of the stream in Coire Muidhe, half a mile south-west of Clachaig, in quartz bands in gneiss.

114. **Epidote (407).** $\begin{cases} m\mathrm{Ca_2(AlOH)Al_2(SiO_4)_3}. \\ n\mathrm{Ca_2(FeOH)Fe_2(SiO_4)_3}. \end{cases}$

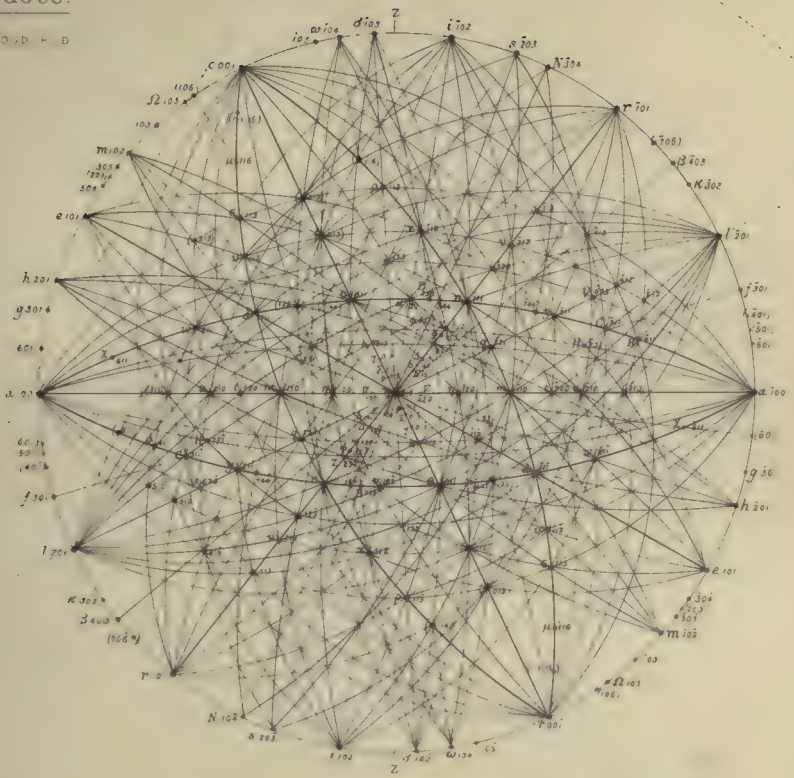
Monoclinic. [m (c), 001 ; t (a), 100 ; z (m), 110 ; e, 101 ; r, $\bar{1}01$; l, 201 ; β, 403 ; f, 301 ; o, 011 ; k, 012 ; n, 111 ; w, 211 ; y, $\bar{2}11$; q, $\bar{2}21$; d, 111.]

Crystals complex, with many partial forms. Hemitropes united by a, 100, also columnar and granular. Clv., m (c) perfect, t (a) imperfect. Fracture conchoidal to splintery. H., 6 to 7 ; G., 3.2 to 3·5. Pellucid ; lustre vitreous. Colour, green to yellowish-grey. B.B. fuses and swells to a dark brown slag ; after fusion it is soluble with gelatinisation in h. acid. Comp., 27·4 Alumina, 8·5 Ferric Oxide, 23·9 Lime, 38·3 Silica, 1·9 Water.

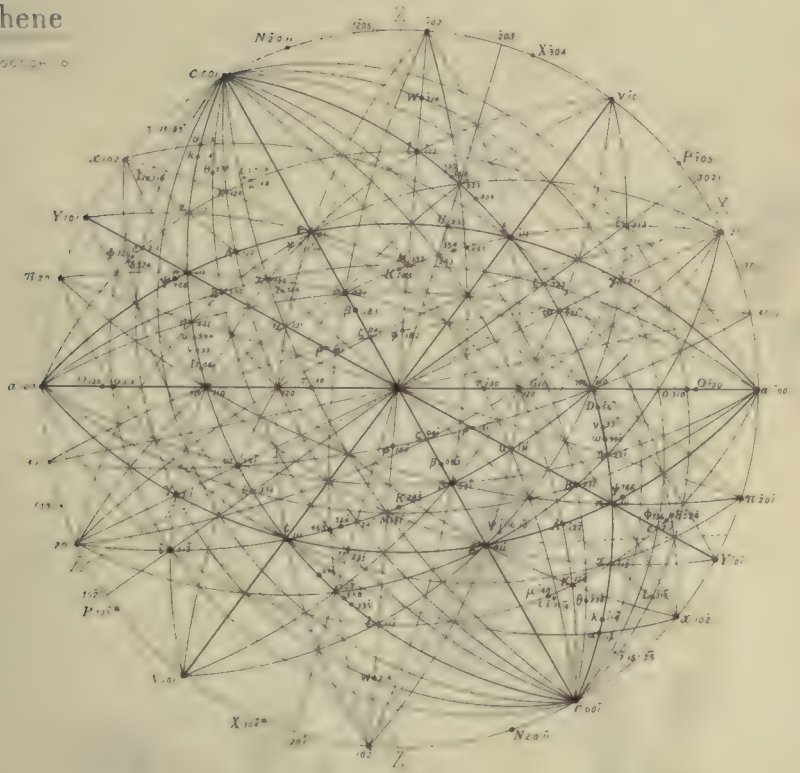
Analyses—Heddle, *Trans. Roy. Soc. Edin.*, xxix. 2 :—

	SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	K_2O	Na_2O	H_2O	Total.
1. Balta Sound,	38·75	26·99	7·90	1·80	·50	20·38	·79	·25	·21	2·37	99·94
2. Niddister,	37·87	24·72	9·96	·36	·54	23·10	·77	..	..	2·82	100·14
3. North Quin Geo,	36·13	20·57	14·92	..	·31	23·02	..	..	..	4·57	99·82
4. Glengairn,	38·37	26·09	10·39	..	·74	21·64	·24	..	..	2·44	99·91
5. Glencoe (Withamite),	43·23	23·09	6·68	1·13	·14	20·00	·88	·96	·94	2·4	99·70

Epidote.



Sphene



M'Farlane & Erskine Edin'

SHETLAND. Balta island, at the Great Geo, in crystals imbedded in Quartz—Anal. 1. Unst, Bridge of Baliasta, *Scorza*, in minute pale pea-green crystals in a matrix of Hornblende (D. and H.). Yell, one mile north of the mouth of Hamna Voe, in radiating acicular crystals associated with Garnet in epidotic "syenite." Mainland, Hillswick, Banks of the Niddister, imbedded in Hornblende, leek-green—Anal. 2. At Carneba, with Tourmaline, *Scorza* (D and H.). North Quin Geo, in stellate groups of green crystals—Anal. 3.

SUTHERLANDSHIRE. In a knoll to the north of Shiness, west of Ness, associated with Sphene in a rock-compound of granular Orthoclase and Hornblende (D and H.).

ROSS-SHIRE. In a hill ridge, 1¼ miles south-east of Loch na Sgalaig, between Loch na Sheallag and Loch Fewa, in hornblendic gneiss, in very fine crystals, five-eights of an inch wide. Combinations: simple figures, *m t f l r n z y o* (Plate LXIX., fig. 1); *m r l f t n z y* [?] *a* (Plate LXIX., fig. 2), opposite end; *m r l f t n z q* (Plate LXIX., fig. 3); *m t f l r* -, opposite ends (Plate LXX., fig. 4); and twins, *m d f r n o* - *z t* (Plate LXX., fig. 5); *m t f r n d* (Plate LXX., fig. 6); *m t f l β r n* (Plate LXX., fig. 7); *m t f l n z o y* (Plate LXX., fig. 8); *m t f l n z o y* (Plate LXX., fig. 9). Craig na Fearn; Poolewe in gneiss; "Glen Logan," in gneiss, and the west slopes of Lurg Mhor.

HEBRIDES. Lewis, half a mile south-west of Airidh a' Chreagain, Loch a' Chlachain, crystallised, and growing out of epidosite in thin veins in hornblende gneiss. Similarly near Breascleit, Loch Roag. In the bed of the stream out of Loch Lacsabhat Iorach, Loch Carloway. Loch Resort, in the cliffs of the stream flowing out of Loch na Craobhaig, east of Loch Thamanabhaidh. North Uist, half a mile north of the inn at Loch Maddy, in Quartz, along with blue Quartz and Orthoclase, in granite veins in hornblende gneiss. Monach Islands, near the Lighthouse, and also on †Eternal Island, in Oligoclase veins [pegmatites] in hornblendic gneiss. These [pegmatites] contain fibrous Hornblende, a little Orthoclase, and some Quartz. The Epidote is fibrous, and is brown and pale green in colour, and is associated with Apatite, masses of Ilmenite, and light brown Sphene.

Skye. Near Loch Scavaig (MacCulloch). Glamaig, crystallised in cavities in syenite [granophyric hornblende granite] (MacCulloch). On the south-east slopes of Sgùrr Dearg, in crystals in cavities in gabbro, associated with brushes of white Natrolite. In crystals penetrating vein-Prehnite on the south slopes of Sgùr nan Gillean and on Druim nan Ramh.

Mull. Loch Scridain, near Killiemore, in vapour cavities in "wackenitic trap" (Rose) which are solidly filled with white Scolecite.

The Epidote occurs as dark green crystals in the part of the druse nearest the rock. It occurs in a similar manner about two thousand feet up the S.W. shoulder of Ben More at Meall nan Damh, *m r t n* (Currie).

Iona. In a rock of red felspar and quartz [gneiss]. "In clinkstone" (Greg). Withamite occurs in an erratic at Port na Curaich (Currie).

Inverness-shire. At Glenelg, crystallised in veins, south of Ellanreoch. Near Loch Spey, in a singular rock-compound of crystals of Epidote imbedded in felspar, with large porphyritic crystals of Augite (Rose). Near Loch Ashie (Aitken).

Argyllshire. At Am Bodach, Glen Coe, about two miles above Loch Triochatan, very rarely, and of a bright green colour, in veins and amygdaloidal nodules, with Byssolite and Chlorite, in purple felspathic porphyry [Old Red andesitic lavas]. At the same spot the variety called Withamite is found in very minute acicular crystals, *m n t r* (Plate LXX., fig. 10); these crystals are of a brilliant lustre, purplish-red in colour, and transparent, and they radiate inward towards the centre of the cavity in which they occur. A narrow zone of a milky substance like Saussurite occurs in some specimens between the Withamite and the rock. The crystals of Withamite are red, and yellow, respectively, in two directions at right angles to each other (Macknight and Brewster) Anal. 5. At Meall Bhalach, north of Kingshouse, on the north-east shoulder, and 300 feet below the summit, well crystallised, in granitic gneiss. Ben Cruachan, on Monadh Driseag, a little east of the quarries, in small crystalline concretions and crystals, associated with Quartz, Sphene, and Molybdenite, in altered dark-coloured gneiss (Stuart Thomson and H.). Bonawe, Loch Etive, in the southern of the two quarries, in Pyrites, in the centre of druses, which are very rarely found in the central portions of the rock. The only associate is finely crystallised Chlorite. In the east cliffs of Creag Dhubh, ten miles from the south end of Loch Awe, in plumose groupings of crystals. On the right bank of the River Awe, below the bridge of Awe, with Calcite, Saponite, and Hornblende in amygdaloid (Macknight). At Erins, Knapdale, and at Ballyphaetrish, Tiree.

Banffshire. In the third granite vein east of Portsoy, associated with Muscovite and Tourmaline, rarely. In a vein traversing diorite, north-east of the Old Battery at Portsoy, in the form of *Scorza*, of a grey colour, massive, and with a granular structure resembling that of marble, in a matrix of plumose crystals of Edenite and massive Idocrase. About a quarter of a mile east of Whitehills, in Quartz belts on the shore, rarely, and associated with Andalusite and Muscovite. On the east bank of the Avon, opposite Gaulrig, in one of the tributaries of that river, associated with acicular Hornblende (Cunningham).

Aberdeenshire. In Dobson quarry, near Inverurie, in biotite gneiss, associated with Oligoclase, Ilmenite, etc. Tillyfourie, in gneiss, in the old quarry, finely crystallised, *m r t n* (Plate LXX., fig. 11). North of Tornahaish, Corgarff Castle, on the north-west side of the Don, in radiated nests of pale-green crystals in "syenite." Creag Mhòr, north of Balmoral, in old limestone quarries, associated with Idocrase, Garnet and Grossular, *m r t n* (Plate LXX., fig. 11). Glen Gairn, in the limestone quarry at Dalnabo, in clusters of radiating sap-green crystals; also pale brown, with Prehnite, Idocrase, Garnet, and Greenovite—Anal. 4. At the Bullers of Buchan, in granite.

Kincardineshire. About half way between the village of Torry and the Girdleness, in granite veins, associated with hepatic Pyrites, together with Orthoclase and Chlorite. At Stonehaven Bay, in acicular crystals in sandstone rock (Greg). At Tilquhillie, in gneiss.

Perthshire. Near Blairgowrie, 1 mile north of the Bridge of Cally, in Quartz veins traversing gneiss, and associated with Ilmenite and Chlorite.

Stirlingshire. Loch Lomond, at Rowardennan, in two dykes of felspar porphyry, in the form of twin crystals, which are associated with Hornblende and Chlorite. Also 1 mile south of that spot, in two dykes of similar character, associated with the same minerals, with the addition of Garnet and Pyrites.

Edinburghshire. At the south extremity of Salisbury Crags [in vapour cavities in Dolerite].

Bute. Arran, *m r l t n z* (Plate LXXI., fig. 12) (Greg).

Kirkcudbrightshire. At Cassencarrie granite quarry, in red granite, Epidote occurs as large crystals of a dark green colour, *m t f l r z o* (Plate LXXI., fig. 13) and *m r l n* (Plate LXXI., fig. 14) (D. and H.).

115. **Allanite (409).** $(Ca,Fe)_2(AlOH)(Al,Ce,Fe)_2(SiO_4)_3$.

Monoclinic. [*m* (*c*), 001; *t* (*a*), 100; *r*, 101; *n*, $\bar{1}11$; *z* (*m*), 110.]

Often massive or granular; fracture conchoidal. H., 6; G., 3·4 to 3·8. Translucent on the edges; lustre vitreous to resinous. Colour black, to brown or greenish; streak greenish-grey. B.B. froths and melts to a brown glass. Gelatinises with h. acid. Comp., 12 to 18 Alumina with Peroxide of Iron, 13 to 26 Oxide of Cerium and Lanthanum, 2 to 12 Yttria, 4 to 20 Peroxide of Iron, 30 of Silica.

Orkney. Savil boulder, Sanday (Flett).

Sutherlandshire. Tongue, in the great [pegmatite] boulder on Beinn Bhreac, in small crystals, rarely, associated with brown Microcline, Magnetite, Fluor, Babingtonite, Thorite, etc. (D. and H.). Lairg, at Cnoc

Dubh, in a granitic vein in "Syenite," with Sphene, Haughtonite, Oligoclase, and Orthoclase.

Ross-shire. In augen gneiss, in the bed of the stream in Strath Vaich. Near the bridge at Inchbae, in the same rock, associated with Molybdenite. On the south-west shoulder of Ben Wyvis. In granitic masses, with Tourmaline, near the inn [? at Aultnamain], between Dingwall and Bonar Bridge (Dudgeon).

Inverness-shire. At the waterfall in Dochfour Burn, in a granitic vein, associated with Pyrites and Abriachanite (Aitken and H.). Glen Urquhart, in the largest of the limestone quarries above Millton, in a felsitic belt, in which it occurs in considerable quantity, *m t r n z* (Plate LXXI., fig. 1). About a mile south of Boat of Garten, in a syenitic boss *m t r n z*.

Hebrides. Harris, on the north side of East Loch Tarbet, about three hundred yards east of the pier, in graphic granite, and associated with black mica. South Uist, at the east end of Loch Bee, with Muscovite, in Hebridean gneiss. Tiree, Salum Bay, in a dyke of pyroxenic granite.

Argyllshire. On the west side of Loch Etive, in Barrs granite quarry, along with Sphene, Molybdenite, Chlorite, and Pyrites. On the island at the Ferry of Bonawe, in granite veins.

Banffshire. At Ternemny, near Knock, in the quarry of micaceous diorite. At the Ord, in "syenite."

Aberdeenshire. In Anguston quarry, in "crocus" veins, with Orthoclase, Oligoclase, Ilmenite, Sphene, and Haughtonite. Tillypronie, near the col between Morven and Pressendye Hill, in a vein in diorite, associated with Hornblende, Labradorite, Iserine, Sphene, and Biotite. At Badnagoach, on the Deskry Water, in a vein in diorite, with Labradorite, Sphene, Hornblende, and Iserine. Near Kincardine O'Neil, on Deeside, in a granite vein on the south side of the river,—one crystal was found nearly an inch in length.

Kirkcudbright. Criffel, in a glen 1 mile west of New Abbey where it occurred in a coarse-grained hornblende granite, associated with crystals of Sphene. Fell Hill, Creetown, forms *m*, *t*, *r*, sometimes twinned on *a* (Flett).

Axinite Group.

116. **Axinite (410).**

[A minute crystal, doubtfully referred to this species, was found by the author in the old quarry of Tillyfourie, Donside, Aberdeenshire, at the junction of the granite with the gneiss, and in association with Epidote and Rock-Crystal.]

117. **Prehnite (411).** $H_2Ca_2Al_2(SiO_4)_3$.

Orthorhombic. [*b* (*a*), 100 ; *a* (*b*), 010 ; *c*, 001 ; *m*, 110 ; *n*, 302 ; *v*, 304 ; *s*, 661 ; *r*, 221 ; *q*, ? 120 ; *e*, ? = *o*, 061.]

Distinct individual crystals rare ; usually in groups of tabular forms parallel to *c* ; but also prismatic parallel to both the vertical and the brachydiagonal axes, hence varying much in form. Commonly occurs in botryoidal aggregations. Faces *c* striated parallel to their intersections with *n* and *o* ; *a*, *m*, striated parallel to their intersections with *c*. Clv., *c* tolerably perfect, *m* less so. Lustre on *c* pearly, vitreous elsewhere. Streak white ; brittle. H., 6 to 7 ; G., 2·8 to 3. Transparent to translucent. Sometimes colourless ; but generally green of bright, but pale, tints ; sometimes lemon-yellow, or even pinkish. Becomes electrically polar by heat. B.B. intumesces greatly, melting to a porous enamel. In powder, only partially soluble in h. acid ; but after ignition is decomposed completely, forming a jelly of silica. Comp., Silica, 43·6 ; Alumina, 24·9 ; Lime, 27·1 ; Water, 4·4.

Analyses :—1, 2, 8, *T.R.S.E.*, xxviii. p. 197 ; 3, *Chem. N.*, xxvii. 56 ; 4, 6, 7, *Miner.* ; 5, *Arsber.* (1825), v. 220 ; 5*a*, *Zeit. d. Geol. Ges.* (1877), xxxix. 579.

	SiO_2	Al_2O_3	Fe_2O_3	FeO	CaO	K_2O	Na_2O	H_2O	Total.	
1. Glen Gairn,	44	22·39	·36	2·22	25·49	·48	tr.	4·83	99·77	Heddle.
2. ,, pseudo.	44·11	22·57	2·89	..	25·48	tr.	tr.	4·60	99·65	Heddle.
3. Bowling,	43·41	24·77	..	..	27·13	..	·27	4·20	99·78	W. Young.
4. Near Glasgow, white,	42·22	23·68	..	2·06	23·52	..	..	5·58	98·06	Thomson.
5. Dumbarton,	44·10	24·26	..	·74	26·43	..	..	4·18	99·71	Walmstedt.
5*a*. ,,	43·45	23·80	1·16	..	26·89	..	..	4·70	100·00	Lemberg.
6. Edinburgh,	43·05	23·84	·66	1·60	26·16	1·03	tr.	4·60	99·76	Lehunt.
7. Hartfield Moss,	43·60	23·00	..	2·00	22·33	..	..	6·40	97·33	Thomson.
8. Girvan,	42·62	23·85	·08	1·66	24·86	·95	1·17	4·71	99·78	Heddle.

SHETLAND. In Yell, in gneiss (MacCulloch).

HEBRIDES. Skye, in the trap of Portree (MacCulloch). In nodules in one of the trap veins which cut the sandstone of Strathaird (MacCulloch). "On the shores opposite to the point of Clachan, in Rasay, often passing into Mesotype, and forming an integral part of a rock composed of augite, glassy felspar, and common felspar" (MacCulloch). Very rarely, in veins, on the south side of Sgùr nan Gillean, pale green, with doubly-terminated white Rock Crystals, which are sprinkled on the surface of the mammillations of the Prehnite. Druim nan Ramh, in solid veins of a white colour, with imbedded crystals of Epidote, next to the rock surface. Rarely, with Augite, and Labradorite, on the west side, just below the peak of Sgùrr a' Bhasteir. Also in Coire Làbain. Raasay, at the point of Clachan, white (MacCulloch).

Mull, in the northern division, with Stilbite, Mesolite, and Analcime (MacCulloch). Near Pennycross, Loch Scridain, sparingly, with Scolecite and Epidote (Rose). With Thomsonite, Carsaig Arches (Currie). In the screes of Meall nam Damh, south-west of Ben More, from a wackenitic rock, associated with Scolecite (Currie).

Aberdeenshire. Glen Gairn, in the limestone quarry of Dalnabo, *c a m b e r v* (Plate LXXI., fig. 1), pale green to colourless, with Idocrase, Coccolite, Anorthite (Anal. 1); also forming pseudomorphs after Anorthite—Anal. 2. In a quarry on [? Creag Mhor, 2 miles north-west] of Crathie, associated with Wollastonite and Coccolite.

Argyllshire. At the Manor House, Oban, as a crystalline, pale green lining of a trap dyke traversing schist. The Prehnite underlies Pectolite (Nicol). Glencoe, about two miles above the lake [Loch Triochatan], near the road side at the foot of Am Bodach, in near association with green Epidote, Byssolite, and Chlorite. In a quarry five or six miles west of Dunoon (Blackwood).

Kincardineshire. At Tremuda Bay, near Stonehaven, *c a b m* (Plate LXXI., fig. 2).

Perthshire. In Glen Farg (MacCulloch). At the south end of the cutting made in 1888; pale green *per se*; and sometimes crystallised, with Chalcocite, Native Copper, earthy Malachite, and Calcite. Sometimes pinkish in colour, and associated with Datolite (A. Craig Christie).

Fifeshire. Rarely, in a dyke in Kinness Burn, 1 mile west of St. Andrews, along with Apophyllite. In the cliffs west side of the island of May, with Scolecite and Datolite (Fleming).

Stirlingshire. At the Campsie Hills, in the vapour cavities of Lower Carboniferous lavas, in which it occurs in the form of radiated, globuliform, mammillated groups of crystals, of a pale green colour, and often accompanied by Thomsonite, *m c*, *m c a b*, *a b s c n v* (Greg). At the north-west end of the Mugdock tunnel, in dark greyish-green mammillations, associated with plates of Native Copper.

Dumbartonshire. Near Frisky Hall (Bowling quarry) (Jameson), in large quantity, chiefly in two great veins which traverse the quarry from west to east; but also occasionally in isolated druses in the north part of this quarry; comb. *c m a b* (Plate LXXI., fig. 2). The Prehnite is nearly persistent throughout these veins, though occasionally, where the veins are not so strong, it gives place to one or other, or to several of the other zeolites mentioned below. Its character at different parts of the veins changes materially. Where the vein structure is most marked, the Prehnite is in sheets, flat, fibrous, and of pale colours, and has indistinct terminations—Anal. 3. Where the veins break up into lines of

more or less separate druses, the colours become finer, the mammillations more prominent, and the individual crystals more isolated, and so more perfectly formed. Occasionally the association of one or more of the other zeolites seems also to effect this more perfect assumption of definitely crystallised terminations. The associated minerals, which are generally in the smaller offset vein, are Analcime, Thomsonite, Natrolite, Laumontite, Harmotome, Barytes, Edingtonite, Chabazite, and Stilbite. The two last named are always in separate veins. The general combinations of the crystals in the veins are *c a b m s* and *c a b m s n v* (Plate LXXI., figs. 3 and 4). S.G., 2, 885 (Haidinger).

Very frequently the pale green fibrous Prehnite passes at one end of the fibres into milk-white solid Pseudo-Analcime. The structure of this is a mass of matted fibres at the faces of the crystals, while their usually hollow centres show mammillations of a green or, rarely, of a bright yellow Prehnite. The colours of the vein-Prehnite are, at the west end of the veins, brownish-white; at the central portions, of a vivid light green; while at the east end, when the colour departs from the usual dull green, it is either bluish-white (with the surface of the mammillations so smooth as to have a chalcedonic appearance), yellow-green, or sulphur-yellow. In the cavities the crystals are generally isolated, *c a b m* (Plate LXXI., fig. 2), and the associates, if there are any, are Natrolite and "Prasilite" (or crystalline Saponite).

Dumbarton Rock, with capillary Mesolite, in basalt (MacCulloch)—Anal. 5, 5*a*. In Cochno Burn (Jameson). Near Loch Humphrey (Jameson).

Edinburghshire. Formerly obtained at the Edinburgh Castle Rock in colourless mammillations, and underlying Pectolite, sometimes with Barytes and Calcite (Thomson)—Anal. 6. Also, rarely, in cavities *per se* Also flabelliform over *a* (Plate LXXII., fig. 5). At the old quarry at the south end of Salisbury Crags, of a pale green colour, and associated with Analcime and Datolite. Also in mammillations and hemispherical groupings, of a fine yellow or orange colour, associated with Barytes and Calcite (Jameson). In a vein immediately to the east of Samson's Ribs, Arthur's Seat, in flabelliform groups, of yellowish-green and greyish-white colours. In the Calton Hill tunnel, with Analcime (Rose). In the great quarry at the north end of Corstorphine Hill, bright green in colour, and in orbicular and flabelliform groups, associated with Chalcopyrite, pinchbeck brown mica (? Biotite), Calcite, and Amethyst (Rose), *c a s n*, *c a s r* (Plate LXXII., figs. 6 and 7). In the east quarry, pale green, and, sometimes pink, with Augite, Labradorite, Amethyst, and Harmotome. Sometimes with Apophyllite (Bryson). Barnton, in veins in Picrite (Goodchild).

Linlithgowshire. In the neighbourhood of Uphall, in distinct sheafs and mammillations, and, rarely, crystals, *c a m s q* (Plate LXXII.,

fig. 8), of a rich brown colour (Stuart Thomson). In a quarry on the east side of the Edinburgh road to South Queensferry, near Dalmeny, *c a m b n* (Plate LXXII., fig. 9) (Craig Christie), unassociated.

Renfrewshire. At Hartfield Moss (Jameson), waxy-white, opaque, and radiated, associated with Cluthalite and Analcime, not infrequently assuming the form of the latter (Greg)—Anal. 7 ; grey in colour, and, in appearance, like Chalcedony, associated with Saponite. Also crystallised, *c m a b*. At Bishopton tunnel (Jameson). Some specimens associated with sheafy Thomsonite, Galactite, and Calcite, are perfectly botryoidal, each grape-like group of crystals being only just in contact with those adjoining—such as these are bright green in colour. Others, associated with Greenockite, are in spheres, imbedded in a wackenitic paste. Rare specimens, which are associated with Datolite, though of paler colour than these latter, are in exquisite groups of fasciculitic tufts and spheres. Harmotome, Analcime, and Galena are here rare associates. At Boyleston quarry, Barrhead, in large quantity, and solely in misshapen druses in the harder portion of a porphyritic basic lava. Free crystals are very rare. The associates are Native Copper, which is frequently disposed in filaments and needles between the brushes of Prehnite, and which colours them brown-red, Analcime, Natrolite, Thomsonite, Malachite, Rubinglimmer, and variously and finely-crystallised Calcite. The Prehnite is usually of a pale green colour, but isolated hemispheres occur, which are of a fine yellow colour, and are sometimes disposed over, or among, the crystals of Analcime. Rarely, some druses contain lustrous groups of an exceedingly light green and milk-white colour. Mickle Cloak, Lochwinnoch, in dull, radiated, dead-white-crystals (Montgomery).

Ayrshire. At the Hill of Beith, half a mile east of Beith (Jameson). With Native Copper, Analcime, and Calcite ; dark green, at Berry Glen, Kelly Burn (Doran). Loudoun Hill, with Datolite (?) (Brown). Channel of the Irvine (Brown). Lendalfoot, 1 mile north of, in Anorthite, with Native Copper, at the Diallage locality. Near Pinbain, crystallised, in small veins in shale, *c a m b* (Plate LXXII., fig. 10). In undulating veins, or bands, with occasionally traces of crystals, in a foliated rock at Carleton Port—Anal. 8. In the Swinzie Burn, more than two miles east of Stewarton, near which the burn passes to join the Annick Water, bluish-white mammillations, in loose bits (Blackwood). Rye Water, about one mile above Baidland limestone quarry, in a porphyritic basic eruptive rock, along with Calcite, pink Stilbite, and Fluor, colourless spheres of the size of peas, generally filling the druses, with little saponitic crust (Watson). Tophead quarry, Caldwell, with Analcime and Calcite (Blackwood).

Bute. Arran, at Dun Fionn, between Brodick and Lamlash, "forming, with Augite and Mesotype, an integral part of a greenstone bed" (MacCulloch).

IV. Subsilicates.

II. *Oxygen Ratio for* Si : R = 2 : 3.

[118. **Calamine (423).** $H_2Zn_2SiO_5$.

Orthorhombic and hemimorphic. *a* (*b*), 010 ; *b* (*a*), 100 ; *c*, 001 ; *m*, 110 ; *w* (*l*), 301 ; *e* (*s*), 101 ; *u* (μ), 201. [In figs. 182, *o*, 101 ; *g*, 110 ; *p*, 301 ; *b*, 010.]

Commonest forms : *a* (*b*), *m*, *w* (*l*). Also occurs in columnar, fibrous, granular, and earthy forms. Clv., prismatic (*m*) very perfect ; along *e* (*s*) less so. H., 5 ; G., 3·3 to 3·5. Transparent to translucent ; lustre vitreous to pearly. Usually colourless ; but often white, light grey, yellow, green, brown, blue. Strongly pyroelectric. B.B. decrepitates slightly, but is infusible ; treated with cobalt solution, becomes blue and partly green. Readily dissolved in acids, with gelatinisation. Comp., 25 Silica, 67·5 Zinc Oxide, 7·5 Water.

Analyses :—1. *Phil. Mag.*, 1840, 2.

	ZnO	Cu	SiO_2	Pb	Fe_2O_3	S	H_2O	Total.	
1. Leadhills,	66·8	..	23·2	..	..	..	10·8	102·8	Thomson.
2. „	59·0	..	31·5	..	1·9	2·6	4·9	99·9	Wheeler.
3. „ yellow,	59·9	..	32·1	1·5	..	..	5·2	98·7	Collie.
4. „ blue,	60·6	..	24·2	2·7	1·9	..	10·7	100·1	Wheeler.
5. „ blue,	62·1	·9	24·3	1·9	1·2	..	9·3	99·7	Collie.

Wanlockhead, Bay mine, in acicular crystals, *b m w*, *b m w u e*, generally colourless, but in some cases coloured chrome-yellow by encrustations of Pyromorphite. Also occurs there (and also at Pibble mine, near Creetown, Kirkcudbright), in botryoidal masses, often brightly coloured various shades of green, blue, and yellow, and occasionally investing crystals of galena. In one case a chalky deposit of this mineral, partly coloured blue, had taken place upon some old timber in the mine.]

119. **Tourmaling (426).**

Rhombohedral and hemimorphic. [*b* (*m*), $2\bar{1}\bar{1}$, $10\bar{1}0$; *a*, $01\bar{1}$, $11\bar{2}0$; *o* (*c*), 111, 0001 ; *r*, *p*, 100, $10\bar{1}1$; *e*, 011, $10\bar{1}2$; *t*, 021 ; $21\bar{3}1$; *s* (*o*), $\bar{1}11$, 2021 ; *x*, $21\bar{1}$, $\bar{2}\bar{1}32$.]

Crystals usually long-prismatic and vertically striated ; also occurs in radiating and fibrous aggregations. Fracture conchoidal to uneven. H.,

6·5 to 7·5 ; G., 3 to 3·3. The black varieties are opaque, most of the others more or less transparent. Lustre vitreous. Colour, generally black ; but sometimes colourless, or yellow, brown, blue, green, and rose-red ; streak white. Different colours often disposed in layers parallel to the vertical axis ; and portions of one crystal differing also in colour along that axis. By friction acquires positive electricity, and becomes electrically polar when heated. Powder insoluble in h. acid ; imperfectly soluble in s. acid. Comp., complex ; but all varieties contain water and fluorine, and some boracic acid.

Analysis by Heddle, *Trans. Roy. Soc. Edin.*, xxxix. p. 348 :—

SiO_2	Al_2O_3	Fe_2O_3	B_2O_3	FeO	MnO	CaO	MgO	K_2O	Na_2O	F	PO_4	H_2O
35·538	35·55	·18	10·768	7·12	·307	1·108	3·538	1·072	·429	1·705	tr.	2·955

Shetland. Unst, on the west slopes of a hill a mile east of Woodwick, with Kyanite, Grenatite, and Garnet, rarely (D. and H.). Mainland, at the north-west end of Colla Firth, in margarodite schist. Hillswick, at Carneba, brown with *Scorza* and red felspar, in mica schist (D. and H.). Opposite St. Ninian's Isle, in mica schist. Fetlar, in large crystals in Quartz, on the west shore of Tresta Voe. Whalsey, in large black crystals in felspar (Thomas).

Sutherland. In granite, near Culrain inn, in large crystals (Dudgeon). Beinn Laoghal, in a vein in the " Syenite " of Sgor a' Chonais aite, along with Amazonstone, Topaz, and Thorite.

Ross-shire. At Stittenham, Sgùrr Mairc-Suidhe, on the south side of Loch Luichart. At the Glensgaich railway cutting, in a nodular Quartz vein, associated with Garnet, Muscovite, Apatite. The Tourmaline here is usually black, and, very rarely, green in colour.

Inverness-shire. Struy Bridge, in the quarry to the south, with Beryl, Garnet, Muscovite, and pink Orthoclase—Anal. 1.

Hebrides. Mull, at Bunessan, in mica schist, and at Creag a' Chromain, on the west shore of Loch Assapol, with felspar and dark mica, in a vein in the schists ; with faces *m r e o a* (Koch[1]) (Plate LXXIII., fig. 1).

Argyllshire. In Glen Finart, half-way up the south-west slopes of Ben a Chabair, brown fibrous in quartz.

Banffshire. Portsoy, in the first granite vein on the east shore of the Bay of Durn, with Muscovite, graphic Garnet, and Orthoclase. In the third granite vein at the point with graphic Garnet, Muscovite, and Apatite, *b a p* (Plate LXXIII., fig. 2), black, and, very rarely, green. The crystals here are frequently curved, and still more frequently fractured across and faulted. Sometimes the dislodged portions are simply recemented, but more frequently the fragments are cemented by Quartz.

[1] *Trans. Geol. Soc. Glasgow*, vol. vii., p. 52.

In the granite vein east of the graphic granite vein, associated with plumose Muscovite. A little east of Whitehills, in veins in gneiss, *b a p*.

Aberdeenshire. At Rubislaw quarry, with Orthoclase, Garnet, Muscovite, Beryl, and Apatite, sometimes in magnificent crystals 8 inches by 1¼ inch, and finely terminated, *m a r t o* (Plate LXXIII., fig. 3). West of Ellon, in gneiss. At Brupter, Old Meldrum, in granite veins in gneiss. Near Smiddyhill, Logie Coldstone, rarely. Near the Manse of Towie, in large crystals in Quartz. At Daviot, in granite. Near Kildrummy. At Thiefs Slack, Broom Hill, Clova, large imbedded, radiating groups of crystals, in Quartz veins and in granite. In granite veins, cutting decomposed micaceous gneiss, on the south-east slopes of Clashnarae Hill, Clova. In the Cabrach, on the south slopes of Leids Hill, in granite. In a field near Blackhills. In the banks of the Burn of the Gauch. In Balvaley Moss. On the Mount of Haddoch, in schorlaceous, lustrous masses. In Glen Bucket, near the Ladder Pass, loose isolated crystals, rarely. Burn of Glenny, north Clova glen, near Todstown, in very fine, lustrous, black crystals, in a graphic granite vein; also, *b a r s*, holohedral. (Plate LXXIII., fig. 4).

Kincardineshire. At Torry, in granite veins, with Beryl. The Tourmaline here often passes apparently into Muscovite. In veins in the Stoney Hill of Nigg, associated with Oligoclase and Pyrites, *b a p*.

Forfarshire. Near Loch Brandy, on its south side; common also in the schists on the west slopes below the loch (Goodchild). In Quartz, on the stone heaps of the †White Catterthun, near Brechin, *b a p*.

Perthshire. Near Dunkeld, in mica schist. Glen Falloch, Beinn a' Chaistel, in the south-east corrie, below the summit, associated with Ilmenite. Ben More, on its west slopes, fibrous.

Kirkcudbright. New Galloway, indigo blue and brownish green, on the north-east side of Knocknairling Hill, graphic in Quartz, in a coarse-grained granite vein, which cuts Silurian grits (Gardiner).

120. **Staurolite (428).** $H_4(Fe,Mg)_6(Al,Fe)_{24}Si_{11}O_{86}$.

Orthorhombic. [*a* (*b*), 100; *c*, 001; *m*, 110; *r*, 011.]

Twins common. Clv., brachydiagonal perfect; fracture conchoidal to splintery. H., 7; G., 3·5 to 3·8. Translucent to opaque; lustre vitreous to resinous. Colour, reddish-brown. Streak, white. B.B. infusible. Not affected by h. acid; partially soluble in s. acid. Comp., Silica, 30; Alumina, 48·5, with 5·5 Iron Peroxide, 12·5 Iron Protoxide, 3·5 Magnesia.

Shetland. Unst, on the west slopes of the Hamars, half a mile to the east of Woodwick, with Kyanite and Garnets, in a micaceous clay slate.

Combs.: *m a r* (Plate LXXIII., fig. 2), *m a c* twins (Plate LXXIII., fig. 1) (Hibbert). Mainland, Bixter Voe, in mica schist; "crystals as large as those from Brittany" (MacCulloch).

Banffshire. Portsoy, about one yard west of the serpentine and immediately west of the clay slate, in black muscovite schist, in good crystals associated with Kyanite. On the east foot of Sillyearn Hill, near Anderson's Wards farm, in a similar rock (Horne). Near Keith. At the upper fork at the Burn of Boharm, imbedded in quartz seams in clay slate, of a rich brown or amber colour, and with a tesselated structure (Plate LXXIII., fig. 1). In the west bank of the Burn of Aldernie, near limestone in clay slate, with black Kyanite, and displaying the same structure. Marnoch, near the mill of Auchintool, Kinnairdy Castle, in phyllite schist, with Andalusite (Peyton and H.). Loch Builg, on the east side of the stream, about one mile north of the lake, in quartz veins in limestone, and associated with Kyanite, Sphene, Chlorite, and Garnet.

Aberdeenshire. In the Ardonald limestone quarry, between Keith and Huntly, in quartz veins, and, in the adjoining rock, associated with Kyanite (Cunningham). In the flagstone quarry at the summit of Correen Hill, rarely, along with Andalusite. On the north-west slopes of Pitfichie Hill, Monymusk, with Andalusite, in phyllite. On a hill south-east of the Buck of Cabrach.

"Xantholite" is apparently a variety of Staurolite containing magnesia and of which the crystalline form may be oblique. It occurs, rarely, in Inverness-shire, at Glen Urquhart, about a hundred yards west of the Free Church of Millton, in small orange-yellow crystals, in a rock consisting of Edenite, together with white and brown Biotite—Anal. 1. The associates are Wollastonite, in veins, hydrous Anthophyllite, and Garnet, this latter mineral inclosing Zircons.

Heddle, *Min. Mag.*, 3, 57.

SiO_2	Al_2O_3	Fe_2O_3	FeO	MgO	H_2O	Total.
27·12	45·92	8·64	6·90	4·41	2·88	100·16

B. Hydrous Silicates.

Zeolite Division.

121. **Okenite (433).** $H_2Ca(SiO_3)_2 + H_2O$.

? Orthorhombic. Usually fine fibrous; radiating. H., 5; G., 2·28 to 2·36. Pellucid; lustre slightly pearly. Colour, yellowish to bluish-white. In powder easily soluble in h. acid, leaving gelatinous flakes, if treated after ignition. Comp., 56·6 Silica, 28·4 Lime, 17 Water.

Analyses, *Trans. Geol. Soc. Glasgow*, vol. ix., p. 251 :—

	S.G.	SiO_2	Al_2O_3	CaO	Na_2O	H_2O	Total.	
1. Loch Brittle, Skye,	2·198	48·28	4·14	30·63	1·68	15·69	100·42	Stuart Thomson.
2. Dunan Earr an Sgùirr, Skye,	2·246	54·22	·68	27·22	1·02	16·64	99·78	Heddle.

Hebrides. Skye, at the mouth of the An Leth Allt, near Loch Brittle, close to Heulandite—Anal. 1. Dùnan Earr Sgùirr—Anal. 2.

122. **Gyrolite (434).** $H_2Ca_2SiO_3.H_2O$.

Lamellar, radiate, spherical, and investing. H., 3 to 4. Lustre pearly. Colour, bluish-white to cream-coloured. Transparent, but rapidly becoming opaque after exposure. Comp., Silica, 53·3 ; Lime, 32·9 ; Water, 13·8.

Analysis by Anderson, *Phil. Mag.*, i. 1851 :—

	SiO_2	Al_2O_3	Mgo	CaO	H_2O	Total.
Storr, Skye, . .	50·70	1·48	·18	32·24	14·18	99·78

Hebrides. Skye, Rudh' Earr an Sgùirr, between Loch Eynort and Loch Brittle, associated with Faröelite (the " farinaceous " zeolite of MacCulloch). An Leth Allt, close to the last-named locality (Currie). Coire Faoin, south-east of the Storr, with Apophyllite and " Cottonstone " (Bryson and Anderson). Carn Liath, 2 miles north of the Storr, Quiraing, associated with Apophyllite. At the foot of the crag of [Meall na Suiramach] north of the Quiraing, with many other zeolites. North slope of Beinn Edra, associated with Stilbite, Analcime, and Chabazite. Lyndale, with Mesolite and Chabazite. At the quarry on Portree Green. At the foot of Rudha na h-Airde Glaise, Portree, underlying Apophyllite. On the south-east shore of Loch Varkasaig, Loch Bracadale, on Mesolite. Sgurr nam Fiadh, between Talisker and Loch Eynort, on the shore at both ends of a mass fallen from the cliffs above, in cavities in a hard basalt, with no associates ; but near to other vapour cavities in the same rock which contain Analcime, Laumontite, Scolecite, Stilbite, Chabazite, Calcite, Pilolite, and Mesolite (= " Cottonstone "). At the foot of the cliff of Beinn nan Cuithean, close to Talisker Point, sea-green in colour, and associated with many other zeolites. Sgurr nam Boc, between Loch Eynort and Loch Brittle, bright green, and associated with Mesolite. At the mouth of An Leth Allt, Loch Brittle. Canna, on the west shore near the cave. Eogg, on the shore west of the Uamh Fhraing, directly

associated in the same cavity with Mesolite alone, but close to other cavities in the same rock which contain only Stilbite, Faröelite, and Mesolite. Eilean Chasgaidh, on its south-west side, associated with Analcime, Mesolite and Uigite.

Mull, behind the farm-house of Carsaig, frequently associated with Analcime. (This is the "foliated zeolite" of Earl Compton.) At both sides of the Carsaig Arches, with many other zeolites. Near †Beinn na Croise, with Laumontite, Tobermorite, and Analcime (Rose). Bloody Bay, north-west of Tobermory. At the foot of the cliffs at Gribun, imbedded in Xonotlite. At Killiemore House, Kilfinichen, Loch Scridain, associated with Graphite. At Dearg Sgeir, and at Carrachan Mòr, Ardmheadhnach, where it is associated with Pectolite, but not with Apophyllite. Treshnish Islands, south-east side of Lunga, overlying Scolecite, and Faröelite. North-east side of Sgeir a' Chaisteil, crystallised. Fladda, at the east-south-east corner, on Mesolite, and overlaid by Apophyllite, in the lowest bed of amygdaloidal basalt lava there. Also in the lowest basalt lava of Cairn a' Burgh More, and of Cairn a' Burgh Beg, overlying Faröelite, and in rosette groups imbedded in Calcite.

Gyrolite was unquestionably observed and recognised as a new mineral species quite independently by MacCulloch, Haidinger, Giesecke, and Earl Compton; but the mineralogical science of their days was not sufficiently advanced to enable them to individualise it as a species. MacCulloch (*Trans. Geol. Soc.*, vol. iii.) writes of it:—Mesotype—one variety "is disposed in a radiated or rather in a ramose manner, in fine fibres *possessing the peculiar lustre and softness of the finest white pulverulent Talc.* . . . In a third instance, which I observed near Loch Eynort, a mass of globules of solid radiated Mesotype, very much resembling some of the oolites, is intermixed throughout with *farinaceous scales of the same substance, having the greasy aspect and lustre already described.* In speaking of this substance, I have, according to common usage, ranked it with the Mesotypes; it appearing to have been thus placed, partly because it is found associated with them, and partly because of the theoretical views which have been held respecting its origin. It will be for mineralogists of more authority to consider *whether it does not deserve a separate place as a species*, the question is evidently of a nature not to be determined by geometrical analysis, as far at least as the varieties already found extend; and the delicacy and uncertainty of unassisted chemical analysis in questions of this nature are far too great to tempt us to seek a new place for it by this kind of investigation."

In the fifth volume of the *Trans. Geol. Soc. London*, again, we find

Earl Compton, in the year 1821, giving, among a list of minerals which occur a little way inland, and behind the farm-house of Carsaig, "Analcime, a *foliated Zeolite*." In volume vii. of the *Edinburgh Journal of Science*, it is stated, at page 19, that Giesecke discovered what must have been Gyrolite, terming it "micaceous Apophyllite or a sub-species of Apophyllite"; and giving as its locality Nia Kornak, in Disco, where it occurs in vesicular cavities in basalt, associated with Apophyllite, and Mesotype – in one specimen with Chabazite and Levyne, of the specific gravity of 2·382. In the same volume, of the date 1827, in a paper in which Haidinger considers the varieties of Mesole, he writes: "Though even now I cannot pretend to offer a perfect description, the more accurate indication of the regular forms being yet a desideration, yet the crystals which I have examined of these new varieties are such that the place of Mesole in the system of Mohs may be fixed with precision." After excellent descriptions of typical globular varieties of undoubted Mesole from the cave of Naalsöe, he thus describes the species: "VI. Reniform groups with a single cleavage: very bright, pale yellowish-grey, from Nia Kornak, Disco. This new variety shows a very great resemblance to certain kinds of Apophyllite, so much so, that Sir Charles Giesecke, who discovered them, was induced to consider this as a particular sub-species, terming it the micaceous Apophyllite." The seventh specimen is described as "occurring in plates, which have a bright pearly lustre, and thin cleavage planes; the whole aggregate resembles, in no small degree, crystallised spermacetie—form part of the inside of a geode at Karartut, near Godhavn, Disco—colour somewhat yellowish; eighth specimen, large, aggregated, uniform shapes, colour yellowish-grey, cleavage easily obtained, and the laminæ show some elasticity when you attempt to separate them," also from Nia Kornak, in the Umanakefjord, Disco. Haidinger remarks upon its perfect simple cleavage, its marked pearly lustre. "Its specific gravity being above 2·3, is much more considerable than that of either Stilbite or Heulandite, which hardly ever exceed the limit of 2·2, *an immense difference* in species whose specific gravity is at the same time *so inconsiderable* and *so constant* as in the genus Kouphone Spar. In this property it nearly agrees with Apophyllite, but it is readily distinguished in its crest or fan-like aggregations, the like of which never occur in Apophyllite, yield also a good empirical mark, although the crystals hitherto observed are too small, or, rather, too thin to allow of an exact determination. In allusion to these aggregated groups and the kind of fracture depending upon it, I propose Flabelliform Kouphone Spar as the systematic denomination of the species, the first varieties of which were described by Berzelius under the name of Mesole." [The author has slightly modified Haidinger's phraseology.]

Haidinger adds : "It is worth noticing that this species, when it is associated with Stilbite or Apophyllite, will always form the lowest stratum immediately adjoining the basaltic, or amygdaloidal, support in the cavities of which it is deposited."

In this paper of Haidinger's we have a retrograde step, for though he clearly separates the mineral from Apophyllite, yet he does so at the cost of associating it with Mesole, a substance from which it differs, both physically and chemically, to a still greater extent than from Apophyllite.

123. **Apophyllite (435).** $H_7KCa_4(SiO_3)_8 4\frac{1}{2}H_2O$.

Tetragonal. [*a*, 100 ; *c*, 001 ; *m*, 110 ; *p*, 111 ; *r*, 210 ; *v*, 105 ; *s*, 102 ; *e*, 101 ; *x*, 1.1.10 ; *d*, 115 ; *z*, 113. On fig. 11, *q*, 321 (Currie).]

Twins very rare. Twin plane *p*. Habit of the crystals varied from extreme differences in the length of the upright axes, and also from the relative size of the face *p*, which produces a more or less perfect acute pyramid. Appearance of the faces characteristic. The terminal face *c* often rough ; *p* more generally uneven ; *y* striated parallel to its intersection with *a*. Clv., *c* perfect. Fracture uneven. Brittle. H., 4·5 to 5·5 ; G., 2·3 to 2·4. Lustre of *c* pearly ; of the other faces vitreous. Colourless, to white, pale emerald-green, or rose red. Streak white. Transparent to opaque. Double refraction weak ; generally positive. Unbroken crystals in polarised light exhibit a beautiful tesselated structure, of which the tesselæ have curvilinear outlines, and differ much in form. No water lost by heating to 100°, nor by exposure over sulphuric acid. All the water that is driven off at temperatures under 300° F. is reabsorbed ; but only after very prolonged exposure to moist air. Werner found that Apophyllite was soluble in water at 180° to 190° C. under a pressure of from ten to twelve atmospheres. Bunsen found that at all the ordinary temperatures not a trace is soluble under pressures ranging from twelve to seventy-nine atmospheres. In the closed tube exfoliates, whitens, and yields an abundance of water, which affords an acid reaction. In the open tube, when fused with salt of phosphorus, often gives a fluorine reaction. B.B. it exfoliates, colours the flame violet through the presence of potash, and fuses with intumescence to a white blebby enamel ; with salt of phosphorus yields a skeleton of silica. Fusibility = 1·5 of Kobell's Scale. In power it is easily soluble in acid leaving a slimy silicious residue ; but if it has been previously exposed to a red heat then it is decomposed only with difficulty.

	SiO_2	Fe_2O_3	FeO	MnO	MgO	CaO	K_2O	Na_2O	H_2O	F	Total.	
1. Storr, Skye,	51·2	1·09	·09	·3	·5	23·13	5·49	·37	17·02	·7	99·89	Heddle
2. Chapel, Raith	52·54	..	..	..	..	24·86	5·50	tr.	16·22	1·12	100·24	Heddle

The lithological range of the rocks yielding this mineral is very limited. We find it occurring in the intrusive dolerites as well as in the contemporaneous basalt lavas associated with the Lower Carboniferous Rocks of the Basins of the Forth and Clyde. It is also associated with the basal lavas of Tertiary age, occurring in the Western Islands of Scotland. It is found, rarely, in both large and small crystals, associated with Elaterite, in one of the limestones interbedded with the Lower Carboniferous basalt lavas. It likewise, formerly, was found at Strontian, in the vein which lies between the granite and the gneiss—this mode of occurrence being similar to some on the Continent.

Apophyllite would appear to be the very last zeolite to separate and solidify in drusy cavities; and it does not seem to affect many associates. At Rudha nan Clach, in Skye, where there are some druses which contain four zeolites along with Calcite, it holds itself apart, and appears only in cavities *per se*. It seems also to be peculiar as regards these associates —confining itself almost entirely to the company of Gyrolite, Pectolite, and Prehnite—minerals which may be said to fringe the borders of the class of the true zeolites.

Inverness-shire. Skye, Rudh' Earr an Sgùirr, on the coast between Loch Brittle and Loch Eynort (MacCulloch). Near Dunvegan (MacCulloch). At Talisker, *a c*, opaque, white, associated with Scolecite, and *a c p* (Plate LXIII., fig. 1), pale green, associated with Pectolite and Scolecite (Russell). At Sgùirr an Duine, south of Loch Eynort, at the foot of the cliff, in amygdaloidal basalt lava, *a p e*, *c* circumvallated, very lustrous, rare (Plate LXXIII. [?], fig. 2. Also, at the same locality, and associated with crystals of Stilbite, in vapour cavities, on Quartz, with Chalcedony, *a p z e*. At Sgùrr nam Boc, on the coast between Loch Eynort and Loch Brittle, in finely doubly-terminated crystals, *a c*, *a c p*, associated with blue Chalcedony; also in crystals, *a c*, like Plate LXXIII., fig. 2, their terminal faces, being depressed in the centre, forming an elevated ridge of circumvallation. At Quiraing, opaque, white, *a c*, *a c r*, *a c p* (Plate LXXIV., fig. 3), *a c p r* (Plate LXXIV., fig. 4), associated with Gyrolite. At Storr, with Faröelite and Chabazite, *a p* (Plate LXXIV., fig. 5), *a c r* (Plate LXXIV., fig. 6), *a c r* (Plate LXXIV., fig. 7), *a c p r* (Plate LXXIV., fig. 8), *a c p r x*, *a c p r* (Plate LXXV., fig. 9), *a c p z* (Plate

LXXV., fig. 10), *a c r p q* (Plate LXXV., fig. 11), *p a c r m* (Plate LXXV., fig. 12) (Anal. 1), *p a c r d v s* (Plate LXXV., figs 13 and 14) (Currie). At the foot of the cliff at Leacan Fhionn. At the foot of the cliff at Bioda Buidhe, associated with Chabazite, Plynthite, etc. At Rudha nan Clach Loch Bracadale, rarely, but in fine, transparent crystals, *a c p*, in vapour cavities *per se*, but near other cavities in the same rock that contain Stilbite, Mesolite, Analcime, Chabazite, and Calcite. In a quarry at Portree. At the foot of Rudha na h-Airde Glaise, overlying Gyrolite. Also at the same locality overlying Mesolite, *a c p r d v s* (see Plate LXXV., figs. 13 and 14) (Currie). On the north shore of Loch Varkasaig, Loch Bracadale, overlying Mesolite.

Argyllshire. At Strontian, rarely, *a c*, on Strontianite (Sowerby). At the Carsaig Arches, Mull, rarely. At the south end of the Wilderness, Loch Scridain, Mull, in large crystals, *a c a c p*, on Analcime and penetrated by Scolecite (Miss M. Currie). In the lowest basalt lavas of the Treshnish Islands, at the E.S.E. corner of Fladda, overlying Gyrolite.

Dumbartonshire. At Bowling quarry, overlying Prehnite, *a p* (Plate LXXV., fig. 16) (Greg). "Kilpartick Hills" (MacCulloch). Old Kilpatrick, *a p* (Greg).

Fifeshire. At Chapel quarries, Raith (Christison), in fine crystals, *a c p r* (Plate LXXV., fig. 15), with Elaterite and Dolomite, in [Yoredale] limestone [which has been covered, until recently, by Lower Carboniferous basalt lavas]—Anal. 2. In a basaltic dyke half a mile west of St. Andrews, *a c*.

Stirlingshire. In Auchinstarry quarry, Kilsyth, on Pectolite, *a c p r* (Duncan) [*a p e*, associated with Pectolite and also with Ænigmatite at Kilsyth, according to Dr. Heddle].

Edinburghshire. On the surface of Prehnite, *p a c*, *p a r* (Plate LXXVI., fig. 17) [in cavities in dolerite], in Corstorphine east quarry (Bryson). In Ratho quarry, on the surface of Pectolite [in cavities in dolerite] in transparent crystals, *p* (Plate LXXVI., fig. 18), *p a* (Plate LXXVI., fig. 19), and *p a c*.

124. Xonotlite (435a).

Massive. H., 6; G., 2·6 to 2·7. Colour, pink, white, grey. Tough. Fracture conchoidal and splintery. Comp., Silica, 49·8; Lime, 43·5; Protoxide of Manganese, 2·3; Protoxide of Iron, 2·9; Water, 3·7.

Analysis by Heddle:—*Min. Mag.*, 5, 4, (1882).

	S.G.	SiO_2	Al_2O_3	FeO	MnO	CaO	MgO	K_2O	Na_2O	H_2O	Total
Kilfinichen, Loch Scridain	2·605	48·91	·11	2·97	2·27	40·39	·56	1·16	·22	4·17	100·76

In the Tertiary basalt lavas of Mull, at Kilfinichen, Loch Scridain

(Rose & H.), s. a. 2·605. At Gribun, opposite Oronsay, and on the north shore of Loch na Keal. It usually overlies Gyrolite (Currie).

115. **Tobermorite (435b).**

Massive, fine granular : translucent ; fracture hackly. H., 5 ; G., 2·4. Colour pale pink. Comp., Silica, 49·8 ; Lime, 37·2 ; Water, 12·9.

Analyses : Heddle :—*Min. Mag.*, IV. 119.

	S.G.	SiO_2	Al_2O_3	Fe_2O_3	FeO	CaO	MgO	K_2O	Na_2O	H_2O	Total.
Tobermory, .	..	46·51	2·40	1·14	1·85	33·40	·47	1·45	·36	12·61	100·19
Bloody Bay, .	2·423	46·62	3·90	·66	1·08	33·98	..	·57	·89	12·01	99·81

Occurs in the basic eruptive rocks of north-east Mull from Tobermory to Bloody Bay, sometimes surrounded by a thin zone of pale blue massive Mesolite – Anals. 1 and 2. Also near Dunvegan Pier, Skye (Currie).

Zeolites—Heulandite Group.

126. **Heulandite (438).** $H_4CaAl_2(SiO_3)_6.3H_2O$.

Monoclinic. [*a*, 100 ; *b*, 010 ; *c*, 001 ; *m*, 110 ; *t*, 201 ; *s*, $\bar{2}01$; *u*, 111 ; *o*, ? 101 ; *x*, 021, *z*, 052.]

The crystals may be elongated along any axis, and thus present very diverse forms ; but they are usually tabular. Clv., clinodiagonal perfect, and presenting a pearly lustre ; the other faces vitreous. Brittle. H., 3·5 to 4 ; G., 2·1 to 2·2. Transparent to translucent ; colourless, white, brick-red, rose-red, green, hair-brown. B.V. melts with exfoliation and intumescence to a white enamel. Soluble in h. acid, leaving silica.

Analysis :—

	SiO_2	Al_2O_3	Fe_2O_3	FeO	CaO	MgO	K_2O	Na_2O	H_2O	Total.
Tod Head, . .	57·46	17·38	·62	·2	5·17	·53	2·14	·16	17·02	100·68

Shetland. Papa Stour, at the Kirksands, rarely, lining the druses [of an eruptive rock] in minute red crystals.

Orkney. Sands Geo, Walls, in small red crystals lining the amygdules of Pearlspar and Analcime in Upper Old Red Sandstone lava.

Hebrides. Skye, at Storr [in cavities in basalt], upon Apophyllite but underlying Stilbite, in colourless, highly lustrous crystals half an inch in length. *b s t c m x*, *b s t c m u*, *b s t c m*, *b s t c m u x* (Currie), *b t s m c z x* (Plate LXXVI., fig. 1), rarely. At Talisker Bay, on the south side, *b t s c* (Mackenzie), and *b s t e m u* (Currie). Loch Bracadale, at the north shore of Loch Varkasaig, underlying Stilbite. In large plates at Sgùrr

an Duine, south of Loch Eynort. At the mouth of Allt Mòr between Loch Eynort and Loch Brittle, *b s t c m x u* (Plate LXXVI., fig. 3), and *b s t c m u x z*, colourless, with Stilbite, Quartz, and Calcite (Currie). At the cliff foot south-west of Sgùrr nam Boc., *b c m s t u o x* (Plate LXXVI., fig. 2), colourless, *per se* (Heddle); also *b s t m u*, *b s t m u c*, *b s t m u c x* and *b s t m u c x a*, *b t s m c x u z*, with Stilbite and Quartz (Currie). Generally, without associates (Plate LXXVI., fig. 4), colourless, or pale flesh coloured, sometimes with Stilbite, rarely with Calcite (Currie).

Canna, towards the southern end of the west shore, rarely, associated with Gyrolite, Stilbite, Plynthite, Mesolite, Chabazite, Analcime, Laumontite, and Calcite. Rudha nan Clach, rarely, *b s t c u*, *b s t c m*.

Sanda, at the east Geo, in highly-lustrous, pearly-white crystals, an inch in length and the same in breadth, *b s t m u*, *b s t m c*, *c b s t m u*, associated with Analcime, Stilbite, Scolecite, Laumontite, Sphærostilbite, and Calcite. Colourless.

Argyllshire. Mull, at Carsaig Arches, in radiating, brush-like groups of crystals of high lustre, over two inches in length, occurring in narrow fissures of a decomposing basic eruptive rock. Also in small crystals, *b t s x*, on Stilbite, both being colourless, rarely, *b s t m c x*, *b t s m c x u*. Kintyre, at Balligroggan, Machrihanish Bay, in crystals over an inch in length, of a deep red colour, and associated with Barytes and red Mesolite (Bell). At Galdrings, near the last-named locality, in small crystals, *b s t c*, *b s t c m*. Treshnish Isles, Bac Mòr (Currie).

Kincardineshire. Kinneff, in a quarry at the cliff of the Slainges, east of Hall Hill, and just south of Tod Head, in small brick-red crystals, underlying red Stilbite. At Gapol, and at Tod Head, in large red crystals, underlying red Stilbite—*b s t m x*; *b s t c x*, *b s t c u*, *b s t c m u x* (Sowerby) —Anal. 1. At Thornyhive Bay, colourless, and associated with Calcite. Similarly, at the Long Craig of Tremuda Bay. In scarlet crystals, associated with red Stilbite, and crystalline Sapenite, in zeolitic Quartz, at the bifurcation of the road near the church of Kinneff.

Fifeshire. At Scurr Hill, Balmerino, in bright red crystals sprinkled over Saponite, and forming the "skin" and also the cores of stalactitic agates. Kincraig, Elie, in small red crystals lining druses of Calcite in agglomerate, and of the forms *m b s t c x* (Plate LXXVII., fig. 6), *b s t m x b s t m x u*, and *m b s t z*. It has been said to occur in the Isle of May.

Perthshire. Said to occur [in the Old Red Andesitic lavas] at Glen Farg (Greg).

Stirlingshire. At Campsie Fells, associated with Quartz, Saponite and Calcite, *m b s t z*, *b s t c*, *m b s t z x*, *m b s t c u x* (Greg). Carbeth, red in colour and associated with red Stilbite, *b s t c x* (Jameson). On the

south slopes of Balhennan Hill, Fintry, in small brick-red crystals, *b c t s m* Plate LXXVII., fig. 7), lining rents in the volcanic rocks. Stockie Muir (Thomson). In minute, rarely in large, deep red crystals, *b s t m x* (Plate LXXVII., fig. 9), underlying red Stilbite, found in excavating for the new reservoir [for the water supply of Stirling] on the Touch Hills Kidston, and also Goodchild). In small crystals, *b m t s c x* (Plate-(LXXVII., fig. 10), underlying red Stilbite ; also in druses, both *per se*, and associated with Rubin- glimmer, near the Earl's Burn Reservoir Touch-adam Muir (Kidston).

Dumbartonshire. Lang Crag (Clacher) and Loch Humphrey, at the dam-cutting (Jameson), *b s t*, *m b s c t - - - x - - - u*, associated with red Stilbite. In an old quarry in the avenue leading to Cochno house, *b s t m u x c* (Plate LXXVII., fig. 11), *b s t m x z* (Plate LXXVII., fig. 12), *b s t m c x*, rarely (Plate LXXVII., fig. 13).

Renfrewshire. In a quarry south of Kilmalcolm, in highly-lustrous, colourless crystals, *b s t c. m b s c t* (Plate LXXVIII., fig. 14). Near the station, *t s c b m x* (Plate LXXVIII., fig. 15), colourless, associated with Quartz, Stilbite, and Calcite (Currie).

Bute. In Little Cumbrae, at the south end, in vapour cavities in eruptive rocks, associated with zeolitic Quartz, and of a brick-red colour *b s t c* (Neilson).

Fig. 11 may be taken as the typical form for Scottish Heulandites. Undue elongation along each one of the three axes may be seen in the figures above referred to. Figs. 7, 8, and 9 present very unusual developments ; and it may be remarked that an apparently re-entering angle on the faces *t* and *s* of the Heulandites from Ben More raises some doubt as to the primary form.

In amygdaloidal eruptive rocks which contain free zeolites and at the same time much Calcite, minute crystals of red Heulandite generally line the druses. Such crystals also occasionally form the inner part of the lining of Celedonite which coats the vapour-cavities in which Agates of both the ordinary type and Moss Agates occur.

127. **Brewsterite** (**439**). $H_4(Sr,Ba,Ca)Al_2(SiO_3)_6{\cdot}3H_2O$.

Monoclinic. [*a*, 100 ; *b*, 010 ; *c*, 001 ; *m*, 110 ; *t*, 120 ; *s*, 230 ; *e*, 016.]

Clv., clinodiagonal perfect ; lustre pearly on the faces of cleavage, vitreous on the other faces ; pellucid. H., 5 to 5·5 ; G., 2·5 to 2·45. Colourless, yellow, brown. Soluble, with gelatinisation in h. acid. Comp., 54·3 Silica, 15 Alumina, 9 Strontia, 6·6 Baryta, 1·3 Lime, 13·5 Water.

Analyses :—1. *Edin. N. Phil. Journal*, x. 35 ; 2 *Minerology*, i. p. 348 ; 5. *Phil. Mag.*, xviii. p. 218.

	SiO_2	Al_2O_3	Fe_2O_3	BaO	SrO	CaO	H_2O	Total.	
1. Strontian, . .	53·67	17·49	·29	6·75	8·32	1·35	12·58	100·45	Connell.
2. ,, . .	53·04	16·54	..	6·05	9·01	·80	14·74	100·18	T. Thomson.
3. ,, . .	54·49	15·42	tr.	6·76	8·78	·92	13·39	99·76	J. W. Mallet.
4. ,, . .	53·66	15·29	·08	6·84	9·20	1·46	13·06	95·59	J. W. Mallet.
5. ,, . .	54·42	15·25	..	6·80	8·99	1·19	13·22	60·87	J. W. Mallet.

ARGYLLSHIRE. Strontian, chiefly in the Bellsgrove lead mine, associated with Harmotome, Morvenite, Barytes, Schiefer Spar, and unusual crystalline forms of Calcite, much of which is brown. Also at Middleshope, at the same mines, without associates; and at Whitesmith mine, associated with Strontianite [usually in the combinations *a b m t e c*], Also *m c a b e*, *m a b e t* (Greg), and *b m c a e t s*.

DUMBARTONSHIRE. Said to occur at Kilpatrick on Calcite (Groth).

128. **Epistilbite (440).** $H_4CaAl_2(SiO_3)_6.3H_2O$.

Monoclinic. [*m*, 100; *c*, 001; *t*, $\bar{1}01$; ? *b*, 010.]

Clv., brachydiagonal perfect. H., 3·5 to 4; G., 2·3 to 2·4. Pellucid; lustre vitreous, but pearly on the cleavage faces. Colourless. Soluble without gelatinisation. Comp., Silica, 59; Alumina, 17·5; Lime, 9; Soda, 1·5; 14·5.

HEBRIDES. Skye, at Talisker, very rarely, with Acadialite, *b m c* (Plate LXXVIII., fig. 1). Said to have been discovered there "in 1852, by Mr. James Russell, of Chapelhall, Airdrie. It occurs in small crystals of a pale-flesh colour, transparent, brilliant, and very perfect, in cavities, in amygdaloid. But two specimens were found; they are in Mr. Greg's collection. The face [*b*] is barely perceptible" (Greg and Lettsom, *Brit. Min.*, p. 166). On the shore below Beal, associated with Analcime, *m c t* (Plate LXXVIII., fig. 2).

Mull, on the shore at Dearg Sgeir, north of the entrance to Loch Scridain, associated with Scolecite, in amygdaloidal basalt.

Phillipsite Group.

129. **Phillipsite (441).** $(K_2,Ca)Al_2Si_4O_{12}+.4\frac{1}{2}H_2O$.

Monoclinic. [*s* (*a*), 100; *b*, 010; *p* (*m*), 110; *a* (*c*), 001; *m*, 110.]

Faces *b* and *m* striated parallel to their mutual intersection. Apparently always twinned: generally these twins are duplicated by intersection, and are frequently arranged so that three of the double twins just mentioned intersect at right angles to each other, and thus gives rise to doubly-cruciform aggregates. When the prismatic faces of these latter are short, the *m* faces of the intersecting individuals form nearly one plane.

Brittle: fracture uneven. H., 4·5; G., 2·15 to 2·2. Gelatinises in h. acid. Comp., Silica, 48·6; Alumina, 20·2; Lime, 7·3; Potash, 6·2; Water, 17·7.

EDINBURGHSHIRE. Corstorphine Hill, in the east quarry, upon the surfaces of Prehnite in cavities in dolerite, in the form *b a s p* (Plate LXXVIII., fig. 1). Also half of a double cruciform aggregate of four individuals of *a p* (? Plate LXXVIII., fig. 2). [The author did not confirm these records.]

RENFREWSHIRE. In Bishopton Tunnel, associated with Prehnite, Greenockite, and Rubinglimmer, in simple crystals like Plate LXXVIII., fig. 1. Kilmalcolm, *a b p*, and twin, *b p*, sometimes associated with Analcime.

130. **Harmotome** (**442**). $H_2(K_2,Ba)Al_2Si_5O_{15}+5H_2O$.

Monoclinic. [*s* (*a*), 100; *b*, 010; *p* (*m*), 110; *a* (*c*), 001; *t*, *s* in figures 5 and 8, 101, and *f*, $\bar{1}01$; *v*, 410; *x* ? 510.]

Crystalline forms like those of Phillipsite; but G. = 2·3 to 2·5; and the present mineral fuses with difficulty. Difficultly soluble in h. acid. Comp., 46·5 Silica, 15·9 Alumina, 23·7 Baryta, and 13·9 Water.

Analyses:—1. *Pogg. Ann*, xxxvii 561; 2. *ibid.*, cx. 624; 3. *Ed. N. Phil. J.*, xxv. 33; 4. *Ann. N. York*, 1828, 9; 5. 6. 7. *Ann. Mines* (1846), ix. 339; 8. *Q. J. G. S.*, xxvii. 374.

	SiO_2	Al_2O_3	Fe_2O_3	BaO	CaO	K_2O	Na_2O	H_2O	Total.	
1. Strontian,	46·10	16·41	..	20·81	·63	90	..	15·11	99·96	Köhler.
2. ,,	47·52	16·94	..	20·25	..	1	1·09	13·45	100·25	Rammelsberg.
3. ,,	47·04	15·24	·24	20·85	·1	·88	·84	14·92	100·11	Connell.
4. ,,	48·73	15·10	..	14·27	3·18	2·55	..	14	97·83	Thomson.
5. ,,	47·74	15·68	·51	21·06	..	·78	·8	13·19	99·76	Damour.
6. ,, *Morvenite*	47·60	16·39	·65	20·86	..	·81	·74	14·16	101·21	Damour.
7. ,,	47·59	16·71	·56	20·45	..	..	..	14·16	99·47	Damour.
8. Corrantee,	48·02	17·42	..	20·17	..	·62		13·77	100·00	Reynolds.

ARGYLLSHIRE. At the Strontian lead mines, in veins traversing granite near its junction with the gneiss, chiefly in the shaft known as Bellsgrove, associated with yellow, brown, and white Calcites of varied and uncommon forms, Schiefer Spar, Morvenite, Brewsterite, etc. At Clashgoim and Harmotome occurs in opaque white crystals, up to an inch in length, associated with Calcite, Barytes, and, occasionally, with Brewsterite. Forms, *b a s p* (Plate LXXIX., fig. 1), *b a s p t* (Plate LXXIX., fig. 2), twins. Also at Féith Dhomhail in small transparent crystals of the forms *a s p*, *a s p v* ("Morvenite"); often occurring upon pale green hornstone, and often coloured by the same. Anal. 6. At Corrantee, on the east slopes of Ben Resipol, in small, brilliant, transparent, crystals,

associated with Calcite, and of the comb. *a s v p b*, twins (Plate LXXIX., fig. 3) (Reynolds)—Anal. 8. The transparent variety known as Morvenite occurs also at Bellsgrove and Whitesmith mines. The usual combination is *a s v p b* (LXXIX., fig. 4); but at Whitesmith crystals of *a b p v s* show in addition to these, a low face *x* (Plate LXXIX., fig. 5). Crystals of *b s*, *b s a*, *b s a p*, of the transparent variety, all twins, also occur.

Stirlingshire. Campsie Fells, *a b p v s* (Greg). Associated with Analcime (Haidinger), both greenish- and reddish-white. At Earlsburn Reservoir, Touchadam Muir, associated with Analcime and zeolitic Quartz, in unstriated crystals, *a b p*, and also in double twins, *a b p v* (Kidston).

Dumbartonshire. Kilpatrick, Bowling quarry, on the west side, *a b p s*, with an inverted twin (Plate LXXIX., fig. 6), in veins in a tufaceous bed, associated with Stilbite, Heulandite, and Laumontite, but with no Prehnite. Forms, *b p*, twins, and *a b p s*, with a low face (*t*) between *a* and *s* (Plate LXXIX., fig. 7). Old Kilpatrick, *s b*, twins (Plate LXXIX., fig 8), associated with Cluthalite, Rubinglimmer, and Edingtonite, on a wackenitic base (Clacher)—probably, however, Bowling. In cavities in crystalline Barytes, underlying Prehnite, in the Prehnite veins on the east side of the quarry, associated with Edingtonite. Very rarely, in druses in association with Edingtonite alone *a b s* (Plate LXXX., fig. 9). In the cliffs on the east side of Glen Arbuck, *a b p*, and *s p*, twins; *a b s - - p* twins (Plate LXXX., fig. 10), sometimes associated with Analcime.

Edinburghshire. Corstorphine Hill, in the north dolerite quarry, on the east side, where it occurs upon the surface of Prehnite, in the form *b a s p*, like that of Plate LXXIX., fig. 1 above; also in the form of half of a double cruciform composition of four individuals of *a p*, which are like Plate LXXIX., fig. 2 above.

Renfrewshire. In Bishopton Tunnel, associated with Prehnite, Greenockite, and Rubinglimmer, in simple crystals, *b a s p*, like Plate LXXIX., fig. 1. Kilmalcolm, *a b p*, and twins, *b p*, sometimes associated with Analcime.

131. **Stilbite (443).** $(Na_2,Ca)Al_2Si_6O_{16}+6H_2O$.

Monoclinic (but with an orthorhombic habit). [Treated as a monoclinic fourling:—*a* (*b*), 010; *b* (*c*), 001; *r* (*m*), 110; *t*, 130; *c*, in figure 2, *p* (*f*), $\bar{1}01$; *m* (*e*), 011.]

Clv., *a* (*b*) perfect. H., 3·5 to 4; G., 2·1 to 2·2. Transparent: lustre vitreous; pearly on *a*. Colourless, white, yellow, pale brown, brick-red. Decomposed by h. acid, leaving silica. Comp., Silica, 57·5; Alumina, 16·4; Lime, 8·9; Water, 17·2.

Analyses :— 1, 2, 4. unpublished ; 3, 3*a*. *Min.*, i. 345 ; 5. *Chem. News*. xxvii. 56.

	SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	MgO	CaO	K_2O	Na_2O	H_2O	Total.	
1. Tod Head,	57·3	14·42	1·22	·75	·4	·6	5·15	1·64	2·23	17·22	100·93	Heddle.
2. ,,	..	..	1·11	·71	·21	·77	5·28	1·71	2·18	..	..	Heddle.
3. Dumbarton,	52·5	17·32	..	..	..	..	11·52	..	..	18·45	99·79	Thomson.
3*a*. ,,	54·81	18·20	..	..	..	..	9·83	..	..	19·00	101·84	,,
4. Cochno, red,	57·8	15·92	·13	..	..	..	8·01	·2	·89	17·06	100·01	Heddle.
5. Lang Crag,	57·82	15·3	..	..	..	..	8·12	..	·83	17·85	99·92	Young.

Ross-shire. Shiant Isles, south-west corner of Eilean Mhuire, in veins with Calcite (MacCulloch) ; and in white crystals of the form *a b m r*, associated with Mesolite. The north shore of Garbh Eilean, at the east angle, associated with Analcime and Mesolite.

Inverness-shire. Skye, at Storr (MacCulloch), in large druses and of the sheaf-like variety ; also colourless, upon the surface of a vein of Laumontite, and of the form *a b p*, *a b r p*. At Talisker, on the south shore of the bay, club-shaped, and white, similar to the Stilbite of the Berufiord in Iceland. The Talisker examples are in groups of the form *a b p r*, *a b p*, and are associated with Gyrolite Loch Snizort, *a b p*. *a b p r*, *a b r* (MacCulloch). On the north shore of Orbost, Loch Varkasaig, Loch Bracadale, *a b r*, overlying Stilbite (Plate LXXX., fig. 1). Rudha nan Clach, rarely, and associated with Analcime, Chabazite, and Olivine. Sgùrr nan Fiadh, 2 miles north-west of the foot of Loch Eynort, in groups of *a b r*, some of the crystals being more than an inch in length ; they are colourless, and highly lustrous (Harvie Brown). These are in cavities *per se* ; and the general aspect of the specimens is in every respect similar to that of the Stilbites from Faröe. On the north slopes of Beinn Edra, associated with Analcime, Chabazite, and Gyrolite. Leacan Fhionn, north of the Quiraing, and on the east of the same locality, associated with Mesolite, Thomsonite, and Alancime. Near Loch Eynort, an inch in length, on Quartz crystals. At the mouth of Allt Mòr, on the coast, 1 mile north-west of the foot of Loch Brittle. At the foot of the cliff at Sgùrr nam Boc, in very fine crystals, 2 inches in length. Between Talisker and Loch Brittle, with a chalcedonic nucleus (MacCulloch), *a b m r t p*, colourless (Currie). Cliff foot of Beinn nan Cuithean, †Geodha Tuill, delicate. At Sgùrr an Duine, associated with Apophyllite. At Rudha na h' Airde Glaise, near Portree, *a b r* (Currie).

Eigg. On the shore west of Uamh Fhraing, at the southern extremity of the island, white, and associated with Gyrolite, Faroelite, Chalcedony, and Mesolite

Canna, west shore, (Jameson). East shore, *a b r* (Miss Currie).

Sanda Island, at the East Geo, associated with Analcime and other zeolites.

Argyllshire. Mull, in the northern part of the island, associated with analcime, Mesolite, and Prehnite (MacCulloch). Carsaig Arches, rarely, in association with Heulandite. In minute yellow crystals, *a b p*, in a rock containing albite, Quartz, and Magnetite ("granophyre"). Beinn a' Chraig, 3 miles south-west of Salen. Maol nan Damh, Ben More, rarely, *a b r* (Currie). Under the cliffs of Torosay, *a b r per se*, on Calcite, and on Quartz (Currie).

Staffa, in amygdaloid (MacCulloch).

Treshnish Islands, Bac Mòr, underlying Analcime, and "Cottonstone." at the south angle of the island. Lunga, on the east side, overlying Scolecite and Faroelite.

Kerrera, in fissures of the schist near trap (MacCulloch).

Mull of Kintyre, on the Kildalloig shore, in thick, pale yellow crystals, *a b p*, associated with yellow Calcite.

Perthshire. Kinnoul Hill, (MacCulloch). Glen Farg (Greg).

Kincardineshire. Kinneff, in a quarry on the cliff face at the Slainges, east of Hall Hill, in large, sheafy groups of crystals of a brick-red colour, over Heulandite (Sowerby). At Tod Head, associated with Calcite, in large red sheaves—Anal. 1 and 2. At Green Downie Rock, Gapol, Braidon Bay, colourless. At a quarry at the bifurcation of the road near Kinneff church, in large crystals of a scarlet colour, associated with Heulandite, Saponite, and zeolitic Quartz.

Forfarshire. At the Craig railway cutting, at the spot marked [at the time this observation was made] for the station, where it occurred in the form of small red, clustered groups of crystals, lining druses, which were filled with Calcite (Mitchell).

Stirlingshire. At "Campsie and Fintry," red, associated with red Heulandite (Greg). Earls Burn Reservoir, Touchadam Muir, red, in large crystals, associated with red Heulandite and Rubinglimmer *a b p r* (Kidston). Also, *a m b r t*, like Plate LXXX., fig. 3 (Goodchild). At Carbeth, red *a b r p* (Plate LXXX., fig. 2) (Jameson). †Carberry, near Stockie Muir, 6 miles north-west of Strathblane (Thomson). Gargunnock Hills, in a loose block which lay at the height of 750 feet upon the west side of a spur of the Black Craig, near the head-waters of the Leckie Burn, dark brick-red, with radiated blue zeolitic Quartz (Kidston). In an excavation made during the construction of the dam for the new reservoir on the Touch Hills (Kidston), red *a b r p*, large aggregates, in andesite lavas.

Dumbartonshire. Near Dumbarton (Thomson)—Anal. 3. 3*a*. At Loch Humphrey, *a b r m t* (Jameson). Lang Crag (Clacher), red,

associated with red Heulandite, in large crystals, *a b r*, *a b p r*, *a b p r m*, *a b r m t* (Plate LXXX., fig. 3)—Anal. 5. In a quarry in the avenue leading to Cochno house (Brown, Lanfyne), red, *a b r*, *a b p r*, *a b p r m*—Anal. 4.

Lanarkshire. Leadhills, associated with Laumontite and zeolitic Quartz, very rarely, in veins traversing Ordovician rocks; the crystals are club-shaped, and brown in colour (Wilson) [?].

Renfrewshire. At Kilmalcolm, in large, pale brown, sheafy crystals, *a b r*, *a b p r*, associated with Chabazite, Calcite, and "Cottonstone." Also in small doubly-terminated, colourless crystals, *a b r*, disposed upon the tufts of the "Cottonstone." At Port-Glasgow (Greg). At Lochwinnoch (Greg).

Ayrshire. New Cumnock (Boué). In the channel of the Calder, half a mile above Cloverstone, red, foliated, in coarse-grained greenstone (Watson). In the channel of the Rye Water, 2 miles above Baidland limestone quarry, in small, pink, grouped crystals, associated with rosettes of white Quartz, and with Saponite (Delessite). (Skipsey.)

Bute. Arran, at Garbh coire Dubh, in brown crystals, *a b r* (Plate LXXX., fig. 4), in veins in granite (Greg); sometimes in small cavities along with lustrous Orthoclase (*Murchisonite*).

132. **Laumontite (445).** $H_4CaAl_2Si_4O_{14}+2H_2O$.

Monoclinic. [*b* (*a*), 100; *a* (*b*), 010; *x* (*c*), 001; *m*, 110; *c*, the (*e*) of Miller, $\bar{1}02$; *z* (*e*), 201; *d*, $20\bar{1}$; *f*, $\bar{6}01$; *u*, $\bar{1}11$; *o* (? *r*, 111; *l*, ? 120; *n*, ? 210.]

Twin face *a*. Cleavage, *m* perfect; very brittle. H., 3 to 3·5; G., 2·3. Pellucid when fresh; lustre vitreous, pearly on cleavage planes. White, cream-coloured, brick-red. Decomposes rapidly through loss of water. B.B. intumesces, and melts first to a white enamel, and ultimately to a clear glass. Gelatinises in h. acid. Comp., Silica, 50·9; Alumina, 21·8; Lime 11·9; Water, 16·3. Rapidly loses one equivalent, or 3·86 per cent. of water, and becomes friable (*Hypostilbite*).

Analyses:—1 and 5. *Edin. N. Phil. J.*, 1829; 2 and 3. *Pogg. Am.*, lix. 339; 4. *Am. J. Sc.*, xxii. 179.

	SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	K_2O	Na_2	H_2O	Total.	
1. Snizort, Skye.	52·04	21·14	..	..	16·62	..	..	14·92	·98·72	Connell.
2.	52·30	22·30	..	..	12·00	..	..	14·20	100·80	Babo &
3.	51·17	21·23	..	..	12·43	..	..	15·17	100·00	Delffs.
4. .. red,	53·95	20·13	..	·87	12·86	..	..	12·42	100·23	Mallet.
5. .. "*Hypostilbite*"	53·04	22·94	..	..	9·67	..	..	14·64	100·31	Scott.
6. Storr. ..	51·98	20·34	·59	..	11·55	..	..	15·78	100·24	Heddle.
7. .. .. crystals.	51·09	21·29	·32	..	11·49	..	·31	15·37	99·87	Heddle.
8. Glen Farg, . .	49·31	19·62	·96	·08	10·05	2·27	1·8	15·74	99·83	Heddle.
9. Mugdock Tunnel, .	51·30	24·00	tr.	..	10·94	..	..	13·70	99·94	Young.

Inverness-shire. Skye, at Snizort, in veins 3 inches thick, associated with Stilbite (MacCulloch)—Anal 1. In acicular transparent crystals on Stilbite, near Talisker (Greg) At the cliff foot of Beinn nan Cuithean, south of Bioda Rudha, between Talisker and Loch Eynort, associated with green Chert, white Calcite, and many zeolites. Between Loch Eynort and Loch Brittle, associated with Stilbite (MacCulloch). In a cave at Sgùrr nam Fiadh, between Talisker and Loch Eynort, in very fine pink crystals, an inch in length, associated with the inverse rhombohedron of Calcite ; also at the same locality, in the form of small crystals, sprinkled over Stilbite. At the foot of the cliff of Sgùrr an Duine, south of Loch Eynort, in doubly-terminated, lustrous crystals, one and a half inches in length, overlying Calcite. At Storr (Anal. 5), in a vein an inch and a half in thickness, and somewhat weathered ("*Hypostilbite*") Anal. 6. It also occurs there sprinkled over Stilbite—Anal. 7. At the north end of Leacan Fhionn, Quiraing, with many other zeolites, in minute crystals.

Canna, on the south-west side, associated with several other zeolites.

Sanda, on the east side, with Analcime.

Argyllshire. Mull, well-crystallised, *c m a b x z n l o* (Plate LXXX., fig. 1), near Beinn na Croise, between the head of Loch Scridain and Loch Buy, isolated in cavities, but with Scolecite and Epidote [in the druses] adjacent (Rose). Also in the form *c m z* (Plate LXXX., fig. 2). At Carsaig Arches, rarely. At Bloody Bay, near Tobermory, associated with Tobermorite, Gyrolite, Analcime, and Mesolite. On the shore in the cliffs north of Aros Castle.

Staffa, rarely, at the north end.

Kincardineshire. At Thornyhive, on the coast 2 miles south of Stonehaven, in druses, with Quartz and Saponite. At Tod Head, on the coast 6 miles south of Stonehaven, in a north-easterly vein which cuts the Lower Old Red Conglomerate, and also cuts the vein of Pilolite which occurs there ; in flesh-red crystals 2 inches in length, and surrounded by Calcite (Sowerby).

Perthshire. At Glen Farg, or Glen Pottie, of a deep red colour, and of the form *c m* [*x*] (Plate LXXX., fig 3) ; sometimes passing into a saponitic pseudomorph (Murray)—Anal. 8.

Stirlingshire. At Carbeth, 2 miles west of Strathblane, crystallised (Greg), associated with Mesotype in the Campsie Fells (Greg). In the Mugdock Tunnel, near Strathblane, in divergent groups of brown crystals (Young)—Anal. 9. At Earls Burn Reservoir, Touchadam Muir, in large crystals underlying Analcime (Kidston and Goodchild).

Dumbartonshire. At Lang Crag, well-crystallised (Clacher). In Bowling quarry, occasionally, in veins, well-crystallised (Jameson).

Renfrewshire. At Hartfield Moss, in white, translucent crystals (Plate LXXXI., fig. 3), in a vein in a basic eruptive rock ; also, at the same locality, in twin crystals (Plate LXXXI., fig. 4). Singularly combined with Barytes, at Cloak, near Lochwinnoch (Greg). At Kilmalcolm, of a brick-red colour, associated with Calcite and Stilbite (Greg), in crystals of the comb. *c m*, nearly an inch in length. In the neighbourhood of Paisley *c m* (Phillips). Also, *c m*, in the railway tunnel at Bishopton, associated with Galactite, Thomsonite, and Greenockite. On a hill south of Port-Glasgow, *m c z x d r* (Plate LXXXI., fig. 5). Boyleston quarry, near Barrhead, associated with Natrolite, disposed on Prehnite and Calcite.

Dumfriesshire. Said to have occurred, with large crystals of brown Stilbite, near Wanlockhead, in veins consisting of radiating crystals of Quartz, which cut Ordovician rocks (Wilson) [?].

Chabazite Group.

133. **Chabazite (447).** $(Ca,Na_2)Al_2Si_4O_{12}+6H_2O$.

Rhombohedral. [*r*, 100, $10\bar{1}1$; *e*, 011, $01\bar{1}2$; *s*, $\bar{1}11$, $02\bar{2}1$; *a*, $01\bar{1}$, $11\bar{2}0$; *t*, 021, $11\bar{2}3$; *z* (*i*), 13.1.10, $12.1.\bar{1}\bar{3}.14$.]

Twins very common, generally intersecting. The primary rhombohedron *r* is sometimes twinned with a crystal with the faces *r*, *e*, *s*. The faces *e*, *r* striated parallel to their intersection with each other, and *a* is striated parallel to its intersections with *r*. Cleavage, *r* perfect ; fracture uneven. H., 4 to 4·5 ; G., 2 to 2·2. Streak white, transparent, or translucent ; lustre vitreous. Colourless, and brownish, yellowish, brick-red, and flesh-red. In the matrass yields water. Melts easily before the blowpipe into a spongy white enamel. Soluble in h. acid, leaving a jelly of silica. Comp., Silica, 47·8 ; Alumia, 20·2 ; Lime, 10·7 ; Water, 21·3.

Analyses :—1 to 3. ; 4 and 5. *Min.*, i. 334 ; 6. *Edin. N. Phil. J.*, 1829, 262.

	SiO_2	Al_2O_3	Fe_2O_3	CaO	K_2O	Na_2O	H_2O	Total	
1. Talisker, blue,	48·72	17·68	..	9·36	1·22	·6	21·88	99·46	Heddle.
2. ,, "*Acadialite*"	47·48	20·21	..	4·88	1·71	4·58	20·80	98·66	Heddle.
3. ,, white,	48·81	18·73	·08	8·01	·08	1·9	23·07	100·68	Heddle.
4. Kilmalcolm,	48·76	17·44	..	10·47	1·55	..	21·72	99·94	Thomson.
5. ,,	49·20	17·91	..	9·64	1·92	..	20·41	90·08	Thomson.
6. ,,	50·14	17·48	..	8·47	2·58	..	20·83	99·50	Connell.

Inverness-shire. Skye, at Storr, in small brilliant crystals (MacCulloch, who describes *r* (Plate LXXXI., fig.1), *t*, *r s* (Plate LXXXI., fig. 2), and *r e s t*, in twins. Simple crystals of *r t s*, *r e z a* (Plate LXXXI., fig. 3), *r e s* (Plate LXXXI., fig. 4), and crystals

of *r*, with the faces much curved. At the Quiraing, in pale brown crystals, associated with Analcime and Mesolite, *r*, *r s a*, *r e s a*, all twins (Plate LXXXI., fig. 5). At the foot of the crag of Leacan Fhionn, and on the hill north of Sgurr Mòr, Quiraing, *r*, *e s t a*, both twins and associated with many other zeolites. On the north slopes of Beinn Edra, associated with Analcime, etc., *r z* (Plate LXXXII., fig. 6). At Lyndale in simple crystals *r*, *r a*, *r e t*, (Plate LXXXII., fig. 7), *r e s a*, *r e a*, and *r s z*, (Plate LXXXII., fig. 8); also twins of *r s*, *r e a*, *r e s a*, *r e s t*, *r e s t a*, and *r e s* (Plate LXXXII., fig. 9). Crystals like those given by Greg and Lettsom (*Brit. Min.*, figs, 2 and 7) also occur, as do twins of *t a*, with small crystals of intrusion, *r e s a*, on the *t* faces, the *a* of the intruding crystals falling into the same plane as the corresponding face of the large crystal. The striæ of the smaller crystals occur so as to form a St. Andrew's cross with the striæ of the larger crystal (Plate LXXXII., fig. 10). There has also been found at this locality a twin crystal composed of *r e s* and *r* combined (Plate LXXXII., fig. 11); and also a hemitrope of *r s* formed by a revolution of one-half of the crystal through an arc of 120° (Plate LXXXII., fig. 12), and a similar twin of *r z s* (Plate LXXXII., fig. 13). These for the most part occur without associates, and are much the finest crystals of this species found in Scotland. At Talisker (Anal. 1), chiefly near the sea stack at the south side of the bay, where this mineral is of a bluish colour, and of the forms *r s*, *r e s*, and twins of *r e s*. The Chabazite is associated with Analcime and with silky crystals of Mesolite. It also occurs in pinkish or flesh-coloured crystals (Acadialite), combinations *r*, *r e*, *r t e*, and twins of *r*, *r e s a*, *r t e s* (Anal. 2); and in colourless crystals, *r*, *r s*, *r e*, *r e s*, unassociated with any other minerals. Crystals of each of the several colours occur apart from each other, and generally in separate vapour cavities; and in the cases where the Acadialite is associated in the same cavity with the ordinary colourless Chabazite, the Acadialite occurs in twins of a more complex character than usual, while the normal Chabazite appears in the form of simple crystals. Chabazite occurs also on the north side of Talisker Bay in the form of simple white crystals, which are associated with Analcime—Anal. 3. Loch Bracadale, at Rudha nan Clach Acadialite occurs with Analcime, and, more rarely, with Stilbite, Mesolite, and Apophyllite, these three latter occurring in association with the Acadialite in cavities separate from those which contain the Analcime. The faces of the crystals at this locality are curved. Sgùrr nam Fiadh, on the coast between Talisker and Loch Eynort, in the form of milk-white, simple, crystals, measuring one inch across the face, which are the largest of the colourless form yet found in Scotland. These occur without any associates. At the same locality there is also found

pale Acadialite in occasional association with Gyrolite, Analcime, Pilolite, Laumontite, yellow Calcite, Scolecite, and Stilbite, and in the form of crystals with curved faces. At Orbost, on the north shore of Loch Varkasaig, Acadialite occurs over Faroelite, and underlying normal Chabazite. At the foot of the cliff of Beinn nan Cuithean, just to the south of Talisker Point. At the mouth of Allt Preshal Beg, 2 miles south of Talisker, associated with Analcime. At Geodha Tuill, Loch Eynort, associated with Scolecite. Eigg (Greg).

Argyllshire. In Mull (Jameson). Treshnish Islands, at the summit of Bac Mòr, associated with Analcime; rarely. At the south-east angle of Fladda, in twins of *r*, occurring over Scolecite. At the south end of Sgeir a' Chaisteil, over Scolecite.

Perthshire. At Glen Farg (Greg).

Stirlingshire. At Earls Burn Reservoir, Touchadam Muir, in the form *r*, associated with Stilbite, Cluthalite, and Laumontite, on trihedral Quartz (Kidston)

Dumbartonshire. In Bowling quarry, similar to "Glottalite," in twins of *r s a* (Plate LXXXIII., fig. 14), coating the sides of fissures in the rock. Its sole associates here are Analcime, rarely, and Calcite. In Glen Arbuck, twins of *e t s a r*, like "Phacolite" (Plate LXXXIII., fig. 15), occur in association with twin crystals of Calcite and with Saponite.

Renfrewshire, Port-Glasgow, "Glottalite" (which Greg ascertained to be merely Chabazite, ill-defined, nearly the form of Plate LXXXIII., fig. 15) (Clacher). At Kilmalcolm (Thomson) (Anal. 4), of a brown tinge, and combinations *r*, *r s*, *r s e*, and associated with Stilbite, Heulandite, Sphæromesolite, and Calcite—Anals. 4, 5, 6. At the same locality there is also found very fine Acadialite, in the form *r*, associated with zeolitic Quartz, Göthite, and, rarely, with normal Chabazite. It has recently been found in crystals an inch and a half across, of a brown tint, and of the combination *r t s*, associated with Stilbite, Calcite, and Mesolite. Said by Greg to occur at "Grainger's quarry, half a mile north of Alton House, two miles and a half south-west of Kilmalcolm." These are the largest crystals of this mineral found in Scotland. Boyleston quarry, Barrhead, in the south-west angle of the quarry, in the form of twin crystals of *r*, associated with Thomsonite.

Ayrshire. In the banks of the Rye Water, about one mile above Baidland quarry, where it occurs as milk-white crystals of the form *r*.

134. **Gmelinite (448).** $(Na_2,Ca)Al_2Si_4O_{12}+6H_2O$.

Rhombohedral. Usually occurs in twins with forms like those of Chabazite. Faces of *r* striated parallel to their polar edges, those of

the prism *m* striated horizontally. Clv., *m* distinct. Gelatinises with h. acid. Comp., 47·6 Silica. 19·7 Alumina, 12 Soda, 20·7 Water.

Analysis by Berzelius :—

	SiO_2	Al_2O_3	K_2O	Na_2O	H_2O
Scotland, (?) Skye, . . .	49·17	18·92	tr.	12·9	19·73

Inverness-shire. Skye, at Talisker, in large, colourless, twin crystals.

135. **Levynite (449).** $CaAl_2Si_3O_{10}+5H_2O$.

Rhombohedral. [*o* (*c*), 111, 0001 ; *r*, 100, 10$\bar{1}$1 ; *s*, $\bar{1}$11. 02$\bar{2}$1.]

Forms intersection twins, as in Plate LXXXIII., fig. 1. Faces *r*, *s* striated parallel to their intersections with each other. Cleavage, *s*, indistinct. H., 4 ; G., 2·1 to 2·2. Colourless and white.

Analyses :—*Phil. Mag.*, v. 40.

	SiO_2	Al_2O_3	FeO	CaO	K_2O	Na_2O	H_2O	Total.	
1. Skye, (?) Storr, .	46·30	22·47	·96	9·72	1·26	1·55	19·11	101·77	Connell.
2. Quiraing, . .	43·13	21·77	1·38	9·25	·95	3·44	20·20	100·12	Heddle.

Inverness-shire. Skye, at the Storr, where it occurs in small vapour cavities in the basic lavas, and is invariably the sole tenant of the druse, even though that in which it occurs may be within a quarter of an inch of other druses containing Chabazite in association with half a dozen other zeolites. In only one instance has the writer seen other minerals associated with Levynite, and that was a case in Skye, where it had minute crystals of Analcime superimposed upon it. (Plate LXXXIII., fig. 1).

Levynite is stated by Greg to occur also at Hartfield Moss, near Glasgow, flesh red, opaque, *r s* twinned.

136. **Analcime** or **Analcite (450).** $NaAlSi_2O_6+H_2O$.

Cubic. [*a*, 100 ; *n*, 211 ; *r*, 332 ; *z*, 543 ; *w*, *m* 11 ; *t*, 421.]

Fracture uneven. Clv., *a* very imperfect. H., 5·5 ; G., 2·1 to 2·28. Colourless, white, flesh-red, scarlet. Lustre vitreous. Translucent, to translucent only on the edges. B.B. melts without frothing to a clear glass. Soluble with gelatinisation in h. acid. Comp., Silica, 54·5 ; Alumina, 23·3 ; Soda, 14·1 ; Water, 8·2.

Analyses :– 1-6, *Min. Mag.*, iii. ; 7, 10, 11, *Chem. News*, xxvii. 56 ; 8, *Edin. J. Sc.*, 1829 ; 9, *Min.*, i. 339.

	S.G.	SiO_2	Al_2O_3	Fe_2O_3	FeO	MgO	MnO	CaO	Na_2O	K_2O	H_2O	Total.	
1. Walls, Orkney,	2·244	57·62	18·72	·19	·74	..	tr.	1·89	10·28	1·39	8·45	99·28	Heddle.
2. Talisker, . .	2·248	55·08	20·72	..	1·09	..	..	1·68	12·82	·57	8·54	99·50	Heddle.
3. The Bowdens, *scarlet*, . .	..	58·23	18·89	·85	·03	..	·46	1·42	9·43	·88	8·72	98·81	Heddle.
4. Gapol, *colourless*, . .	2·23	56·91	20·05	·04	·75	..	..	1·33	11·29	·44	9·19	100·00	Heddle.
5. Shooter's Point,	2·25	55·91	20·38	·02	·69	·69	..	2·19	11·32	·06	8·59	99·85	Heddle.
6. Kinkell, . .	..	55·3	19·5	..	1·8	..	..	2·00	11·61	·76	9·35	96·88	Heddle.
7. Mugdock, .	2·271	54·48	23·01	..	..	..	..	..	14·00	..	8·28	99·77	Young.
8. Kilpatrick, .	..	55·07	22·23	..	..	..	..	..	13·71	..	8·22	99·23	Connell.
9. ,, .	..	55·36	23·00	..	..	..	..	..	14·19	..	8·08	99·05	Thomson
10. Boyleston, .	2·259	55·54	22·27	..	..	..	..	..	13·75	..	8·55	100·11	Young.
11. Crofthead, .	2·153	54·85	22·59	..	..	..	..	·89	12·58	..	9·06	99.97	Young.

Orkney. Walls, at Sands Geo, in the vapour cavities of an amygdaloidal lava of Upper Old Red Sandstone, in the form *a n* (Plate LXXXIV., fig. 1), the faces of the cube being slightly bevelled; colourless, and associated with Saponite, red Heulandite, Barytes, and Pearlspar —Anal. 1.

Ross-shire. Shiant Isles, at Eilean Mhuire, in the form *n*, in a cave at the connecting neck at the north-east extremity of the island, in coarse dolerite, associated with Pyrites, Magnetite, Labradorite, Augite, and Nepheline. At the east end of the north shore of Garbh Eilean, associated with Stilbite and Mesolite.

Inverness-shire. Skye, at the north side of Talisker Bay, milk-white (MacCulloch), and pale blue (Dudgeon)—Anal. 2. The pale blue variety is in translucent crystals, which are more than an inch and a half in length and of the form *n*. These are in some cases almost suspended upon filaments of Mesolite, which also generally invests them. They are associated also with yellow Calcite. At the stack at the corner at the south side of the bay, in minute brilliant crystals, *n*, either *per se*, or occasionally in druses along with Chabazite. At Storr, in small *n* crystals, associated with Chabazite, etc. At the Quiraing in opaque crystals of the form *n*, associated with Gyrolite and Apophyllite. On the north slopes of Beinn Edra, and at the cliff-foot, along with Stilbite, Chabazite, and Gyrolite. On a hill north of the Quiraing, in association with Saponite and Mesolite, and many other zeolites. North of Leac an Fhionn, near the Quiraing, on red, massive Mesolite, in fine white crystals, *n*. At Bioda Buidhe, along with Apophyllite, Stilbite, and Plynthite. In the quarry at Portree, with Gyrolite, and Apophyllite. On both the north and the south shores of L. Varkasaig, Loch Bracadale, on Mesolite. At Rudha nan Clach, Loch Bracadale, in small crystals, associated with Stilbite, Chabazite, Mesolite, Apophyllite, and yellow Calcite, in a rock containing Olivine. At Sgurr nam Fiadh, in the form

n, it occurs commonly, and in association with Chabazite, Gyrolite, Pilolite, Laumontite, Scolecite, and Calcite. One specimen of a pale blue colour was more than a foot across, and its crystals, of the form *n*, were an inch and three quarters across. At the foot of the cliff of Beinn nan Cuithean, near Talisker. At the mouth of Allt Preshal Beg, along with Chabazite.

Canna, 1 mile south of the mansion house, where the Analcime occurs on Stilbite. At 2 miles to the south of that house it occurs upon Scolecite. On the west shore of the island, near the cave, in association with Gyrolite, Heulandite, Laumontite, Chabazite, Stilbite, Mesolite, Calcite, Apophyllite.

Sanda, at the east Geo, in milk-white crystals of the form *n*, which are sometimes two inches in dimensions, and occur along with Mesolite, Scolecite, Heulandite, Stilbite, Sphærostilbite, Laumontite, and Calcite.

Eigg, near the cave, in transparent glassy crystals[1] (Fleming). Eilean Chasgaidh, on the south-west shore, with Gyrolite and Faröelite.

Muck, at [Eilean an Each], with Gyrolite, Mesolite and Uigite.

Argyllshire. Mull, inland of the farmhouse of Carsaig (Earl Compton). At the west side of the Carsaig Arches. In the amygdaloidal basalts of the sea-cliffs below Beinn Chreagach, between Carsaig Arches and Carsaig Bay, *n*, associated with Stilbite, Mesolite, and Scolecite (Goodchild). In the northern division of the island, with Stilbite, Mesolite, and Prehnite (MacCulloch). At Dearg Sgeir [at the foot of the cliff below Fionn Aoineadh, Bearraich, on the north side of the entrance to Loch Scridain], with Gyrolite, Mesolite, and Scolecite (H. and Goodchild). Calgarry Bay, on the south side (Currie). On the north shore of Loch Scridain, near Kilfinichen, *n*, on Quartz (Mrs. Currie).

Staffa, at the north-east end, on Scolecite.

Ulva (MacCulloch).

Treshnish Isles, Bac Mòr, at the south-east corner, on Stilbite, and covered with " Cottonstone " Natrolite. Fladda, at the E.S.E. end, in a scoriaceous upper bed of basalt, over Scolecite, and covered with " Cottonstone " Natrolite. Sgeir a' Chaisteil, at the south end, in white crystals an inch and a half across, and of the form *n*. Lunga, on the east side *per se*, and also in cavities associated with Faröelite and Scolecite.

Aberdeenshire. Stated by Greg to occur in the parish of Auchindoir.

Kincardineshire. In the parish of Kinneff, at Green Downie Point, and the Bowdens, Gapol, Braidon Bay, *n*, *a n*, bright, and scarlet in colour

[1] These crystals, presented by Fleming to Brewster, enabled the latter to describe the optical properties of the mineral—which appeared anomalous, on the supposition that Analcime belonged to the Cubic System.

—Anal. 3. At Tod Head, colourless (Anal. 4), and near Calcite, Pilolite, and Laumontite. Strathlethan Bay, Tremuda Bay, and the Long Gallery, in all of which localities the Analcime is colourless and of the form *n*.

Forfarshire. At Craig railway cutting [? two miles south of Montrose], *n*, associated with Pilolite, Natrolite, Saponite, and zeolitic Quartz (Mitchell). Near the Free Church at Ferryden, ½ mile south of Montrose (Mitchell).

Perthshire. In Glen Farg (or Glen Pottie), in isolated crystals 2 inches across and of a flesh colour (MacCulloch). Associated with Fargite, Natrolite, Laumontite, Prehnite, Saponite, and Datolite, in the forms *n* and *n a*, very fine. (Plate LXXXIV., fig. 7).

Fifeshire. At Kellie Law, *a*, *a n* (Plate LXXXIII., fig. 2) (Rose). At Shooter's Point (Ruddons Point), between Elie and Largo Bay, in large transparent grey crystals, *n*, in vapour cavities, in agglomerate, partially enveloped in Calcite—Anal. 5. In a decomposing brecciated basalt lava of Lower Carboniferous age on the coast just north of the Abden shipyard, Kinghorn, colourless, pellucid, and of the form *n a* (Goodchild). At the Rock and Spindle, Kinkell, on the coast south of St. Andrews, *n*, in veins, with Calcite, in agglomerate—Anal. 6. At Craighall, Ceres, in flesh-red crystals in a basic eruptive rock overlying limestone of Lower Carboniferous age.

Stirlingshire. "In large opaque white crystals, sometimes flesh-coloured and two or three inches in diameter, at the Campsie Fells, accompanied by Calcite, Prehnite, and Mesotype" (Greg). At Mugdock water-tunnel, where it was found in association with Laumontite (Wallace Young)—Anal. 7. Earlsburn Reservoir, Touchadam Muir, with Harmotome and Quartz, *a n*; also in highly-distorted crystals (Plate LXXXIII., fig. 3) and overlying Laumontite (Kidston). The crystals are red "Cluthalite," sometimes in their centres and sometimes throughout. In vapour cavities in the Lower Carboniferous lavas in the Touch Muir, in both branches of the Touch Burn, in opaque white *n* crystals, sometimes an inch across (Goodchild).

Dumbartonshire. Dumbarton Castle rock. (MacCulloch) Bowling quarry (Frisky Hall), *n*, *a n* (Jameson), milk-white in colour, and passing into pseudomorphs of Prehnite. Also on Erythrite (pseudo-Orthoclase) [? pseudo-Albite], associated with Thomsonite—Anals. 8 and 9. Three forms of distortion of the crystals are found in this quarry. The first Plate (LXXXIII., fig. 4) occurs in the large, opaque, white crystals. The second lines the vacuities in the centres of veins of massive Analcime, which passes at the sides into the red-stained variety termed Cluthalite by Thomson. The third occurs in decomposing veins in the quarry. The

crystals are charged with Göthite, and are so clustered together that if the vacuities in the cluster were to be filled a solid of the form *n* would result. At Hawkcraig, Glen Arbuck, on Crocalite, with Saponite and Chalcedony. At Lang Crag, associated with Weissigite (Albite,—pseudo-Stilbite) and ordinary red Stilbite (Clacher).

HADDINGTONSHIRE. Nearly opposite the †Sheep Craig, North Berwick, in red tuff, associated with Amethyst and Natrolite. Near Canty Bay, with crystallised Natrolite (Dudgeon). In veins in the tuffs, and also in the intrusive basalts, at the foot of the cliff below the eastern golf links (Rugged Knowe) at North Berwick, nearly always in association with pale brick-red Natrolite (Goodchild).

EDINBURGHSHIRE. Formerly in white opaque crystals "six inches across" (Greg) in the south quarry of Salisbury Crags, in vapour cavities in the dolerite, associated with Calcite, greenish-yellow Prehnite, and Datolite. The crystals are often distorted as in Plate LXXXIII., figs. 5, 6. At the Cat Nick, Salisbury Crags, associated with Barytes and Calcite (Watson). On the south terrace of the Calton Hill (Thomson), called "Sarcite" (Townson), *n*. In the Calton Tunnel, with Prehnite (Rose). In cavities in the basalt of the Edinburgh Castle rock (MacCulloch). In Ratho dolerite quarry, *n*, *a n*, underlying Pectolite, and often changed into that mineral. Rarely the crystals are 5 inches across. In the east [north] quarry of Corstorphine Hill, on Prehnite (Bryson).

LINLITHGOWSHIRE. Near Kirkliston, in "greenstone," *n* (Sowerby). In a ridge of dolerite running parallel to the road from Ecclesmachan to Niddry, on Newbigging farm, in a vein containing Amethyst and Calcite, white crystals of the form *n* (Stuart Thomson). Queensferry (Craig Christie).

LANARKSHIRE. In Brownieside quarry, near Airdrie (Blackwood).

RENFREWSHIRE. In the Bishopton railway tunnel, associated with Prehnite, Greenockite, and Datolite (Lord Greenock), "at Erskine." At Kilmalcolm, in small, distorted, transparent crystals, with Stilbite. Changed into white Prehnite at Hartfield (Greg). At Boylestone quarry, Barrhead (Wallace Young), in very fine milk-white specimens, *n*, *n a* (Plate LXXXIV., fig. 7), associated with Native Copper, Prehnite, Thomsonite, Natrolite, Malachite, Rubinglimmer, Erythrite, and pellucid crystals of Calcite—Anal. 10. Sometimes bright green. Minute, brilliant, transparent, and colourless crystals, *n a r z w*, *n a r z w t*, occur on Prehnite [as described on pp. 101-2 (Plate LXXXIV., figs. 8 and 9)]. In the Gryfe tunnel above Greenock, associated with Calcite and Thomsonite. At Crofthead, in a vein containing Thomsonite (Wallace Young) —Anal. 11. In a railway cutting just south of Neilston (Blackwood).

Ayrshire. Near Beith (Jameson). In the channel of the Rye Water about 1 mile above Baidland limestone quarry, north-west of Dalry.

"Boylestone quarry, near Barrhead in Renfrewshire, is (or rather was, for it is temporarily at least exhausted) a storehouse of zeolites. It did not yield so many species as did the great quarry at Bowling; but such specimens as Boylestone yielded were obtained continuously or regularly—those at Bowling being got for the most part only when the two great Prehnite veins were being removed. In Boylestone, as in Bowling, Prehnite was very much the most common mineral; in the former Analcime stood next in frequency of occurrence, and was much more frequent there than it was at Bowling.

"The appearance, though not the association, of the mineral is different in the two quarries. The groups formerly obtained at Bowling were cream-coloured, opaque, and dull on the surface; the usual associate was Thomsonite, in groups of long radiating crystals. The crystals from Boylestone are white—purer than what Ruskin calls 'paper-white.' The usual associate is still Thomsonite—here, however, it is in bladed crystals, of the form which I have already described and delineated.[1] The specimens formerly obtainable of this Boylestone white Analcime were the most showy to be got from any British locality, being superior to the Irish specimens, and even to the pale blue variety from Talisker in Skye.

"In addition to these opaque white specimens, however, Boylestone supplied us, though very much more rarely, with Analcime of an entirely different appearance. Upon the surface of mammillations of pale green Prehnite there were occasionally sprinkled isolated crystals of perfectly colourless and perfectly pellucid Analcime. It is certain of these only which carry the new faces.

"The crystals of the specimen on which I first observed them are only about the sixteenth of an inch in size, and they do not, like the large and opaque crystals, in any way evidence a composite or tesselated structure.

"The predominant form is the deltohedron n (211), but the crystals carry in addition the faces of the cube a (100)—always irregularly developed; an adjacent very flat deltohedron w (m 11); the faces of the trigonal trisoctohedron r (332)—truncating those edges of the leucitoid faces which converge upon its octohedral angles; and an exceedingly narrow face lying between r and n. This last form is an hexoctohedron, a type which has not hitherto been observed in Analcime. The other edges of n seem also in some of the crystals to be bevelled. The two hexoctohedra are represented by such exceedingly narrow, although

[1] *Min. Mag.*, vol. vii. p. 136.

brilliant, faces, that it has been impossible to measure them accurately with any goniometer at present in my possession ; they seem, however, to be *z* (543), and *t* (421) respectively.

" The surfaces of the faces *n* are profusely pitted by a system of somewhat symmetrically-arranged depressions of triangular form. These are exceedingly minute ; but reflected light and high magnification show that they are definitely bounded by the faces *r* and *z*, which form the sides of a very obtuse triangle, and by the faces *a w*, which form its base.

" A highly magnified plan of their arrangement is shown [(Plate LXXXIV., fig. 8)].

" It has been stated above that the faces *a* are always irregularly developed ; they are generally, through the dominance of two opposite faces, reduced to mere lines. Inasmuch as everything points to the crystal of Analcime being composite—one of the *tesselites*—I had hopes that the direction of these lines—whether they lay alternately at right angles to each other or not, or in any definite arrangement—might indicate the system to which the primary crystal belonged.

" In most of the crystals opposite sets of the leucitoid 3 × 8 faces truncate most deeply. This would seem to indicate a tetrahedral tendency, and crystallographic simplicity ; and, as already stated, they do not exhibit the usual evidences of composite structure.

" As is well known, the deltohedron *n* is the characteristic form of Analcime, and generally occurs alone. The only other form which is at all frequent is the cube. Out of over fifty different localities for this mineral in Scotland there are only [eleven] in which any form but *n* occurs, and in all these (except Boylestone) the sole additional form is the cube. These localities are—Sands Geo in Walls ; Gapol (Kinneff) ; Glen Farg ; Kelly Law, near Elie ; Bowling ; Kilpatrick ; Hartfield, in Renfrewshire (Prehnite pseudomorphous after Analcime), Earlsburn, Ratho [Kinghorn] ; and lastly, Boylestone.

" The other forms which occur in Analcime are excessively rare, some of them being limited to a single locality. The only localities given by Hintze are—

" Friedensdorf, in Nassau, (211) (110) (100) (210) (332). Vesuvius, (211) (100) (110). Cyclopean Islands, (211) (100) (*m* 11). Phillip Island, Victoria, (211) (111). Kerguelen Island, (211) (332).

" It is evident that the Boylestone specimens, which show the combinations (211) (100) (332) (543) (*m* 11)...(421), *narzw...t*, are the most complicated yet observed of this usually excessively-simple mineral ; and it is certainly remarkable that while nowhere else in Scotland are crystals found showing more than two forms, those at Boylestone exhibit no less than six, of which two have so far never been found elsewhere.

"It is worth noticing also, that although Analcime is one of the commonest zeolites of the Tertiary Traps of the Hebrides, the form there is invariably the simple deltohedron. All the Scottish examples mentioned above, where the cubic faces are developed, are from igneous rocks of palæozoic age.

"A similar tendency to great (apparent) simplicity is observable in the crystals produced artificially, which are always either deltohedrons, or combinations of that form with the cube." – HEDDLE, *Trans. Edin. Geol. Soc.*, vii. pp. 241-2 (1898).

137. **Edingtonite (452).** ? $BaAl_2Si_3O_{10}+3H_2O$.

Tetragonal. [*a* (*m*), 110 ; *e* [*p*), 111 ; *n*, $1\bar{1}2$; *s*, $1\bar{1}3$], with sphenoidal hemihedrism. Crystals generally small, and inconspicuous. Clv., *a* perfect ; fracture uneven. H., 4 to 4·5 ; G., 2·7 to 2·71. Translucent ; lustre vitreous ; colourless, but sometimes greyish-white, tinged with brown. Yields water in the matrass, and becomes white and opaque. B.B. fuses with some difficulty into a colourless glass. In h. acid dissolves with gelatinisation Comp., Silica, 36·8 ; Alumina, 20·9 ; Baryta, 31·3 ; Water, 11·9

Analysis by Heddle, *Phil. Mag.*, ix. p. 179, March 1855 :—

SiO_2.	Al_2O_3.	BaO.	CaO.	SrO.	Na_2O.	H_2O.	Total.
36·98	22·63	26·84	·22	·08	tr.	12·46	98·91

DUMBARTONSHIRE. Rare generally, but its most frequent occurrence is stated by Greg to have been in a quarry half a mile north-east of Old Kilpatrick, *a e n s* (Plate LXXXIV., fig. 1). On Thomsonite (Haidinger). On Cluthalite (Thomson). At Bell's quarry, near Bowling quarry. At a quarry 5 miles north of Old Kilpatrick, associated with Prehnite (Greg). At Bowling quarry, associated with Barytes, Harmotome, and Prehnite. [Dr. Heddle states, in Greg and Lettsom's *Brit. Min.*, that he has not, in a single instance, seen Edingtonite in association with Thomsonite.]

Natrolite Group.

138. **Natrolite (453).** $Na_2Al_2O_3Si_3O_{10}+2H_2O$.

Orthorhombic. [*a*, 100 ; *b*, 010 ; *m*, 110 ; *o*, 111 ; *y*, 131 ; *z*, 331 ; *s*, 311.] Usually occurs in the form of radiating acicular crystals. Clv., *m* perfect ; *a* striated parallel to its intersection with *m*. The face *o* is sometimes curved. H., 5 to 5·5 ; G., 2·17 to 2·26. Pellucid ; lustre vitreous. Colourless, ochre-yellow, pale red. Is not pyroelectric. B.B. melts quietly to a clear glass, colouring the flame sodium-yellow. Soluble in oxalic acid. Comp., Silica, 47·4 ; Alumina, 26·8 ; Soda, 16·3 ; Water 9·5.

Analyses :—1, 2, 3, 5, 6, *Phil. Mag.*, xi. 272 ; Liebig-Kopp's *Jahresber.*, 1852, 868 ; 7, *Chem. News*, xxvii. 56 ; 8, *Edin. New Phil. Journ.*, Oct. 1852, 9.

	SiO_2	Al_2O_3	CaO	Na_2O	H_2O	Total.	
1. Glen Farg,	48·24	27·0	·82	14·82	9·24	100·12	Heddle.
2. Campsie,	47·32	27·36	2·62	13·35	10·39	101·05	Heddle.
3. Bowling Quarry,	48·03	25·26	2·31	13·97	9·72	99·29	Heddle.
4. Bishopton,	47·63	27·17	..	15·12	9·78	99·70	Scott.
5. ,, *Galactite, white*,	47·60	26·60	·16	15·86	9·56	99·78	Heddle.
6. ,, ,, *pink*,	47·76	27·20	·93	14·28	9·56	99·73	Heddle.
7. Loch Thom,	46·29	27·10	·72	15·37	10·43	99·91	Wallace Young.
8. Bishopton,	47·90	26	..	16·00	9·22	..	Scott.

INVERNESS-SHIRE. Skye, in the south-west ridge of Sgùrr Dearg, covering Epidote, in white radiating groups, in epidotic gabbro.

ARGYLLSHIRE. Mull. Bloody Bay, with underlying Farõelite (Currie).

KINCARDINESHIRE. About four miles north of Bervie, at " Precentor and Priest " rocks, in flesh-coloured tufts imbedded in stalactitic chert. Near Arbuthnott (Watson) (Plate LXXXIV., fig. 1).

FORFARSHIRE. At Craig middle railway cutting, with zeolitic Quartz (Mitchell). Near Ferryden Free Church, red (Mitchell). In Pitloch quarry, near Lunan Bay.

PERTHSHIRE. Glen Farg ; formerly in fine, transparent, colourless crystals, *m o* ; sometimes forming the summits of flesh-coloured crystals —Anal. 1. Pebble Knowe, Ballindean, rarely, in pink feathery tufts, traversing quartz with agates.

STIRLINGSHIRE. Fintry, in the banks of Endrick, east of the church, in small druses, with Saponite. At the Campsie Fells, radiated and compact (Greg)—Anal. 2. At Carbeth, in fine specimens (Greg). Earlsburn Reservoir, Touchadam Muir, pinkish, in druses *per se* (Kidston).

DUMBARTONSHIRE. In Bowling quarry, north side, in spheres of radiating white crystals, sometimes intermingled with Saponite, and the terminations running into scaly crystalline Saponite (Prasilite)—Anal. 3. This variety has been sold as " *Stellite*." Also in spheres of dull yellow, tufted crystals, imbedded in chert, in the west side of the quarry. Dumbarton Moor, Cochno, and Duntocher (Greg). Lang Crag, and also in Bowling quarry, in delicate pink acicular plumes, imbedded in zeolitic Quartz.

HADDINGTONSHIRE. North Berwick, near Canty Bay, in very fine crystals, *m o y a b z s* (Plate LXXXIV., fig. 2), with Analcime (Dudgeon). With Analcime, Amethyst, and Carnelian, in red tuff, opposite the

†Sheep Craig, rarely. In the cliffs below Rugged Knowe, North Berwick (Goodchild).

EDINBURGHSHIRE. "Formerly in the greenstone of Salisbury Craig" (? Pectolite). In cavities in the dolerite of Barnton quarry, Corstorphine Hill, in minute tarnished crystals, with Prehnite and (?) Stilbite (Galletly). At the Braid Hills (Greg).

RENFREWSHIRE. At Bishopton Tunnel, in pearly, acicular, and sometimes interlacing, crystals, several inches long ("Galactite of Haidinger"), associated with Prehnite, Calcite, and Greenockite—Anals. 4, 5, 6. At Hartfield Moss (Greg). With Analcime and Thomsonite, at the Gryfe Tunnel, south of Greenock, Loch Thom cutting (Wallace Young)—Anal. 7. In Boyleston quarry, Barrhead, associated with Calcite, Prehnite, and Laumontite, sometimes in doubly-terminated crystals *m o* two to three inches long.

BUTE. Little Cumbrae, at the southern extremity, in calcitic druses, of a flesh colour (Neilson).

Thomson mentions the Shiant Islands, Ayrshire, and also Dun Fionn, Arran, as localities for Natrolite. In all these occurrences the substance is more probably Mesolite.

Crocalite is a bright red Natrolite, with a little lime replacing soda. It occurs in delicate tufted crystals, forming the caves of Quartz stalactites, at Long Gallery; Tremuda Bay; underlying Calcite, in large cavities, at Crawton Bay; the Pulpit Rock; and other spots along the coast of Kincardineshire; in lustrous, divergent, brush-like crystals, under Quartz, in druses, in the rock of the south Craig cutting near Montrose; lining Calcite veins in a rotting dolerite, south of Wemyss, Ayrshire; at Ballygroggan, Machrihanish Bay, Mull of Kintyre, in Barytes, and associated with red Heulandite.

In the absence of Heulandite, flesh-coloured Natrolite is a common lining of calcitic druses in those amygdaloids which contain few zeolites. It is also frequently superimposed on Celedonite as a tufted lining of agate-druses, as at Scurr Hill, Ballindean, and Usan, near Montrose.

139. **Fargite (453a).** 2 of Natrolite and 1 of Mesolite.

Analyses :—1, 4, *Phil. Mag.*, xi. 272; 2, ?; 3, ?.

	SiO_2	Al_2O_3	CaO	Na_2O	H_2O	Total.	
1. Glen Farg,	47·84	27·11	4·31	11·30	10·24	100·80	Heddle.
2. ,,	46·99	26·84	4·36	10·13	10·56	[illegible]	Kenngott.
3. ,,	48·03	26·66	5·47	8·32	11·72	100·20	Thomson.
4. Dumbarton Moor,	46·96	26·91	3·76	12·83	9·50	99·96	Heddle.

Perthshire. Glen Farg, in flesh-red to white divergent lustrous crystals, generally *per se*, but occasionally associated with Laumontite or with Analcime—Anals. 1, 2, 3.

Fifeshire. At Scurr Hill, Balmerino. Occasionally filling the whole of an agate druse in divergent crystals; generally in tufts of crystals imbedded in the outer layers of agates. At the west shore of Wormit Bay.

Dumbartonshire. Dumbarton Moor (? Carbeth), in radiating spheres of some inches in size, the crystals mottled white and red—Anal. 4.

140. **Scolecite (454).** $CaAl_2Si_3O_{10}+3H_2O$.

Monoclinic. Generally in the form of divergent groups of slender, prismatic, or acicular crystals. Twins on *a* common; a feather-like striation on face *b*; the *m* faces often delicately striated horizontally. Cleavage, *m* perfect. H., 5 to 5·5; G., 2·2 to 2·3. Pellucid; lustre vitreous; colour white to reddish-white. Pyroelectric. B.B. twists into vermicular forms, melting readily to a porous glass. Only partially soluble in oxalic acid. Comp., Silica, 45·8; Alumina, 26·2; Lime, 14·3; Water, 13·7.

Natrolite and Scolecite pass into one another. There are two definite intermediate sub-species: Fargite (already noticed under Natrolite), which consists of two equivalents of Natrolite and one of Scolecite, and Mesolite, which consists of one equivalent of Natrolite and two of Scolecite. Mesolite (to be noticed below) is the ordinary radiated zeolite of the amygdules in the basaltic eruptive rocks of the Hebrides and Faröes. In these rocks Mesolite occurs in matted groups of crystals of extreme tenuity [the "Cottonstone" Natrolite heretofore referred to]. In Renfrewshire Mesolite occurs in spheres with an internally radiated structure, and also in acicular forms, and in downy tufts.

Analyses:—1 and 2, unpub.; 3, *Ed. Phil. J.*, liii. 277; 4, *Schw. J.*, xviii. 13.

	SiO_2	Al_2O_3	CaO	Na_2O	H_2O	Total.	
1. Portree,	45·61	25·91	13·38	3·0	12·56	100·46	Heddle.
2. Storr,	45·92	25·32	13·43	3·52	12·36	95·55	Heddle.
3. Loch Scridain,	46·21	27·00	13·45	..	13·78	100·44	Scott.
4. Staffa,	46·75	24·82	14·20	·89	13·64	98·8	Fuchs and Gehlen.

Inverness-shire. Skye, Talisker, on the south side of the bay, past the stack, in small druses, in the form of brilliant, colourless, acicular crystals, which are very brittle (Russell). Sgurr nam Fiadh, between Talisker and Loch Eynort. At this locality two vapour cavities containing this mineral were found. One cavity measured 3 feet by 4; the other was 4 feet 6 inches high, 3 feet 6 inches wide, and 4 feet deep. Both

cavities were lined throughout with glancing acicular crystals of Scolecite, which were about one inch in length, and very slender and brittle. They were disposed upon pale green Celedonite. It also occurs, rarely, along with Mesolite, Faröelite, and Gyrolite, between Loch Eynort and Loch Brittle (MacCulloch). At the cliff foot of Beinn nan Cuithean, on Chabazite. Geodha Thuill, Sgùrr an Duine, and the mouth of Allt Mòr, are also localities for this species. At the last-named locality Scolecite occurs in large brushes. At Rudh na h-Airde Glaise, near Portree, it occurs in druses, which are either totally filled with spherical groups of radiating bundles of crystals, which show no crystalline termination, or else, occasionally, have the central part of the cavity filled with Apophyllite over Gyrolite Anal. 1. On the west side of the Old Man of Storr, it also occurs in a similar manner—Anal. 2. Such specimens (which contain soda) were termed "basement mineral" by the late Mr. Thomas Brown of Lanfine; and Dr. MacCulloch argues, apparently from observations upon such specimens, which occur all along the coast of Skye from Loch Bracadale to Loch Brittle, that there is a passage from Mesolite through Prehnite into Chalcedony. Though this substance is a *basement*, that is to say, it is nearer to the rock than the two minerals that are here associated with it, other specimens show that Faröelite, Chabazite, and Heulandite all three occur in inferior position, and are therefore prior in date of deposition to the Scolecite; the Faröelite being the earliest formed, or earliest solidified, of the zeolites in this case.

Sanda, at the east Geo, associated with Heulandite and Laumontite.

Argyllshire. Mull, at the Carsaig Arches. In the basalts of the cliffs on each side of Nuns Cave, below Beinn Chreagach (Goodchild). In the basalt lavas of the cliffs to the south-west of Bearraich, Ardmeanach (Goodchild). Also in the vapour cavities of similar rocks on the shores of Loch Scridain, at Ardtun (Goodchild). Near Beinn na Croise, east of the head of Loch Scridain, in large, opaque, white, divergent groups of crystals, associated with crystallised Epidote, which lines the cavities solidly filled with the Scolecite (Rose)—Anal. 3. In solidly-plugged druses in loose blocks which were derived from a disintegrated pale green wackenitic rock at Maol nan Damh on the south-west slopes of Ben More, at a height of about a thousand feet above the sea, associated with Epidote, Heulandite, and Celadonite (Currie).

Staffa, at the north-east end, penetrating crystals of Analcime. Also between the basalt pillars, according to Fuchs and Gehlen—Anal. 4.

Treshnish Isles, Bac Mòr, at the south-east corner, in the lowest basalt exposed there. Lunga, on the east side, overlying Faröelite, and occurring beneath Analcime, Gyrolite, and Stilbite. Sgeir a' Chaisteil, beneath

Chabazite. Fladda, at the south-east corner, in a vesicular bed, beneath Analcime and Mesolite, or Gyrolite ; and also beneath Chabazite.

Mull of Kintyre, at Kildalloig shore, near Campbelton.

Fifeshire. On the May, in the cliffs on the west side, associated with Prehnite and Datolite (Fleming). In solidly-filled druses in the basalt of Kincraig, west of Elie.

141. **Mesolite (455).** $\begin{cases} m\mathrm{Na_2Al_2Si_3O_{10}.2H_2O}. \\ n\mathrm{CaAl_2Si_3O_{10}.3H_2O}. \end{cases}$

Monoclinic, and also Triclinic.

In prismatic crystals near Scolecite in form and angles, and twinned ike those of that species. Lateral planes often vertically striated. Occurs in more or less divergent groups or tufts, often very delicate. Also found massive ; and in nodular masses of silky, fibrous crystals, which are disposed in a sphæroradiate structure. Sometimes consisting of interlaced fibres. Occasionally crypto-crystalline, or porcelain-like, or chalky in aspect. [See also under Scolecite above.]

Analyses :—1-3, *Phil. Mag.*, xiii. 50 ; 4, *Min. Mag.*, v. 118.

	SiO_2	Al_2O_3	Fe_2O_3	CaO	MnO	Na_2O	H_2O	Total.	
1. Storr, . .	46·72	26·70	..	8·90	..	5·40	12·92	100·63	Heddle.
2. Talisker, "*Cottonstone*," .	46·71	26·62	..	9·08	..	5·39	12·83	100·64	Heddle.
3. Kilmuir, Skye, . .	46·26	26·48	..	10·00	..	4·98	13·04	100·76	Heddle.
4. Quiraing, *solid, red*, . .	45·62	26·47	1·43	6·12	..	6·91	12·25	100·18	Heddle.
5. Crossgreen, Linlithgow, . .	46·65	26·19	..	7·31	·38	7·47	11·66	..	S. Thomson.

Ross-shire. Shiant Isles, Garbh Eilean, on the north shore of the east horn, associated with Stilbite and Analcime. Eilean Mhuire, at the south-west corner, with Stilbite and Calcite (MacCulloch).

Inverness-shire. Skye, in plumose tufts, at the Storr, over Faröelite, Chabazite, and Apophyllite—Anal. 1. Talisker, in delicate acicular crystals, coating Analcime, on the north side of the bay—Anal. 2. Also at the same locality it occurs in stalactitic shoots, resembling Harringtonite, which penetrate crystals of Analcime. On the south side of the bay near the stack, in long acicular crystals, and in diverging brushes of crystals, which are of extreme tenuity. Crystals of Chabazite are sometimes suspended in the centre of a druse upon a single, slender, needle-like crystal of Mesolite. Quiraing, coating Apophyllite, Faröelite, or Gyrolite, in downy tufts. On a hill north of the Quiraing, coating Stilbite and other zeolites. Rudha nan Clach, Loch Bracadale,

where the Mesolite occurs as a downy coating on Analcime, Chabazite, etc. Sgurr nam Fiadh, in hemispherical brushes of acicular crystals. Orbost, north of Loch Bracadale, in solid spheres, overlying both Apophyllite and Analcime. On the south shore of Loch Eynort, also in solid spheres overlying Analcime alone, and underlying Gyrolite. Dunvegan, associated with Apophyllite (MacCulloch). Rudh' Earr an Sgùirr between Loch Brittle and Loch Eynort, in felted masses of delicate crystals: "Cottonstone"; and also intermingled with crystals of Hornblende according to MacCulloch. Snizort, Kilmuir, in a congeries of mammillations of stout divergent crystals—Anal. 3. Rudha na h-Airde Glaise, with Farœlite and with Analcime (Currie); also with Apophylite Gryolite.

Canna. Sparingly in the rocks on the west shore, and also, rarely, at the south of the mansion-house.

Sanda. At the east Geo, and also stalactitic, like Harringtonite, traversing crystals of Analcime.

Eigg. With Chabazite (Greg). Near Uanh Fhraing, with Analcime; west of the cave, with Gyrolite, Farœlite, Chalcedony, and Stilbite.

Argyllshire. Mull, in the northern division of the island, with Prehnite, a mealy zeolite, and Stilbite (MacCulloch). Calgary Pier, Mornish, in large felted masses of the "Cottonstone" variety. In the basalt lavas of the sea-cliffs south of Beinn Chreagach, and south-west of Carsaig Bay (Goodchild). Treshnish Islands, Bac Mòr, and Fladda.

Dumbartonshire. In the rock of Dumbarton, in a capillary form, associated with Prehnite (MacCulloch).

Lanarkshire. At the Pap Craig, Tinto, as a mealy zeolite. At Philipshill quarry, East Kilbride, as a white fibrous zeolite, as the same in a compact crystallised form, and also as a radiated crystallised zeolite, associated with rhombohedral spar (Watson).

Renfrewshire. At Hartfield Moss (Greg), Kilmalcolm, in spheres of delicate acicular divergent crystals of a brown tint, resembling the finest down, which occur on crystals of Chabazite and Stilbite. Loch Thom cutting, with Thomsonite, in solid, opaque, white spheres, from the size of peas to over an inch in diameter. These spheres are sometimes coated with a lustrous sheath of downy white crystals.

Linlithgowshire. Crossgreen, near Linlithgow (Stuart Thomson)—Anal. 5.

Mesolite also occurs in semi-solid masses resembling the finest loaf-sugar, but more confusedly and delicately crystalline. Along with the tufted variety found at the crag foot of the hill north of the Quiraing the solid form is also found; but at this locality it occupies the outer part of the druse instead of the inner, and it is here underlain only by

Saponite. It is here of a brick colour to whitish, and it has a specific gravity of 2·103—Anal. 4. The same variety is found also at the Storr, in vapour cavities which are filled by Mesolite alone. Here also it is red.

Thomsonite Group.

142. **Thomsonite (456).** $(Na_2,Ca)Al_2Si_2O_8+\frac{5}{2}H_2O$.

Orthorhombic. [*b* (*a*), 100 ; *a* (*b*), 010 ; *c*, 001 ; *m*, 110 ; *d*, 401 ; *e*, 801 ; *o*, 0.1.45 ; *y*, 012 ; *x*, 0.1.48 ; *f*, 705 ; *k*, ; *l* ; *n*, ; *z*, .]

Distinct crystals rare ; usually occurs in prisms, with the prismatic faces strongly striated vertically. Cleavage, *a* and *b* both perfect ; brittle. H., 5 to 5·5 ; G., 2·35 to 2·38. Translucent ; lustre vitreous, pearly on *a*. Generally colourless ; but sometimes reddish or greenish. B.B. fuses with difficulty, and with intumescence, to a white enamel. Soluble with gelatinisation in h. acid. Pryoelectric. Optically positive. Comp., Silica, 38·7 ; Alumina, 30·8 ; Lime, 13·4 ; Water, 13·1.

Analyses :—1 and 2, *Min. Mag.*, v. 119 ; 3, *Chem. News*, xxvii. 56 ; 4, 5, *Ann. N. York* (1829), 9 ; 6, *Journ. pour Chem.*, lix. 349 ; 7, *Arsber.* (1822), 116 ; 8, *Bull. Soc. Min.*, x. 149 ; 9, 10, *Ann. Phil.*, xvi. 409 ; 11, *Zeit. d. Geol. Ges.*, xxviii. 555 ; 12, *Handb. Orykt.*, 208.

	SiO_2	Al_2O_3	Fe_2O_3	CaO	K_2O	Na_2O	H_2O	Total.	
1. Storr, massive,	39·02	28·13	3·28	10·73	1·01	3·71	13·99	99·87	Heddle.
2. Quiraing,	39·7	29·95	1·43	10·08	·38	5·511	13·07	100·11	Heddle.
3. Mugdock,	36·84	31·57	..	13·54	..	4·31	13·54	99·8	Wallace Young.
4. Dumbarton,	34·63	32·35	..	18·65	..	1·25	14	100·88	Thomson.
5. ,,	37·08	33·02	..	10·75	..	3·70	13	97·55	Thomson.
6. ,,	38·09	31·62	..	12·60	..	4·62	13·40	100·33	Rammelsberg.
7. Bowling,	38·30	30·70	..	13·54	..	4·53	13·10	100·17	Berzelius.
8. Bishopton,	38·44	30·24	..	13·44	..	6·45	11·83	100·38	Lacroix.
9. Lochwinnoch,	36·8	31·36	·60	15·40	..	..	13	97·16	Thomson.
10.	37·56	31·96	·72	15·1	..	..	13·2	98·54	Thomson.
11. Kilpatrick,	37·21	31·72	..	13·60	..	4·20	13·27	100	Lemberg.
12. ,,	38·50	30·60	..	12·60	..	4·80	13·50	100	Gmelin.

Inverness-shire. Skye, at Talisker, at the east foot of the Stack, in Tertiary amygdaloidal basalt lava ; on fasciculate groups of small pearly crystals which, although they delineate the form of spheres, do not assume the solid form as Faröelite does. These groups of crystals are associated in the same cavity with Acadialite, Chabazite, Mesolite, and Analcime. At Storr Thomsonite occurs, rarely, and in a manner similar to that at Talisker. A massive, granular, or confusedly-crystalline variety of a chalk-white colour, which fills the druses, is also found at the Storr. It has a specific gravity of 2·139—Anal. 1. In some cavities this form of Thomsonite is associated with Saponite, which it overlies. At the foot of the cliff of Leacan Fhionn the crystalline variety occurs in association with Analcime, while the cavities adjacent

contain Saponite, Farëelite, Mesolite (in both the dense form and in tufts), Apophyllite, Gyrolite, spherical Plynthite, Stilbite, Laumontite, and Chabazite—Anal. 2. The massive granular white variety is also found here. Thomsonite also occurs in the basalt lavas at the foot of the cliff below Beinn nan Cuithean, south of Talisker Bay, in association with Jasper-Hornstone.

Eigg. On the south shore, with Analcime.

Stirlingshire. In the Lower Carboniferous lavas in Mugdock Tunnel (Wallace Young)—Anal. 3.

Dumbartonshire. In the neighbourhood of Dumbarton (Greg)—Anals. 4, 5, 6. At Bowling quarry, on the east side, associated with veins of Prehnite, in radiating groups of acicular white crystals, which are sometimes barred with red. Such groups of crystals do not usually show distinct crystalline terminations—Anal. 7. The same mineral also occurs with Analcime and Erythrite, in large lamellar and translucent crystals, which show the combinations *m a b o*, *m a b e o* (Plate LXXXIV., figs. 1, 2), *m a b d e c*, *m a b d o y* (Plate LXXXV., figs. 3, 4). Also in reddish acicular divergent groups, in the banks of the stream descending from the south-east side of the The Slacks, Kilpatrick (Lamb).

Renfrewshire. Kilmalcolm (Anal.) and Port-Glasgow (Greg). In the Bishopton Tunnel, *m a b d e o*, *m b d c f e* (Plate LXXXV., figs. 5, 6), in sheafs of lamellar white crystals, on Prehnite—Anal. 8 (Lacroix). At Lochwinnoch (Thomson)—Anals. 9, 10. At Boyleston quarry, Barrhead, associated with Analcime, Rubinglimmer, yellow Prehnite, and rare forms of Calcite, *m a b d e o*, *m b c f d*, *m b c f d a* (Plate LXXXV., fig. 7), *m a b c d n k z l* (Plate LXXXV., fig. 8), *m a b c f d e n k z* (Plate LXXXV., fig. 9). From the cutting for the water channel at Loch Thom (Doran); and at Greenock waterfall at the Shaws. In very fine glassy crystals, with opaque, white, spheroidal and tufted Mesolite, in the Gryfe water works tunnel. Near Johnstone.

143. Farœlite (456a).

Is a variety of Thomsonite with 42·5 of Silica. It takes the place of Thomsonite in the basalt lavas of Tertiary age.

Analyses:—1, 3, 4, 5. *Phil. Mag.*, xiii. 150; 2.

	SiO_2	Al_2O_3	CaO	Na_2O	H_2O	Total.	
1. Storr,	41·32	28·44	11·54	5·77	13·26	100·33	Heddle.
2. Old Man,	40·33	29	12·12	5·33	13·22	100	Thomson.
3. Portree,	41·20	30	11·40	4·38	13·20	100·18	Heddle.
4. Uig,	43·17	29·30	9·82	5·33	12·40	100·02	Heddle.
5. „	48·21	29·03	10·35	5·16	12·46	100·21	Heddle.

INVERNESS-SHIRE. Skye, at the foot of the most south-easterly of the cluster of rocky pinnacles at the Storr, in nearly spherical, bluish-white, implanted spheres, with feathery Mesolite, and, rarely, with Apophyllite superposed—Anal. 1. On the east slopes of the pyramidal mound that supports the Old Man of Storr, where it occurs in the vapour cavities of the basalt lavas as a mammillated coating - Gyrolite being present in other cavities adjoining—Anal. 2. At Talisker, on the south shore, in implanted globules of a beautiful white colour, and with a radiated structure, associated with delicate crystals of transparent Laumontite and small crystals of Tesselite (Greg). Quiraing, as a mammillated coating of the surface of druses, underlying Apophyllite and Gyrolite, rarely. At the foot of the crag of the hill next Sgurr Mòr, north-east of Leacan Fhionn, Quiraing, associated with other zeolites, Saponite, and Plynthite. Loch Bracadale, at Orbost, on the north shore, underlying Acadialite and Chabazite. Loch Eynort (? Rudh' Earr an Sgùirr), globules of solid radiating Mesotype very much resembling the oolites (MacCulloch). Cliffs on the south shore of Uig Bay, at the north-east corner—Anals. 4, 5. Near Portree, at Rudha na h-Airde Glaise, lining druses, rarely associated with Gyrolite—Anal. 3.

Eigg. Shore west of Uamh Fhraing, with Gyrolite and Analcime.

ARGYLLSHIRE. Treshnish Isles, Lunga, underlying Scolecite, Analcime, Gyrolite, and Stilbite. Cairn a' Burgh More, and Cairn a' Burgh Beg, on the east shore, underlying Gyrolite.

Mull. South of the Wilderness, Ardmeanach, with Analcime (Currie).

II. MICA DIVISION.

1. *Mica Group. Monoclinic.*

144. **Muscovite (458).** $H_2 K Al_3 (Si O_4)_3$.

Monoclinic, with pseudo-hexagonal habit. Clv., basal, perfect; elastic. Lustre metallic pearly. Usually colourless; but occasionally tinged various shades. B.B. fuses to an opaque enamel. Not affected by acids.

Comp., 45·1 Silica, 36·6 Alumina, 11·8 Potash, 4·5 Water.

Anals. 1 to 6 inclusive, Heddle, *Trans. Roy. Soc. Edin.*, xxix. pp. 1-13 (1879); 7 and 8, Barrow, *Q.J.G.S.*, xlix. 355—

	SiO_2	Al_2O_3	Fe_2O_3	MnO	CaO	MgO	K_2O	Na_2O	F	H_2O	Total.
1. Lamb Hoga, with Kaolin,	50·77	31·71	1·32	·23	·95	·79	5·11	·53	..	7·97	99·38
2. Vannlip, with Kyanite, .	45·43	29·65	8·33	·02	·79	1·7	6·94	2·27	..	5·29	100·42
3. Grevasand, with Quartz,	45·42	30·30	6·87	·82	·60	2·60	6·09	2·01	1·06	5·01	100·78
4. Botriphnie, Banffshire,	45·1	29·90	7·87	·03	·62	·72	7·84	2·56	tr.	5·51	100·15
5. Glen Bucket, Aberdeenshire, . . .	46·18	31·83	4·1	..	1·66	1·23	8·81	1·31	..	5·71	100·83
6. Chaipaval, Harris, .	43·08	32·86	·74	·08	1·07	·33	9·08	·85	..	9·12	99·97
7. Clova, in Pegmatite, .	43·08	32·85	·73	..	1·07	·33	8·78	1·	..	9·12	99·72
8. Clova, in Schist, . .	45·80	31·84	..	..	..	1·15	7·36	3·19	..	4·90	100·30

[1] Fe, 2·76.

Shetland. Balta ; at the south end. Yell, at the north-east corner, and at Sandwick, in granitic veins (Hibbert). At the Noups of Graveland, in granitic veins, associated with Haughtonite. Mainland, south-west of Bixter Voe, in large rosette crystallisations, in a quartzose vein (D. and H.).

Caithness. On the Berriedale River, above the Bridge of Dalson, in large plates ; called " the silver rock."

Sutherland. Near the mouth of the Naver River, at Clach an Eoin, in quartz veins, with Garnet, Rutile, Ilmenite, and Haughtonite (D. and H.).

Ross-shire. At the head of Glen Shiel, in plates nine inches by six. Near the foot of Loch Glass, in boulders, along with Garnet and Zircon, in plates about ten inches across (Joass). At Glensgaich railway-cutting, in a nodular quartzose vein, in fine rose-tinted crystals, sp. gr. 2·782, sometimes fifteen inches across, and associated with Garnet, Zircon, and Tourmaline. South of the Black-Water outlet of Loch Garve, in a granite vein, pale green crystals along with Garnet.

Inverness-shire. South-east of Moidart, well crystallised, in large crystals, in Quartz. In a quarry about one mile south of Struy Bridge Inn, of an olive-green colour, associated with blue Microcline, and with pink Orthoclase ; also with Garnet, Beryl, and Tourmaline.

Hebrides. Harris, at the Dùn of Borve, dark green (D. and H.) In the great vein of Chaipaval, green, associated with rose Quartz (D. and H.) Anal. 6. Taransay, at the south end, greenish, in globular arrangements, and two and a half inches in width, in granite veins, along with Haughtonite, blue Quartz, and Microcline.

Aberdeenshire. In Rubislaw quarry, of a rich brown colour, sp. gr. 2·783, associated with flesh-coloured Microcline, and also with Tourmaline, Beryl, Apatite, and Oligoclase. At Sterling Hill quarry, with Quartz and Orthoclase. At Dyce quarry, salmon-coloured, along with graphic Microcline. At the Pass of Ballater, in granite, in brown crystals, with Smoky Quartz, Zinnwaldite, Agalmatolite, Microcline, Beryl, and Fluor (Bell and Thoms). Cabrach, at the Black Hill, with Tourmaline.

Elginshire. Near Duffus, " formerly in plates sufficiently large for glazing windows."

Banffshire. Portsoy : the first granite vein which cuts the schists to the east contains silvery mica, called " sheepy silver," in association with Albite. The third vein contains brownish mica with Tourmaline. The graphic-granite vein contains brown and plumose grey Muscovite. The vein further east contains large and fine grey plumes of the same mineral.

Forfarshire. Clova [in pegmatite veins in thermo-metamorphosed schists, associated with Tourmaline, Kyanite, Fibrolite, Quartz, etc. (Barrow and Goodchild)]—Anal. 7 and 8.

HADDINGTONSHIRE. Lammermuirs, north of Faseny Bridge, in granite.

BUTESHIRE. Arran, at †Coire Bhradan, in dark brown, elongated, six-sided plates (Greg). [? Biotite.]

[Margarodite, originally regarded as a species distinct from Muscovite, has been treated as a mere variety by Dr. Heddle in arranging the Scottish minerals in the Edinburgh Museum. Its localities, however, are here given separately.]

SHETLAND. Fetlar, at Moo Wick, Lamb Hogo, in Kaolin (Hibbert), Mainland. Hillswick, at Vannlip, sp. gr. 2·825, associated with Ripidolite and red Kyanite—Anal. 2. At Grevasand, in hexagonal plates, in schist (Hibbert)—Anal. 3. Colla Firth. Loch of Burroland (Gordon).

SUTHERLAND. At the west side of the mouth of the Halladale River, associated with Haughtonite, Chlorite, and Pyrites, in rosettes imbedded in Albite. West of Ledbeg, in dolomitic marble, along with Magnetite, Malacolite, and Serpentine.

BANFFSHIRE. Near Botriphnie, in the quartz veins in argillite, along with Kyanite—Anal. 4. At Limehillock, near Grange, with Calcite and Pyrrhotite. Redhythe, in limestone, with green Talc, white Biotite, and Rutile. Whitehills. On the shore to the east of Whitehills, associated with Andalusite.

ABERDEENSHIRE. In Ardonald quarry, near Huntly, rarely, associated with Kyanite and Grenatite. Glen Bucket, in the limestone quarries along with Pyrites, Pyrrhotite, Rutile, and Actinolite—Anal. 5. In the Coyle Hills, white and green, associated with Actinolite. Clova, at Clashnarae Hill, along with Andalusite, Fibrolite, and Biotite. Dyce quarry, associated with Oligoclase.

KINCARDINESHIRE. In granite veins on the shore at Torry, associated with Tourmaline, Pinite, and Beryl. Many of the Tourmaline crystals are passing, as pseudomorphs, into Margarodite.

PERTHSHIRE. Glen Lochay. Beinn Heasgarnich, on the south-east slopes near the summit, with Actinolite (Peyton and H.). Near Pitlochry, associated with Apatite, in mica-schist (Greg).

Sericitic Muscovite is found to the north of Beinn Laoghal, at the junction of the "syenite" with the schists. On the Skerry, of Stack and Skerry, 30 miles north of Sutherland. At the col on the path west of Goberunisgach. It also occurs in Coll.

Cylindrical clusters of crystals of red mica, which penetrate quartzite, occur on the steep west side of the cone of Stob Choire Easian Mhoir, near Loch Treig, Inverness-shire; also on the west side of Stob Coire an Laoigh,

and along to Stob a' Choire Leith, of the quartzite range of Stob Choire Claurigh. These cylindrical clusters of mica apparently represent the "worm holes" of the Sutherland [Lower Cambrian] quartzites.

Fuchsite occurs in minute scales in a rock of grauwacké appearance upon the north-west slope of Ceann Garbh, the most northerly of the three summits of Beinn Bhuidhe, near the head of Loch Fyne, in Argyllshire. [The specimens in the Scottish Mineral Collection in the Edinburgh Museum occurs in a highly-granulitised epidiorite, and range in colour from olive to bright emerald green.]

144A. Pinite (458a).

[Now usually applied to a variety of mineral substances essentially allied in composition to Muscovite, and regarded as decomposition-products of various minerals, especially of felspar.]

Analyses, Heddle :—1 and 2, *Min. Mag.*, v. 17.

	S.G.	SiO	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	K_2O	Na_2O	H_2O	Total.
1. Ceannabeinne,	2·77	48·72	31·56	2·43	..	..	.	1·8	9·48	·31	5·74	100·05
2. Buck of the Cabrach,	2·91	41·22	28·49	·15	5·48	10·2	·91	6·61	10·36	95	5·67	100·04

Sutherland. Occurs in imbedded massive patches in granite in the cliffs below the village of Ceannabeinne [Sangobeag], opposite the island of A' ghoil Sgeir. The felspar of this granite is soft and somewhat pearly in lustre. The Pinite is fine-granular, and pale pea-green in colour—Anal. 1. Also in the Canisp Porphyry, "Geog. Scott.," *Min. Mag.*, iv. p. 220, and v. p. 137.

Aberdeenshire. It occurs imbedded in diorite gneiss on the north-east slope of the Buck of the Cabrach, crystallised in prisms, and passing into Chlorophyllite. Its colour is asparagus-green, and it is transparent, and is vitreous in lustre. In general appearance it is intermediate between Apatite and Beryl—Anal. 2.

144B. Agalmatolite (458c).

Agalmatolitus, Bildstein, Klaproth, *Beitr.*, ii. p. 184 (1797); Pagodite, Napione, *Jour. Phys.*, xlvi. p. 220 (1798); Agalmatolite, Heddle, *Geog. Scot.*, p. 284, 1880.

Massive, with amorphous compact structure. Lustre glimmering, translucent, fracture splintery to conchoidal, rather sectile; H. 2 to 3, sp. gr. 2·8 to 2·9. Colour pea-green, grey, red, and yellow. Feels somewhat greasy, but does not adhere to the tongue.

Comp., 55 Silica, 33 Alumina, 7·6 Potash, 5 of Water. In several localities, however, it is somewhat magnesian.

Anal. 1, Heddle, *Min. Mag.*, iv. p. 215; 2, Macadam, *Min. Mag.*, vii. p. 28; 3, Macadam, *Min. Mag.*, vii. p. 74.

Locality.	Colour.	Sp. gr.	SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	K_2O	N_2O	H_2O	Total.
1. Lua Yayi, Eribol, . .	Pea-green,	2·77	48·72	31·56	2·43	1·81	..	9·49	·31	5·75	100·07
2. Ceannabeinne,	..	..	51·22	33·05	2·52	·33	·14	6·49	·18	6·03	99·96
3. Creag Mhòr Thollie, .	..	..	50·36	32·02	2·21	·52	·09	7·83	·12	6·74	99·89

Pyr, etc. B.B. on charcoal whitens and presents some slight marks of fusion; with borax affords a colourless glass. Soluble in s. acid.

Sutherland. Ceannabeinne; Lua-yayi [? Cnoc nam Braich], with flesh-coloured Orthoclase—Anal. 1; both localities near Loch Eireboll. Geodha-na-Seamraig; Cnoc Dubh, near Lairg.

Hebrides. Tiree, near Crossapol, with Haughtonite; at Ceann a' Bharra, with Magnetite (Currie).

Ross-shire. Loch Garve, at the foot of Little Ben Wyvis, with Garnets (Macconochie). Creag Mhòr Thollie (Macadam)—Anal. 3.

Aberdeenshire. Murdoch Head Quarry. Ballater Pass (Bell). South side of Creag an Daraich, in granite. Rarely in Rubislaw Quarry. Under the sea at Peterhead (Peach).

Inverness-shire. Glen Loy, near Banavie (Livingston). Glen Fyne at East Ruadh (Cadell).

145. **Zinnwaldite (461).** $(K_1\,Li)_3\,Fe\,Al_3\,Si_5\,O_{16}\,(OH_1\,F)_2$?

Monoclinic. In form near Biotite (Meroxene), b (010), c (001), H. (201), o (112), M (221), μ ($\bar{1}11$), x ($\bar{1}01$).

Measured angle, c H = 85°, c M = 85°, c o = 73° 19′, c μ = 81· to 82°, b x = 30° 30′.

Twins, according to the mica law, with c as comp. face. Faces b, c often bright, the others dull. A fine wrinkling common on the cleavage surfaces normal to the edes of the b planes. Crystals often in fan-shaped groups; in rosettes.

Cleavage : basal perfect. Laminæ tough and flexible. H = 2·5 to 3. G = 2·82 to 3·20. Lustre often pearly. Colour pale violet, or yellow, to brown and dark grey. Successive layers of different colours. Pleochroism distinct in some kinds ; in dark varieties—$\mathfrak{c}$ and $\mathfrak{B}$ dark brown, $\mathfrak{a}$ yellowish brown or reddish ; in light coloured kinds, $\mathfrak{c}$, $\mathfrak{B}$ brownish grey, $\mathfrak{a}$ nearly colourless.

Analysis by William Marshall :—

	SiO_2	Al_2O_3	Fe_2O_3 and FeO	MnO	K_2O	Li_2O	F
Pass of Ballater, .	58·70	24·27	7·55	1·15	12·70	1·88	Not estimated.
,, ,, .	..	..	..	..	..	2·85	

Aberdeenshire. Pass of Ballater (east end of Pass), associated with Muscovite, Microcline, Beryl, and Quartz (Cairngorm) (Plate lxxxv. fig. 1) —(Thoms).

[In addition to the specimens found by Mr. Thoms there are in the Scottish Mineral Collection in the Edinburgh Museum others found at "Monaltree Cliff," *i.e.*, the Pass of Ballater, by the late Mr. Thomas Bell of Ballygroggan. These occur in druses within coarse graphic granite, and are associated with Muscovite, red Microcline, Albite, and Smoky Quartz. The crystals show well-defined pseudo-hexagonal boundaries, are partly enveloped in the Quartz, and are succeeded by sheaves of small colourless crystals of Albite. Other similar specimens are from Culblean, Ballater.]

146. **Biotite (462).** $(H_1\,K)_2\,(Mg\,\dot{\dot{F}}e)_2\,(Al_1\,\dot{\dot{F}}e)_2\,(Si\,O_4)_3$.

Monoclinic, with pseudo-rhombohedral symmetry. [? *b*, 010 ; *m*, 110 ; *o* (*c*), 001 ; *r* (? *o*), 112 ; *z*, 132.]

Analyses 1 to 6 inclusive, Heddle, *Trans. Roy. Soc. Edin.*, xxix. pp. 15-19 (1879) ; 7, Cole, *Q. J. G. S.*, xli. 403.

	S.G.	SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	K_2O	Na_2O	F	H_2O	Total.
1. Glen Urquhart, .	2·867	38·69	17·66	·25	12·95	..	1·16	17·54	8·92	·13	·52	2·14	99·96
2. Laggan, . .	..	39·5	15·04	·24	10·23	·75	1·4	18·46	9 37	·62	·73	3·21	99 55
3. Skiness, . .	..	39·77	16·68	·65	6·73	·62	2·2	20·92	6·5	·48	..	5·4	99·95
4. Gleann Beag, .	2·85	39·46	16·45	·39	10·	·53	1·59	19·	8·22	·26	·32	3·34	99·56
5. Hillswick, . .	..	39·8	14·19	2·59	11·58	·24	·1	18·32	8·43	2·11	·56	2·52	100·44
6. Millton, Urquhart	2·781	40·31	12·58	1·81	3·35	·38	7·58	21·	6·56	·95	..	5·74	100·25
7. Loch Scye, .	2·8	38·	13·	4·5	3·	..	5·	24·	..	..	..	6·5	94·00

Shetland. Mainland. Hillswick, near the mouth of the Niddister burn, bronzy-brown, in hornblendic gneiss, in a bed, *per se*, but in the

immediate neighbourhood of Actinolite, Talc, and Anthophyllite (D. and H.)—Anal. 5. Occasional scales occur elsewhere in hornblendic rocks in Shetland.

Sutherland. At the north-west foot of Beinn Laoghal, in white scales, in a basic eruptive rock. At Shiness, of a grey-brown colour, in the belt of rock between the limestone and the gneiss, associated with Sahlite and Sphene (D. and H.)—Anal. 3.

Caithness. At the north end of Loch Scye, south of Reay, associated with Augite and Serpentine [in hornblende picrite]. It occurs in the form of white scales, an inch or more in size, forming one of the constituents of the rock called Scyelite (J. Gunn)—Anal. 7. [See Judd, *Q. J. G. S.*, xliv.]

Ross-shire. Loch Duich, at Inverinate Lodge, associated with Hornblende. At Totag, in the limestone, emerald-green in transmitted light (Currie).

Inverness-shire. Glen Urquhart, Millton, near the Free Church, pearly-white, associated with Actinolite, Edenite, Xantholite, Garnet, and Zircon—Anal. 6. Also brown, at the same spot. Upper Gortally, pinchbeck-brown, in a granitic belt which cuts the limestone, associated with Andesine and Quartz—Anal. 1. Glenelg, one mile north-east of Balvraid, Gleann Beag, with Necronite and Balvraidite, chocolate-brown (D. and H.)—Anal. 4. At Dulnan Bridge, near Grantown, in a granitic belt in the limestone, associated with Orthoclase and Andesine. One mile east of Laggan Inn, in limestone, with Chlorite.—Anal. 2.

Hebrides. Harris; at Eilean Glas, Scalpay; imbedded in Steatite, with Chlorite and Hornblende (D. and H.). Skye, the Cuillins, on the south-east side of Scuir nan Gillean, in "hyperite" (Dudgeon). Rum, in the troctolite of Allival, rarely. Iona, at Port an Duine Mhairbh, in serpentinous marble, in small white crystals, *m b e o r z*.

Banffshire. West of Portsoy, in parallel veins in limestone, and in clayslate, brown, and, rarely, colourless. At Redhythe, in limestone, white, associated with Margarodite, green Talc, Pyrrhotite, and Rutile.

Aberdeenshire. At Forester Hill, near New Meldrum, brown, associated with Pyrrhotite, Ilmenite, Sphene, Talc, and Sahlite. Near Inverurie, in Dobston quarry, in Biotite gneiss, with Ilmenite, Apatite, Chlorite, and Oligoclase. In a vein traversing diorite, at the summit of the road west of Tillypronie, Logie Coldstone, associated with Hornblende, Iserine, Labradorite, Allanite, and Sphene. Strath Don, at Badnagauch, on the Deskry, brown, in veins in diorite, associated with Labradorite, Hornblende, Sphene, and Allanite. Coyle Hills, at Allt

Cailleach, brown, associated with Malacolite and Serpentine. Near Abergeldie, at Boultshoch quarry, in a granitic belt traversing limestone, brown associated with Orthoclase and Andesine. In a similar belt in the limestone quarries at Craigs, Muir, and Midstrath, Deeside. At Crathie limestone quarry, brown, associated with Garnet, Idocrase, Sphene, Pyrrhotite, Fluor, and Coccolite. Glen Gairn, in Dalnabo quarry, brown, rarely in the limestone, associated with Cinnamonstone, Idocrase, Sphene, Epidote, Prehnite, Pyrrhotite, Wollastonite, and Coccolite. At Leac Ghorm limestone quarry, near Inver Inn, brown, in a granitic belt in the limestone, associated with Orthoclase and Andesine. Clova, at Clashnarae Hill, brown, with red Andalusite, Fibrolite, and Labradorite. Rhynie, at New Meldrum, associated with Labradorite.

Perthshire. Blair Athole, in the limestone quarry south of the Garry, associated with Ripidolite and Quartz. At Edintian limestone quarry, south of Tulach Hill, associated with Ripidolite, Sphene, Ilmenite, and Pyrrhotite.

Fifeshire. [As ejected crystalline masses in agglomerate] at Kinkell [near the Rock and Spindle]; Kincraig, Elie; and also near St. Monans. [At each of these localities it occurs] occasionally in plates nearly two inches in diameter, all brown. Inchcolm, at the south end.

Ayrshire. On the east side of Coal Water, near Giffordstrand, Dalry, in volcanic ash, with limestone nodules, dark brown, rubbed crystals (J. Smith).

[Common in all Scottish diorites, picrites, amphibolite schists, metamorphic marbles, and hornfels.]

147. **Haughtonite (462a).** $(Al_2O_3,Fe_2O_3)SiO_2+(FeO,K_2O)_2SiO_2$.

Monoclinic. Cl. basal, perfect. H. 3; sp. gr., 3·1. Lustre vitreous to adamantine. Colour chocolate-brown to black. Soluble in acids with difficulty. BB. fuses with difficulty to a highly-magnetic bead. Weathers pale green and ochry.

Comp., Silica, 36; Alumina, 18; Ferric Oxide, 4·5; Ferrous Oxide, 18; Magnesia, 9; Potash, 8; Water, 3.

Analyses 1 to 14 inclusive, Heddle, *Trans. Roy. Soc. Edin.*, xxix. pp. 21-33 (1879); 15-16, Barrow, *Q. J. G. S.*, xlix. 353 (1893).

	S.G.	SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	K_2O	Na_2O	H_2O	Total.
1. Roneval,	3·03	37·16	15·0	7·69	17·35	1·04	1·13	8·88	8·18	1·61	2·12	100·17
2. Chaipaval,	3·07	36·81	15·22	7·61	17·35	·96	1·54	8·78	8·31	1·34	2·47	100·39
3. Loch-na-Muilne,	..	36·46	17·25	4·18	15·33	·54	·69	2·23	9·2	·66	3·38	99·92
4. Foinne Bheinn,	3·03	36·75	17·86	2·78	15·17	·42	·93	11·17	9·44	1·25	4·23	100·00
5. Rispond,	2·99	36·54	22·28	2·43	16·01	·78	1·25	10·	8·26	·79	1·51	99·85
6. Clachan-Eoin,	2·96	35·85	21·54	4·47	18·31	·31	1·25	8·08	7·78	·79	1·96	100·32
7. Kinnairds Head,	3·13	35·67	17·95	7·19	18·06	2·	1·40	1·5	9·27	3·81	3·20	100·05
8. Cove,	..	35·47	18·8	4·61	19·19	·64	·90	7·01	8·19	·24	4·97	100·02

	S.G.	SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	K_2O	Na_2O	H_2O	Total.
9. Nisabost,	3·05	35·15	16·7	5·96	19·06	1·02	·82	7·46	9·24	1·26	3·13	99·80
10. Lairg,	..	35·56	16·69	1·88	18·04	·69	2·72	8·47	9·90	·11	5·71	99·77
11. Portsoy,	3·07	34·08	17·34	3·61	18·70	·38	3·23	10·54	6·78	1·19	4·05	99·90
12. Ben Stack	3·05	35·69	20·09	2·23	14·01	1·	1·89	14·77	7·38	·53	2·47	100·06
13. Cape Wrath,	..	34·15	14·84	10·96	13·47	1·38	1·81	10·31	7·93	2·14	2·80	99·79
14. Clashnarae,	..	39·00	25·10	6·51	9·80	·67	·93	6·17	7·08	1·63	3·47	100·36
15. Clova (1),	..	34·90	23·27	2·56	20·87	..	1·20	4·32	6·94	2·01	3·60	99·67
16. Clova (2),	..	35·00	25·06	3·94	15·30	..	1·50	6·48	9·31	1·84	1·72	100·15

[Haughtonite differs in composition from normal Biotite in its relatively larger percentage of iron to magnesium. The author regarded it as the usual dark mica in Scottish gneiss, pegmatite, and granite.]

Shetland. Yell, at the Noups of Graveland, with Muscovite.

Sutherland. Lairg, at Cnoc Dubh, in granitic veins in "syenite," dark to light green, associated with Orthoclase, Oligoclase, and Sphene—Anal. 10. On the west side of the mouth of the Halladale river, associated with Albite and Chlorite. Mouth of the Naver, at Clach an Eoin, in quartz veins, with Garnet, Ilmenite, Rutile, and Chlorite (D. and H.)—Anal. 6. Loch Eireboll, at Rispond, in a graphic granite vein, both black and brown, associated with Oligoclase and Magnetite. Two miles south of Cape Wrath, in a vein with Oligoclase (Geikie and H.)—Anal. 13. Foinne-Bheinn, on its west spur, 750 feet up, with Orthoclase and Oligoclase, in jet-black hexagonal crystals, 1 inch across—Anal. 4. Ben Stack, in fallen masses of Hebridean gneiss, at the north foot of the cliff, associated with Quartz and Orthoclase (D. and H.)—Anal. 12.

Inverness-shire. In a quarry on the road between Inverfarigaig and Foyers river; pale-green, with Epidote and Abriachanite—(Aitken and H.).

Hebrides. Lewis, Loch Roag, at Loch na Muilne, brown, in a granite vein with pink Orthoclase, pale-blue Oligoclase, and fatty Quartz (D. and H.)—Anal. 3. Harris, Roneval, in a granite vein on the north-east side, in plates 16 inches long, associated with Orthoclase (D. and H.)—Anal. 1. In the great vein of Chaipaval, at its north extremity, black (D. and H.)—Anal. 2. In veins parallel to the last at Hushinish House, rarely (D. and H.). Taransay, in veins at the south-east extremity. Stromay, Sound of Harris, in crystal plates, 4 inches wide, jet black, with Moonstone and Microcline; and also in long fan-shaped crystals, with green envelopes of stained Microcline, the folia being parallel to the *b* cleavage of the felspar. Between Nisabost and Borve—Anal. 9.

Shillay, in the south cliffs, with red Orthoclase.

North Uist, Loch Maddy, in a quarry north of the pier, with blue Quartz, Epidote, and Epidosite. On the north-west shore of Berneray Sound, in a rock overflowed at high water, where it is associated with

Actinolite schist. At Port nan Long, on its east side, in 6-inch crystals, with Oligoclase and graphic granite. At Hornish, with Oligoclase.

South Uist ; Loch Boisdale, near the hotel, in large twisted crystals in quartz veins, in gneiss, with red and white Orthoclase.

West Monach Island ; with Hornblende and Pyrites.

Coll ; in granite veins, with Muscovite.

Tiree ; near Crossapoll, in a granite vein, with pink aventurine Oligoclase, Magnetite, Microcline, and Agalmatolite.

Banffshire. Bay of Durn, Portsoy, on the west shore, of a bronzy colour, in diorite, rarely, in veins, associated with Paulite, Augite, and Labradorite (Peyton and H) At the north-west corner of the bay, in granitic belts in gneiss.

Aberdeenshire. In Rubislaw quarry, in the great dyke, in elongated brown crystals, associated with Muscovite, Beryl, Tourmaline, Apatite, and Garnet. At Anguston granite quarry, in veins, "crocus," with Oligoclase, Ilmenite, Sphene, and Allanite. Fraserburgh, north of Kinnairds Head lighthouse, in dark-green crystals, in a vein of lavender-coloured Microcline, associated with radiated Cleavlandite. The vein cuts gneissic schists (Grant Wilson)—Anal. 7. At Sclattey quarry, along with Orthoclase and Oligoclase. At the Burn of Craig, north of Tombhreac in elongated crystals. Clashnarae, with Andalusite, etc.—Anal 14.

Kincardineshire. In Durris Parish, north of Cairn-mon-earn, associated with Orthoclase and Apatite. In the granite quarry at Cove, in dark-brown, elongated crystals, which lie parallel to the folia of Muscovite—Anal. 8. At Blairydrine, and at Brathens, near Banchory, in felspathic bands of gneiss. It is here of a light-green colour, and is imbedded in milky-white Microcline, along with Apatite.

Forfarshire. In gneiss and pegmatite in Glen Clova. (Barrow) — Anal. 15, 16.

148. **Lepidomelane (462b).** $(H_1\,K)_2\,Fe_3\,(Fe_1\,Al)_4\,(Si\,O_4)_5$.

Comp., 37 Silica, 17 Alumina, 24 Iron-peroxide, 3 Iron-protoxide, 8 Potash, 10 Magnesia, 4 Water.

Anal. 1-3, Heddle, *Trans. Roy. Soc. Edin.*, xxix. pp. 19-21, 44 (1879).

	S.G.	SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	K_2O	Na_2O	H_2O	Total.
1. Achadh a' Phris.	2·971	40·38	12·11	14·52	3·03	3·15	1·03	13·	7·13	1·80	3·57	99·72
2. Tongue.	2.965	40·08	12·41	13·47	2·67	·61	1·08	14·66	7·57	2·15	5·29	99·99
3. Badnagauch.	2·845	33·03	13·17	26·07	2·01	·15	1·63	4·83	4·02	1·16	13·88	99·95

Sutherland. Tongue; in the great "syenite" boulder on Beinn Bhreac, in a granitic vein with Amazon-stone, Ilmenite, Fluor, etc. (D. and H.)—Anal. 2. Loch Shin, at Achadh a' Phris, in quartzose veins, in gneiss, associated with Sphene and Apatite (D. and H.)—Anal. 1.

Ross-shire. Near the summits of the following peaks of the Maol-Cheann-dearg range. Sgùrr na Forcan; Sgùrr na Sgine; the west slopes of Sgùrr an Lochain; with Garnet, on Sgùrr an Doire Leathan; Aonach air Chrith; on the south-east slopes of Creag a' Mhàim, along with Chlorite and Rock Crystal.

Inverness-shire. Moidart; on Scuir na Caiche, at the south foot of the summit cone, associated with red Orthoclase and also with Garnet.

Hebrides. Tiree; Gott Bay, south shore, with Garnet, in gneiss.

Aberdeenshire. At Murdoch Head granite quarry, associated with Orthoclase, Albite, and Fluor.

The brown mica in the matrix rock of Glen Gairn, Muir, Midstrath, etc., being very insoluble in HCl, may be Lepidomelane.

[It may be useful to append here several analyses of dark micas, as they will serve to show the relationship of Biotite and Haughtonite to each other, and of Lepidomelane to both. The analyses are by Dr. Heddle. *Trans. Roy. Soc. Edin.*, xxix. p. 34.]

	SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	K_2O	Na_2O	H_2O	Fl.	TiO_2	Totals.
Biotite—													
Glen Urquhart,	38·69	17·66	·26	12·95	..	1·16	17·54	8·92	·13	2·14	·52	..	99·96
Loch Laggan,	39·5	15·04	·24	10·23	·75	1·4	18·46	9·37	·62	3·21	·73	..	99·55
Shiness,	39·77	16·68	·65	6·73	·62	2·2	20·92	6·5	·48	5·4	..	..	99·95
Glenelg,	39·46	16·45	·39	10·	·53	1·59	19·	8·22	·26	3·34	·32	..	99·56
Hillswick,	39·8	14·19	2·59	11·78	·24	·1	18·32	8·43	2·11	2·52	·56	..	100·64
Millton,	40·31	12·58	1·81	3·35	·38	7·58	21·	6·56	·95	5·74	n.d.	..	100·25
Haughtonite—													
Coire Roneval,	37·16	15·	7·69	17·35	1·04	1·3	8·88	8·18	1·6	2·12	..	..	100·17
Chaipaval,	36·81	15·22	7·61	17·35	·96	1·54	8·78	8·31	1·34	2·47	..	..	100·40
Loch-na-Muilne	36·46	17·25	4·18	15·33	·54	·69	12·23	9·2	·66	3·39	..	..	99·92
Foinne-Bheinn,	36·75	17·88	2·78	15·18	·42	·93	11·17	9·44	1·25	4·23	..	..	99·99
Rispond,	36·54	22·28	2·43	16·01	·78	1·25	10·	8·26	·79	1·51	..	..	99·86
Clach-an Eoin,	35·85	21·54	4·48	18·31	·31	1·25	8·08	7·76	·79	1·96	..	..	100·33
Kinnairds Head,	35·67	17·95	7·19	18·06	2·	1·4	1·5	9·27	3·81	3·2	..	..	100·05
Cove,	35·47	18·8	4·61	19·19	·64	·9	7·01	8·19	·24	4·97		..	100·02
Nisabost,	35·15	16·7	5·96	19·06	1·02	·82	7·46	9·24	1·26	3·13	..	..	99·81
Lairg,	35·56	16·69	1·88	18·04	·69	2·72	8·47	9·9	·11	5·71	..	..	99·77
Portsoy,	34·08	17·34	3·61	18·70	·38	3·23	10·54	6·78	1·19	4·05	..	..	99·9
Ben Stack,	35·69	20·09	2·23	14·01	1·	1·89	14·77	7·38	·53	2·46	.	..	100·06
Cape Wrath,	34·15	14·84	10·96	13·47	1·38	1·81	10·31	7·93	2·14	2·8	..	..	99·79
Clova	39·	25·1	6·51	9·8	6·67	·93	6.17	7·08	1·63	3·47	..	..	100·33
Lepidomelane··													
Achadh a' Phris,	40·38	12 11	14·53	3·03	3·17	1·03	13·	7·13	1·8	3·57	..	..	99·72
Tongue.	40·08	12·41	13·47	2·67	·62	1·08	14·66	7·57	2·15	5·29	..	..	99·99

2. *Clintonite Group. Monoclinic.*

149. **Chloritoid (466).** $H_2 (Fe_9 Mg) Al_2 Si O_7$.

Anal. 1 and 2, Heddle, *Trans. Roy. Soc. Edin.*, xxix. pp. 76-7 (1879); *Min. Mag.*, iii. p. 28 (1879). 3, Barrow, *Q. J. G. S.*, xlii. pp. 152, 154.

	Sp. Gr.	SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	H_2O	Total.
1. Vannlip,	3·36	25·36	41·74	3·90	13·93	·92	·90	6·82	6·57	100·14
2. ,,	3·313 to 3·462	24·47	41·33	·38	18·52	·91	·30	6·8	6·98	99·70
3. Kincardine,	..	26·00	40·05	5·05	19·50	·02	..	2·88	6·00	99·50

A basic Iron, Magnesium, and Aluminium Silicate.

Shetland. Hillswick, at Vannlip, dark green, with included Sphene, and associated with Kyanite, Muscovite, and Quartz. Also, at the same locality, in brown, foliated, crystal plates, with a submetallic lustre, and associated with Rutile and Quartz—Anal. 1. Large, green, rough, crystalline masses also occur—Anal. 2.

Kincardineshire. In small dark green crystal plates in schist, along the coast between Stonehaven and the North Esk—Anal. 3; Cowie Water, and Red Man, 2 miles north of Stonehaven. (Barrow).

3. *Chlorite Group. Monoclinic.*

150. **Clinochlore (468).** $Hg (Mg Fe)_5 Al_2 Si_3 O_{18}$.

Monoclinic. Basic Magnesium, Iron, and Aluminium Silicate.

Analyses, 1 to 5, Heddle, *Trans. Roy. Soc. Edin.*, xxix. 65-9 (1879); 6, Varrentrapp, *Pogg. Annal.*, xlviii. 185.

	Sp.Gr.	SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	K_2O	Na_2O	H_2O
1. Niddister, Hillswick,	..	39·81	11·43	..	7·97	·26	2·80	25·64	1·20	3·15	7·91
2. Sandy Geo,	..	32·55	13·95	·97	5·27	·16	·79	32·78	·48	·06	13·17
3. Cape Wrath,	2·823	31·03	14·85	5·73	17·42	·99	·36	17·42	..	..	12·48
4. Tulach Hill,	..	30·30	19·40	..	8·23	·37	..	29·10	..	..	13·07
5. Bishop's Seat, Duncon.	2·96	35·41	18·08	·48	26·16	·60	1·01	8·76	·97	·52	8·02
6. Bute,	..	28·50	19·60	..	23·50	..	..	16·00	..	..	11·40

Shetland. Hillswick, at Niddister, in twisted folia, in close association with Anthophyllite—Anal. 1: "*Talc Chlorite.*" Sandy Geo, opposite Gordi Stack, in rosette crystallisation, of bright green colour, enclosing

octohedral crystals of Magnetite, and associated with beds of pink Steatite—Anal. 2. Hagdale, Unst, in veins traversing Serpentine.

SUTHERLAND. At "Torridon" Geo, 1 mile south of Cape Wrath, in blackish green foliated plates, associated with Actinolite and Steatite, in hornblendic gneiss, underlying Torridon Sandstone—Anal. 3. Also at 1 mile south of the above-mentioned locality, in two other geos, where it is associated with dark Hornblende, and where the crystals are larger than those from the locality to the north.

PERTHSHIRE. In a limestone quarry south of the Garry, near Blair-Athole, in very dark green rosettes, associated with Biotite and Quartz—Anal. 4. At Edintain, south of Tulach Hill, in metamorphic limestone, associated with Sphene, Ilmenite, Pyrrhotite, and Biotite.

ARGYLLSHIRE. Dunoon, at Bishop's Seat, on the east side, in scaly masses, of a blackish green colour, associated with Quartz and Ilmenite —Anal. 5. In Quartz blocks, loose in Balgie Burn, cryptocrystalline, and associated with Wad, Pyrites, Quartz, and Ilmenite.

BUTESHIRE. In Bute (Thomson). Anal. 6.

151. **Penninite** (**468a**). $H_8 (Mg_1 Fe)_5 Al_2 Si_3 O_{18}$.

Monoclinic, with rhombohedral symmetry. Lustre resinous. H., 2 to 3; G., 2·6 to 2·77. Streak greenish-white. BB. exfoliates, becomes white, and fuses on the edges to a white enamel. Sol. in warm S. acid. A basic Magnesium, Aluminium, and Iron Silicate.

Analyses, Heddle, *Trans. Roy. Soc. Edin.*, xxix. pp. 61-3 (1879).

	S. G.	SiO_2	Al_2O_3	Fe_2O_3	Cr_2O_3	FeO	MnO	CaO	MgO	K_2O	Na_2O	H_2O	Total.
1. Scalpay, Harris, .	3·099	30·41	11·58	2·34	..	10·71	1·19	tr.	30·63	·01	1·31	11·74	99·22
2. Corrycharmaig, .	2·895	34·31	13·64	·36	tr.	10·31	·23	8·97	18·04	1·36	·13	12·41	99·66
Kämmererite—													
3. Unst, massive, .	3·099	29·89	12·93	..	5·97	1·96	..	3·54	29·93	1·16	·97	13·27	99·62
4. Do., crystallised,	..	32·31	7·5	..	7·89	2·08	..	3·83	32·15	..	..	14·25	99·56
Pseudophite—													
5 Beauty Hill, Aberdeen, . .	2·59	34·73	12·44	..	..	2·68	1·17	1·6	34·1	..	..	13·1	99·10

SHETLAND. Unst, Hagdale Chromite quarry, associated with Chromite and Grastite. In the quarries on Nikka Vord, with Kämmererite and Serpentine. Keen of Hamar, Harolds Wick. Balta Sound, associated with Calcite, Kämmererite, and Serpentine.

HEBRIDES. Harris: Scalpay, at Eilean Glas, in a bed 2 feet thick, in serpentine, fine granular to slaty, with Zircon, Steatite, Dolomite, and Chlorite (D. and H.)—Anal. 1.

PERTHSHIRE. Glen Lochay, half a mile south of Corrycharmaig, in mica schist, with Chromite and Picrolite. Forms a layer of scaly crystals half an inch wide, coating the Chromite (Doran)—Anal. 2.

ARGYLLSHIRE. At St. Catherines, Loch Fyne, with Pentlandite and Gersdorfite, etc.

Var. *Kämmererite.*

SHETLAND. Unst; at Hagdale, purple and green, in Serpentine, with Chromite and Hibbertite—Anal. 3. In the Nikka Vord quarries, in crystalline groups like fig. 12 of Dana, 6 Edn., associated with Chromite, Aragonite, and Hibbertite (D. and H.)—Anal. 4. In a quarry near Buness, associated with picotitic Chromite, and Brucite, plum-coloured crystals *l o.*

Var. *Pseudophite.*

ABERDEENSHIRE. Beauty Hill, near New Machar, on the east side, in thin veins in gabbro, with a waxy lustre, and grass-green in colour (Nicol and H.)—Anal. 5.

152. **Prochlorite (469).** $H_{40}(Fe_1 Mg)_{23} Al_{14} Si_{13} O_{90}$.

Monoclinic. A basic Magnesium, Iron, and Aluminium Silicate.

Analyses by Dr. Heddle, *Trans. Roy. Soc. Edin.*, xxix. pp. 69-76 (1879).

	S. G.	SiO_2	Al_2O	Fe_2O_3	FeO	MnO	CaO	MgO	K_2O	Na_2O	H_2O	Total.
1. Pundy Geo, Fethaland, Shetland,	2·67 ..	24·3	20·86	3·57	16·72	·55	·5	22·2	..	..	11·55	98·35
2. Beinn Dearg, Perthshire	3·002	24·72	21·57	·62	26·16	·47	·45	12·86	1·73	·05	10·89	99·52
3. Creag-an-Lochain, do.	2·697	24·29	21·18	·10	18·74	·8	1·66	21·03	1·29	·56	10·08	99·91
4. Lude, Perthshire.	2·852	23·92	22·98	1·11	19·54	·28	2·45	17·26	..	..	11·78	99·32
5. Lude, Perthshire.	2·852	24·66	23·19	·64	20·58	·29	·4	17·79	..	..	12·12	99·30
6. Loch Laggan, Inverness	2·834	26·25	19·22	1·67	16·44	1·02	..	24·35	..	..	11·67	100·66
7. Portsoy, Banffshire.	2·792	26·71	20·42	3·47	13·99	·73	..	23·9	..	..	11·17	99·58
8. Girdleness, Kincardine.	3·038	24·77	20·16	1·38	27·37	·61	·9	13·34	..	..	12·05	99·77

SHETLAND. Unst, on the north shore of Uyea Sound, in Quartz. Mainland. Fethaland, at Klebber Geo, with Ilmenite and Dolomite, and at Pundy Geo, with Magnetite, both scaly, massive (D. and H.)—Anal. 1. Hillswick, South Queen Geo, with Rock Crystal (D. and H.). Vannlip dark green with Quartz and Specular Iron, also with Kyanite. Fetlar; near Oddsta, with Magnetite (Hibbert).

Sutherland. Mouth of the Navir, at Clach-an-Eoin, with Rutile, Ilmenite, Garnet, and Haughtonite, in Quartz veins (D. and H.). Shiness, foliated, crystalline, blackish-green, associated with Quartz and Microline.

Ross-shire. Creag a' Mhàim, with Quartz and Lepidomelane.

Inverness-shire. Glen Nevis, on the south-west slopes of Aonach Beg, in gneiss, with Garnet. Loch Laggan, in metamorphic limestone, associated with Quartz, Sphene, and Pyrrhotite—Anal. 6.

Hebrides. Jura, on the road from Ardfin to the Small Isles, crystallised in six-sided tables, in chlorite schist (Jameson). Islay, at the north-west extremity, crystallised.

Argyllshire. Near Dalmally, compact, "with limestone and greenstone" (Macnight). Loch Etive, Bonawe, at the south quarry, in druses in the centre of only very large masses of granite, in which Prochlorite occurs as fine rosette groups in association with Epidote and Pyrites. At Glen Finnart, with Quartz. At the east foot of the pillar of the "Cobbler," associated with Rutile, Muscovite, Ilmenite, and Quartz. Ben Buidh, Gareloch, dark green scales, associated with Muscovite and Quartz. Am Bodach, Glen Coe, associated with Epidote and Byssolite. Appin, as chlorite schist, associated with metamorphic limestone. Beinn Doireann, on the south-west side, fifty feet from the summit.

Banffshire. Half a mile east of Whitehills, associated with Margarodite and Andalusite, in veins in gneiss. At Candelmore, in limestone, moss-green. Portsoy, in schist west of the serpentine, bright-green to golden-yellow—Anal. 7. Glen Avon, Gaulrig, at Three Burns, in rosette crystallisation, in Calcite, associated with Fluor and Sphene. Tralair Quarry, in rosette crystallisation, imbedded in a Quartz vein. Laoch, half a mile below, west of the mines at Tomintoul, in chlorite schist, with Pyrites and Margarodite (Muscovite).

Aberdeenshire. New Meldrum, at Forester Hill, in limestone, associated with Sphene, Sahlite, and other limestone contact minerals. Inverurie, at Dobston quarry, in biotitic gneiss, associated with Epidote, Ilmenite, etc. Tillyfourie, old quarry. Huntly, at Cairney, and at Gingomyres (Greg). Hill of Milleath, north of Bogforth, in tufted crystals, surrounding Garnet, in chlorite schist, near serpentine. Between Glen Bucket and Glen Nochty, in limestone, associated with "Margarodite," Pyrites, Rutile, etc. Culsalmond Hill, on the north side, imbedded in massive Talc in a vein (Nicol). Rubislaw, in granite, associated with Apatite.

Kincardineshire. On the shore between Torry and Girdleness, in granite veins in gneiss, rarely crystallised, and massive, scaly, associated with Epidote and red Orthoclase—Anal. 8.

Forfarshire. Tarfside, in fine rosettes, associated with Kyanite, on the north-west side of Garlet Hill (Murray). In Glen Effock in rosettes

(Murray and H.). These, with specimens from Aonach Beg and Glen Avon are the finest rosette crystallisation of Chlorite I have found in Scotland.

Perthshire. In Glen Tilt, crystallised (MacCulloch). Beinn a' Ghlo on both west and east slopes of Càrn nan Gabhar. Athole, in crystals half an inch across, associated with crystals of felspar, in cavities of mica schist (MacCulloch). In cliffs on the hill ridge, extending from Meall Gruaidh by Ben Lawers round to Crianlarich, in hyaline Quartz, with Rutile ; also from Crianlarich to Beinn Mhòr of Loch Eck, with Rutile and Ilmenite ; and thence westward across Cantyre without these associates. Specially at Aberfeldy, in a quarry of mica schist behind Moness House (Glen). Glen Lyon, on the west slopes of Beinn Dearg, massive, fine-grained—Anal. 2. Meall nan Tarmachan, at Creag an Lochain, in large bright-green scales, and also massive, associated with Ilmenite – Anal. 3. Creag na Caillich, with Rutile. Beinn Heasgarnich, on the south-east slopes, with Margarodite, Rutile, and Actinolite (Peyton and H.). Ben More, on the west slopes. Stob Luib, on Cruach Ardran, compact, granular. Beinn Laoigh, south ridge, large granular massive. Dunkeld, Birnam quarry, crystallised, in veins in clay slate. [Phyllite] associated with Calcite and Pyrites. At Newtyle quarry, associated with Chalcopyrites. With Talc near Cally. Blair Athole, at Lude quarry, pale olive-green—Anal. 4 ; and in yellow Quartz veins in limestone, of a bright green colour —Anal. 5.

Ayrshire. At Bennane Hill and at Knockdolian Hill, where serpentine meets limestone. It is here associated with Steatite.

Buteshire. In Arran (Greg).

[The Prochlorite mentioned above from Glen Finnart is referred by Greg doubtfully to Aphrosiderite. It does not appear to have been analysed. The Prochlorite from Beinn Dearg, and that from Girdleness (Analyses 2 and 8, above), and the Clinochlore from Dunoon and Bute (Analyses 5 and 6, above), which are all highly ferriferous, approximate in composition to Aphrosiderite, and may be referable to that not-very-well-defined species ; but it would seem more expedient to exclude from the designation those chlorites in which a considerable proportion of the ferrous oxide is replaced by magnesia (Currie).]

153. **Delessite (478).** $H_{10}(Mg_1 Fe)_4 Al_4 Si_4 O_{23}$.

Massive, with a scaly, or short fibrous feathery texture. H. = 2·5 ; G., 2·6 to 2·7. Colour, olive green to dark green. Powder, greyish green. In tube, yields water and becomes brown. B.B. fuses with difficulty on the edges. Easily soluble in acids, with separation of silica.

Analyses 1 to 5, Heddle, *Trans. Roy. Soc. Edin.*, xxix. 81, 1879 ; 6, Stuart Thomson and H., *Min. Mag.*, vol. xi. p. 29.

	S. G.	Loss at 212°	SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	K_2O	Na_2O	H_2O	Total.
1. St. Cyrus, Kincardine,	2·652	2·744	32·69	13·44	4·40	6·62	..	·86	28·77	..	..	13·25	100·03
2. BowlingQuarry, Dumbarton,	2·573	5·7	32·00	17·33	1·19	12·45	..	1·57	20·42	..	..	15·45	100·41
3. Dumbuck, do.	2·598	6·3	32·01	18·87	1·18	12·09	tr.	1·39	19·64	..	..	15·46	100·64
4. Lang Crag, do.	2·656	4·678	30·93	15·32	3·16	15·31	·38	1·38	18·65	..	..	14·69	99·82
5. Elie, Fifeshire,	2·672	3·389	30·69	12·83	1·63	18·32	1	1·59	18·60	·57	1·11	13·77	100·11
6. KnockScalbert, Argyll,	2·608	7·29	34·69	5·48	10·82	18·71	..	2·49	12·21	..	..	15·19	99·59
Formula,	..	..	31·53	16·28	2·8	12·61	..	..	21·02	..	..	15·76	..

KINCARDINESHIRE. At St. Cyrus cliff, bright-green, scaly, filling the steam holes of amygdaloids of the Old Red Sandstone, with an intervening skin of Celadonite—Anal. 1. The mineral here decomposes, through peroxidation of the ferrous oxide, into brick-red or dark-red tints.

FIFESHIRE. "Ferry Port-on-Craig" (Parton Craig), in the railway cutting, rarely; inclosed in Celadonite, in druses in the amygdaloid with agates. Elie, in two vertical dykes of basalt, 1 mile east of the town; dark green, minutely scaly, with Iserine, Olivine, [? derivative] Sanidine, [Soda-Microcline, Hornblende] and Pyrope—Anal. 5. Also in tufa, [agglomerate] north-west of the old summer-house, [Ladies' Tower].

DUMBARTONSHIRE. North-east of Glen Arbuck, near Bowling, in basalt. Dark-green, foliated, granular—Anal. 2. Near the reservoirs north of Dumbuck Hill, filling irregular druses in decomposing "melaphyre," with "Ferrite," Olivine, and Calcite. Light-green when fresh, dark on exposure—Anal. 3. In the Lang Crag, associated with red Stilbite and with Quartz—Anal. 4.

RENFREWSHIRE. Kilmalcolm, in a quarry south-east of the town; in amygdaloidal "felstone," associated with Heulandite, Stilbite, and other zeolites.

ARGYLLSHIRE. Knock Scalbert, near Campbelton, Kintyre, in thin veins, slickensided, in a basic eruptive rock, dark-green—Anal. 6.

154. **Serpentine (481).** $3MgO.2SiO_2.2H_2O$.

Varieties:—Antigorite, Schweizer; Williamsite, Shepard, *Am. J. Sc.*, vi. p. 249, 1848; Marmolite, Nuttall, *Am. J. Sc.*, iv. p. 19, 1822; Chrysotile, Kobell, *J. pr. Ch.*, ii. p. 297, 1834; Picrolite, Hausmann, Moll's *Efem.*, iv. p. 401, 1808; Baltimorite, Thomson, *Phil. Mag.*, xxii. p. 191, 1843.

It occurs only as pseudomorphs. Usually massive, microscopically finely-fibrous, also fine-granular to slaty. Fracture usually splintery,

Feels smooth. H. = 2·5, to, rarely, 5·5 ; G. = 2·5 to 2·65. Lustre feeble, but varying from earthy through resin-like or wax-like to pearly. Colour usually leek-green, but passes from white to siskin-green, through brownish-yellow, brownish-red, and oil-green to blackish-green. When weathered it becomes yellowish-grey. Streak white, slightly shining, translucent to opaque. Pleochrism feeble, optically −, perhaps + in Chrysolite. Double refraction weak. Ax. pl. ‖ *a* (100), Bx. (a) ⊥ (010), the cleavage surface ; c. ‖ to elongation of fibres. Biaxial angle variable, often large ; 2E = 16° to 98°, Tschermak ; 2V = 20° to 90°, Lévy-Lacr. Dispersion, $\rho > v$. C.C. Silica 44·1, Magnesia 43·0, Water 12·9.

Varieties :—Many species have been made out of Serpentine, differing in structure (massive, slaty, foliated, fibrous) or, as supposed, in chemical composition, and these now in part stand as varieties ; all would seem to be produced by an alteration of other substances.

1. *Chrysotile*,—Delicately fibrous, the fibres usually flexible, running transverse to the veins, and easily separating ; lustre silky ; colour white, golden yellow, olive-green, brown. G. = 2·219. Often constitutes seams in Serpentine. It includes most of the silky Amianthus of Serpentine rocks and much of what is popularly called Asbestus.

2. *Picrolite*.—Columnar, but fibres or columns not easily flexible, and often not easily separable, or affording only a long splintery fracture ; colour dark green to mountain green, greenish, grey, and brown.

3. *Marmolite*.—Thin foliated ; the laminæ brittle but easily separable, yet graduating into a variety, in which they are not separable. G.=2·41 ; lustre pearly ; colours greenish white, bluish white to pale asparagus green.

4. *Precious Serpentine*.—Generally short and brittle in structure ; oily lustre, rich green and red colours, with opaline reflections, translucent, but sometimes in ramifying veins passing to white and opaque.

5. *Bastite*, or Schiller Spar, is Enstatite (Hypersthene), altered more or less completely to Serpentine.

6. *Williamsite*.—A lamellar Serpentine of apple-green colour, with H. = 4·5.

7. *Common Serpentine*.—Coarse and earthy, of blotched and variegated appearance, more resembling a rock mass.

8. *Pseudomorphous Serpentine*.—Shows crystalline faces or outlines.

Analyses 1-8 by Heddle, *Min. Mag.*, and *Trans. Roy. Soc. Edin.*, xxviii. 45 ; 9, Thomson's *Mineralogy* ; 10-16, Heddle, as above.

	Sp.Gr.	SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	K_2O	NaO	H_2O	Total.
Chrysotile.												
1. Hesta, Fetlar, .	..	39·73	·09	..	2·92	..	..	41·61	..	..	15·66	100·02
Picrolite.												
2. Pundy Geo, .	2·67	42·93	1·85	5·10	..	·42	·8	36·19	·81	·37	11·5	
3. Corrycharmaig.	2·63	41·47	..	4·01	4·83	·26	..	37·13	..	..	12·5	100·20
Precious Serpentine.												
4. Niddister, .	2·52	41·46	·01	2·42	1·16	·23	tr.	41·76	..	..	12·43	
5. Portsoy, brown veins,	2·41	42·55	·22	..	1·63	·35	..	39·65	..	..	16·11	
6. ,, green veins, .	2·37	40·97	·06	2·06	..	·11	1·36	38·45	..	..	16·43	
7. ,, pale green, .	..	38·62	·70	1·27	..	·23	2·84	37·00	·63	2·12	16·58	
8. Polmaily, white, .	2·15	40·60	2·72	2·95	..	·4	2·58	38·80	·32	1·64	15·16	
9. Iona, . . .	2·59	44·35	1·3	..	3·6	..	..	36·05	..	..	18·55	
Schiller Spar.												
10. Black Dog Rock, .	2·65	38·19	2·18	·03	8·48	·51	2·91	32·42	1·4	·06	14·03	
11. Balhamie Hill, .	..	37·41	..	13·54	·06	·24	·2	34·76	..	..	13·59	
Common Serpentine.												
12. Haaf Gruney, . .	..	44·4	..	·11	6·29	..	·44	36·71	..	tr.	13·20	100·31
13. Totag, . . .	..	37·92	·13	1·35	1·62	..	3·45	39·00	·44	1·22	14·8	
14. East Head, Portsoy, .	..	40·54	2·45	2·12	..	·23	..	36·23	18·10	..	..	
15. Matrix of Chromite, Unst, . . .	..	34·46	..	6·76	..	·63	·58	28·96	..	..	18·53	
Pseudomorphs.												
16. Matrix, 1st. vein, Portsoy, . .	..	38·83	2·02	2·03	..	·77	1·07	38·76	..	..	16·38	
17. Pseudo, red crystals (west of Portsoy), .	..	37·33	1·13	4·36	4·05	·38	2·12	36·71	·83	·73	13·37	
Formula, . .	..	44·14	..	..	..	..	..	42·97	..	..	12·89	

Var. 1. *Chrysotile.*

SHETLAND. Unst, at the north shore of Balta Sound, near Swinna Ness, with Brucite, rarely.

Fetlar. At Hesta Ness, Gruting, in golden-yellow veins, with a high lustre, associated with Magnetite (Dudgeon)—Anal. 1.

Mainland. Colla Firth, south shore, in Common Serpentine, in numerous waved inosculating colourless veins or layers (D. and H.). At Scousburgh, pale-green, rare.

BANFFSHIRE. Portsoy, in the verdigris-green Serpentine to the west of the town; in veins of a salmon colour (D. and H.). In a Serpentine quarry north of the Bin of Huntly, and a mile west of Rothiemay station, in veins in Picrolite and Asbestus, brown.

ABERDEENSHIRE. Auchindoir, Hill of Tombhreac, on the north side; dark-green, with grey Pyrosclerite. In the east Coyle Hill, in veins 2 to 3 inches wide, brown in colour, passing to white.

Var. 2. *Picrolite.*

SHETLAND. Balta island, dark green at Doos Geo.

Haaf Gruney, yellow. Aith Voe, pale-green tufts, and at Houbie.

Mainland. Fethaland, at Pundy Geo, dark-green, columnar, associated with Magnetite, Chlorite, and Asbestus (D. and H.)—Anal. 2.

Banffshire.—Portsoy, in a quarry a little west of the town; pea-green in colour, sometimes asbestiform. In the quarry west of Rothiemay.

Perthshire. Glen Lochay, at Corrycharmaig, very fine green, associated with Ripidolite and Chromite, "Baltimorite" (Doran)—Anal. 3.

Vars. 3 and 4. *Precious Serpentine* and *Marmolite.*

Shetland. Unst, in a bay north-east of Swinna Ness, of a rich dark green, mottled by Enstatite Serpentine. At South Cross Geo, similarly (D. and H.).

Haaf Gruney, in veins of a lemon-yellow colour, with Igelströmite —Anal. 12. Fetlar, near Aith, bright yellow.

Mainland. Hillswick Ness, "Banks" of the Niddister, in two veins, one greenish-yellow—Anal. 4; the other chocolate-brown and resinous "Retinalite."

Banffshire. Portsoy, in the westernmost of the Serpentine beds, in intersecting veins of a waxy appearance, and displaying a girasole play of colour when viewed by transmitted light; of pale-green, lavender, brown and white colour, perfectly transparent (D. and H.)—Anals. 5, 6, 7.

Inverness-shire. Glen Urquhart, above Polmaily, in veins in dark Serpentine, of a cream colour, but dull, resembling meerschaum-"Porcellophite," rare—Anal. 8.

Hebrides. Iona, Port na Curaich, yellow and pale-green nodules in white marble—Anal. 9.

Tiree, at †Callivar, greenish-yellow, sulphur- and lemon-yellow, in marble. Ballyphaetrish Bay, dark-green, and sulphur-yellow, in marble.

Var. 6. *Williamsite.*

Pale nickel-green, weak lustre, and slaty fracture; occurs very rarely at Hagdale, Unst, Shetland, associated with ? Genthite, Chromite, and Pentlandite.

Var. 5. *Bastite* or *Schillerspar.*

Aberdeenshire. Belhelvie, in a quarry near Broomhillock, in large crystals, in Serpentine; pea-green in colour (Nicol and H.). In a quarry near Whitecairns, in Serpentine, with plumose Pyrites, in bronzy crystals (Nicol and H.). In boulders of black Serpentine at the mouth of the Black Dog Burn, in very large crystals—Anal. 10.

Banffshire. Near Rothiemay, in Serpentine.

Ayrshire. Balhamie Hill, near Colmonell, in leek-green crystals,

imbedded in black Serpentine. These on the rock surface are bronzy; Chonicrite is an associate—Anal. 11.

Var. 7. *Common Serpentine.*

This often forms great beds, or even mountain masses. It is a mixture of all the foregoing varieties, together with, probably, some Deweylite, Hydrophite, Pyrosclerite, or Kaolinite. It is also frequently veined with Dolomite or Calcite, and is studded with partially or completely pseudomorphosed crystals of Olivine, Enstatite, Sahlite, Actinolite, Nephrite, Chromite, or Picotite, and even felspars. These (varied constituents) often mottle it with red, green, or white, thereby giving it the aspect of a porphyry. The names Serpentine, Ophite, and Lapis Colubrinus, refer to the serpent-like markings displayed when it is cut and polished; it is then, sometimes, improperly called Serpentine marble. This common Serpentine occurs in Unst (Anal. 15) and Fetlar, as the matrix of Chromite. Usually of yellow colour.

Shetland. Unst and Fetlar. Several beds of Serpentine diverge like the blades of a fan from a point lying to the south of the last of these islands, and pass northward. The most westerly traverses both islands; the two next in order traverse Fetlar, touch the islets Urie Lingey and Daaey, but do not reach Unst. The most easterly forms a large mass in Fetlar, the whole of Haaf Gruney (Anal. 12), and the promontory of Mu Ness in Unst. These beds are associated with limestones, gabbros, and gneissic schists.

Mainland. A bed which appears first north of Ollaberry, crosses the heads of Quey Firth and Colla Firth voes, and reappears in Fethaland at Pundy and Klebber Geos. Other localities are the south-west extremity of Bixter Voe, Hillswick Ness and the south-west of Scousburgh, on the shore.

Inverness-shire. In Glen Urquhart, above Polmaily, in association with limestones and margarodite (Muscovite) schists.

Hebrides. Lewis, at Loch Thamanabhaidh (Nicol).

Harris, Scalpa Island, at Eilean Glas. Nearly crossing Harris from Scara Rudhá to the Dùn of Borve, north of Loch Langavat.

Banffshire, Aberdeenshire, and Perthshire. At Portsoy, two beds show themselves to the west of the town; a series of thin beds in and on the west shore of Durn Bay, and two more massive ones near Cowhythe Head. These traverse in a S.S.W. course the counties of Banff, Aberdeen, and part of Perth, as two beds, sending an offset which forms a third about the Hill of Noth to the east; this appears at several points, and passes into the sea north of Aberdeen. All seem united as far south as about Huntly, appearing on the east side of a quartz range,

as at Damhead, near Durn Hill, Fordyce, Lurg, and Knock Hills; at Limehillock, near Grange, and west of Rothiemay station. The several points at which the more westerly branch is now seen are at the Hill of Milleath, Drumhead, near Ruthven, the Sockach [? Succoth] Hill, south of Glass, on the Deveron, and skirting its west bank upwards at Craigdornie, Craig luie, above Shenwell, Blackwater Lodge, and west of Creag an Sgòr. A great mass forms Greer Hill of Strathdon; it is again seen at Dalnein, on the Dee; at Braemar, near the Dee; and, according to MacCulloch, in the Eye Forrest.

The central band shows itself at the Red Craig of Rhynie, the Hill of Tombhreac, in Auchindoir, at several points near Redford in the Cabrach, on the Kindy and on the Deskry, between Morven and Culblean, in large mass at the Coyle Hills, near Ballater, and at Little Kilrannoch, at the head of the White Water, a branch of the South Esk. The eastern branches appear at Leith Hall, at Chapelton and Premnay, at Bourtie, Barra Hill, and Forester Hill, near Meldrum, in large mass at Belhelvie, and, lastly, at the Black Dog Rock, 5 miles north of Aberdeen.

The igneous rock which appears here, and again in the vicinity of the great fault which separates the Old Red Sandstone from the northern schists, shows itself at several places as Serpentine; as at Cortachy Bridge, Balloch on the Carity; near Barry, Hill of Alyth, and near the limestone at the south end of Loch Cluny: probably it is the same as appears north of Balmaha, on Loch Lomond. Near Kinnordy, in Forfar, and at Balmaha, it contains altered crystals of Enstatite.

Ayrshire. At Balhamie Hill, near Colmonell, with Pseudo-Enstatite, and near Lendalfoot, north of Ballantrae, Carlton Castle (Greg).

Serpentinous Marbles.

"Primitive limestones," with included patches or nodules of Serpentine, which have been derived from the serpentinisation of Malacolite and Sahlite, for the most part, and, rarely, of Olivine, occur in—

Sutherland. At Ledbeg, colourless, and sulphur-yellow, rarely black.

Ross-shire. At Totag and Beinn Chuirn, Glenelg, grey, yellow, and slate-blue.

Hebrides. Skye, in Strath, dull yellow. Harris, at Rodil, grey. Iona, at Port na Curaich, yellow and green. Port an Duine Mhairbh, yellow and grey. Tiree, Ballyphaetrish.

Inverness-shire. Grantown, Achnagonalin, colourless, yellow, and black.

Perthshire. Glen Tilt, at Marble Lodge, yellow, pale-green, and grey. Cluny, dull-yellow.

Certain substances whose nature has not been sufficiently determined, and probably in themselves mixtures, somewhat like potstone, have been assigned to Serpentine: as that of a dull-green colour, which fills rents in Logan rock at Ullapool and elsewhere, and which apparently passes into Epidosite.

The value of Serpentine as an ORNAMENTAL STONE depends upon an admixture of the more precious varieties with their varying colours in vein and blotched arrangements, still more diversification being at times imparted by admixtures of Steatite, Nephrite, Marmolite, Asbestus, and Chlorite.

The Unst ornamental stone is rarely fine. The most common variety is dark-green, with pale yellow-green veinings. In small masses a finer stone occurs north of Swinna Ness. This has pale-green crystals of softening Enstatite, impacted in a deep-green base of Precious Serpentine. The Haaf Gruney rock is pale purple, with greyish-yellow bands. That of Scousburgh is dark-green, with a network of pale yellow-green to white.

The more westerly of the Portsoy beds of Serpentine is highly variegated, and, though difficult to obtain in large blocks, is probably the most beautiful and most variegated known. It was long wrought by a French company, and the pillars of the great Hall at Versailles are made of it. The admixture of colours of all tints except bright blues is beyond number. A stone with a dark green basis sprinkled with bright red pseudomorphs of Olivine, or of Augite, and pale-green markings, predominates towards the west. A pale green nephritic base with interlacing veinings of dark-green Precious Serpentine, and nodules of pale olive-coloured Steatite, occurs in the centre. The Precious Serpentine is sometimes studded with blood-red spots. Verdigris-green, with blue-black dendritic markings, is found at the east. The second vein, formed apparently by alteration of gabbro, is greyish-green, with mottling of dark greyish-blue. Lavender, rich brown, green and white veins of Marmolite, pervade the first two varieties. One vein, below water, in the East Bay, affords blocks of dull-green, mottled with brown, and is traversed by broad bands of fawn-yellow. That of the Hill of Tombhreac has a plicated intermixture of dark- and light-green, with white. Its appearance suggests a rock of gneissic structure as its origin.

The Serpentine of Glen Kindy and Culblean is similar to that of Scousburgh. The rock at Lendalfoot is occasionally banded dark-green, mottled pale-green, and cream-colour, in alternate bands of an inch in width.

Certain of the Serpentinous Marbles rank as ornamental stones. That of Glen Tilt is sap-green and sulphur-yellow, mottled with white.

The Tiree Marble is flesh-red, with imbedded granules of bright-green Sahlite, in every stage of alteration into Serpentine, with occasionally large lustrous crystals of dark Diallage.

Other localities than these yield ornamental combinations, but in masses large enough only for inlaid work. At Beinn Chuirn, in Glenelg, snow-white with blue and green. In Tiree, white with sulphur-yellow ; and Ceann a bharra, and at Ballyphaetrish in Tiree ; to the east of which is a white marble, with lead-blue enclosures. At Leslie and Leith Hall the Serpentine is fibrous, as if formed from Amianthus. It is greyish-green, with grey and dark-blue specks, and is made into snuff-boxes, etc.

155. **Totaigite (481).**

[Dr. Heddle at one time regarded a yellowish-brown substance which occurs in the metamorphic marble of Totag, Loch Alsh, and Beinn Chuirn, Glenelg, as a new mineral species, and described it as such (*Trans. Roy. Soc. Edin.*, xxviii. 455, 1878). There is reason to believe that he subsequently abandoned this view. The mineral is now referred to Forsterite.

His analyses gave :—

	Sp. Gr.	SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	K_2O	Na_2O	H_2O	Total.
Totag, 1,	2·84 to 2·893	36·19	·26	·29	2·958	·45	3·27	45·57	·25	·42	10·20	99·87
,, 2,	..	37·22	·76	..	1·05	·23	5·24	44·97	..	..	10·64	100·11

The same substance had previously been referred to Chondrodite.]

156. **Genthite (483).** $2NiO.2MgO.3SiO_2.6H_2O$.

[Dr. Heddle at one time referred one of the green compounds associated with the Chromite of Shetland to this species ; but he appears, subsequently, to have abandoned this view.]

157. **Pimelite (483a).**

[Another hydrated Magnesium and Nickel silicate, also of somewhat doubtful occurrence in Scotland. The substance here referred to occurs chiefly in the form of a rather bright ivy-green saponaceous encrustation upon the divisional planes of the decomposed andesitic lava of Devonian age, at Blackford Hill, south of Edinburgh. A mineral similar in its general aspect occurs also at Comrie, in Perthshire. Neither this nor the foregoing appears to have been analysed.]

158. **Talc** and **Steatite** (**484**). $H_2O.3MgO.4SiO_2$.

Talck, Glimmer, Agric, foss. Lapis Ollaris, Wall, *Min.*, 133, 1747. Talcum, Steatites, Cronst., *Min.*, 89, 75, 1758. Talc, Soapstone, Steatite, Potstone.

Orthorhombic or monoclinic. Rarely in tabular crystals, hexagonal, with the prismatic angle 60°. Usually foliated, massive. Cleavage, basal. Sectile. Flexible, but not elastic. H. = 1 to 1·5; G. = 2·7 to 2·8. Lustre, pearly on cleavages. Colour silvery-white to apple-green. Streak white, transparent to translucent. Optically negative.

Var. 1. *Foliated Talc.* Easily separated folia, having a greasy feel.

2. Massive, *Steatite* or *Soapstone.*—*A.* Granular, grey. H. = 1 to 2·5. *Potstone* or *Lapis Ollaris* is more or less impure Soapstone. *B.* Fine granular, and soft enough to be used as chalk, as the *French Chalk*. *C. Indurated Talc.* An impure slaty Talc, harder than the ordinary.

63·5 Silica, 31·7 of Magnesia, and 4·8 of Water. The water given off only at a red-heat. Pyr., In the closed tube, B.B. emits a bright light, exfoliates, and hardens to = 6, but is infusible; with cobalt solution becomes pale red. Not soluble in acids, either before or after ignition. B.B., in closed tube, evolves water on intense heating. In forceps with cobalt solution becomes pale red, and fuses on edges to white enamel. [Talc is usually an alteration product.]

Generally associated with Serpentine, Chlorite Schist, and Dolomite; and, when massive, often contains imbedded crystals of Magnetite, Tourmaline, Actinolite, or of Dolomite or Breunnerite.

Analyses—Heddle, *Min. Mag.*, 1, ii. 9; 2, iii. 18; 3, iv. 197; 5, v. 71.

	S.G.	SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	K_2O	Na_2O	H_2O	Total.
1. North Cross, Geo	2·76	62·5	·45	..	·53	..	..	31·84	..	..	4·79	100·11
2. Niddister, .	2·82	60·89	4·14	..	1·24	..	..	28·09	tr.	..	4·72	99·08
Steatite—												
3. Cape Wrath,	2·8	59·11	·46	2·65	3·251	·23	·43	28·67	..	..	5·16	99·96
4. Bogie, Fife, .	2·63	57·26	2·189	..	2·15	·96	2·72	27·91	..	..	6·51	99·69
5. Shiness, . .		67·09	1·59	..	1·82	..	..	23·30	..	..	6·04	99·84

Shetland. Unst, Taing of Norwick, at the junction of the Serpentine with schists, in both colourless and apple-green foliated masses, with Ankerite (Hibbert). At North Cross Geo, Harolds Wick, in magnificent apple-green foliated masses, associated with Nemalite, Dolomite, Breunnerite, and Magnetite (D. and H.)—Anal. 1. Half a mile north-west of this locality, white, in a vein.

Fetlar. At Houbie, foliated, in Serpentine (Hibbert). At Aith, grass-green, foliated.

Mainland. Between Colla Firth and Quey Firth voe, yellowish-white (D. and H).. Hillswick, at Niddister, pearly-white, the matrix of Actinolite crystals—Anal. 2. At the Taing of Hillswick. Vannlip, sap-green, plumose, in Quartz (D. and H.).

SUTHERLAND. At Shiness, in lustrous crystals, studding nodules of grey Steatite in the limestone (Joass)—Anal. 5.

BANFFSHIRE. Portsoy, in quartz-rock, west of the Battery (Peyton). Culvie, at Knowehead, in radiated crystalline concretions, in a thin bed of Serpentine (Horne). On the south-east side of Durn Hill, yellowish, pseudomorphous after Kyanite (Peyton). At Redhythe, pale emerald-green, in limestone, with Pyrrhotite, Rutile, Margarodite, and bronzy Biotite. At Fordyce, in limestone, pale green.

ABERDEENSHIRE. New Meldrum, at Forester Hill, rarely, in limestone, associated with Sahlite, Pyrrhotite, Sphene, Andesine, Chlorite, and Biotite. At Cairnie, in foliated, radiating masses, of a brown colour, and silvery lustre,—identical in appearance with that from Wolfsberg, Karntheim, said by Tschermak to be pseudomorphous after Grammatite (Greg). In a quarry near the road north of the Bin of Huntly, 1 mile west of Rothiemay station, of a brownish-green colour, associated with Amianthus and Chrysotile. On West Coyle Hill, Deeside, with Steatite. Eslie, in limestone, rarely, of a pale green colour, along with Sahlite Pyrrhotite, Graphite, Sphene, Apatite, and Margarodite (Muscovite). Huntley, near the summit of the Hill of Milleath, in rosettes in Serpentine.

FORFARSHIRE. Balloch Carity, green, foliated, with hexagonal mica, in claystone porphyry (Lyell) ? Prasilite.

PERTHSHIRE. Near Cally, with Chlorite. Glen Clova, Glen Doll, at Little Kilrannoch, in Serpentine.

Nemalite. Fibrous Talc.

SHETLAND. Unst. North Cross Geo, in a vein 1½ inches wide (D. and H.).

Steatite. Massive Granular Talc.

SHETLAND. Fetlar, at Oddsta.

Mainland. Fethaland, at Kleber Geo, forming a bed of great thickness and of a pinkish-white colour. Hillswick, at Niddister, rarely (Hibbert). At Kleber Geo, similar to that at Fethaland. At Sandy Geo, with Ripidolite and Magnetite. At the summit of a hill between Sand Voe and Sandsting manse, white.

SUTHERLAND. Shiness, in hard grey nodules in the limestone (Joass). 2 miles south of Cape Wrath, in hornblendic gneiss, of a lavender colour, with Actinolite and Ripidolite (Geikie and H.)—Anal. 3.

Hebrides. Harris. In Scalpa, at Eilean Glas, with Chlorite, Zircon, and Magnetite, in hornblendic gneiss (Neill). Iona. Port na Curaich, in white marble, with Precious Serpentine.

Banffshire. Portsoy, leek-green, in Serpentine. Durn Hill, in a quarry on the east side, grey.

Aberdeenshire. Avonside. Gaulrig, at Three Burns, with Flour, Chlorite, and Sphene, in Calcite. Abergairn lead mine, with Flour, Galena, and Blende, which is of a yellow colour.

Perthshire. In Menteith, in veins 3 feet thick.

Stirlingshire. Alva, above Westerton, leek-green, in seams, which lie between beds of basaltic clinkstone [andesite], associated with cubic Pyrites. ? Saponite.

Fifeshire. Kirkcaldy, at Bogie quarry, blue-green, in limestone—Anal. 4.

Haddingtonshire. In the upper part of Dunglass Burn, in greywacke.

Potstone.

Shetland. Unst. Balta Island, at South Doos Geo—S.G., 2·806; mixed with Pyrites. This seems chiefly Steatite. Fetlar. South-west of Houbie; massive, granular; – in Steatite, with imbedded Talc. At Smithfield, Gruting Voe (Dudgeon). Mainland. Fethaland, at Kleber Geo– S.G., 2 787; associated with Ilmenite (D. and H.). At Colla Firth, south shore, with Chrysotile (D. and H.). At Quey Firth voe. Hillswick, at Sandy Goe, with pink Steatite, Magnetite, and Chlorite (Hibbert).

Hebrides. Harris, Scalpa, at Eilean Glas, with Steatite; and also a thick mass imbedded in Serpentine (D. and H.). Scara Ruadh, along the north shore of Loch Langabhat to the Dùn of Borve, in Serpentine (D. and H.). Lewis, at Loch Bhalumis, with Augite (Nicol).

Argyllshire. Loch Fyne on the East side, 1 mile below the lower quarry Inveraray, of grey clouded marble. The Castle is built of this.

Perthshire. Near Dunkeld, in Cluny limestone quarry, between the trap and the limestone (MacCulloch).

159. **Saponite (488).** $(Al_2O_3,Fe_2O_3)SiO_2{\cdot}6(Fe,Ca,Mg)SiO_2 + 13H_2O$.

Pierre a Savon, Haüy. Saponite, Svanberg, *Ak. H. Stockh.*, 153 (1840). Prasilite, Thomson, *Phil. Mag.*, III. xvii. p. 416 (1840). Piotin, Svanberg. *Pogg.*, 54, 267 (1841). Thalite, Owen, *J. Ac. Philad.*, ii. 179 (1852). Bowlingite, J. B. Hannay, *Min. Mag.*, i. 154 (1877). Saponite, Heddle, *Trans. Roy. Soc. Edin.*, xxix. (1879). Cathkinite, J. J. Dobbie, *Trans. Geol. Soc. Glasgow*, vii. p. 166 (1883). Soapstone, pars. Mountain Soap, pars.

Hexagonal ? Prasilite is in fan-shaped groups of hexagonal crystals ; the Saponite associated with zeolites, shows under the microscope clusters of hexagonal crystals lining the druses, or in vermicular aggregates. It is massive or nodular when it fills the cavities. Often soft like butter or cheese, but on loss of water becomes granular and crumbly. When filling veins often transversely fibrous. G. = 2·18 to 2·3. Lustre greasy. Colour white, lavender, wax-yellow, olive-green, bluish, brown, venetian red, usual colour sap-green—several of these colours being sometimes associated in onyx-like bands. Does not adhere to the tongue. Some varieties fall to pieces when placed in water, often with a slight explosive sound.

Anals. 1-9, Heddle, 10, Dalziel, 12-14, Heddle, *Trans. Roy. Soc. Edin.*, xxix. 91 *et seq.* (1879). 11, Dobbie, *Min. Mag.*, v. 131 (1883). 15, Brewster, *Phil. Mag.*, III. xvii. p. 416 (1840). 16, Heddle. [Hannay, *Min. Mag.*, i. 154 ; Dobbie, *T. G. S. Glas.*, vii. 212.]

	S.G.	Loss at 212°	SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	K_2O	Na_2O	H_2O	Total
From Volcanic Rocks of Devonian, and Carboniferous, Ages—													
1. Gaipol, Kincardineshire,	2·179	15·746	42·13	7·25	6·57	·19	·13	·8	19·33	·58	2·09	21·07	100·14
2. Kinneff, Kincardineshire (green),	split	14·092	42·1	5·95	4·96	·18	·09	2·15	20·98	·28	·46	22·93	100·08
3. Kinneff, Kincardineshire (purple),	2·28	14·52	42·5	5·88	4·91	·12	·12	2·13	20·74	·19	·47	22·75	99·81
4. Glen Farg, Perthshire,	2·235	12·961	36·54	9·39	2·85	5·25	·15	2·5	21·62	..	..	21·68	99·98
5. Wormit Bay, Fifeshire,	..	13·87	42·84	4·83	6·50	2·36	·20	2·16	21·81	tr.	..	20·7	101·39
6. Tayport, ,,	2·282	13·96	40·11	6·49	5·61	2·37	tr.	2·01	21·67	·32	·21	21·6	100·39
7. Cathkin Hills (scaly),	2·799	15·61	41·34	10·53	1·86	3·84	·09	1·22	21·07	·05	·37	19·48	99·58
8. ,, (fibrous) (" Bowlingite "),	2·288	14·76	42·22	8·52	2·99	4·88	·07	·92	21·23	..	..	19·49	100·32
9. Bowling, Dumbarton,	2·308	12·315	38·08	6·26	4·36	4·98	·23	2·97	21·46	·95	·11	20·48	99·88
10. Bowling, Dumbarton,	..	12·965	36·74	5·35	5·94	6·96	·08	3·06	20·22	·49	·21	21·28	100·33
11. "Cathkinite" (Dobbie),	2·214	13·02	40·07	6·61	4·16	8·69	..	2·67	19·24	tr.	tr.	17·16	98·98
12. Kilpatrick ("Prasilite")	..	..	..	..	..	..	..	..	..	..	..	18·	..
13. Bowling, ,,	..	13·72	40·15	7·39	3·67	4·73	·15	1·95	20·35	..	·17	21·89	100·45
From Volcanic Rocks of Tertiary Age—													
14. Storr, Skye (olive),	2·296	13·652	41·41	9·08	2·05	..	·11	1·86	22·8	..	..	23·43	100·74
15. Quiraing, Skye (white),	split	15·536	42·50	5·06	·85	..	·23	3·27	23·95	·17	·45	23·68	100·16
16. ,, ,, (yellow),	split	15·132	40·33	8·72	1·97	..	·13	2·80	21·71	..	..	24·34	99·99
Average,	2·272	14·22	40·63	7.18	3·96	2·38	..	2·14	21·43	..	..	21·76	..
Formula,	..	..	40·81	7·5	3·88	2·62	..	2·04	20·61	..	..	22·73	..

Of this water from 6 to 7 per cent. is given off at the heat of the human body, but the mineral reabsorbs the whole amount from a moist atmosphere in half an hour.

Pyr., etc.—B.B. gives out water very readily and blackens; thin splinters fuse with difficulty on the edge. Decomposed by sulphuric acid. The sap-green scaly Saponite which totally fills many of the vapour vesicles of the St. Cyrus and Usan shores of Forfarshire is generally peroxidised [by exposure] to a ruddy brown colour, the liberated nodule being rent by the concomitant expansion.

In Igneous Rocks of Devonian and Carboniferous Ages.

Shetland. Mainland. At the Cannon, near the village of Stenness, Northmavine, greenish-yellow, impalpable, in amygdules, with Amethyst (D. and H.). [At the Grind of the Navir.]

Papa Stour. At the Kirk Sands, with Barytes, Fluor, and Psilomelane, in amygdaloid (D. and H.). †Ungly-braed Head and Bordie, in quartzose cavities of felsite. North shore of Housa Voe, with Fluor and Calcite, [in the vapour cavities of a subacid eruptive rock]. At †Little Peattie Geo, in felsite.

Argyllshire. On the right bank of the Awe, below the Bridge of Awe, with Epidote, Calcite, and Hornblende, in amygdaloid (Macnight).

Kincardineshire. At [?Trelung Ness], south of Stonehaven, filling amygdules, with a skin of Celadonite. At the Long Gallery, Tremuda Bay, fibrous, transverse to veins, which are usually vertical. At Gapol Tod Head, in layers between beds of amygdaloid, leek-green, impalpable near zeolites—Anal. 1. South of Tod Head, in amygdules, green, speckled with red. Kinneff road, at the branch to the church, in porphyritic amygdaloid, forming clusters of crystals, of an olive-green colour, which rest upon zeolitic quartz, with red Stilbite and red Heulandite—Anal. 2. The same cavities contain at base Saponite, in solid lumps, of a mottled appearance and colour, like Naples soap—Anal. 3. St. Cyrus cliff, filling amygdules, scaly, dark-green, sometimes red.

Forfarshire. Montrose, at Craig railway cutting, in three veins. Solid, and grass-green, in the north vein. Fibrous transverse to vein, and dark green (with ?Hydrophite) in the central vein, which is 2 inches wide. Sap-coloured, in the south vein; solid with black spots; also here white, yellow, and brick-red. In druses in the same cutting, white, putty-coloured, brick-red, yellow, sap-green, grass-green; with Satin Spar, Barytes, Natrolite, Pilolite, Zeolitic Quartz, Analcime, and Stilbite. In these druses the first layer is Saponite, the second Zeolites, the third Calcite (Mitchell and H.). Usan, at The Blue Hole, rarely, solidly filling druses, greenish-brown. At Lunan railway-cutting, green,

with a skin of red Celadonite, *flêches d'amour* in Rock Crystal, and Agates. Broughty Castle Rock, lining druses, in rosettes of hexagonal crystals; dark green, and of a brilliant lustre. Roy Quarry, with Moss Agate, in veins and druses.

Perthshire. Kinnoull Hill, Corsiehill quarry, grass-green, foliated, and staining zeolitic Quartz (Lauder Lindsay). Glen Farg, filling druses, dark green—Anal. 4, and red (Murray). Ballindean, †Agate Knowe, rarely, filling druses. At Bridge of Cally, impure.

Fifeshire. West of Tayport, in the railway cutting, in druses lined with mammillated Celadonite. Massive, like green wax, near agates—Anal. 6. East of Tay Bridge, in veins and lumps, grass-green, opaque, earthy-looking—Anal. 5. In †quarry, as a vein in andesite, massive (Durham). West of Crail, oil-green, massive.

Dumbartonshire. Bowling quarry, very rarely, in large hexagonal scales, of emerald-green colour, and a pearly lustre, associated with Natrolite—the "Prasilite" of Thomson—or with Prehnite, at the centre of the north face of the quarry—Anals. 12, 13. In veins of a dark green colour and transverse fibrous structure, "Bowlingite" (Young)—Anal. 8. As a velvet-like coating to rents, almost black, with a pale-green streak.

Haddington. "To the north-west of Sea Cliff [house, in] amygdaloid, with much Saponite and Calcite." [At Fenton Tower, North Berwick, white, associated with Manganite, in cavities in a sub-basic lava of Lower Carboniferous age.]

Midlothian. Bathgate, at Blackburn, in veins an inch wide, in dolerite, transversely fibrous (Stuart Thomson). Ratho, south quarry, in mammillated groups of fibrous crystals of a dark greenish-brown colour, with Calcite. Pentlands, with Agates, in amygdaloid, at Hillend quarry and elsewhere.

Renfrewshire. Barrhead, at Boyleston quarry, generally lavender coloured. Gryfe tunnel, near Greenock, crystallised in minute plates on Natrolite, sap-green.

Lanarkshire. Cathkin quarry, 2 miles south of Rutherglen, in veins, bright green, transversely fibrous (Young). In lenticular nodules up to eight inches across, at the base of the quarry, brown, massive, with conchoidal fracture (Dobbie)—Anal. 11. In the porphyritic lava of the Cathkin Hills, in small druses, with Labradorite, Olivine, and Ferrite. At the bridge over the Clyde, on the road to Biggar, in chalcedonic druses in amygdaloid.

Ayrshire. At Berry glen, crystallised, in small scales, upon Natrolite, sap-green; with Erythrine and pseudo-Laumontite (Doran). Rye Water; above Cunninghame, Baidland limestone quarry, with red Stilbite, and white Quartz.

From Tertiary Igneous Rocks.

Hebrides. Skye. Storr, at the foot of the Old Man, in druses, underlying Chabazite, pale yellow—Anal. 14. Half a mile east of Quiraing, filling druses *per se*, white, wax-yellow (Anal. 15), and olive-green. In the valley between the cliff and The Prison, as soft as butter or pulpy, colour milk-white, associated with Gyrolite and Apophyllite. At the foot of the Echoing Rock, north of Leacan Fhionn, dark brown, green, yellow, light green, venetian-red; sometimes all in one cavity, in onyx-like bands. These underlie Chabazite, Plynthite. Calcite, Thomsonite, Apophyllite, Analcime, and Mesolite (D. and H.)—Anal. 16. Dunvegan Loch; at Rudha nan Clach, brown of various shades, in onyx-like bands. These form the bottom of zeolitic cavities up to one and a half inches in thickness. The associates are Olivine and Calcite. Also in small druses, red, yellow, and green. At Orbost Loch, Bracadale, on the north shore, with zeolites. Humela Rock, south of Canna, amber-coloured. The rock of the east side of Scuir Dearg, Skye, rarely has minute cavities with an intensely-blue substance, in structure resembling Saponite.

The following localities assigned to *chlorite* doubtless refer to Saponite. "With quartz in a felspar dyke traversing greywacke and conglomerate, at Carolside on the Leader." "In amygdaloidal porphyry at Muirhouse law, 2 miles south-east of Maxton, Roxburghshire."

The following localities assigned to *Steatite* doubtless also refer to Saponite. Lanarkshire, at Phillipshill quarry, "finest in Britain, with zeolites." "Berwick. Dunse, near Cumledge House, in a dyke in the bed of the Oxenden burn, in beautiful crystals, a mineral like Steatite in veins, with zeolites." "In thin veins in the felspar porphyry of Lamberton Hill, quarried near Nunlands."

A study of the mode of association of Saponite with the minerals which occur along with it shows that the Saponite of the volcanics of Old Red Sandstone and Carboniferous ages has been the substance *last* deposited in their vapour vesicles; while that of the volcanics of Tertiary volcanics has been the *first*.

The earliest notice of so-called Saponite gave Cornwall as its locality, and Cronstadt, Klaproth, and Kirwan considered the mineral there occurring as belonging to this species. An analysis of an exceedingly fine specimen specially sent the author by Professor King, of Belfast, showed that it was a slightly weathered vein of white precious Serpentine.

A graver and more persistently indulged in error consists in petrologists assigning the ever-recurring Saponite of decomposing basic and

sub-basic eruptive rocks to Chlorite. This is still, by many petrographers, even by those occupying positions which confer the widest experience, referred without hesitation to that mineral. This error was pointed out in the year 1879 by the author, when it was shown that Chlorite and its congeners were confined absolutely to rocks which had undergone dynamo-metamorphism (see *Trans. Roy. Soc. Edin.*, vol. xxix. p. 101). On the other hand, Saponite, and what may be regarded as its congeners, are equally absolutely confined to eruptive rocks, which present these minerals as the resultants of hydro-thermal alteration. The prominent feature of the alteration is the pronounced hydration which accompanies the chemical change. The so-called "viridite" of the Car Craig Rock and the "Chlorite" of the Kinghorn melaphyre, figured in plate xxii. of Teall's *British Petrography*, are, in point of fact, ordinary typical examples of investing and vermicular Saponite—such vermicular forms the employment of a higher magnifying power resolves into piles of crystals of a rudely hexagonal form.

Though generally devoid of definite crystalline form, Saponite is possessed of no little interest, in virtue of the varieties of its aspect, its very large content of water, and the singularity of the manner in which it comports itself therewith. No mineral presents itself under more varying forms than this, as is seen in the white, clotted-cream-like Saponite of Quiraing—the fibrous, amianthoid, lustrous, sap-green veins of Craigs railway cutting, in Forfar—the brown, nodular, bole-like, concretionary masses of some of the so-called "Bowlingite"—the blue-grey mottled bands, which floor zeolitic cavities, with much the appearance of Naples soap—the diversely coloured, onyx-like variety, with its bands of vivid red, which is rarely seen in the rocks north of the Echoing Crag, Quiraing—and the deep green, fan-like, lustrous rosettes of the "Prasilite" of Bowling.

This solid stone contains one-fourth of its weight of water. That the whole of that fourth exists in it as a liquid, or in an ordinary hydrating condition, cannot be for a moment supposed. A certain portion must be playing the part of a base. But the functioning of the solid part to the large percentage of water given off at a temperature of 212°F. is peculiar in itself; about one half of that quantity being given up at the ordinary temperature of the human body, and this same amount is reabsorbed by it, if it be placed in a moist atmosphere, so that the total water content ultimately is identical with that of its first composition. Now this extraordinary mode of functioning, as regards percentages so high as from six to seven, may come even to affect to a certain extent the humidity, if not the climate, of a locality, if any great quantity of the mineral is present in the rocks; and there is a locality which, though not of great

extent, is probably so affected. The peculiar vibration which is observed when we bring the eye close to the ground on an exceptionally warm day, in a locality of unusually brilliant exposure, is due to the rise of currents of air heated by contact with parts of the rocks affected by such exposure. Now a district of some miles in extent, which lies between Dumbuck and the Lang Crag, in Dumbartonshire, consists of a rock of which perhaps one-third is Saponite of a very dark green or almost black colour. The amount of atmospheric vibration there seen in the circumstances above detailed is so great as to leave no doubt that large quantities of aqueous vapour are here ascending along with the currents of heated air. In dry, sunshiny weather the air over this district must be thus rendered more humid; while in moist weather, in virtue of its power of reabsorbing the lost water, the atmosphere must be, to an equivalent extent, rendered less humid.

Ferrite.[1]

Wallace Young, quoted by Heddle, *Min. Mag.*, v. 28 (1882). Heddle (*ibid.*, vii. 134, 1887).

An alteration product of Olivine in the basalt lavas of the Glasgow district, chiefly between Gleniffer Braes and Boyleston. It frequently retains the form of the Olivine crystals, but has cleavages nearly equally eminent, parallel to both *a* and *b* of the original Olivine crystal. It is soft, greasy to the touch, and of high tinctorial power, of a deep red to chocolate brown colour. The air-dried mineral loses 3·83 % at 212° F.

An analysis by Dr. Heddle (*Min. Mag.*, v. 29) gave :—

SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	MgO	CaO	H_2O		Total.
13·03	13·16	53·47	4·51	0·15	6·62	0·75	8·39	=	100·08

160. Chlorophaeite.

Massive, encrusting, or disseminated in small nodules, in amygdaloidal basalt. Fracture conchoidal. When first exposed it is translucent and pistachio-green or olive-green to bright amber-coloured; but, when exposed to the air, changes, in the course of a few minutes, to dark brown or to almost black colour, and becomes opaque, splitting up in so doing into minute hexagonal prisms. Soft, brittle, and greasy to the touch. Lustre slightly glimmering. When fresh its lustre is vitreous. H., 1·5 to 2; G., 2 to 2·8.

Comp. It does not easily yield a formula. Its analysis yielded (Heddle, *Trans. Roy. Soc. Edin.*, xxix. 84) :—

[1] [Classed as a pseudomorph by Dr. Heddle.]

	Loss at 212°	SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	K_2O	Na_2O	H_2O	Total.
1. Rum, .	19·227	36	..	22·8	2·46	·5	2·52	9·5	tr.	tr.	26·46	100·24
2.	..	17·75	·53	49·67	2·15	1·20	3·07	3·99	..	..	21·82	100·18
3. Kinkell. (*Hullite.*)	8·039	38·59	17·34	15·97	n.d.	1·56	3·94	8·65	·67	..	13·48	100·20

Pyr., readily sol. in h. acid.

Hebrides. Rum, near the summit of Creag nan Stardean (Anal. 1 and 2), filling vapour cavities from the size of small shot to that of a bean. Of varying colours and appearances. The colours range from that of amber to malachite green. The structure at times very much resembles that of Malachite. All these rapidly pass, with loss of water, into black. Canna, on the south-west side, near a cave. The specimens here, in appearance, resemble cobbler's wax, and they are several inches in length.

The occurrences noted by MacCulloch from Fifeshire do not refer to this substance, but are more of the nature of Hullite. The analysis of one from Kinkell has been subjoined above to that of the Creag nan Stardean mineral, in order that the difference in composition might be made apparent.

Kirwanite.

Specimens much resembling the Kirwanite of Thomson occur in an exceptionally hard and tough basalt to the west of the house of Glenforsa, on Loch Baa, Mull. On being sectioned, however, these proved to be of an entirely different nature. [This mineral appears to have been regarded by Dr. Heddle as an undetermined species belonging to the same group as the following.]

161. Celadonite[1] (489).

$$3(\tfrac{1}{4}FeO\,\tfrac{1}{2}MgO\,\tfrac{1}{4}K_2O)6SiO_2.(\tfrac{1}{3}Al_2O_3\,\tfrac{2}{3}Fe_2O_3)2SiO_2+5H_2O.$$

Terre verte de Verone, De Lisle, *Crist.*, ii. 502 (1783). Grünerde, Hoffm., *Bergm. J.*, 519 (1788); Green Earth, pt.; Green Earth of Verona. Seladonite, Glock., *Syn.*, 193 (1847).

In minute scales, or earthy. Very soft. Colour deep olive-green, celandine-green, apple-green; feel more or less greasy. Gr., 2.56.

Anal. 1 to 3. Heddle, *Trans. Roy. Soc., Edin.*, xxix. p. 102. 4. Stuart Thomson and Heddle, *Min Mag.*, x., No. 47, pp. 248-250.

[1][Dr. Heddle latterly preferred to spell this "Celedonite," in which form it appears elsewhere in the present work.]

	G.	Loss at 212°	SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	K_2O	Na_2O	H_2O	Total.
1. Sgùrr Mòr, Rum,	2·574	5·99	57·72	·33	17·05	3·73	·08	·6	3·84	5·55	·42	10·78	100·10
2. Tayport, Fife,	2·59	5·048	52·69	5·79	9·75	5·37	·31	1·16	8·54	6·21	·39	10·48	100·69
3. Tay Bridge,	2·598	3·879	52·54	5·82	9·71	5·4	·31	1·29	8·31	6·5	·64	10·41	100·93
4. Blue Hole, Forfar,	2·605	6·13	51·74	4·44	11·91	4·19	tr.	0·54	8·29	7·40	0·55	11·49	100·55
Formula, . .	..	..	54·05	3·83	11·94	5·40	..	..	6·76	7·88	..	10·14	..

Not soluble in acids.

ORKNEY. Walls. Sands Geo. Bright green, coating amygdules.

HEBRIDES. Rum. At Sgùrr Mòr. In bands an inch thick in amygdaloid, structure granular impalpable—Anal. 1. Also coating agates. It is the colouring matter of the heliotrope.

KINCARDINESHIRE. At the cliff of St. Cyrus ; coating agates, and as the outer skin of some of the druses filled with Delessite.

FORFARSHIRE. At the " Blue Hole," near Usan, Montrose, of a dark green, and lustrous, coating agates (Anal 4), and as the central core of agate stalactites. Lunan railway cutting, in amygdules, which have a centre of Saponite. At Hare Craig, near Broughty Ferry.

PERTHSHIRE. Path of Condy, coating agates. Binn Hill, with Carnelian.

FIFESHIRE. At Tayport slip cutting, filling amygdules. In the railway cutting west of Tayport, filling, and also only coating, druses. Sometimes like Malachite in structure, with lighter and darker bands of colour—Anal. 2. Scurr Hill, near Balmerino, forming stalactites in vein agates, and also in moss agates, of a beautiful light-green colour ; often associated with small crystals of red Heulandite and tufts of Natrolite. To the east of the Tay Bridge, granular, earthy, in veins—Anal. 3. Rock and Spindle, St. Andrews.

RENFREWSHIRE. In a quartzose and calcitic vein, cutting a fine grained dolerite at [?Muirhouse] quarry, in massive bands.

AYRSHIRE. At Whilk, near Lendalfoot, very rarely, with Enstatite, in veins, largely calcitic, cutting dense dolerite.

162. Glauconite (490).

Glaukonite, Keferstein, *Deutsch. geol. dargest.*, v. 510 (1828) ; Gloeker, *Handb.*, 832 (1831). Green Earth, pt. : Terre verte, pt. Fr.

Amorphous, and resembling earthy chlorite. Either in cavities in rocks or loosely granular, massive. H., 2 ; G., 2·2 to 2·4. Lustre dull or glistening. Colour, various shades of green, generally pale green.

Comp., Silicate of Protoxide of Iron and Potash.

Analyses by Dr. Heddle, *Trans. Roy. Soc. Edin.*, xxix. p. 79 :—

	SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	K_2O	Na_2O	H_2O	Total.
1. Ashgrove,	49·09	15·21	10·56	3·06	..	·55	2·65	6·05	1·21	11·64	100·02
2. Bridge of Cally,	54·70	·83	2·60	9·82	·24	5·71	16·34	..	..	10·82	100·46
3. Elie,	58·02	16·50	·52	6·06	·11	..	2·91	7·89	1·3	7·41	100·73

Elginshire. Ashgrove Quarry, near Elgin, in a granular condition [in cornstones, which are probably Rhætic in age], associated with manganesian Calcite and well-crystallised Pyrites—Anal. 1.

[Glauconite, in its restricted modern sense as applied to one of the Deep-Sea deposits, occurs in connection with sedimentary rocks, at the following places in Scotland :—

Argyllshire. In the Upper Greensand, and probably also in the Rhætic Rocks of Mull and Morven.

It also occurs in connection with remnants of the Upper Greensand, in Sutherland, Elgin, Banff, Aberdeenshire, and elsewhere.]

Perthshire. Bridge of Cally, on the ease side of the Ardle. It occurs filling small cavities in a trap, and ranges in size from that of small shot to the size of beans. Colour dark green. Structure, minutely-granular—Anal. 2. [The author appears doubtful regarding this.]

Fifeshire. Between Elie and St. Monance, in agglomerate—Anal. 3.

Edinburghshire. A green substance which occurs in scaly patches [shale galls in the cornstones at the base of the Lower Carboniferous rocks], at the north end of Salisbury Crags, may possibly be this mineral.

Ayrshire. Said to occur in the Ordovician limestones, near Girvan.

IV. Kaolin Division.

163. **Kaolinite (492).** $2H_2O.Al_2O_3.2SiO_2$.

Monoclinic ; a basic Aluminium Silicate.

Massive, in beds and veins. Fracture uneven ; fine earthy, very soft sectile, and friable. H., 1 ; G., 2·2. Opaque, dull ; white or grey inclining to blue, green, yellow or red. Feels meagre, not greasy when dry, and is plastic when wet. B.B. infusible. Not affected by hydrochloric acid, but is decomposed by warm sulphuric acid, leaving silica.

Analyses :—1. Heddle, *Min. Mag.*, ii. 119 ; 2. *Ib.*, *Min. Mag.*, v. p. 296; 3. Thomson ; 4. Richardson, Thomson's *Mineralogy*.

	SiO_2	Al_2O_3	Fe_2O_3	MnO	CaO	MgO	H_2O	Total.
1. Moo Wick,	46·15	38·35	·878	·384	·603	·692	13·08	100·137
2. Ledbeg,	44·80	36·05	4·804	..	·407	·675	13·835	100·574
3. Tweed,	44·30	40·40	..	..	·75	·50	13·50	99·45
4. „	43·80	40·10	·94	..	·64	·55	14·21	100·24

Shetland. Fetlar. In beds at Moo Wick, Lamb Hoga (Hibbert) ; at Grunies Geo, on the west coast (Anal. 1), and, rarely, in crystals mixed with Margarodite. On the west shore of Trista Voe, in minute crystals.

Mainland. Burn of Tractigill and the trough north from Weisdale Hill (Hibbert).

Sutherland. At Liath Bhad, north-west side of Glasven, massive, in Hebridean gneiss. In red porphyry near the bridge over Ledbeg river (Anal 2) ; Cnoc na Sròine, massive and crystalline.

Hebrides. Harris. Between Rodil and Finsbay, forms a deposit under peat at the bottom of a lake. The former inhabitants of Rodil whitewashed their houses with it (MacCulloch). ? Diatom earth.

Lanarkshire. Abington. In a vein at the head of Glen Capel.

Ayrshire. At Loch Doon.

Tuesite.

On the right bank of the Tweed, about 1 mile below Dryburgh (Thomson.)—Anal. 3 and 4.

Lithomarge.

Kirkcudbright. Castle Douglas, on the road to Tongueland, 1½ miles from the latter ; in veins of porphyry (Cunningham).

Nacrite.

Shetland. Unst. Nika Vord, lining druses in Serpentine, in mammillated clusters of crystals with Kämmererite, very rarely.

164. Bole (492a).

Bole cannot be regarded as having any claim to be considered a simple mineral ; nor is it easy to say to what species it should be referred as an impure variety ; for that it is a mixture of two or more minerals there can be little doubt. Probably the substance to which the term has been generally applied comes nearer to Saponite than to anything else. It is probably the fact that all the substances to which the term has been

applied in Scotland have been associated with basic eruptive rocks—usually with basalt lavas. Of such definite application we do not find, perhaps, so many in Scotland as in England. We find Greg (p. 442) giving as localities "in sandstone at Quarry Wood, Morayshire, and Bridgehouse in Peeblesshire," and the present writer has heard the name applied to some of the brown Saponite of Bowling; the fact of the substance falling to pieces in water seemed to be its only characteristic property.

[165. **Allophane (498).** $Al_2SiO5H2O$.

An amorphous, hydrous Aluminium Silicate. Usually botryoidal and reniform. Fracture conchoidal; brittle. H., 3; G. 18·2. Pellucid, vitreous.

A mineral referred by Dr. Heddle to this species occurs at Kings Laggan Mine, Lauchentyre, Kirkcudbright, in the form of a dull earthy encrustation, which coats quartz in one of the lead veins there. Chrysocolla and Pyromorphite occur with it.]

[166. **Plinthite.**

A dull-red earthy material, somewhat botryoidal in form on the weathered surface, and with a greasy lustre, sometimes earthy; is found in connection with the Tertiary basalt lavas of the parts of Skye near the Quiraing and the Storr Rock.] It falls to pieces in water, and by this and its uniformly dense structure it may be distinguished from red Mesolite.

An analysis by Dr. Heddle (*Min. Mag.*, v. 26) gave :—

SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	H_2O	Total.
29·55	19·03	28·01	3·25	·84	2·23	17·39	100·30

167. **Fuller's Earth.**

Massive and reniform. H., 1·5 to 2·5; G., 1·9 to 2·1. Translucent when moist. Colour bluish-white, green, or yellow.

Comp., 41·5 Silica, 34·4 Alumina, 24·1 Water.

Hebrides. Canna, near to, and in, a cave on the south-west side.

Peeblesshire. In a seam near Bridge House Bridge, on the west side of the Lyne water, in the parish of Lynton.

Linlithgowshire. In the parish of Uphall.

Roxburghshire. Maxton.

167A. **Chrome Ochre.**

[A green, earthy, encrustation, on Chromite, at Hagdale, Unst, has been referred by the author to this clay.]

[168. **Chrysocolla (504).** $CuSiO_3 2H_2O$.

Cryptocrystalline, a hydrous Copper Silicate.

Botryoidal or investing; brittle; fracture conchoidal. H., 2 to 3; G., 2 to 2·3. Translucent; lustre resinous; colour verdigris-green to emerald-green; streak greenish-white.

Comp., 34·83 Silica; 44·96 Copper Protoxide; 20·23 Water.

Sutherland. Collabol, Loch Shin, as a green film on Barytes and vein-quartz, associated with Azurite (Joass). Foinne Bheinn, with Chalcopyrites.

Argyllshire. Erins, Knapdale, as a green film, on the joints of epidiorite, associated with Chalcopyrites and Malachite.

Stirling. Dunyat, Ochils, associated with Chalcocite (Goodchild).

Renfrewshire. Boylstone, coating Prehnite, and associated with Native Copper.

Dumfriesshire. Wanlockhead, especially at the Bay Mine, films assuming occasionally a botryoidal form coat the matrix in which Cerussite, Anglesite, Pyromorphite, Tile Ore, etc., occur.

Kirkcudbright. Gatehouse, Kings Laggan Mine, associated with Allophane, Malachite, Pyromorphite, etc.]

[169. **Balvraidite.** Heddle, *Min. Mag.*, iv. 17.

Structure saccharoidal. H., 2; G., 2·91. Colour pale purplish-brown. B.B. fuses with intumescence to a vesicular pale-blue glass.

Analyses by Dr. Heddle, *Min. Mag.*, iv. p. 117 (1880):—

	Sp. Gr.	SiO_2	Al_2O_3	Fe_2O_3	MnO	MgO	CaO	Na_2O	K_2O	H_2O	
1. Glenelg, . .	2·908	46·04	20·11	2·52	·79	8·30	13·47	2·72	1·36	4·71	100·02
2. „ . .	2·905	46·17	20·95	1·86	·84	7·36	13·25	3·25	1·56	4·90	100·14

Occurs at Balvraid, Glenelg, Inverness-shire, in a metamorphic marble.]

[170. **Bhreckite** *or* **Vreckite.** Heddle, *Min. Mag.*, iii. 57.

Fine granular, scaly; soft and friable. Occurs as a light apple-green coating on Quartz crystals. Soluble in hydrochloric acid.

Analysis by Dr. Heddle, *Min. Mag.*, iii. p. 57 (1879):—

SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	H_2O	Alkalies.	Total.
34·92	7·16	12·71	2·11	0·41	16·08	8·26	17·77	tr.	99·10

Occurs in a boulder of Pegmatite at Beinn Bhreac, near Tongue,

Sutherland. Associated with Amazonstone, Cleavelandite, Babingtonite, Quartz, Haughtonite, Thorite, Fluor, Specular Iron, and Strontianite.]

171. **Chonicrite.**

Massive, crystalline granular and globular radiated. H., 2·5 to 3; G., 2·91. Lustre weak, silky. Colour whitish with yellow spots, greenish blue. B.B. fuses easily, with intumescence, to a grey glass. Decomposed by h. acid.

Comp., 35·7 Silica, 17·1 Alumina, 22·6 Magnesia, 12·6 Lime, 9 Water.

Ayrshire. In veins of rather dull cream colour, which run from 1 to 4 inches in thickness, in a markedly parallel direction to one another, through the Enstatite-serpentine of Balhamie Hill, near Colmonell, In less pure and solid condition as a vein about 2 inches in thickness coating the Enstatite rock between Lendalfoot and Pinbain. A third locality, in numerous veins, which hold a parallel course, cutting Enstatite-serpentine, at Whilk, 2 miles south of Lendalfoot. At this last locality the veins are studded with crystals of pale fawn-coloured Enstatite.

Analysis by Dr. Heddle :—

	Sp. Gr.	SiO_2	Al_2O_3	Fe_2O_3	FeO	CaO	MgO	K_2O	Na_2O	CO_2	H_2O	Total.
Balhamie Hill,	2·881	31·66	11·73	4·57	9·21	11·15	19·38	·69	·79	tr.	11·11	100

172. **Pilolite.** $4MgO,SiO_2.Al_2O_3$, $SiO_2.15H_2O$.

Mountain Leather, Mountain Cork, Rock Wood, Mountain Paper, Lana Montana. Pilolite, Heddle, *Ency. Brit.*, 9th ed. Mountain Silk, Heddle, *Ency. Brit.*, 9th ed.

Felted or Matted fibres more or less dense.

Extremely tough. H = 1; G = ·68 to 1·34. Dull. Absorbs water like a sponge. Cream yellow to buff. Opaque. Streak same as colour.

The structure varies considerably, and has given rise to the above trivial names.

Analyses :—1, 2, 4-8, Heddle, *Min. Mag.*, ii. 206; and 3, Thomson, *Mineralogy*, p. 148.

	Loss in Bath.	SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	H_2O	Total
Mountain Leather—										
1. Boyne Burn,	9·2	51·10	6·81	2·27	2·28	1·01	·86	10·16	23·90	98·93
2. Tod Head,	5·9	52·48	6·33	·60	2·11	2·88	1·34	11·95	21·70	99·39
3. Strontian,	...95	57·65	9·50	..	5·80	..	10·00	2·06	21·70	106·71
4. Leadhills,	5·96	51·45	7·98	·97	3·29	1·49	1·97	10·15	21·70	98·99
Mountain Cork—										
5. Portsoy,	10·88	51·43	7·52	2·06	2·49	1·30	·58	9·35	25·04	90·76
6. Cabrach,	10·64	51·00	12·88	·09	2·68	·08	..	7·54	24·74	99·73
7. Tod Head,	9·27	51·61	6·63	..	2·70	2·77	1·11	10·81	25·00	100·63
8. Tayport (Parton Craig),	9·26	54·37	11·27	·21	1·09	.33	·98	9·49	22·41	100·15
Formula,	..	51·6	8·6	..	2·88	..	..	10·2	23·3	..

Shetland. Colla Firth, south side, in Potstone, like felt (D. and H.), possibly only a matted Amianthus.

Banffshire. Mouth of the Burn of Boyne. In limestone, in thin leaves, leather-like (Anal. 1), and like cork or the roots of trees. With Pyrites, Calcite, and Steatite. Near Portsoy, in Serpentine (Jameson) —Anal. 5. In the Cabrach. In the west bank of the Burn of the Cairn a short distance above its junction with the Ronster Water. In rifts of a decomposing granite in large sheets like cork—Anal. 6. Burn of Craig, north of Tombhreac. In the Burn of the Daugh (Hinxman).

Hebrides. Skye. Loch Bracadale, at Sgurr nam Fiadh. In druses on Analcime. Associated with Scolecite, Stilbite, Chabasite, Mesolite, Laumontite, Calcite. Filamentous, and like scum.

Argyllshire. Strontian. In the calcareous gangue of the Galena, like leather—Anal. 3.

Kincardineshire. At the Tod Head. In Old Red Sandstone conglomerate, in a calcite vein, with cockscomb Barytes, which penetrates the Pilolite upon one side. The mineral here is like both cork (Anal. 7) and leather—(Anal. 2).

Forfarshire. In the railway cutting near Craigs, as thin filaments in the centre of amygdaloidal druses. Colour brownish-white; sometimes like scum.

Fifeshire. In the railway cutting near Tayport on the west. It forms a coating like floss-silk to one side of veins of Calcite, in amygdaloid —Anal. 8. Colour pure white. Associates, Natrolite, Barytes, and zeolitic Quartz. Similarly, in small druses near Auchtermuchty.

Lanarkshire. At Leadhills. (Wanlockhead, Jameson). In calcareous veins in Ordovician rocks (Jameson)—Anal. 4.

Berwickshire. In veins in greywacke, near Kelso (Reid, Geo. Gunn, and Goodchild).

This singular substance used to find a place amongst the varieties of Hornblende. How previous authors, and how Dr. Thomson, and others who analysed it, could place a substance which contained 23 °/₀ of water along with one which is anhydrous is not easily explained Had these analysts gone into the detail of ascertaining the amount of that water given off at 212° F, it would have been still more unaccountable.

It is a substance peculiar also both as regards the features of its occurrence and the wide range in lithological character of the rocks in which it is enclosed.

As regards its appearances, we find it assuming the character of felt;

in leather-like leaves; resembling cork or the roots of trees; forming large sheets, which, in virtue of its altogether unrivalled toughness, would have served for the targe of a Highland warrior; in tufted filaments with zeolitic associates; a scum which appears to have sedimented from suspension in a muddy liquid, and simulating the very finest floss silk.

As regards the parent rocks, these include *Serpentine*, *Granite*, *Conglomerate* (Old Red), *Andesitic lava*, *Basalt lava*, associated with *Gneiss* and in Ordovician *Argillites*.

Its associated minerals accordingly are equally diverse. Those with the limestone matrix are—Pyrites, Calcite, and Steatite; those of the Andesites are Calcite and cockscomb Barytes (the crystals of which penetrate the Pilolite), at one locality; Analcime at another; and Natrolite, Barytes, and zeolitic Quartz at a third. Those of the basalts also comprehend a wide range of minerals—Analcime, Scolecite, Stilbite, Chabazite, Mesolite, Laumontite, and Calcite.

[173. **Pihlite.**

Now regarded as a mechanical mixture of Muscovite and a felspar.

There is one specimen of thermo-metamorphosed argillaceous mica schist from Clova, Aberdeenshire, in the Scottish Mineral Collection, which has been referred by Dr. Heddle to this species.]

[174. **Rubislite.**

Heddle, *Trans. Roy. Soc. Edin.*, xxix. p. 112 (1879).

A dark green, compact-granular, or fine-foliated aggregate. Completely decomposed by hyhrochloric acid. B.B. fuses to a brown slag.

Analysis by Dr. Heddle :—

Sp. Gr.	SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	K_2O	H_2O
2·442	37·85	10·92	9·84	9·01	·46	4·22	8·00	3·33	16·13

From the granite of Rubislaw, Aberdeenshire.]

Titano-Silicates.

175. **Sphene or Titanite (510).** CaO,TiO_2SiO_2.

Monoclinic. [*a*, (? *w* or *ξ*) $\bar{2}21$ or $\bar{3}32$; *b*, 010; *c*, (*a*), 100; *n*, 111; *t*, $\bar{1}11$; *r* (*m*), 110; *s*, 021; *y*, (*c*), 001; *v*, $\bar{1}01$; *x*, 102; *m*, (*M*), $\bar{1}32$; *o*, 310; *e*, 212; *u*, 131; *l*, $\bar{1}12$; *d*, (*D*), 661; *w*, (fig. 12), ? 217; $d\frac{1}{2}$, (*η*) 221; $e\frac{1}{4}$ (*ζ*), 041; *a* (? *P*) $\bar{7}05$; o^1 (Y), 101; $a\frac{2}{5}$, $\bar{3}01$; *n*, (fig. 3) ?; *u*, (fig. 3) ?; d^1 (*z*), 112; *w*, 214.]

Crystals vary extremely in form, being generally apparently oblique, tabular from predominance of the face *v*, which are hemidomes in alternate position on opposite ends ; also, but more rarely, prismatic, with dominance of *l* and (*M*). Twins frequent. Twin face *c* (*a*), and formed by revolution of either *a* or an axis normal *c* (*a*), or *b* on a vertical axis. The former is very common, and usually produces thin tabular crystals with a re-entering angle along one side, and sometimes elongated. It occurs occasionally in double twins. Sometimes it is granular or foliated. Cl. in some *c* (*a*), *l*, *n*, in others *r* (*m*). H., 5 to 5·5 ; G., 3·4 to 3·6. Semi-transparent ; lustre adamantine to resinous. Colour yellow, brown, and green. B.B. fuses with microcosmic salt in the reducing flame, and gives a reaction for titanic acid.

Comp., Silica, 30·6 ; Titanic Acid, 40·8 ; Lime, 28·6.

Analyses by Dr. Heddle, *Min. Mag.*, v. 100, 102 :—

	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	ZrO_2	MnO	CaO	MgO	Total.
1. Tongue, . . .	35·50	30·40	2·59	4·91	..	..	·40	26·42	..	100·22
2. Shiness, . . .	54·67	35·46	2·89	tr.	..	..	·499	26·85	tr.	100·38
3. ,, dark brown, . .	36·70	35·39	2·21	·281	..	..	·30	25·40	..	100·37
4. Glen Gairn (*Greenovite*)	36·48	29·29	9·01	1·02	·55	·301	..	23·71	..	100·36
5. Glen Gairn (*Pseudo-Sphene*), . . .	42·29	no trace	19·73	2·09	4·86	..	·751	30·26	..	99·98

In Granite.

Aberdeenshire. In red granite, a mile west of Braemar.

Perthshire. Glen Tilt. It occurs in the large-grained granites in larger crystals than in the syenitic granites (MacCulloch).

Kirkcudbrightshire. In the Burn of Palnure, west of Cairnsmuir, in rolled blocks of granite (Jameson). [In all the Galloway Granites.]

In Granitic Veins.

Sutherland. Tongue, in the granitic vein which cuts the " syenite " boulder on Beinn Bhreac, dark brown, imbedded in brown Amazonstone, associated with Thorite, Magnetite, and Allanite, *c n y x* (Plate LXXXVI., fig. 1 ; *c n y* $a\frac{2}{5}$ o^1 (Plate LXXXVI., fig. 2) ; *l n y x u b r* (Plate LXXXVI., fig. 3) ; *n r v* (Plate LXXXVI., fig. 4)—Anal. 1. Also, imbedded in Babingtonite, Cleavelandite, and blue Fluor (D. and H.). In a vein which cuts the " syenite " of Cnoc Dubh, Lairg ; with Haughtonite, Oligoclase, and Allanite.

Hebrides. Iona, near the ruins, in veins cutting hornblendic gneiss, numerous doubly-depressed oblique prisms (Fleming).

Aberdeenshire. Anguston Quarry. In the " crocus " veins, cutting

grey granite, dark brown along wth Orthoclase, Oligoclase, Ilmenite, Allanite, and Haughtonite.

Argyllshire. In the granite of Strontian (Allan), *n y c* (Greg); *n y c x*, *n y c x r*, *n y c z*, the usual combinations at Strontian (Currie).

In Syenitic Granite.

Inverness-shire. Half a mile south of the Boat of Garten, with Allanite.

Argyllshire. Lag Choan Quarry, Cruachan, light brown, with Epidote, Hornblende, Apatite, and Pyrites (G. Thomson and H.). Bunawe quarry, north side of Loch Etive, with Pyrites. Barrs Quarry, west side of Loch Etive, with Chlorite, Allanite, Pyrites, and Molybdenite.

Aberdeenshire. Culblean, on the north-east slopes, brown.

Perthshire. Loch Tulla, at the foot of Meall Gabhair, in grey granite blocks.

In Gneiss.

Shetland. Mainland, Hillswick, Vannlip, imbedded in Chloritoid; very rare. Burray, at Alta Ness, in porphyritic gneiss (Fleming).

Caithness. Reay, in "syenitic" belts in gneiss, west of Loch Thormaid, hair-brown, *c n y*, *c n y r*.

Sutherland. Tongue, in a quarry west of Ribigill, with Albite, Actinolite, and Orthoclase, *c n r x* (Plate LXXXVI., fig. 5). Beinn Laoghal, in hornblendic gneiss, at Càrn a' Mhadaidh, and Meallan Liath, to the west: *c n y x r*, *c n y x z*, *r n x v*, *r n y v*. Beinn Spionnaidh, on the north-west slopes, near a fault, with pink Orthoclase and Augite, mahogany-brown, with resinous lustres. North of Achadh a' Phris, in the upper gneiss with Apatite and Hornblende (D. and H.). In a hill 1 mile north-east of Shiness, associated with Hornblende and Epidote (D. and H.). At Shiness, in the matrix of the limestone, buff-coloured, with Orthoclase and Lepidomelane. One crystal 2 by 1 inches (D. and H.).—Anal. 2 One mile west-north-west of Armadale, at the mouth of a stream in the bay east of Creag Gharbh, with Scapolite and Sahlite (Macconochie).

Ross-shire. At Port Ewe, in the gneiss.

Perthshire. Killin, at Creag na Caillich, straw-yellow, associated with Chlorite and Rutile, *c n y r v* (Plate LXXXVI., fig. 6). South of Tyndrum (Odenheimer).

Inverness-shire. Dochfour, in boulders of hornblendic gneiss, in large yellow twins, *c n y* (Plate LXXXVI., fig. 7); *c x l y* (Plate LXXXVI., fig. 8); and *c x y l*, simple (Plate LXXVII., fig. 9) (Aitken). On the south side of Loch Ness (Greg).

Hebrides. West Monach Island. In the Oligoclase layers of hornblendic gneiss, hair-brown, associated with Orthoclase, Apatite, Epidote and Ilmenite. Also in †Eternal Island.

In "Syenite."

Orkney. In "syenitic" belts in the Skerry, of Stack and Skerry.

Caithness. Reay; burn of Achvarasdale, with Hornblende.

Sutherland. Beinn Laoghal, chiefly at Sgùrr Dubh, hair-brown. Near Pittentrail, in Strath Fleet (Cunningham).

Inverness-shire. In "boulders" on Culloden (MacCulloch). Near Aviemore (Greg).

Argyllshire. On the road from Appin to Ballachulish, on the south-west of the granite (MacCulloch). Near Beregonium (Ledaig, Ardmucknish Bay), "a fragment of syenite contains beautiful crystals of Hornblende and very distinct ones of Sphene" (Macknight). At Strontian, pale-brown. At Inverary. Ben Nevis, in red "syenite," below the north-west end of the great precipice. (Greenough).

Elgin. At Freeburn (Greg).

Aberdeen. Old Meldrum, half a mile south of Forester Hill, associated with Orthoclase, Hornblende, and Ilmenite.

Perthshire. In the hills around Kingshouse, Rannoch (MacCulloch).

Banffshire. East of Durn Hill, pale-brown, *c n y x*. At Tiremnay Quarry, and at the Ord, rarely.

Kirkcudbright. On Criffel (Jameson). In a "syenitic" [Plagioclase-Hornblende granite] cliff, 2 miles north-west of new Abbey (Cunningham). In a glen 1 mile west of New Abbey, with Allanite, *c n y* (Plate LXXXVII., fig. 10); *c n y x*, *c n y r*, *c n y x r* (Plate LXXXVII., fig. 11); *c n y x w* (Plate LXXXVII., fig. 12); *c n y x w z* (Plate LXXXVII., fig. 13) (D. and H.). At Dalbeattie.

In Diorite.

Banffshire. Portsoy. In the rock near the Old Battery, and in a vein close thereto to the east, along with Edenite, Idocrase, and Enstatite. In the great bed of white Labradorite, west of Portsoy, in minute pale-yellow crystals. In a tortuous vein of Andesite, white Sahlite, and ? Babingtonite, cutting Diorite, east of the Bay of Durn, pale-brown.

Aberdeenshire. Tillypronie, at the summit of the road to Donside, in a vein, associated with Hornblende, Labradorite, Biotite, Iserine, and Allanite. Near Badnagauch, on the Deskry, in a similar vein, in rotting Diorite, with the same associates. In the great vein at Creag an Innean, Glenbucket, associated with Hornblende, Labradorite, Iserine, and Biotite.

Stirlingshire. Ochils, at the summit, in basaltic clinkstone (Nicol).

In Primitive Limestones.

Shetland. Fetlar. On the north shore of Loch Trista, with chromiferous Magnetite (Fleming).

Sutherland. Shiness, dark-brown, associated with Malacolite, Sahlite, Pyrrhotite, and Molybdenite : *c n y x r* (Plate LXXXVII., fig. 14) ; *c n y x z* (Plate LXXXVII., fig. 15) ; *n x r v* (Plate LXXXVII., fig. 16) ; *n y r v* (Plate LXXXVII., fig. 17) ; also *c o e n u d'* (Plate LXXXVIII., fig. 18). Twins of *c n y* (Plate LXXXVIII., fig. 19) ; *c n y r* (Plate LXXXVIII., fig. 20); *c n o r-d y* (Plate LXXXVIII., fig. 21); *c n o r v,$d\frac{1}{4}$,$e\frac{1}{4}$* (Plate LXXXVIII., fig. 22) ; *c o n y r u $d\frac{1}{4}$* (Plate LXXXVIII., fig. 23) ; *c r - n x l b* (Plate LXXXVIII., fig. 24) (D. and H.)—Anal. 3.

Inverness-shire. Glen Urquhart, Upper Gortally, light-brown, imbedded in Andesine, and associated with Edenite, green Apatite, Zoisite, and Graphite. Sometimes imbedded in Andesine : *c n s l m x y t* (Plate LXXXVIII., fig. 25) ; *c r l t n x y* (Plate LXXXIX., fig. 26).

Banffshire. Avonside. At Three Burns, near Gaulrig ; pale brown with Chlorite, Calcite, and Steatite, associated with Fluorite. Loch Builg, 1 mile north of, on the east side of the stream, in argillaceous belts in limestone, with Garnet, Quartz, Kyanite, Grenatite, and Chlorite.

Aberdeenshire. At Forester Hill, with Ilmenite, Pyrrhotite, Biotite, Talc, and ? Saponite. At Eslie Quarry, yellow, along with Sahlite, Actinolite, Apatite, Pyrrhotite, and Orthoclase. Aboyne, at Muir and at Midstrath quarries, with Orthoclase, Malacolite, Fluor, Graphite, and Pyrrhotite. Corntulloch, with Wollastonite, Malacolite, Pyrrhotite and Graphite. Crathie, at the junction of the matrix with the limestone, rarely. Glen Gairn, specially associated with Sahlite, Calcite, Anorthite, and Prehnite. The crystals are of two varieties, pinkish, flesh-coloured "Greenovite" (Anal 4) ; and in elongated twins, with rough surfaces *x z n e r d*—Anal 5.

Perthshire. Athol. Edintian Quarry, south of Tulach Hill, associated with Ilmenite, Biotite, Pyrrhotite and Ripidolite. In the quarry on the south side of the Garry, along with Ripidolite.

Hebrides. Tiree. At Ballyphaetrish, in the flesh-coloured marble in highly lustrous but round-angled crystals, of a watery brown, with Sahlite, Malacolite, Pyrrhotite, and Graphite (Wollaston).

176. **Keilhauite (511)**. $15CaSiTiO_3(Al,Fe,Y)_2Si,Ti)O_5$?

Monoclinic. A calcium, aluminium, ferric iron, and yttrium titanosilicate.

[A mineral doubtfully referred by Dr. Heddle to this species occurs in Oligoclase-Haughtonite Pegmatite at Cnoc Dubh, east of Lairg,

Sutherland, associated with Allanite and Sphene, also in Pegmatite ; and a similar mineral at Balallan, Loch Erisort, Lewis.

The specimens referred to are in the Scottish Mineral Collection in the Edinburgh Museum of Science and Art.]

A. Niobates, Tantalates.

Samarskite Group.

177. **Yttrotantalite (528).**

Orthorhombic. Essentially a tantalo-niobate of iron and one or more metals of the yttrium group.

[Dr. Heddle referred to this species an obscure mineral which occurs along with Sphene and Allanite in a Diorite-Granite at Beinn Bhreac, Tongue, Sutherland. The specimens are placed next the Sphenes in the Collection above referred to.]

178. **Monazite,** var. *Cryptolite* **(537).** $(Ce,La,Di)PO_4$ with ThO_2.

[Dr. Heddle recognised the acicular variety Cryptolite in the Apatite which formed one of the constituents of a far-travelled boulder found at Saville, Otters Wick, and also in the Apatites of the Achadh a' Phris and Rubislaw granites. It does not occur in the Apatites found in the metamorphic limestones.]

Apatite Group.

179. **Apatite (549)** $3Ca_3P_2O_8.CaF_2$, or, $3Ca_3P_2O_8.CaCl_2$.

Rhombohedral. [*a*, (*m*) $01\bar{1}$, 1010 ; *b*, (*a*) $2\bar{1}\bar{1}$, 1120 ; *r*, (*s*) 122, $11\bar{2}1$; *z*, $13\bar{1}$, $30\bar{3}1$; *h*, $3\bar{1}\bar{2}$, $21\bar{3}0$; *o*, (*c*) 111, 0001.]

The basal plane *o* (*c*) is seldom wanting. Crystals usually short prismatic or thick-tabular in habit. It also occurs in granular, fibrous, or compact states. Fracture conchoidal or splintery ; brittle. H., 5 ; G., 3·1 to 3·25. Transparent to opaque ; lustre vitreous to resinous. Colourless or white, but usually some light shade of green, sometimes grey, blue, violet, or red.

Shetland. Mainland. Hillswick, at Vannlip, pale green, in Quartz.

Orkney. Sanday. Otters Wick, in a large boulder, on the west shore near Saville. The boulder may be of Scandinavian origin. The Apatite was in a crystal 5 inches by 1.

Sutherland. Loch Shin, near Achadh a' Phris, in gneiss, associated with Sphene and fibrous Rutile. Crystals blue-green, twins *o a r* (Plate

LXXXIX., fig. 1) (D. and H.). Shiness, in lumps imbedded in the limestone (D. and H.). At the west side of the mouth of the Halladale River, in nodules in Quartz ; asparagus-green, contains no Cryptolite.

Ross-shire. Near Bonar Bridge, in gneiss and granite (MacCulloch). Near Kincardine, crystallised in Quartz-veins which cuts gneiss (Jameson). Glensgaich, at the west end of the railway cutting ; grass green, in Quartz, associated with Garnet, Muscovite, and Zircon. In granitic boulders in the neighbourhood of Castle Leod and the Raven's Rock (Creag an Fhithich), associated with Garnet, comb. *a o b r z* (Plate LXXXIX., fig. 2). The crystals grass-green, sometimes over an inch in length and breadth (Bell).

Inverness-shire. Glen Urquhart. At Upper Gortully, imbedded in the limestone and associated with Edenite and Sphene, *a b o* (Plate LXXXIX., fig. 3) ; *a b o h* (Plate LXXXIX., fig. 4).

Hebrides. In West Monach Island, in Oligoclase bands or layers of Hebridean gneiss, associated with Ilmenite, Epidote, and Sphene. On †Eternal. Berneray, Barry Head, in the gneiss of the old quarry south-west of the lighthouse.

Banffshire. Portsoy, in the third granite vein east of Durn Bay, *a o*, associated with Tourmaline, Orthoclase, and Graphic Garnet. Macduff, in the granite of Longmans Hill (Cunningham).

Aberdeenshire. Huntly, on Clahsmach Hill, blue-green, in granite veins along with Oligoclase, Tourmaline and Muscovite (Peyton). In Dobson Quarry, near Inverurie, associated with Ilmenite, Chlorite, Orthoclase, Oligoclase, and black mica. In Dyce Quarry, in white Microcline crystals which occur in Quartz veins, traversing granite. In Rubislaw Quarry, *a o*, in granite veins, with Beryl, Muscovite, Tourmaline, Garnet, &c. In Eslie limestone quarry, associated with Sahlite, Pyrrhotite, and Sphene. At Muir and Mid strath limestone quarries, in Orthoclase adjacent to the limestone. In Glen Kindie, in graphic granite. In Crathie limestone quarry. Glen Gairn, in Dalnabo Quarry, rarely, in the limestone. With porphyry in the fields in Kildrummy parish (Greg). At Tyrebagger, associated with Garnet.

Kincardineshire. At Cove, in granitic veins. One mile north of Blairydrine, in milky Orthoclase, associated with Haughtonite.

Perthshire. North of Pitlochry, associated with Margarodite (Muscovite), in mica schist (Greg and H.).

Dumbartonshire. In the complex of Garabal Hill, *a o* (Teall).

Edinburgh. Salisbury Crags, at the south end of, in Dolerite, in a matrix of Calcite, red Albite [? Labradorite], and dark-green Saponite in prisms, rarely, three-quarters of an inch (Jameson and Connell). In trap near St. Anthony's Chapel (Rose).

180. **Pyromorphite (550).** $3Pb_3P_2O_8.PbCl_2$.

Rhombohedral. [*a*, (*m*) 011, $10\bar{1}0$; *o*, (*c*), 111, 0001.]

Crystals usually simple in form ; occasionally thicker in the middle, or spindle-shaped. Also occurs in reniform or botryoidal masses. Fracture conchoidal to uneven. H., 3·5 to 4 ; G., 6·9 to 7. Translucent ; lustre resinous or vitreous. Sometimes colourless, but generally grass-green, pistachio-, olive-, or siskin-green, and clove- or hair-brown.

Comp., 89·7 Phosphate of Lead, 10·3 Chloride of Lead.

Analysis : –1, Heddle ; 2-4*a*, Collie, *Journ. Chem. Soc.*, lv. p. 93.

	PbO	P_2O_5	Cl_2.	Fe_2O_3	Total.
1. Leadhills,	81·81	16·63	2·68	..	..
1*a*. ,,	75·98	15·8	2·67	·3	94·75
2. ,, (orange),	81·4	15·7	2·6	..	94·48
3. ,, (green),	..	15·9	2·6	..	..
4. ,, (yellow)	81·6	15·9	2·8	..	100·3
4*a*. (Calculated),	81·7	15·6	2·6	..	99·9

ARGYLLSHIRE. Strontian, green and yellow (Greg).

ELGINSHIRE. Stotfield, near Lossiemouth, green, botryoidal, on Quartz, associated with Galena (Peyton).

LANARKSHIRE. Leadhills. In Susanna Mine, orange and red, either on Quartz *per se*, or with Susannite, Lanarkite, Leadhillite, Caledonite, and Cerussite, *o a*—Anals. 1-4. Leadhills Dod, olive-green, associated with Linarite and Leadhillite ; also sheathing Galena.

DUMFRIESSHIRE. Wanlockhead, Beltongrain vein, sheathing Galena

KIRKCUDBRIGHT. Gatehouse, at Lauchentyre, associated with Wulfenite, in Galena, yellow (D. and H.). Pibble, near Creetown, with Linarite, Cerussite, and Galena (D. and H.).

180*a*. **Calcium Vanado-Pyromorphite.**

Collie, " On Some Leadhills Minerals," *Journ. Chem. Soc.*, lv. p. 94, describes a mineral from Leadhills under the above name. It occurs in black botryoidal masses, and is unlike either Pyromorphite or Vanadinite in appearance. The fracture is uneven or conchoidal ; it fuses easily before the blow-pipe, leaving a brown granule, which, when broken shows a crystalline structure. It dissolves readily in hydrochloric acid when warm, and leaves a slight residue of a brown colour, which consists chiefly of an oxide of iron. Two analyses were made :—

	Sp. Gr.	$Pb_3(PO_4)_2$	$Pb_3(VO_4)_2$	$Ca_3(PO_4)_2$	$PbCl_2$	$Cu(OH)_2$	Residue.
1.	6·9-7·0	52·0	19·2	15·8	14·4	1·6	0·6
2.	..	..	..	..	10·7	1·4	0·5

The mineral is therefore a Pyromorphite in which calcium replaces lead, and Vanadic acid replaces phosphoric acid.

181. **Mimetite (551).** $3Pb_3As_2O_8.PbCl_2$.

Rhombohedral. Combinations similar to those of Pyromorphite. Fracture conchoidal or uneven. H., 3·5 to 4; G., 7·19 to 7·25. Translucent. Colourless, but usually honey- or wax-yellow, or yellowish-green.

Comp., 90·7 Arseniate of Lead, 9·3 Chloride of Lead; but part of the arsenic may be replaced by phosphoric acid.

Lanarkshire. Leadhills. Formerly, in small crystals of a brilliant yellow colour, *a o*, and coating other minerals (Greg).

Dumfriesshire. Wanlockhead, Beltongrain vein, High Pirn Mine. Doubtfully, in dull pale-brown crystals, *a o* on silicate of zinc.

182. **Vanadinite (552).** $3Pb_3V_2O_8.PbCl_2$.

Rhombohedral. [*a*, $01\bar{1}$, 1010; *b*, (*m*) $2\bar{1}\bar{1}$, $11\bar{2}0$; *o*, (*c*), 111, 0001; *z*, $13\bar{1}$, $30\bar{3}1$; *r*, $\bar{1}22$, 1012.]

Transparent to opaque; lustre resinous. Colour honey-yellow to greyish-brown; streak white. H., 3; G., 6·8 to 7·2.

Comp., Oxide of Lead 70·83, Vanadic Acid 19·35, Lead 7·2, Chlorine 2·62.

Analyses:—1, 2, 2*a*, Collie, *Journ. Chem. Soc.*, lv. p. 94; 3, Frenzel, *Min. Mitth.*, 3, 504; 4, Genth, *Am. Phil. Soc.*, October 1885.

	PbO.	V_2O_5.	As_2O_5.	P_2O_5.	Cl.	CaO.	H_2O.	Total.
1. Leadhills,	80·00	16·70	..	..	2·50	..	1·2	99·40
2. ,,	79·60	16·20	..	..	2·40	..	1·4	99·60
2*a*. (Calculated),	78·20	19·30	..	..	2·50	..	..	100·00
3. ,,	73·97	17·92	..	2·75	2·34	3·02	..	100·00
4. ,,	78·39	18·04	0·34	0·27	2·53	..	..	99·57

Other analyses by Damour and R. D. Thomson are given on p. 409 of Greg and Lettsom's *British Mineralogy*.

Lanarkshire. Leadhills, in very minute crystals. (Anals. 174).

Dumfriesshire. Wanlockhead, Beltongrain vein, High Pirn Mine, "only in one spot, about six fathoms in length, where the vein had been subjected to violent disruption" (*Brewster's Journal*, N. S. II., p. 2). The crystals range in colour from pale wax-yellow, through reddish-yellow to dark-brown; they are implanted on white to green (silicate of zinc), and are associated with Calcite in highly-modified forms, and with Plumbocalcite and Plattnerite.

Comb., *a o*; *a o b*; *a o z*; *a o b z r*; but it occurs most frequently in

globular forms. Very rarely implanted on large muddy white cubes of Fluor Spar (Wilson).

182*a*. **Olivenite (561).** $Cu_3(AsO_4)_2.CuO.H_2O$ Orthorhombic.

[Lanarkshire. A mineral occurring in minute tufted groups of crystals, and associated with Chrysocolla and Leadhillite, at Brown's Vein, Glen Gonner, Leadhills, has been placed by Dr. Heddle under this heading in the Scottish Mineral Collection.]

183. **Dechenite (564).** $(Pb,Zn)_2(OH)VO_4$.

[Dr. Heddle left a note in pencil that he obtained a single specimen of this mineral in an old heap from the High Pirn Mine, Wanlock Dod, Dumfriesshire.]

B. Acid and Basic Phosphates, Arsenates, &c.

Olivenite Group.

184. **Erinite (568).** $5CuO.As_2O_5.2H_2O$.

Reniform and foliated. Fracture conchoidal. H., 4·5 to 5; G., 4 to 4·1. Translucent in the edges; lustre dull resinous. Colour and streak emerald or grass-green.

Comp., 59·9 Copper Protoxide, 34·7 Arsenic Acid, 5·4 Water.

[Lanarkshire. A green encrustation on Cerussite, and lining cavities in Chalcopyrite, in the vein-stuff of Brown's Vein, Glen Gonner, Leadhills, has been referred by Dr. Heddle to this species. It occurs associated with Linarite, Pyromorphite, Chrysocolla, Chalcopyrite, Cerussite and iron ochre.

C. Hydrous Phosphates, Arsenates, &c.

Vivianite Group.

185. **Vivianite (597).** $Fe_3P_2O_8.8H_2O$.

Monoclinic. *a*, 100; *b*, 010; *m*, 110; *y*, 310; *e*, 011; *n*, 101; *v*, 111; *r*, 112; *x*, 111; *z*, $\bar{1}12$.

Crystals generally prismatic, also fibrous or earthy. Cleavage clino-diagonal, perfect. Thin laminæ flexible. H., 2; G., 2·6 to 2·7. Translucent to transparent; lustre vitreous or pearly on the cleavage faces. Colour indigo to blackish-green; streak bluish-white, but this soon turns to blue after exposure.

Comp., 33·1 Iron Protoxide, 29 Phosphoric Acid, 25·7 Water.

Shetland. "In a peat moss."

[It is said to be the blue colouring matter of the Old Red Sandstone fish of the Moray Firth.]

Ayrshire. Loch Lee, in a crannog, in the centre of bones (Munro). [Fasciculate groups of thin crystals tabular to *b*, *a b m y e n z r v*.]

Edinburghshire. In a granular form, in clay, in a drain at the foot of Salisbury Crags. On bones from alluvium, Queen's Park (J. G. Duncan). At the foot of the Castle Rock (Nicol).

Linlithgowshire. Around bones in an old lake bed at the head of the Haugh Burn, Cauldhame (Cadell).

186. **Erythrite (601).** $Co_3As_2O_8.8H_2O$.

Monoclinic. Cleavage clinodiagonal, perfect; sectile, thin laminæ flexible. Often forms a chalky encrustation. H., 1·5 to 2·5; G., 2·9 to 3. Translucent; lustre vitreous, pearly in the cleavage. Colour crimson to peach-blossom red.

Comp., 38·2 Arsenic Acid, 37·8 Cobalt Protoxide, 24 Water, but often contains nickel.

Perthshire. Clifton lead mine, Tyndrum (Jameson).

Stirlingshire. Occurs as a peach-blossom red chalky-looking encrustation on the vein material associated with the "Silver Mines" at Alva, along with Cobaltite and Annabergite (Jameson).

Linlithgowshire. Is found under similar conditions in the lead-veins at the "Silver Mine" at Cairn Naple, in the Bathgate Hills, associated with Niccolite, Barytes, Galena, Calcite, &c. (Goodchild).

Edinburghshire. At Broughton quarry, Edinburgh.

187. **Annabergite (602).** $Ni_3As_2O_8.8H_2O$.

Monoclinic. Occurs, when crystalline, in capillary crystals; often in an earthy form. Sectile. H., 2 to 2·5; G., 3 to 3·1. Lustre dull or glistening. Colour apple-green to greenish-white; streak greenish-white and shining.

Comp., 38·7 Arsenic Acid, 37·3 Nickel Protoxide, 24 Water; sometimes contains a little cobalt or iron.

Stirlingshire. At Alva, associated with Cobaltite and Erythrite in the "Silver Mines."

Linlithgowshire. Occurs also in the Silver Mine at Cairn Naple, Bathgate Hills, with Niccolite, Erythrite, &c.

188. **Dudgeonite** (Heddle, *Min. Mag.*, viii. 200) is regarded as a variety of Annabergite with one third of the Nickel Oxide replaced by Lime.

Kirkcudbrightshire. At Pibble Mine, near Creetown, in cavities in Niccolite associated with Galena, Linarite, Pyromorphite, &c.

Lanarkshire. Said to occur at Leadhills.

189. **Wavellite (639).** $4AlPO_4.2Al(OH)_3+9H_2O$.

[Orthorhombic. Distinct crystals, rare. Generally in acicular crystals, radially grouped into hemispheroidal, or discoidal, aggregations Clv. (101) and (010) rather perfect. H., 3·25 to 4; G., 2·337 to 25. Lustre vitreous, inclining to pearly. Colour various, but generally grey, ranging ochreous or to lead blue. Streak white. Translucent. Comp., Phosphoric acid, 35·2; Alumina, 38; Water, 26·8.

Principally at Garbh Eilean, the largest of the Shaint Isles, where the writer of this note has found it on the north shore, close to Sgeirean a' Bhaigh. It occurs in the form of discoidal aggregations of radially-disposed acicular crystals, coating the joints of one of the Middle Jurassic clays, close beneath the base of a thick intrusive sheet of dolerite of Tertiary age, and highly indurated by the contact. An orbicular structure has been developed in the clay by the contact metamorphism, and a note on one of the specimens in the Scottish Mineral Collection states that the author regarded the Wavellite as forming the basis of the spheroids referred to.

In the article "Mineralogy," in the 9th edit. of the *Encyclopædia Britannica*, the author refers to this species a mineral occurring in the form of contiguous groups of thin discoidal aggregations of acicular crystals, which coat the joint faces of one of the andestic lavas of Devonian age in Glencoe. A specimen of the mineral referred to was placed with the Wavellites in the Scottish Mineral Collection; but the author left no further information regarding it than the statement that the specimen is in the near neighbourhood of Withamite. Wavellite usually occurs on the joint faces of fossiliferous rocks of argillaceous composition, which have been affected by contact metamorphism (J. G. G.).]

OXYGEN SALTS.

Sulphates, Chromates, Tellurates.

A. Anhydrous Sulphates.
B. Acid and Basic Sulphates.
C. Hydrous Sulphates.

A. Barytes Group. RSO_4. Orthorhombic.

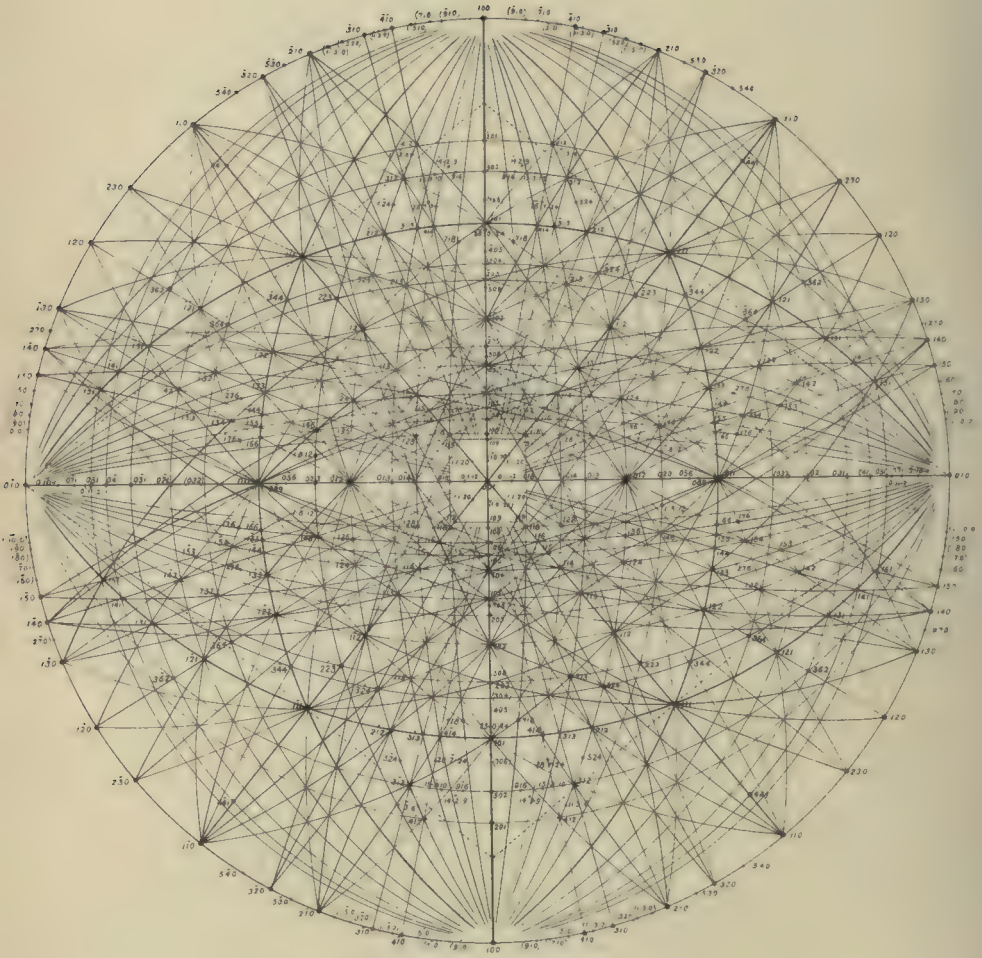
190. **Barytes (719).** $BaSO_4$.

Axes $a : b : c = 0{\cdot}8152 : 1 : 1{\cdot}3136$.

[a, 100; b, 010; c, 001; β, 310; λ, 210; η, 320; m, 110; N, 230; n, 120; χ, 130; E, 150 [see ξ]; K, 109; W, 108; w, 106; σ, 105;

Barytes.

W. Bert Goodchild



M&N. Hanhart & Eyre Edin.

l, 104 ; *g*, 103 ; *i* (*κ*), 205 ; *d*, 102 ; *u*, 101 ; D, 302 ; **a**, 0.1.12 ; S, 014 ; *φ*, 012 ; *y′*, 023 ; *o*, 011 ; *i*, 021 [see *κ*] ; **s**, 071 ; *H*, 119 ; *k*, 118 ; *P*, 116 ; *v*, 115 ; *q*, 114 ; *f*, 113 ; *r*, 112 ; *z*, 111 ; *p*, 441 ; *π* 916 ; *δ*, 414 ; (421 of Dr. Heddle) ; *t*, 11.3.6 ; *γ*, 312 ; *σ′*, 11.5.55 ; **o**, 213 ; *τ′*, 324 ; *μ*, 124 ; [123] ; *y*, 122 ; *s*, 132 ; *ρ*, 144 ; *E* (*ξ*), 142.]

The crystals show many forms and combinations. [They are usually elongated along the axis *a*, and are tabular parallel to *c*. Cleavages chiefly *m* and *c*, *m* being sometimes more perfect than *c* ; *z* and *b* less complete, traces parallel to *d*, and occasionally to other faces]. [In this species forms which can be distinctly seen on certain specimens, but which have not been identified, are here denoted in the combination by an asterisk ; faces much obstructed to view are denoted by the hyphen (W. G.)[1]]. H., 3 to 3·5 ; G., 4·3 to 4·7. Transparent to translucent ; lustre vitreous to resinous. Colourless and white ; but sometimes reddish, greenish, yellow, grey, blue, or brown. Comp., 34·3 Sulphuric acid, 65·7 Baryta, with occasional traces of Strontium sulphate. B.B. decrepitates violently, and fuses with much difficulty, and then only on the edges, colouring the flame yellowish-green if no strontium is present. Not soluble in acids. [The numbers preceding the initials S.M. refer to specimens in the Scottish Mineral Collection in the Edinburgh Museum of Science and Art.]

Shetland. Papa Stour, at the Kirkness Sands, in druses in a porphyritic eruptive rock, in which it occurs in lamellar crystals associated with Chalcedony, Quartz, Calcite, and Fluor (Jameson).

Orkney. Walls, at Sands Geo, in druses in amygdaloidal eruptive rock, *m c a o d z*, associated with Pearlspar and Analcime.

Caithness. Reay, at Achavarasdale Lodge Iron Mines, *c d o* (Plate XC. fig. 1) [719.16 S.M.], associated with Gœthite and Quartz.

Sutherland. Lairg, at The Ord, in veins in red "syenite" (granite), and between Rhian (Claonel) and Pitarxie (Gruids), very rarely, *m c b d o γ* (Plate XC. figs. 2 and 3), *m c a o d u η b* (Plate XC. fig. 4) associated with Rock Crystal. [*c d u ? η m o γ* ; 719.2 S.M. (W. G.).]

Elginshire. In Newton quarry, in green, laminated crystals (Gordon). At Quarrywood (Greg), south of Rothes, in a Hæmatite vein, *c g d m o* ; *c m o d b* ; [*c d a m ? n b* ; 719.42 S.M. (W. G.).]

Argyllshire. North of Loch [?Teàrnait], in Baich Burn [?Allt Beitheach, Morven], associated with Chalcopyrites. Strontian, at Fee Donald (part of Whitesmith Mine), associated with Calcite and Galena [*c d η m χ b o* ; 719.17 S.M. ; *c d m χ b o z* ; 719.18 S.M. (W. G.).]

[1] Mr. Wilbert Goodchild has helped to revise the crystallography of this and the following species, and has also redrawn several of the figures and contributed others.

Banffshire. Mulben railway cutting, *c o a d b* (Nicol). [*c d a b o φ v f*, 719.85 S.M.; *c d u a m b o f z*, 719.86 S.M.; *c ? w l g d u a m n χ b o v z y*, 719.87 S.M.; *c ? w l d m n o - r z y**, 719.88 S.M., * being apparently a new form in the zone *z n* and between these forms (W. G.).] Mulben in Auchroish quarry, in a vein traversing greywacke (Grant Wilson).

Kincardineshire. At Birnie Slack (Slack Burn), *c m* [*c a m*] (W. G.), white and opaque. In crystals *m o*, imbedded in vein of chert, associated with Natrolite, on the shore north (east) of Craig David.

Forfarshire. Johnshaven, on the shore between the Factory and the farm town, in laminated crystals. Craig Railway Cutting, in "melaphyre," associated with Satinspar, Pilolite, Saponite, and Natrolite (Mitchell). In a vein in the Geary Pot Cave, near Auchmithie [*c l d b o*, 719.20 S.M.] (W. G.).

Perthshire. Tyndrum mines, in veins traversing schistose quartzite generally in lamellar forms, associated with yellow Blende, Galena, Chalcopyrites, Quatrz, etc. At Ballindean, of a bright sulphur-yellow colour (Greg).

Fifeshire. Kinkell, in cavities in agglomerate, *c o m d* (Plate XC. fig. 5); [*c l d u m*] (Plate XC. fig. 6); *c m z*; *c m n o z* (Plate XCI. fig. 7); *m c*; *c d a η * b o s π* (Plate XCI. fig. 8), associated with Calcite and Dolomite; blue, *c m a b o d* (Plate XCI. fig. 9); with Pearlspar and pink Quartz; *c m φ o b*. [Also, *c d m b o z y γ*, 719.62 S.M.; *c d m χ b o z γ s*, 719.63 S.M.; *c d m b o π*, 719.102 S.M.; *c d a m o r z*, 719.103 S.M.; *c - d - m - o - z*, 719.104 S.M.; *c d η m b o z y s γ*, 719.23 S.M.] (W. G.) Elie, at Kincraig, in veins in agglomerate, *c - o m n* [χ] *w l g d u z* [*f*] *μ y s* (Plate XCI. fig. 10), associated with Asphalt and Amethyst; *c m u o* (Plate XCI. fig. 11); *c d m n χ o y s* [? ξ] (Plate XCI. fig. 13). [Also *w σ d m o ? a z* (Plate XCI. fig. 12); *c w l g d u - m - χ o φ r z y*, 719 4 S.M.; *c ? w l d m n b o z y ? μ*, 719.22 S.M.; *c w σ d m o ? v z y **, 719.46 S.M.; *c w σ l d a m b * o k z y*, 719.47 S.M.; *c σ l d a m χ o z γ*, 719.48 S.M.; *w σ d a m n o ? a z ? q*, 719.49 S.M.; *c w σ d a m n b o ? a q z y ? μ*, 719.50 S.M.; *c w σ l d m n o φ k z y*, 719.51 S.M.; *c ? W σ l g d u m o * * z * y*, 719.52 S.M.; *c ? K w d - - m n - - o * r z y **, 719.53 S.M.; *c ? K ? W ? w d u a m n χ b o * k v q f r z y **, 719.54 S.M.; *? K ? w d u a m o ? a f ξ*, 719.55 S.M.; *c * ? K W w ? σ d u m o **, 719.56 S.M.; *c ? w l d u a m χ b o * r z y*, 719.57 S.M.; *c l ? g d u a m χ b o * r z y*, 719.58 S.M.; *c w l g d u λ m n χ b o z y s*, 719.59 S.M.; *c d u a m n b o r z y μ s*, 719.60 S.M.; *c l g d u a m o z - -*, 719.89 S.M. The low form ? a, combined with ? *K*, *W*, or *w* to the comparative exclusion of *c*, seems very typical of the Kincraig crystals] (W. G.). Ruddons Point, associated with Analcime [*c m z*, 719.45 S.M.] (W. G.). Near Balmerino, in divergent groups of lamellar crystals within agates, imbedded in Quartz and Chalcedony. Common also in veins in

the Lower Carboniferous basalt lavas between Burntisland and Kirkcaldy (Goodchild). [Goat Quarry, Aberdour (Hamilton), in divergent groups, lamellar parallel to *c*, *c l d g u a m n χ b o P v q f r z p y*, associated with Calcite, Quartz, and Pyrites. Auchtertool (Clark), in lamellar crystals *c d u m* ? o (Case H, S.M.) (W. G.).]

STIRLINGSHIRE. Aberfoyle, in a vein on the west side of Arndrum, associated with Quartz, *c m o d a*; *c m o d a b* [*c d η m* ? *b o φ k f r z*, 719.6 S.M.] (W. G.). At Airthrey and also at Alva [in veins traversing the andesitic lavas of the Old Red, associated with Chalcocite, Malachite, Chrysocolla, Chalcedony, and Quartz (Goodchild)]. Blairlogie (Macconochie), [*c d a λ m χ b o f z*, 719.3 S.M. Also on the south side of Dumyat, *c w l g d u D a λ η m - - b o* ? *S H k P v q r z p* (fig. in Appendix) (W. G.).]

DUMBARTONSHIRE. Bowling Quarry, in the Prehnite vein, associated with Harmotome and Edingtonite, *c o m f d g φ*; [*c* ? *σ l g d - o - k v q f*; *c l g d u m o φ* ? *S v f z* (also fig. in Appendix, *c l g d u m o φ S*); 719.105 S.M.; *c l d a m - - o v f*, 719.106 S.M. (W. G.).]

EDINBURGHSHIRE. West Calder, in the Addiewell Shale pits, crystals elongated along the axis [*a*], *c u d m z*; *c o d m z*; *c o* [*a*] *m n χ l g d u z* (Plate XCII. fig. 14); *c o* [*a*] *m n χ l g d u z y* (Plate XCII. fig. 15); *c o a b m n χ E* (*ξ*) *l d u τ′ r μ σ′ z y* (Plate XCII. fig. 16, Dr. C. O. Trechmann), associated with Chalcopyrites. Calcite, Pearlspar, and Halite (Stuart Thomson), [and Dr. C. O. Trechmann, "Barytes from Addiewell," *Min Mag.*, vii. 49, June 22, 1886]; [*c l* ? *κ d u a m n χ b* § *o r z y ξ*, 719.29-32 S.M.; *c l g κ d u a m n χ b o z y ξ*, (fig. in Appendix); 719.33 S.M. (W. G.)]. Midcalder, Belstane, Lyden Quarry, transparent in amygdules. Niddrie [No. 12 pit], in shale, associated with Calcite. Combinations:—*c b d g l m o*; *c b d g λ m o z y* (Plate XCII. fig. 17); *c m a o z f y - - d* [*b*] (Plate XCII. fig. 18); *c d a η m o r z y* (Plate XCII. fig. 19); *- - - d g*; *c m o y b d g z v*; (Budge), crystals elongated along the axis [*b*] [Also *c d u a λ η m o φ f r z* ? *p y** (fig. in Appendix), 719.7 S.M.,* seemingly being at the intersection of the zones *u r o* and *g f b*, and therefore having the index 123—a form new to barytes (W. G.).]. [In cavities, usually associated with Calcite, in the dolerite of Salisbury Crags, in the Lower Carboniferous basalt lavas of the Crow Hill, and in the vapour cavities in the Andesite lavas of the same age on the Calton Hill. Crystals have lately been found by Mr. J. G. Duncan in a cutting from a drain on the north side of the Queen's Park, Edinburgh. From these Mr. Wilbert Goodchild has identified the following combinations:—*c d m - - o z y γ δ*, 719.130 S.M.; *c d u a β η m o k z γ δ* and *c d u η m χ b o z y γ δ ρ*, (fig. in Appendix); both on 719.131 S.M.; *c d u η m χ b o z γ*, zoned,

719.132 S.M.; *c d u η m - - o γ*, 719.133 S.M.] [Also on the north shore of the west end of Loganlee Reservoir, Pentland Hills, *c m*; *c d a m b o z* (W. G.).]

Linlithgowshire. Near Linlithgow, associated with Blende and Galena.

Lanarkshire. At Kiffockside, "in hexagonal prisms truncated at both ends in a pyramid of six sides—a great variety of them." Leadhills, *c m b d* (Plate XCII. fig. 20), associated with Calcite. Also occurs there of a sea-green colour, *c m* (Plate XCII. fig. 21); green crystals associated with Calcite, *c d m* (Plate XCIII. fig. 22); *m o d y*; *c m* [*b*]; *w c d m* [*b*] *φ*; and blue, *c d m - - φ o* [*b*]; *c m d o a λ b*; all elongated along the axis [*b*]. Glen Gonner Shaft, *c a d m n*, pellucid crystals, associated with Quartz, also [*c η m*] (Plate XCIII. fig. 23): [*c d m b o φ π*; blue crystals: *c l g d u D a λ η m b o ʔ f γ*, 719.28 S.M.; *c d m b o π*, 719.67 S.M., a typical Leadhills crystal; *c ʔ σ d u λ η m b o z s*, 719.114 S.M.; green crystals; *c w d a m b z*, 719.74 S.M.; *c w d m n b*; *c d η m b o ʔ H r z*; *c d m η b o*; *c d λ η m b o φ ʔ s*; *c ʔ σ d m*, 719.11 S.M.; *c ʔ W d m*, 719.34 S.M.; *c d ʔ η m b o z π s*, 719.78 S.M.; *c w d u a m*, 719.110 S.M.; *c w d u m*, 719.112 S.M.; *c ʔ σ d m z*, 719.118 S.M. (W. G.)]. In the Cumberhead lead mine, at the head of the Nether Water (Sowerby).

Renfrewshire. At Mearns, in veins traversing Lower Carboniferous lavas, *c φ o m z g d w* (Plate XCIII. fig. 24), associated with Calcite; [*c l d u a b o* (W. G.)]. Gourock, at Kempock Quarry, in eruptive rocks, associated with Calcite and Fluor (Young); [*c d u m ʔ f*, 719.109 S.M.; *c m z*, 719.66 S.M. (W.G.)]. Two miles north-west of Lumsden Hill, and one mile north of the hill of Stake, in a vein from three to fifteen feet thick, white, with flesh-coloured layers upon *c* and *z*, *m* being sprinkled with dark brown. At Eaglesham (Young).

Buteshire. Arran, in the great vein in Glen Sannox, rarely, in tabular forms, *c o* [*a*] *n i* (*κ*) *d u v f z* (Plate XCIII. figs 25 and 26); - - - *w*; *c o* [*a W*] *n* (*N*) *i* (*κ*) *d v q f r z y* (Plate XCIII. fig. 27); *c o a m l i* (*κ*) *d u q f r z y* (Plate XCIII. fig. 28); *c o m a l* (*g*) *d q f z* (Plate XCIII. fig. 29); and prismatic, *m c o n l i* (*κ*) *d v f z* (Plate XCIV. fig. 30); *c o m l i* (*κ*) *d u v q r z y* (Plate XCIV. fig. 31); *c o n* [*W*] *g i* (*κ*) *d u* [*q*] *f r z y* (Plate XCIV. fig. 32). Crystals elongated along the axis [*a*]. Also the following:—*g i* (*κ*) *d u n o φ q f z y* (Plate XCIV. fig. 33); *c g i* (*κ*) *d n o q f z y* (Plate XCIV. fig. 34); *c l g d a n o v q f r z y* (Plate XCIV. fig. 35); *c l g d a m o q f z* (Plate XCIV. fig. 36); [*c l g κ d u a m n o k v f r z y*, 719.65 S.M. (W. G.)].

Roxburghshire. Yetholm Law, at the foot, and also at the top, "in rectangular crystals with bevelled terminations."

KIRKCUDBRIGHTSHIRE. At Balcary [Hestan Island] Copper Mine, *c m a*, associated with Chalcopyrites (D. and H.); [*c d o* - -, 719.10 S.M. (W. G.)].

DUMFRIESSHIRE. Wanlockhead, Glen Crieve mine, *c d m b π o a*, associated with Calcite and Pearlspar (Plate XCV. fig. 37); *c o d m v z* (Plate XCV. fig. 38), associated with Blende; *c o a m η d* [*b*] *γ* (Plate XCV. fig. 39); *m c o d* (*g*) *v*; *c m d u* [*a*], associated with Galena and Quartz; *c d m o* [*a*], associated with Quartz; *c d* - - *η*, associated with Calcite; *c d o m*; and *d b o* [? *c d m* (W. G.)] (Plate XCV. fig. 40). All these are elongated along the [*b*] axis; [*c d η m a o π s*, 719.35 S.M.; *c d m o v π*, 719.40 S.M.; *c d u m b o π*, 719.111 S.M.; *c d m b o π*; *c d m b o k v z*; other Wanlockhead combinations in the Scottish Mineral Collection are: *c l d m* ? *E b o* - *k* ? *v* ? *s*, 719.13 S.M.; *c d m o z*; *c σ d m*; and, in Case H:—*c d η m b o* ? *H r z* ? *γ*; *c d η m b o*; *c d η m b o φ s*; *c σ d u a m b f z*; *c l d m i o y′ k P v q* ? *ξ*; *c d m o k v q π* (W. G.)]. West Groove, *c d o a m* [*k v*] (Plate XCV. fig. 41); *c d m* [*b*]: *c d m* [*b*] *o* -; *c d o b* -; all these with the crystals elongated along the [*b*] axis; *c m η*, associated with Calcite (Plate XCV. fig. 42); *c o d m z v*. [*c d π*; - *m b*; *m b o* (W. G.).]

[BERWICKSHIRE. At Cockburnspath, in Lower Carboniferous Shales, lining cavities in what appear to be coprolites, *c l m d o*, *c d a m b* (J. B. Mears).]

COCKSCOMB BARYTES.

SHETLAND. Papa Stour, at the Kirk Sands (Jameson).

ARGYLLSHIRE. At Strontian (A. Thoms).

PERTHSHIRE. Near Callander, on the north-east, in quarries in Lower Old Red conglomerate, associated with Chalcocite and Malachite.

EDINBURGHSHIRE. Compensation Pond, Pentland Hills, in a north affluent of the Glencorse burn, below the pond.

STIRLINGSHIRE. Aberfoyle, at Arndrum.

LANARKSHIRE. In the Leadhills mines, with Blende, and also with Quartz, in hemispherical rosettes, sometimes ten or more inches in diameter; snow-white, overlaid by Calcite.

VEIN BARYTES.

CAITHNESS. Near Clyne, in a vein one hundred feet wide. At Skinnet Hill, equally large, with Galena and Marcasite. In a brook at Sempster, Thrumster (Joass). All in [Orcadian] Old Red Sandstone.

SHETLAND. Fair Isle (Fleming).

ORKNEY. At the Bay of Scalpa.

INVERNESS-SHIRE. In conglomerate, with Fluor, at Loch Bruithaich (Wallace).

BANFFSHIRE. Cabrach, in the hill of Dumeath, parish of Glass.

STIRLINGSHIRE. Campsie Hills, at Corrie, in trap; a vertical vein of

pale-red colour, with traces of copper and lead ores. Lamellar Barytes is the vein stone of the Alva, Airthrey, and Castle Campbell mines.

Forfarshire. At the Geary Pot, near Auchmithie Bay. In a quarry near the town of Forfar.

Edinburgh. At Salisbury Crags, formerly, with Agaric Mineral in [the Craigmillar] Sandstone. [In veins and cavities in the eruptive rocks of the several other localities on Arthur Seat. In Blackford Hill Quarries, and at various other localities in the Pentland Hills.]

[Haddingtonshire. In veins, and also in druses, in Lower Carboniferous eruptive rocks; particularly at North Berwick.]

Linlithgowshire. Hilderston Hills, at Cairn Naple, associated with Niccolite (Fleming).

Lanarkshire. At Carlton [Cartland] Crags, near Lanark. A wasted vein of eighteen inches wide forms Wallace's Cave.

Ayrshire. In limestone, in the hills north of Dalry (Young). In the parish of Lochwinnoch, east of Dalry (Young).

Berwickshire. On the Whitadder, between Millknowe and Priestlaw, in "syenitic greenstone" [granite], in veins from one to four inches thick.

Kirkcudbright. Barlocco, near the house of Orroland, a vein six feet wide, which cuts [Silurian] greywacke vertically: its cavities contain Malachite and Azurite. Also near the House of Port Mary, Rerwick, many veins up to three feet thick. In the Pibble Mine near Creetown, associated with Lead and Copper ores (D. and H.). At little Ross Island, veins [traversing Silurian] greywacke.

Stalactitic Barytes.

In the banks of a burn near Meikle Ben of Campsie, Stirlingshire.

191. **Celestine (720).** $SrSO_4$.

Orthorhombic. Axes $\breve{a} : \bar{b} : \dot{c} = 0{\cdot}77895 : 1 : 1{\cdot}28005$. [*b*, 101; *c*, 001; *m*, 110; *n*, 120; *z*, 111; *f*, 113; *d*, 102; *o*, 011; *y*, 122.] Crystals like Barytes and Anglesite in habit; also columnar and foliated; or fibrous fine granular, and compact. Clv., macrodiagonal perfect. H., 3 to 3·5; G., 3·9 to 4. Usually more brittle than Barytes. Transparent or translucent, vitreous or resinous. Colourless, but usually bluish-white to indigo-blue, and rarely reddish or yellow. Pyr., B.B. decrepitates and fuses easily to a milk-white globule. Distinguished from Barytes by the flame coloration. A splinter moistened with hydrochloric acid, after ignition in the inner flame, and then held in the blue border of the flame, colours this a lively purple-red. In charcoal in the reducing flame

it yields sulphide of strontium ; if this is dissolved in hydrochloric acid, the solution evaporated, and then alcohol added to it, the mixture colours the flame carmine. Attacked but sparingly by acid. Phosphoresces when its powder is thrown on a hot iron.

Comp., 43·6 Sulphuric Acid and 56·4 Strontia ; but it often contains also some lime or some baryta.

Inverness-shire. At Clachnaharry, in a quarry one mile to the west of Inverness, where it occurs in veins traversing Old Red Sandstone conglomerate ; blue, foliated, and, rarely, with crystalline form (Jameson Torry). [*c d k m* (Plate XCV. fig. 1) 720·6, S M. (W. G.).]

Elginshire. Near Elgin, in small, white, translucent crystals, in sandstone (Greg). ? Newton Quarry. Barto-celestine [*c m n b o y* - (Plate XCV. fig. 2) ; and *c d m f z* - (Plate XCVI. fig. 3) on 720·3 S.M. (W. G.)].

Argyllshire. Strontian, at "Fee Donald" Mine, associated with Calcite, green Chert, and Galena.

Banffshire. Near Portsoy, in the limestone quarry near Redhaven ; in blue crystals, associated with Calcite and Margarodite.

Fifeshire. Near St. Andrews, in a dolerite quarry, blue, lamellar.

Haddingtonshire. On the shore opposite the Bass Rock ; pale-blue, diverging, fibrous, forming veins in trap (Greg). Near North Berwick [below Rugged Knowe], opposite the Lothies, blue, lamellar, in druses in basic eruptive rocks [associated with red Natrolite] ; and in crystals, [*c m d b o y z* and *c m d o y*] colourless ; [*c l d k a o* ? *h*, 720·2 S.M. ; (Craig Christie), *c d o* ? 720·2 S.M. : *c l d* - - - (Plate XCVI fig. 4), 720·5 S.M. ; *c l d m o z* (Plate XCVI. fig. 5), 720·2 S.M. (W. G.)].

Edinburghshire. Edinburgh, in sandstone, found in cutting the foundation of George IV. Bridge. In the Calton Hill, in small foliated masses in trap (Greg) ; also with Chalcedony and Agate in limestone veins (Fleming).

192. **Anglesite (721).** $PbSO_4$.

Orthorhombic, $a : b : c = 0{\cdot}78516 : 1 : 1{\cdot}28939$. [$a$ (c), 001 ; b, 010 ; c (a), 100 ; m, 110 ; λ, 210 ; o, 011 ; ϕ, 012 ; d, 102 ; z, 111 ; r, 112 ; l, 104 ; y, 122 ; τ, 221 ; θ, 116 ; ζ, 142 ; s, 132.]

The crystals, of many forms and combinations, are short, prismatic, pyramidal, or tabular. Faces m, a often striated vertically ; d striated horizontally. Also massive, granular, to compact. Sometimes stalactitic, or in nodular forms enclosing an unaltered core of Galena. Prismatic and basal cleavage distinct but not perfect. Fracture conchoidal ; very brittle. H., 3 ; G., 6·2 to 6·35. Transparent to translucent. Lustre adamantine to vitreous or resinous. Colourless or white, but

occasionally yellow, grey, brown, blue; streak white. Pyr., Decrepitates in the flame of a candle. B.B. on charcoal fuses in the O.F. to a clear bead, which on cooling becomes milk-white. Before the R.F. is reduced with effervescence to metallic lead. With soda on charcoal in R.F. gives metallic lead, and the residue, which is absorbed by the charcoal, gives the reaction for sulphur when moistened and placed on a clean silver coin. Difficultly soluble in acids; wholly soluble in a solution of potash.

Comp., $PbOSO_3$ = 73·7 Lead Protoxide and 26·3 Sulphuric Acid.

Lanarkshire. Leadhills, in the Susanna mine, frequently, its associates being Lanarkite, Linarite, and Cerussite; *l m y*; [*l m φ*] (Plate XCVI. fig. 1); *a l o m y z* (Plate XCVI. fig. 2); *l o* [*d*] *m c z* (Plate XCVI. fig. 3); *a b m l d o z* (Plate XCVI. fig. 4); *a l m o z θ*; [*a b o m d z*] (Plate XCVI. fig. 5).

In the mines of the Leadhills Dod, in cavities of such Galena as is covered with Pyromorphite. The Anglesite is usually without any associated mineral, and it occurs in crystals elongated in the direction of the greater diagonal, and so in bladed forms. Occasionally they are in plates parallel to *a*. *l m* (Plate XCVII. fig. 6); *l m y*; *a l m r* (Plate XCVII. fig. 7); *a m z o* (Plate XCVII. fig. 8); *l m z o c*; *a l d o b m ζ s* (Plate XCVII. fig. 9); *d z* (Plate XCVII. fig. 10); *l d z b o*; [*c a m o d τ z r*] (Plate XCVII. fig. 11).

Dumfriesshire. Wanlockhead mines. The Bay mine, *l y*; *l m o*; (Plate XCVII. fig. 12); *a d m z o*. The High Pirn Vein, Beltongrain Mine; *d o* (Plate XCVII. fig 13); *a l d m* [*c l m*] (Plate XCVIII. fig. 14); *l y m* (Plate XCVIII. fig. 15); *l* [*n*] *m λ* (Plate XCVIII. fig. 16).

Greg mentions the following additional combinations as from "Leadhills"; but he does not separate these from those obtained at Wanlockhead; nor does he give localities, nor figures, nor the relative proportions of the faces: *m l a*; *m l a z*; *m l d o a*; *m d o z a*; *m d z b a*; *m d z a*; *m l θ z*; *m l θ z a*; *m l o p*; *m l θ a*. [The Anglesites of Leadhills and Wanlockhead are well figured by Dr. Victor von Lang, in his "Versuch einer Monographie des Bleivitriols," *Sitzungsb. d. k. Akad. d. Wein*, xxxvi. (1859), pp. 241-292, which contains 170 figures and 2 maps.]

193. **Vauquelinite** (727). $2(Pb,Cu)CrO_4.(PbCu)_3P_2O_8$.

Monoclinic. Crystals always twinned. Sometimes botryoidal or reniform. H., 2·5 to 3; G., 5·5 to 5·8. Semi-translucent or opaque. Lustre resinous. Colour blackish-green or dark olive-green; streak siskin-green.

A phospho-chromate of lead. Chromine trioxide, 15·0; Phosphorus pentoxide, 10·6; Lead protoxide, 69·5; Cupric oxide, 4·9 = 100.

Dumfriesshire. Occurs, very rarely, at the High Pirn Mine, Wanlock Dod, in the neighbourhood of Vanadinite (T. Davies, *Min. Mag.*, 1877, I., 112).

Lanarkshire. Leadhills, at an unknown mine. ? Susanna (T. Davies).

Sulphates with Chlorides, Carbonates, etc.—in part Hydrous.

194. **Leadhillite (734).** $4PbO.SO_3.2CO_2.H_2O$.

Monoclinic. [$a : b : c = 1.74764 : 1 : 2.21545$; $\beta = 89° 47' 3''$ (Laspeyres) ; a, 100 ; b, 010 ; p (c), 001 ; m, 110 ; d, 410 ; x, 111, and r, 111 ; f (w), 101 ; f, 101 ; s, 411 ; ? z, 211 ; v, 112 ; v (t), 112 ; u, 201 ; e, $\bar{2}01$; i, 203 ; o ( ), 814 ; p, 212 ; q, $\bar{2}14$; n (h), 034 ; w (g), 012 ; l (a), 014.]

Crystals commonly tabular, $\parallel c$. Cleavage : c very perfect ; a in traces ; m, imperfect. Lustre of c slightly pearly, of the other face resinous or vitreous to adamantine. Fracture imperfect, conchoidal. Transparent to translucent. Colour yellowish-white to grey, yellowish-green, yellow, brown. Streak white. H., 2·5 ; G., 6·26 to 6·44.

Comp., Lead, 8·08 Carbon Dioxide, 8·12 Sulphuric Anhydride, 1·8 Water.

Analyses :—1-5, Collie, *Journ. Chem. Soc.*, lv. p. 92.

	PbO.	CO_2.	SO_3.	H_2O.	Total.
Leadhills,	82·5	8·6	9·1	1·5	101·7
,,	82·3	8·5	9·2	1·6	101·6
,,	82·1	8·7	9·2	1·5	101·5
,,	81·8	9·8	8·0	1·6	101·2
,,	84·3	11·5	7·3	1·8	101·6

Pyr., B.B. intumesces, and turns yellow, but becomes white on cooling. On charcoal it is easily reduced to lead. Partially soluble, with effervescence, in nitric acid, leaving a residue of sulphate of oxide of lead.

Lanarkshire Leadhills ; has been found in all of the veins, but in largest quantity in the Susanna Mine (Wilson). It sometimes occurs alone ; more frequently with Cerussite, or with this and Lanarkite. Very rarely Aurichalcite is its associate. In the veins of the Leadhills Dod it accompanies Caledonite, or Caledonite with Linarite, Chrysocolla, Malachite, and Cerussite. Here it occurs only in acuminated crystals, apparently $m\,e\,f\,v$. It also occurs in these mines in larger crystals, with face p.

Dumfriesshire. Wanlockhead ; has been found in all the veins, except the Belton Grain vein.

[The following combinations have been figured, or otherwise recorded, by previous authors :—*c a d m u w i f e x r t v s z o h g a* (see Plate XCVIII. fig. 1) ; *a c m x r u* (Plate XCVIII. fig. 2) ; *c a m x r t v w e f* (Plate XCVIII fig. 3) ; *c m a d s x r t v p q o h g a w i z* (Plate XCVIII. fig. 4) ; *c a m x f* (Plate XCVIII. fig. 5) ; *c a m x r w f* (Plate XCIX. fig. 6) ; *c a m f x r g* (Plate XCIX. fig. 7). Greg and Lettsom also give *c w x* ; *c u x w f v* ; *m c a* ; *m c a p v* ; *m c a u e x r* ; *m c* (*y*) *u f w x r* ; *m c a w f p v t* ; *m c a u e w f v t x r* ; *m c a e f s q v t x r* ; *m c a e f v t p s* ; *m p a e u x r s* ; *m c a e u i x r v t* ; *m c a d e f a h o s v t x r z p*. (The additional symbols here inserted are due to the monoclinic character of this species, which was formerly regarded as orthorhombic.)]

195. **Susannite (734a).**

Variety of Rhomboidal Carbonate of Lead, Bournon, *Catalogue*, Sulphato-tricarbonate of Lead pt. (from Susanna Mine, Leadhills), Brooke, *Edin. New. Phil. Jour.*, iii. 117, 138 (1827) ; Suzannit, Haidinger, *Handb.*, 505 (1845).

Clv. basal, perfect. H., 2·5 ; G., 6·55. Colour white, green, yellow, brownish. Lustre resinous to adamantine ; pearly on the cleavage faces. Powder white.

Comp., $3\dot{P}b\ddot{C} + 4\dot{P}b\ddot{S} = 72{\cdot}5$ Carbonate, and 27·5 Sulphate, of Lead (H. J. Brooke).

Pyr. The same as those of Leadhillite.

Formerly regarded as a dimorphous form of Leadhillite ; but now as a mere variety of that mineral.

Lanarkshire. Leadhills, in the Susanna Mine, associated with Lanarkite, or with Lanarkite, Leadhillite, Caledonite, Cerussite, and red Pyromorphite. *r*, *r o* (Plate XCIX. fig. 1) ; *r b* (Plate XCIX. fig. 2). In one vein in the Leadhills Dod, associated with Chrysocolla and Malachite, or pale green, *per se*, upon minute crystals of Quartz, *r b*.

[Fig. 3, Plate XCIX., is reproduced from Brooke's figure in Phillips' *Mineralogy*. "The small planes are not in general sufficiently defined to admit of measurement."]

Acid and Basic Sulphates.

196. **Lanarkite (737).** $(Pb_2O)SO_4$.

[Monoclinic. $a : b : c = 0{\cdot}8681 : 1 : 1{\cdot}3836$; β, 88° 11′. *a*, 100 ; *c* 001 ; *u*, 103 ; σ, $\bar{3}02$; *z*, 131 ; *s*, 1.10.5 ; *v*, 10.1.29 ; *j* [?] ; (*w*) *W*, 13.4.37 ; τ, $\overline{23}$,1.15. Schrauf and Dana.]

Clv. basal, perfect ; sectile ; thin laminæ flexible. H., 2 to 2·5 ; G., 6·3 to 6·7. Transparent ; lustre resinous to adamantine, but pearly on *c*. Colour greenish-white to yellowish-white, in some cases inclining to grey ; streak white. Partially soluble in n. acid with effervescence.

Comp., Sulphate of Lead, 57·6 ; Oxide of Lead, 42·4.

Analyses, all from Leadhills :—3, Pisani, *Comp. Rend.*, lxxvi. 114 (1873) ; 2, Flight, *Jour. Chem. Soc.*, xxvii. 103 (1874) ; 4, 5, Collie, *Jour. Chem. Soc.*, lv. 92 (1889).

	Sp. Gr.	SO_3.	PbO.	Loss on Ignition.	Total.
1.	6·8	15·10 $PbSO_4$.	82·73	·83	98·66
2.	..	57·70	42·89	..	100·59
3.	..	57·20	40·60	0·8	98·60
4.	..	57·80	41·40	..	99·20
5.	..	57·50	41·80	0·5	99·80

Lanarkshire. Leadhills, Susanna Mine, associated with Susannite and Caledonite : rarely with Cerussite. Combinations :—*c a u z W* (*w*) *s* (Plate XCIX. fig. 1) [from Schrauf] ; *c a v τ z s* (*s* hemihedral) (Plate XCIX. figs. 2 and 2*a*) ; *c a w z* (Plate C. fig. 3) ; *c v z* (Plate C. fig. 4) [Schrauf] ; *c a v z s* (Plate C. fig. 5) [Schrauf] ; *a c v* (Plate C. fig. 6) ; *a c j s* ; *c a v τ z s* (Plate C. fig. 7) ; *a c v s z* (Plate C. fig. 8) ; *a c v s* (Plate C. fig. 9).

Lanarkite is much the rarest of the minerals occurring at Leadhills ; and it has not been met with in the workings since the last flooding of the Susanna Mine.

197. **Caledonite (739).** $(Pb_1Cu)_2OH_2SO_4$.

? Orthorhombic, $a : b : c = 0.9163 : 1 : 1.4032$. According to Schrauf — Monoclinic. $a : b : c = 1.09134 : 1 : 1.5786$; $\beta = 89°, 18'$ composed of numerous twin lamellæ

[*b*, 010 ; *c*, 001 ; *m*, 110 ; *x*, 201 ; *k*, 016 ; *f*, 012 ; *e*, 011 ; *s*, 223 ; *r*, 111 ; *t*, 221 ; *γ*, 0.1.10.]

Crystals prismatic in the direction of the brachydiagonal axis, commonly [?] hemihedral. Cleavage *C*, *a*, *m*. H., 2·5 to 3 ; G., 6·4. Transparent ; lustre resinous. Colour verdigris-green to mountain-green ; streak greenish white.

Comp., Oxide of Lead, 68·42 ; Oxide of Copper, 17·3 ; Sulphuric Acid, 17·3 ; Water, 4·05.

Analyses. Leadhills.—1, W. Flight, *Jour. Chem. Soc.*, xxvii. p. 101 (1874); 2, Collie, *ibid.*, lv. p. 92 (1889).

	SO_3.	PbO.	CuO.	CO_2.	H_2O.	Total.
1.	17·30	68·42	10·17	..	4·05	99·94
2.	15·60	67·70	10·70	1·9	3·50	99·40

Lanarkshire. Leadhills. In the Susanna Mine, associated with Lanarkite and Susannite, in blue crystals. Combinations :—$c[b]m$ (Plate CI. fig. 1); $c[b]m\,s$ (Plate CI. fig. 2); $c\,[b]\,e\,m\,t\,r\,s$ (Plate CI. fig. 3); $c\,[b]\,t\,r\,s$ (Plate CI. fig. 4). Vertically bladed, and associated with Lanarkite :—$c\,[b]\,e\,r\,s$ (Plate CI. fig. 5). Horizontally bladed :—Twins, $c\,[b]\,e\,m\,r\,s$ (Plate CI. fig. 6). In twins, associated with Leadhillite :—$c\,a\,k\,m\,r\,s$; $c\,[b]\,e\,m\,r\,s\,x$ [? 203] (Plate CI. fig. 7); $c\,[b]\,e\,k\,m\,r\,s$ (Plate CI. fig. 8); $\lambda\,k\,f\,e\,[b]\,m\,t\,r$ - s - (Plate CII. fig. 9). Rod-like, and associated with Leadhillite, $m\,c\,[b]\,r\,s\,e\,i$ [? x] t (Plate CII. fig. 10).

In the Leadhills Dod Mine it generally occurs as green crystals, in association with Malachite; or with Linarite and Plumbonacrite, in some of the above combinations: also $c\,[b]\,m\,e\,t\,x$, vertically bladed.

Dumfriesshire. Wanlockhead. Belton Grain Vein, High Pirn Mine, associated with Linarite, Chrysocolla and Tile Ore (earthy Cuprite). Also in the Bay Vein.

198. **Brochantite (740).** $Cu_4(OH)_6SO_4$.

? Orthorhombic. $a : b : c = 0.7739 : 1 : 0.4871$; Koksharov. But regarded by Schrauf as monoclino-triclinic.

Crystals commonly prismatic parallel to c, with the faces $m\,r\,b$ vertically striated. Also elongated parallel to b, with curving faces. In groups of acicular crystals and drusy crusts. Also reniform, massive. Cleavage b perfect, m traces. H., 3·5 to 4; G., 3·7 to 3·9. Transparent to translucent; lustre vitreous. Colour emerald to blackish-green; streak bright green. Comp., Copper Protoxide, 70; Sulphuric Acid, 18; Water, 12.

[Specimens referred by Dr. Heddle to this mineral species form part of the collections of Scottish Geology and Mineralogy in the Edinburgh Museum of Science and Art. They occur as dark green coatings on the vein stuff of a mine at Sandlodge, Mainland, Shetland. They are associated with Chalcopyrite, Malachite, and Iron ochre. They were presented by Mr. J. Walker.]

199. **Linarite (741).** $PbCu(OH)_2SO_4$.

Monoclinic. $a : b : c = 1.7161 ; 1 : 0.8296$; β, 77° 23′.

[a, 100; b, 010; c, 001; m, 110; l, 210; y, 101; d, $\bar{1}08$; o, $\bar{2}03$;

t, $\bar{5}06$; *s*, 101 ; *x*, $\bar{3}02$; *u*, $\bar{2}01$; *f*, ; *w*, 012 ; *r*, 011 ; *q*, 112 ; *e*, 111 ; *n*, $\bar{2}21$; *g*, $\bar{2}11$; *z*, $\bar{8}17$; .]

Twins : twinplane *a*. Crystals elongated parallel to *b*, and often tabular parallel to *c*, and also to *s*. Cleavage, *a* very perfect, *c* less so. Fracture conchoidal. Translucent ; lustre adamantine ; colour azure-blue to dark-blue ; streak pale-blue. H., 2·5 to 3 ; G., 5·2 to 5·45.

Comp., Sulphur Trioxide, 20·0 ; Lead Oxide, 55·7 ; Cupric Oxide, 19·8 ; Water, 4·5.

Analyses :- 1-3, J. Collie, *Jour. Chem. Soc.*, lv. p. 93 (1889) ; 4, Brooke (given in Thomson's *Mineralogy*).

	$PbSO_4$.	CuO.	H_2O.	Total.
1.	75·3	19·6	5·2	100·1
2.	75·4	18·0	4·7	99·1
3.	74·8	19·7	5·5	100·0
4.	74·4	18·0	4·7	97·1

LANARKSHIRE. Leadhills. In the Susanna Mine, formerly, associated with all the Leadhills minerals, except Susannite. Combinations : —*m a u - d* ; *m a b d o u x* ; *m a b c d o t s u* [see Greg, fig. 3] ; *m a b l r c d o t s x u* ; *m a t c w* (Plate CII. fig. 2) ; and twins *m a d t s* (Plate CII. fig. 4) ; *m a c o k* (Plate CII. fig. 5) [Greg, figs. 6 and 7] ; *m a u - t z c s* (Plate CII. fig. 3) ; *m a u s c d - w r*.

In the mines of the Leadhills Dod, lately, associated with pyramidal Leadhillite, and with Cerussite, Caledonite, Chrysocolla, and Malachite. Generally in bladed forms, resembling Lanarkite. Combinations :— *m a u t s z* (Plate CIII. fig. 8) ; *m a u s l z* (Plate CIII. fig. 9) ; *m a u d b c z g b - - - -* ; *m a u t s z g b* ; and twins *m a u d z* ; *m a u d t s* (Plate CIII. fig. 11) ; *m a u x s z g* ? twinned with *m a e w* ; and *m a y u t z g* twinned with *m a c* (Plate CIII. figs. 12 and 13) [see fig. 4*a* of Greg].

DUMFRIESSHIRE. Wanlockhead. In the Belton Grain Vein of Wanlock Dod. In the High Pirn Mine, associated with Caledonite, Chrysocolla, and Tile Ore (Earthy Cuprite) ; *m c s x u a z* - ; *m a y u x z g* ; *m a d t s u*. In the Bay Vein, with nailhead Calcite, and with Cerussite, Wad, and Leadhillite.

KIRKCUDBRIGHTSHIRE. In the mine at Pibble, four miles north-east of Creetown ; in minute crystals associated with Galena, Cerussite Pyromorphite, Chalcopyrites, Malachite, Chrysocolla, Chalybite, Blende, Calamine (Hemimorphite), and Barytes.

[Fig. 1 after Greg's fig. 3, fig. 14 after Naumann, and figs. 6 and 7, are not referred to in the manuscript. Figs. 4, 6, and 11 have been pro-

jected in accordance with the symbols inserted on the respective sketches left by the author.]

As the consideration of Linarite concludes that of the special Leadhills minerals, the following statements as to their local occurrences and special associates fittingly find a place :—

Cerussite.

Is associated with Leadhillite, Lanarkite, etc., in the Susanna Mine. Also in the mines of the Leadhills Dod, with Linarite, Leadhillite, and Pyromorphite. Also in the Wanlockhead Mines generally—sometimes with Blende, but generally with Galena, and on Quartz.

Anglesite.

Frequent in Susanna Mine. Not so in Leadhills Dod—in Galena, covered with Pyromorphite, the Anglesite being in cavities of the Galena. Its associates are, in Susanna Mine, Lanarkite, Linarite, and Cerussite. In Wanlock Head Mines it occurs *per se*.

Linarite.

In the Susanna Mine, its associates being Anglesite, Caledonite, and all except Susannite. In the Leadhills Dod it occurs with pointed Leadhillite, associated with Cerussite, Caledonite, Chrysocolla, and Malachite. In the Wanlockhead Dod, in the Belton Grain Vein, and in the High Pirn Mine, with Caledonite, Chrysocolla, and Tile Ore. Also in the Bay Vein, with flat, nailhead Calcite, Cerussite, Wad, and Leadhillite. Lately, in small crystals, with new faces, at the Glengonner Shaft.

Leadhillite.

Occurs at all the Leadhills and Wanlockhead Mines, except the Belton Grain Vein. At the Leadhills Dod it occurs only in acuminated crystals, apparently *M e f v* : also in larger crystals with the *P* face, its associates being Caledonite, Chrysocolla, and Cerussite.

Lanarkite.

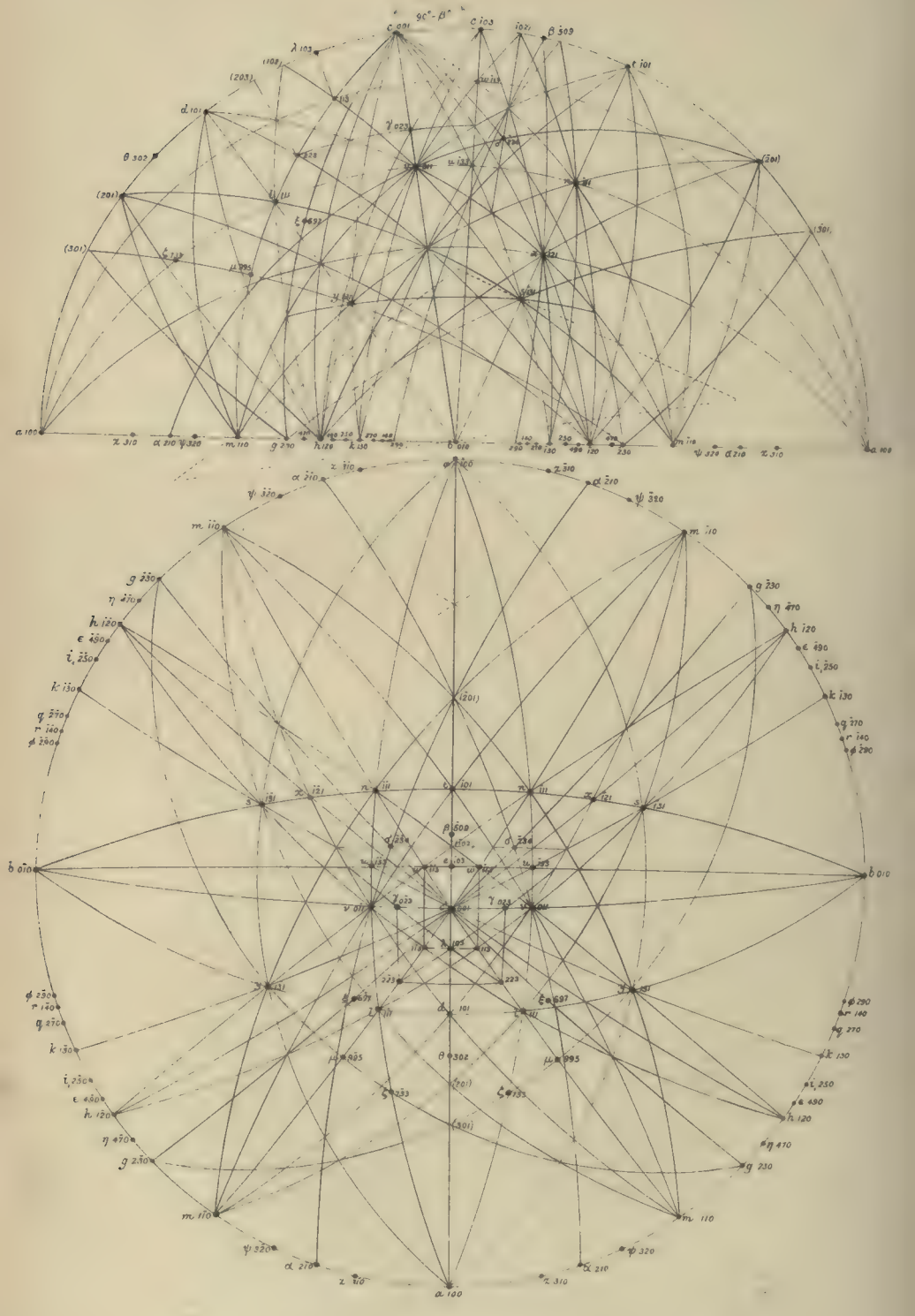
Occurs only in the Susanna Mine.

Caledonite.

In the Susanna, Leadhills Dod, and the Belton Grain Vein of the High Pirn.

Gypsum.

J. G. Goodchild



M.ᵉ Fariane & Erskine Edin.ʳ

PYROMORPHITE.

At the Susanna Mine and Leadhills Dod, and the Wanlockhead Dod; the orange being fine only in the Susanna Mine, but a bright sulphur-yellow occurring in the Wanlockhead Dod.

VANADINITE.

At the High Pirn Mine; but also at the Leadhills Dod, with Silicate of Zinc, being there crystallised in orbicular groups.

200. Gypsum (746). $CaSO_4 + 2H_2O$.

Monoclinic. Axes $a : b : c = 0.68994 : 1 : 0.41241$; $\beta = 80° 42'$ [1]. [b, 010; m, 110; l, 111; v, 011; h, 120; k, 130; e, 103; w, $\bar{1}13$.] Crystals usually simple in habit, but commonly occur as twins. Lenticular crystals common; hemitropes frequent; also granular, compact, fibrous, scaly, or pulverulent. Faces m b striated parallel to their intersection with each other; e, l, w, frequently rough or curved; cleavage b perfect; along m much less perfect; sectile; thin plates flexible. H. = 1·5 to 2; G.= 2·2 to 2·4. Transparent or translucent; lustre vitreous, pearly or silky on cleavage face. Colourless and snow-white, but often red, grey, yellow, brown, and more rarely greenish or bluish. Heated in the closed tube yields water. B.B. becomes white and opaque, and finally melts into a white enamel. Soluble in 400 to 500 parts of water; scarcely more so in acids. At a temperature of about 140° C. the water of crystallisation is driven off, and the assay becomes friable.

4 C.C. 46·5 Sulphuric Acid, 32·6 Lime, and 20·9 Water.

HEBRIDES. Mull. In Mackinnon's Cave. Inchkenneth (Judd).

ELGINSHIRE. In Linksfield Quarry.

ARGYLLSHIRE. Near Campbelton, at Glen Ramshiel (Galbraith).

FORFARSHIRE. Arbroath; among the Abbey Ruins [$b\,m\,l\,d\,n\,t\,v$ to u 113].

STIRLINGSHIRE. Strathblane. In Ballagen Glen, of a red colour, in granular veins, which cut the strata at right angles, also fibrous, of a yellow colour, in laminæ between the beds.

DUMBARTONSHIRE. In Auchenreoch Glen and Dumbuck Glen, white or colourless, and fibrous.

FIFESHIRE. In weathered Lower Carboniferous shales, on the shore at Abden, Kinghorn, $b\,m\,l\,h\,k\,v$ often in stellate groups (Goodchild).

EDINBURGHSHIRE In joints in Carboniferous Rocks in the Dalkeith coalfield, and commonly occurs in stellate groups in weathered shale, on the shore at South Queensferry $b\,m\,l\,k$ (Goodchild).

LANARKSHIRE. Near Hamilton, brown, fibrous.

Renfrewshire. Gourock, in Kempock quarry, in lustrous crystals, in quartz-lined druses in Lower Carboniferous lava associated with Calcite Fluor, and Pearlspar. Near Hurlet, in ferruginous earth, near the coal and alum shales.

Ayrshire. Near Girvan.

Berwickshire. At Burnmouth, on the shore, in red nodules and white fibrous masses in shale. At Milngraden, in a boring for coal. On the Leet near Hirsel (Greg). [Veins of red and salmon-coloured Satin Spar traverse the clays of the Ballagan Beds in the banks of the Whitadder.]

Roxburghshire. At the well near Kelso. At Haddon Hill, east of Kelso, in the parish of Chirnside, on the north bank of the Eden, about one mile above its junction with the Tweed, in blue clay. At Lochton, near Bingham, on the borders of Berwickshire, in veins from half-an-inch to two inches wide in clay beds. The veins are red and white fibrous, and run in all directions. There are red nodules in the white veins, with crystals in the nodules, and also *per se* in cracks. In the cliffs about one and a-half miles above Tweed Mill, crystals nearly transparent and an inch long. On the Tweed above Kelso, one mile above Floors Castle.

Dumfriesshire. Near Sanquhar, in fire-clay. At Frenchland Burn, near Moffat, in New Red Sandstone. At Canobie, white, fibrous, also in rocks belonging to the New Red. At Archer Beck, in Liddesdale, in New Red Sandstone, and at the junction of the Liddle and the Esk in thin veins traversing sandstone

201. **Epsomite (748).** $MgSO_4 + 7H_2O$.

Usually in fibrous crystalline or botryoidal masses, rarely pulverulent. Cleavage *b* very perfect; *v* (011) less so; *m* traces. Fracture conchoidal. Brittle. H., 2·0-2·5; G., 1·751. Lustre vitreous to earthy, transparent to opaque. Taste bitter and saline.

C.C. 16·32 Magnesia, 32·53 Sulphuric Acid, and 51·15 Water.

Pyr. Liquefies in its water of crystallisation. Gives much water in the closed tube at a high temperature. The water gives an acid reaction. B.B. on charcoal fuses at first, and finally yields an infusible alkaline mass which, with cobalt solution, gives a pink colour on ignition. Soluble in less than double its weight of water. Does not effervesce with acids.

Renfrewshire. Hurlet, in the shale beds, in white, silky, and capillary crystals, which effloresce on the sides of the mines.

202. **Morenosite (750).** $NiSO_4 + 7H_2O$.

Acicular, fibrous, and as an efflorescence. H., 2-2·25; G., 2. Lustre vitreous. Colour apple green; streak white. Soluble.

C.C. Sulphur Trioxide, 28·5 ; Nickel Protoxide, 26·6 ; Water, 44·9.

Argyllshire. Morven.

203. **Melanterite (751).** $FeSO_4 + 7H_2O$.

Chiefly stalactitic, reniform, or in crusts. Cleavage : basal, perfect ; prismatic less so. H., 2 ; G., 1·8 to 1·9. Translucent, rarely transparent. Lustre vitreous. Colour, leek or mountain green, often with a yellowish coating of ferric sulphate after exposure. Streak white. Taste sweetish, astringent, and metallic.

C.C. 26 Protoxide of Iron, 29 Sulphuric Acid, and 45 Water.

Pyr. In the closed tube yields water, and after a time sulphurous and sulphuric acids. On charcoal turns at first brown, then red, and finally black, becoming magnetic. Gives the reaction for iron with fluxes. Soluble in twice its weight of water, and the solution is blackened by a tincture of nutgalls.

Renfrewshire. Hurlet [and many other localities. It usually occurs as an efflorescence on artificially-exposed shale containing vitriolescent Pyrites].

204. **Alum (764).** $K_2SO_4.Al_2(SO_4)_2 + 24H_2O$.

Cubic. Generally efflorescent, in fibrous crusts. Cleavage octohedral ; fracture conchoidal. H., 2 to 2·5 ; G., 1·75 to 1·9. Translucent. Colour usually white. Taste sweetish, astringent. Soluble. B.B. evolves sulphurous fumes

C.C. 33·7 Sulphuric Acid, 10·9 Alumina, 9·9 Potash, 45·5 Water.

Stirlingshire. Near Campsie, in Carboniferous shales.

Renfrewshire. At Hurlet ; effloresces from the shales.

Dumfriesshire. Moffat (Greg).

Kirkcudbright. Ferrytown of Cree (Greg).

[It also occurs as an efflorescence in more or less abundance at numerous other localities where shales containing Pyrites have been exposed to the action of the weather.]

205. **Halotrichite (769)** $FeSo_4.Al_2(SO_4)_3 + 24H_2O$.

Monoclinic or Triclinic. Silky fibrous. Colour yellowish white. Taste inky astringent. Becomes dull and pulverulent on exposure.

C.C., Sulphur Trioxide, 34·5 ; Alumina, 11·0 ; Iron Protoxide, 7·8 ; Water, 46·7. (Dana, 6th ed., p. 954.)

An analysis by Dr. Thomson, of a specimen from Hurlet, closely accords with the above.

Greg & Lettsom (*Brit. Min.*, p. 274) state, "This salt occurs abundantly in the shale of exhausted coal beds at Hurlet and Campsie, near Paisley." [Similar conditions to these existing at those localities are to be found at other places in Scotland, and therefore Halotrichite is probably of commoner occurrence than has been supposed.]

206. **Wulfenite (818).** $PbMoO_4$.

Tetragonal. *C*, 001 ; *a*, 100 ; *m*, 110 ; *f*, 320 ; *e*, 101 ; *u*, 111 ; *s*, 113. Fracture uneven or conchoidal. H., 3 ; G., 6·3 to 6·9. Pellucid ; lustre resinous to adamantine. Colour orange-yellow, honey-yellow, or colourless.

C.C., Molybdenum Trioxide, 39·3 ; Lead Oxide, 60·7.

Kirkcudbrightshire. Lauchentyre [in veins traversing rocks of Silurian Age, chiefly in cavities within quartz veins, and associated with Galena, Chalcopyrites, Malachite, Pyromorphite, Limonite, Chrysocolla.

In interpenetrating groups of small translucent, tabular crystals of a chrome yellow colour, some with a darker border and with a bright resinous lustre. A few shew the hemihedrism characteristic of the species. In the Scottish Mineral Collection the chief combinations appear to be :— *a c*, *c s*, *c u*, *c n f*, *c s m*. Dr. Heddle also figures *c s n m e* (Plate CIII. fig. 1), and *c s n m* (Plate CIII. fig. 2)].

207. **Reinite** v. **Eosite (819).** Vanado-Molybdate of Lead (Schrauf).

In minute square octohedrons, *p*, 111 ; *c*, 001. H., 3-4. Colour deep aurora-red ; streak brownish orange-yellow.

Found implanted in very minute crystals on Pyromorphite and Cerussite at Leadhills. (Dana, after Schrauf, *Ber. Ak. Wien.*, 63, 176.) Schrauf's figure, *p c*, CIII.

HYDROCARBON COMPOUNDS.

[The substances grouped under this heading include some of which the chemical composition varies in different specimens. It has therefore been considered advisable to print the part relating to the Hydrocarbon Compounds in the same form and order in which it was left by the author.]

Analyses of Hydrocarbon Compounds, by Dr. Heddle, from the *Mineralogy of Fife* and the Scottish Mineral Collection in Edinburgh.

No.		Specific Gravity.	Water.	Gas.	Residual Carbon.	Ash.	Coke.	Per cent. of Do.	
								Carbon	Ash.
	ORKNEY.								
	BITUMINOUS FLAG—								
1	Osmondwall,	..	3·11	17·61	5·936	73·044	..	..	..
	CLOUSTONITE—								
2	Skaill,	..	·10	47·82	51·84	·24	..	..	..
3	Yeskenaby,	..	·1	47·82	51·84	·24	..	..	..
	PEAT—								
4	Graemsay,	1·31	6·06 at 240° 6·88	15·52	·62	70·92	..	..	..
	SUTHERLAND.								
	LIGNITE—								
5	Brora,	1·373	11·494	35·077	45·183	8·246	..	..	..
	CARBONACEOUS SHALE—								
6	Brora,	1·825	6·247	20·338	19·72	53·895	..	..	..
	HEBRIDES.								
	LIGNITE—								
7	Vaternish, Skye,	..	10·0	36·40	50·16	3·44	..	..	..
	FIFE.								
	CANNELS—								
8	West Wemyss,	..	..	52·12	36·58	11·30	47·88	76·40	23·60
9	Capeldrae, No. 1,	1·27	3·16	51·84	38·18	6·82	45·00	84·84	15·16
10	,, No. 2,	1·44	2·76	33·59	37·33	26·32	63·65	58·65	41·35
11	Methil,	..	..	48·83	38·36	12·81	51·17	74·96	25·04
12	Pirnie Hill,	..	..	44·80	38·78	16·42	55·20	70·25	29·75
13	Cowden Hill,	..	..	41·20	57·16	1·64	58·80	97·21	2·79
14	Lumphinnans,	1·32	3·39	32·03	55·31	9·00	64·31	86·00	14·00
15	Ladeddie,	1·26	3·42	52·00	32·32	12·16	42·48	72·66	27·34
16	Lochgelly,	1·23	..	40·40	48·78	2·66	51·44	94·83	6·17
17	Pitkinny, glossy,	1·47	6·20	32·13	35·93	25·74	61·67	58·27	40·73
18	,, dull,	1·45	2·90	47·86	12·04	36·84	49·24	25·18	74·82
19	Lumbo,	1·27	5·82	44·14	46·00	4·04	50·04	91·93	8·07
20	Largoward,	1·23	5·58	41·94	49·66	2·82	52·48	94·63	5·37
21	Garscube,	1·25	2·94	41·14	52·84	3·08	55·92	94·49	5·51
22	,, Radical,	1·47	4·44	24·48	42·88	28·20	71·08	60·32	39·68
	CARBONACEOUS SHALES—								
23	Methil, brown, best,	..	..	74·93	10·78	41·29	25·07	43·00	57·00
24	,, ,, worst,	..	..	68·07	18·99	12·04	31·03	61·19	38·81
25	West Wemyss, rum,	..	..	47·96	31·04	21·00	52·04	59·65	40·35
26	Denbrae Den,	2·19	2·87	21·13	5·02	70·98	76·00	6·61	93·39
27	Brigton,	1·74	3·02	26·52	16·03	54·16	70·46	23·13	76·87
28	Clockmydron,	1·44	4·44	23·28	30·36	41·92	72·28	42·00	58·00
29	Cairney Hill,	2·04	3·32	20·68	7·98	68·02	76·00	10·50	89·50
30	Capeldrae,	..	3·43	23·01	31·02	42·54	73·56	42·17	57·83
31	Cairnsmill,	1·58	5·28	33·32	20·96	40·44	61·40	34·14	65·86
32	Kincaple,	2·12	4·24	29·22	9·52	57·02	66·54	14·31	85·69

No.		Specific Gravity.	Water.	Gas.	Residual. Carbon.	Ash.	Coke.	Per cent. of Do.	
								Carbon	Ash.
	FIFE—CARBONACEOUS SHALE—*continued.*								
33	Balmuto, waved,	1·65	2·29	32·78	11·84	53·09	64·93	18·24	81·76
34	,, slaty,	1·86	4·25	20·30	10·56	64·89	75·45	12·67	87·33
35	Kenly, black,	2·21	4·48	12·60	3·96	78·96	82·92	4·78	95·22
36	,, brown,	1·79	4·54	25·29	9·27	60·09	70·17	13·22	86·78
37	Kinkell, imbedded in tufa,	2·57	2·64	6·00	·44	90·92	91·36	·48	99·52
38	Witch Lake, coaly,	1·71	9·48	19·52	35·78	35·22	71·00	50·39	49·60
39	Gilmerton,	1·66	3·32	23·08	8·04	65·56	73·60	10·90	89·10
40	Capeldrae,	1·44	3·20	35·15	37·33	26·32	63·65	58·65	41·35
41	Bark of Lepidodendron, Denhead (Cherry Coal),	..	4·80	36·58	57·17	1·45	58·62	97·70	2·30
	BITUMEN—								
42	Kincraig, Elie,	..	..	82·65	17·35	1·25	..	..	..
	AYRSHIRE.								
	SPLINT COAL—								
43	Marchburn,	1·38	2·4	28·88	59·10	9·62	..	..	..
	CHERRY COAL—								
44	Marchburn,	1·31	4	32 04	62·20	1·76	..	..	..
	THE LOTHIANS.								
	BITUMINOUS SHALE—								
45	Gilmerton,	1·66	3·32	23·08	8·04	65·56	73·60	10·9	89·10
	OZOCERITE—								
46	Binny Quarry, Linlithgow,	·961 Volatile at 210°	Naphtha ·691 at 240°	96·974	"Free Carbon" 2·039	·327	..	..	..
47	George the Fourth Bridge, Edinburgh,	·03	·02	98·52	1·24	Sand. ·14	..	..	..

[HATCHETTITE.

Under the name of Mountain Tallow this substance was recorded in 1824 from a bog on the borders of Loch Fyne by Brande, *Edin. Phil. Jour.*, xi. It has not been analysed. Dana, 6th ed., p. 997, states that this substance is "probably identical with the kind of paraffin that fuses at 45°-47° C.; and which has been obtained by the destructive distillation of Boghead Coal and peat, and from other sources."]

FICHTELITE, C_5H_8.

Monoclinic. Crystals tabular ‖ *c* or elongated ‖ *b*. Forms: *a* (100, i ī), *c* (001, O), *m* (110, I), *i* (101, l ī).

Angles (measured): $m\,m''' = 97°$, $a\,c = 53°$, $a\,i = 52°$, $c\,i = 75°$.—Clark.

Twins: t w. pl. *c*. H. = 1. Lustre somewhat greasy. Colour white. Translucent. Brittle. Without taste or smell. Distils over without decomposition. Solidifying temperature, 36°. Easily soluble in Ether; less so in Alcohol. Ax. pl ‖ 010.

Analysis—Macadam, *Min. Mag.*, viii. 137.

	C.	H.	O.
Shieldaig, . . .	87·143	12·082	0·775.

ROSS-SHIRE. In a peat moss in Shieldaig.

NAPHTHA.

ORKNEY. Shapinshay, in small cavities in basalt dykes.

HEBRIDES. Eigg. Rudh' an Tancaird, in cavities of one of the pitch stone dykes.

EDINBURGHSHIRE. West Calder, in Nos. 2, 11, 14, 15 Shale Pits (Stuart Thomson).

LINLITHGOWSHIRE. At Broxburn.

PETROLEUM.

ORKNEY. Walls, at the Burn of Summery, at the junction of an amygdaloid with Orcadian Old Red Sandstone, in Barytes and Calcite. At Sands Geo, at the junction of amygdaloid with Upper Old Red Sandstone, in laminated crystals of Barytes.

CAITHNESS. At Gie uisg Geo, with Galena and Blende.

HEBRIDES. Skye. Talisker, on crystals of Analcime, and in tears exuding from cavities in the rock, which are sometimes filled with it, but are usually only half full. Also in rents and pervading the substance of the rock.

Mull. "In the mountain of Benenich or Bein a neunich there is a zeolite impregnated with Petroleum."—(*Travellers' Guide through Scotland.*)

FIFESHIRE. Elie. Kincraig, in agglomerate. Occurring in cavities of the rock; impregnating Calcite; and also dispersed in drops and masses among crystals of Barytes and Calcite. Where it occurs in cavities which are near the surface of the rock, it is frequently found exuding in tears and stalactites, its more volatile part having been distilled out by the sun's rays—Anal. 42. Impregnating Calcite in tuff east of Kinghorn. In Carboniferous limestone near Burntisland (Greg). In lumps in limestone near King Alexander's Crag, Kinghorn, in trap.

EDINBURGHSHIRE. At St. Catherine's Well, east of Edinburgh city, where it occurs in both the solid and the liquid states.

ASPHALTUM.

EDINBURGHSHIRE. At Addiewell, black, with Barytes, in Pit 15 (Stuart Thomson); also filling bones and associated with Calcite. Oakbank, near Mid-Calder (Currie). Inchkeith, imbedded in fissures of the rock, and in shales. South Queensferry, in the Oil Shales, lining cracks in clay ironstone nodules (Goodchild).

HADDINGTONSHIRE. In clay ironstone nodules (Greg).

DUMBARTONSHIRE. Near Dumbarton, filling the interstices of ironstone septaria.

RENFREWSHIRE. At Hurlet, along with Calcite.

KIRKCUDBRIGHTSHIRE. At Little Ross Island, in fossiliferous rock accompanied by Anthracite.

ELATERITE.

FIFESHIRE. Kirkcaldy. Chapel, limestone quarries associated with Calcite and Apophyllite. At Lochhead, north of Dunfermline.

EDINBURGHSHIRE. At St. Bernard's Well, in rifts in Lower Carboniferous sandstones.

LINLITHGOWSHIRE. At New Liston. On the side of the road from Bathgate to Knockhill, "in felspathic greenstone," plentiful (S. Thomson). In the field immediately east of this, in greenstone, with Calcite (S. Thomson). In fissures in the Lower Carboniferous [Yoredale] limestones of the Bathgate Hills (Goodchild).

ALBERTITE.

ORKNEY. Walls. Old Head, in fissures of the Upper Old Red Sandstone, near the summit of the cliff.

Ross-shire. Mountgerald, two miles north-east of Dingwall, on the River Skiack and in the railway cutting. [Kiltearn (Morrison, *Min. Mag.*, vi. p. 101, 1884); Castle Leod, Strathpeffer; and Ben Wyvis.] Thirty-six veins have been opened in both the gneiss and the Old Red Flagstone. One vertical vein in gneiss is nearly two inches thick—Anal. .

Edinburghshire. [Gavieside.] West Calder. Addiewell, in Pits 11 and 27. Pumpherston, in Oil Shales (S. Thomson).

Cloustonite. (Heddle, *Min. Mag.*, iii. p. 222 (1879).)

Orkney. Mainland. Yeskenaby, one mile north of the granite of Inganess, Skaill. In patches imbedded in blue limestone, and filling cross rents in blue flag—Anal. 2. [Noup Head, Westray.]

Amber.

Fifeshire. Rolled specimens have been picked up upon both the East and West Sands near St Andrews, and on the shore between "Ferry-Port-on-Craig" and Newport.

Guayaquillite.

Linlithgowshire. Bathgate, in the centre of ironstone nodules, in Lower Carboniferous rocks. In the *Edin. Phil. Journ.*, second series, vol. xv. p. 398, we read: "Antediluvian Ambergris. In the clay ironstone of our coal formation, near to Bathgate, Burntisland, etc., we have been long familiar with the pale, yellowish-white and wine-yellow, translucent, soft, inflammable mineral, to which no particular name has been given. It is now said to have the characters of ambergris." The present author has two specimens of this; and a specimen identical with these in appearance, in the Gallery of Scottish Geology and Mineralogy in the Edinburgh Museum of Science and Art, has the foregoing notice attached to it. Though no analysis has been made, the physical properties quite agree with those of Guayaquillite

Ozocerite.

Edinburghshire. Found in laying the foundations of George the Fourth Bridge, Edinburgh; amber coloured—Anal. 47. Mid-Calder. At Breich, No. 1 Pit, in a cavity immediately under the Oil Shales (S. Thomson). Pumpherston, in the ironstone nodules (S. Thomson).

Linlithgowshire. In Binny Sandstone Quarry, near Uphall, in joints of the sandstone, yellow and dark brown, with occasional green fluorescence—Anal. 46. Phillipstoun, 2 ms. N. of Binny (Cadell).

Ayrshire. At High Blantyre, in limestone. In the Dalry limestone, at Glen Cart. On the Lugar.

Torbanite.

[Torbanite, although related to Cannel Coal, has a very nearly uniform composition, according to all analyses thus far made, excepting that of Miller, and this composition is like that of Bathvillite, but with less oxygen. It corresponds very nearly with the formula $C_{40}H_{68}O_{2\cdot25}$ = carbon, 82·19 ; hydrogen, 11·48 ; oxygen, about 6·0 ; nitrogen, 1·37 = 100 : excluding the nitrogen, C., 82·28 ; H., 11·54 ; O. 6·08 = 100. Less than 1½ % of Torbanite is soluble in naphtha (Fyfe) From Dana, *Syst. Min.*, 6th ed., p. 1009.

In Upper Carboniferous Rocks, at Torbane Hill, Bathgate parish, Linlithgowshire.

" It frequently occurs in seams of some considerable size, and always in the neighbourhood of coal, sometimes in immediate contiguity with it, but at other times . . . separated from it by a layer of fireclay." The colour varies from tan colour to sooty-brown. Its fracture is dull, and often conchoidal, like that of cannel coal, and it is translucent in thin section. " Its specific gravity ranges from 1·2 to 1·3." Its streak varies in colour from saffron to umber, and is usually shining, and very similar to that afforded by oil shales. " It is tough, and not so brittle but that thin sections may be made of it." It possesses considerable elasticity, and, " when struck by the hammer, it emits a dull sound. The remains of plants, especially of Stigmaria, are of constant occurrence, and can be distinguished by the naked eye without difficulty. . . . Under the microscope it is found to consist of masses of a yellow material, some being of irregular figure," spores and spore cases, " others more or less rounded, embedded in a granular matrix, which vary in colour from a yellowish-brown almost to a black." (The sections in quotation marks are from a paper by Professor Queckett, *On the Minute Structure of . . . Boghead Cannel Coal*, pp. 34-36, 1853 ; the others by J. G. G.)

Dr. Redfern, *Micro. Journ.*, iii., and *Rep. Brit. Assoc.*, 1854, states, regarding its mode of occurrence :—" It has a layer of cement stone immediately above it, half an inch to two inches in thickness. Above that is a bed of shale, varying in thickness up to four feet. Immediately below the bed is a stratum of fireclay, with occasional ironstone balls, about two inches thick, and very full of impressions of plants. Under that is a layer of good bright-looking coal six inches in thickness. Occasionally a thin layer of common coal of variable thickness runs right through the Boghead Mineral."

With reference to the composition of Torbanite as compared with Scottish (and other) coals, the following tables of analyses, given by Professor Fyfe, *Journal of the Royal Scottish Society of Arts.* iv. pp. 250-266 (1854), may usefully be reproduced here] :—

Table of the Proportions of Volatile Matter, of Coke, of Fixed Carbon, and of Ash, in 100 *Parts of Different Coals, and in the Torbane Mineral.*

COALS. *c*, cannel. *h*, household.		Specific Gravity.	In 100 Parts of Coal.		Coke.		In 100 Parts of Coke.	
			Vol. mr.	Coke.	Carbon.	Ash.	Carbon.	Ash.
Wigan Ince Hall,	*c.*	12·55	37·6	62·4	5·6	6·4	89·7	10·3
Do. do.,	*c.*	..	37·7	62·3	50·5	11·8	81	19
Torbane, household,		..	38·3	61·7	52·5	9·2	85	15
Kinneil,	*c.*	..	44·4	56·6	44·4	11·2	80	20
Donibristle,	*c.*	12·37	46·5	53·5	49·2	4·3	92	8
Capeldrae (2nd),	*c.*	13·10	47·2	52·8	24·3	28·5	46	54
Knightswood,	*c.*	..	47·5	52·5	48·5	4	92·4	7·6
Balbardie,	*h.*	..	43·6	56·4	29·8	26·6	52·8	47·2
Lochgelly,	*c.*	..	50·4	49·6	36·2	13·4	73	27
Disco Island,	*h.*	13·84	50·6	49·4	39·6	9·8	80	20
Monkland,	*c.*	..	54·2	45·8	39·5	6·3	86·2	13·8
Lesmahagow,	*c.*	..	57·4	42·6	39	3·6	91·5	8·5
Do.,	*c.*	..	58·3	41·7	35·3	6·4	84·6	15·4
Methil,	*c.*	..	59	41	18·5	22·5	45	55
Capeldrae (1st),	*c.*	12·38	59·1	40·9	33·2	7·7	18·8	81·2
Wemyss,	*c.*	..	66·6	33·4	21·9	11·5	65·5	34·5
Torbane,	*c.*	..	66·9	33·1	15·6	17·5	47·1	52·9
Do.,	*c.*	..	68·1	31·9	14·5	17·4	45·4	54·6
Do.,	*c.*	..	68·4	31·6	8·6	23	27·2	72·8
Do.,	*c.*	..	69	31	9·3	21·7	30	70
Do.,	*c.*	..	69·8	30·2	13·1	17·1	43·3	56·7
Do.,	*c.*	..	69·8	30·2	6·6	23·2	29·8	70·2
Do ,	*c.*	..	70·1	29·1	16·3	12·8	56	44
Do., average,		11·99	68·8	31·2	11·9	18·3	38·4	61·6
Tree in Torbane,		..	68·8	31·2	10·8	26·4	34·6	65·4

Table of the quantity of Coke, and quantity and quality of Gas from a Ton of Coals, and from the Torbane Mineral, as shown by the Chlorine Process.

COALS.	Coke.	Cubic Feet of Gas.	Specific Gravity of Gas.	Duraby 1 Foot = Minutes and Secs.	Condensation by Chlorine.	Comp. Value of 1 Foot of Gas.	Comp. Value of Coals
Bemish caking,	1600	8,545	485	43 0	5·0	1·0	1·0
Leven Splint,	1120	8,060	492	43 0	5·3	1·06	1·01
Leven caking,	1600	10,560	550	38 0	6·0	1·2	1·4
Adamson's caking,	1620	12,456	646	38 0	6·3	1·2	1·75
North Lithins,	1280	9,021	555	53 0	10·8	2·1	2·2
Knightswood,	1164	9,184	557	48 0	9·0	1·8	2·3
Blackwook,	1200	8,000	645	60 0	13·0	2·6	2·6
Kelvinside,	1150	9,007	640	65 0	14·0	2·8	2·9
Grange,	1280	9,160	618	67 0	14·0	2·8	3·0
Lumphanan,	1200	8,953	622	66 0	14·5	2·9	3·0
Lithin's Glen,	1280	9,500	646	68 0	15·0	3·0	3·2
Marquis Lothian,	1074	10,080	590	60 0	13·0	2·6	3·2
Lithin's Hill,	1200	9,100	690	72 0	16·0	3·2	3·4
Kilbirnie,	1200	10,290	624	67 0	15·0	3·0	3·6
Lochgelly,	1200	9,054	637	57 30	14·0	2·8	3·7
Capeldrae (2nd),	1256	9,670	650	73 37	17·8	3·56	4·02
Kinneil,	1292	9,803	739	75 0	17·5	3·5	4·1
Lesmahagow,	1120	10,176	652	70 0	17·5	3·5	4·1
Monkland,	1142	10,192	667	67 0	16·0	3·2	4·2
Methil,	1198	7,706	683	66 0	15·5	3·1	4·3
Kirkness,	1380	9,038	711	78 0	22·0	4·4	4·6
Capeldrae (1st),	999·9	11,500	644	65 25	18·0	3·6	4·8
Torbane,	760	15,480	726	84 44	25·0	5·0	9·0

Middletonite.

Occurs, filling small druses, in basalt lavas (Lower Carboniferous) in the Bathgate Hills, about three miles to the north-east of Bathgate town (Stuart Thomson and H.). Also in rounded pellets in both the calcite and barytic gangue of the nickel in the old silver mine at Hilderston, near Linlithgow (Stuart Thomson and H.).

Anthracite.

Ross-shire. Strathpeffer, at Glensgaich, in circular scales or disks between thin plates of Muscovite in the quartzose vein with Garnet and Zircon.

Fifeshire. At Carnock, near Dunfermline, in the upper coal beds.

Edinburghshire. In the Calton Hill, Edinburgh, near the Old Observatory, in trap, with twin Calcite, always fragmentary. At Craiglockhart. Ratho, in veins in the dolerite near the railway station.

Linlithgowshire. In imbedded nodules, with Calcite, in dolerite, at Magdalena, where the canal crosses the road to Linlithgow. Near the

Inn of West Craigs, Binny Craig. In Binny Craig Quarry, in brilliant stalactites of divergent crystalline structure. At Crawhill and Wallhouse (Forsythe).

STIRLINGSHIRE. Campsie Hills. Near Barraston, on the south slope of the south hill.

ARGYLLSHIRE. One mile north-east of Campbelton, where a dyke of porphyry touches coal.

AYRSHIRE. In the Dalry Water, where greenstone dykes touch coal. At Riccarton, south of Kilmarnock, a bed four to five feet thick, resting on sandstone. Saltcoats, and New Cumnock [near intrusive rocks].

DUMFRIESSHIRE. On the estate of Mansfield, nearly between the sources of the Afton and the Nith, in a bed four feet thick. At Crawick Bridge, between Kirkconnell and Sanquhar, columnar (Nicol). At Craigmichan Scars, east of Moffat Water; and at the Bell Craig, a mile above the linn. In considerable beds at Sanquhar.

PEEBLESSHIRE. At Grieston quarry, Traquair, in fragments in greywacke slate (Nicol). Opposite the mouth of the Leithen, on the Tweed, in greywacke (Nicol).

KIRKCUDBRIGHTSHIRE. At (? at Cadon Bank) Cadenbank Hill, in an irregular bed or vein, in greywacke slate. At Little Ross Island, with fossils (Nicol).

WIGTONSHIRE. North of the Mull of Galloway, in fragments, with Jet, in greywacke.

AMETHYSTOLINE.

"This name may be given to the volatile fluid observed by Brewster in cavities of Amethyst" from Scotland (Greg).

BREWSTERLINITE.

[A colourless transparent fluid, described by Sir David Brewster as occurring in the cavities within Topaz crystals from Aberdeenshire—*Edin. Phil. Journ.*, ix. (1823); *Trans. Roy. Soc. Edin.*, x. p. 407 (1826).

Its composition is not definitely known; but it is regarded as one of the volatile hydrocarbons.]

CRYPTOLINE.

"Occurs along with Brewstoline[ite] in the Topaz from Aberdeen, as a fluid not miscible with the former, though occurring often in the same cavities. On exposure it hardens speedily into a yellowish transparent resinous substance, not volatilizable by heat, nor soluble in water or

alcohol, but rapidly dissolving with effervescence in sulphuric, nitric, and muriatic acids" (Greg). See *T. R. S. E.*, x.

Lignite.

Sutherland. At Brora [in Jurassic rocks]—Anal. 5.

Hebrides. Skye. Opposite Portree: long worked. Ardmore Point, Vaternish, in a bed 18 inches thick, mostly tree trunks, overlaid by a bed of amygdaloid, with an intervening bed of red clay one foot thick—Anal. 7. North-east of Uig, brown and fibrous. Canna, in detached pieces in tuff. Mull, on the west side, near the Cave of the Macdonalds, under basalt.

Argyll. North of the Mull of Galloway (Nicol).

Edinburghshire. At Gilmerton [? Anal. 45].

Jet.

Edinburghshire. At West Calder

Peat Jet.

Orkney. Island of Graemsay, in veins in sandstone, below peat—Anal. 4.

Wigtownshire. In the peninsula between Loch Ryan and the Irish Channel, under peat and over clay (Agnew).

SUPPLEMENT

By J. G. Goodchild.

In the course of printing the Mineralogy of Scotland, it has been found that one or two species have been accidently overlooked. Besides these, there were some few other species regarding the validity of which, there is reason to believe, the author's views had changed. Others were of doubtful authenticity as occurring in Scotland. Then, again, during the last three years, a few species have been added to the Scottish list, chiefly by the officers of the Geological survey. To these species must be added those already known as Scottish, which have lately been discovered in new localities. Finally, the Editor has been continuously at work during the last three years at the arrangement of the Scottish Mineral Collection in the Edinburgh Museum of Science and Art. In the course of this work he has determined a large number of forms, and has made drawings of several hundred combinations. The crystals so drawn are all indicated by blue pointers, are all duly registered, and are placed so that the public can easily study them, and the drawings are exhibited in contiguity to the specimens. The results of some part of this work are given in the notes that follow, in which the symbols employed are all Dana's (sixth edition), and the Museum reference numbers are given in prefixed brackets.

The Editor is responsible for all the following statements, except where it is stated to be otherwise.

Edinburgh, *November*, 1900.

Diamond (1).

Localities. On the ticket of a specimen found by Dr. Heddle, and given to Mr. Thoms shortly before his death, and now in Mr. Thoms' cabinet, is as follows: "This specimen of Aventurine, from a lake 3 miles to the north-east of Ben Hope, Sutherland, contains, besides the red mica, red Zircons, and either colourless Garnets or Diamonds."

In handing this specimen to me, however, Dr. Heddle remarked that in his own mind he felt confident that these small crystals were Diamonds, as they had certain optical properties which no other mineral he knew of possessed.

Although not alluded to in the manuscript of this book, it is judged advisable to place this on record (A. Thoms).

Graphite (2).

Close examinations of the minerals occurring in the various metamorphic limestones occurring amongst the Highland Schists and Gneisses has brought to light the fact that scales of Graphite are present in nearly every case. A conspicuous example is presented by the limestones of Glenelg, described by Mr. Clough (*Q.J.G.S.*, lv. 372). Probably some, at least, of the supposed Molybdenite recorded from the metamorphic marbles of Scotland will prove to be really Graphite.

Sulphur (3).

Crystallised Sulphur has been found as a product of the spontaneous combustion of Lower Carboniferous shales containing Pyrites, at several places in Scotland. It would seem to be almost as much entitled to rank as a native species as most of the Nitrates and Hydrous Sulphates.

Bismuth (11).

This is mentioned by Greg. *Brit. Min.*, 378, as occurring formerly at Alva, in Stirlingshire ; reticulated and associated with Erythrine.

Gold (13).

Small specks of gold have lately been detected in various eruptive and metamorphic rocks from Scottish localities. Probably, in a very sparsely distributed state, its occurrence may prove to be much more general than has hitherto been supposed.

Greenockite (68).

The Editor has examined and drawn a large number of crystals of Greenockite, almost the whole of which are characterised by complex oscillatory combinations of the prism (1010) with various pyramids, chiefly (1011), (2021), and (1012) ; all appear to be hemimorphic, and all show more or less want of symmetry in regard to the relative sizes of the faces of each form. The figures by Mügge, *Jb. Min.*, ii. 18, accurately represent the general habit of the Scottish crystals, and Dana's

description of the morphology of Greenockite (*Syst. Min.*, sixth edition, p. 69) embodies the results of Mügge's investigation of that species.

Pyrrhotite (74).

Like Graphite, this mineral proves to be an almost constant associate of limestone in the Highland Metamorphic Series; it is of common occurrence also in the accompanying epidiorites.

Pyrite (85).

Argyllshire. Strontian, *a*, *a o*, and botryoidal. Strachur, in Mica schist, in small quarry behind village, *a*. Onich, in old slate quarries, nickel replacing part of the iron, in large quantities, the crystals decomposing on exposure to the atmosphere (A. Thoms).

Rammelsbergite (100).

This mineral is stated, by Dr. Heddle, on one of the tickets in the Scottish Mineral Collection in the Edinburgh Museum of Science and Art (602.3), to occur in connection with Niccolite and Dudgeonite at "Menimuir Burn, Cassencarrie."

Bruiachite (175).

Noticed by T. D. Wallace (*Min. Mag.*, vi. 169) and described by Macadam (*Min. Mag.*, vii. 42) from Loch Bruithaich, Inverness-shire, shown by Heddle to be identical with Fluor (*Min. Mag.*, viii. 274).

Amethyst (210).

Occurs lining the vapour cavities in the upper of the two basic intrusive sheets at Hound Point, Dalmeny, Firth of Forth, and also forming small amygdules in a dyke traversing the red rocks below the new promenade west of Dunbar; the same rock may be traced westward as far as the rifle butts on the east side of Belhaven Bay.

Quartzine (210A).

A fibrous form of crystalline SiO_2; supposed to be the cryptocrystalline constituent of Chalcedony, and therefore present in all Agates.

Agate (210).

Many new localities for Agates in Scotland have been discovered while the present book was passing through the press. Almost without exception they are from vesicles in rocks of sub-basic composition—mostly from Augite Andesites. Mr. R. Dykes has collected them from the

Devonian Andesites of the Ayrshire coast and from the Pentlands; Mr. Benjamin Brown from the same rocks near the foot of the lower reservoirs in the Pentlands; Mr. J. Bisset from the same rocks at Connel Ferry; Mr. Robertson and Mr. Mears from Arthur's Seat; the Editor has obtained them from Devonian Andesites, among other places, at St. Abb's Head, various localities on the Scottish flank of the Cheviots; from ? Andesitic lavas of Lower Carboniferous age at Jovis Neuk, N.E. of Aberlady Bay, etc.

Veins of Chalcedony occur traversing the dolerite of Hawk Crag, Aberdour, and also that of Burntisland.

Molybdite (219). MoO_3.

"At Mount Coryby near Loch Creran in Argyllshire; and at East Tulloch, south of Loch Tay, in Perthshire, according to Heddle" (Greg and Lettsom, *Brit. Min.*, p. 348).

Tenorite (230).

In the Scottish Mineral Collection there is a specimen from Leadhills, which has been regarded as a pseudomorph of this species after Galena.

Corundum (231).

An account of the geognostical relations of Corundum (in Scotland and elsewhere) is given by Teall in his Presidential Address to the Geologists' Association, "The Natural History of Cordierite and its Associates" (*Proc. Geol. Assoc.*, xvi. 2, pp. 61-74). In this, Mr. Teall describes the occurrence of Corundum in minute crystals, in thermo-metamorphosed schists from the neighbourhood of the Cruachan diorite-granite. "The Corundum in this rock occurs in crystals and more or less irregular grains. The crystals are combinations of the hexagonal prism, the primitive rhombohedron, and the basal plane. They are sometimes flat and sometimes prismatic. The flat forms, in which the prism is feebly developed, are frequently stepped on the basal plane, owing to the repeated alternations of this face with the faces of a rhombohedron" (*op. cit.*, p. 64).

Mr. Thoms sends the following note:—

"White Sapphire" of Tiree, or Corundum, was first mentioned by Greville, *T.R.S.*, 1798, whose description was quoted by Jameson (*vide* his *Scottish Isles*, ii. 33), but this identification was almost at once abandoned and the true nature of the mineral was recognised at least as early as 1817 by Sowerby. Dr. Heddle also refers it to Malacolite in his last Chapter, confirming Sowerby.

Hæmatite (232).

This appears to be, in the great majority of cases, a vestigial product from one or other of the Red Rocks—usually from the New Red. It therefore occurs here and there over the greater part of Scotland which is not occupied by rocks of later date than the New Red. The Editor has discussed this view of its geognostical relation in several papers, especially in "The Genesis of Scottish Minerals" (*Proc. Roy. Phys. Soc.*), and "Hæmatite on Arthur's Seat" (*Trans. Geol. Soc. Edin.*, 1900).

Ilmenite (233).

Dr. Heddle always distinguished between Iserine, which is the form occurring in connection with basic eruptive rocks (which forms much of the iron sand) and Ilmenite, which is confined to dynamo-metamorphosed rocks. This distinction appears to be a very useful one, and is thoroughly borne out by the facts. Nearly all the specimens of Ilmenite proper occur in connection with Quartz veins, and are associated with one or more members of the Chlorite Group.

Spinel (234).

Mr. Teall's paper, above referred to, mentions the frequent occurrence of spinel in thermo-metamorphosed rocks. Mr. C. T. Clough has lately presented to the Edinburgh Museum a fine series of Spinels from the metamorphic marble of Glenelg, in which this mineral is associated with Diopside, Tremolite, Forsterite, a light mica (usually regarded as Phlogopite) Crystalline Graphite, and other minerals (see Clough and Pollard "On Spinel and Forsterite from the Glenelg Limestone," *Q.J.G.S.*, lv. 372), in which these occurrences are described, and from which the following analysis is taken :—

Analysis of Spinel from Glenelg. Dr. Pollard (*Q.J.G.S.*, lv. p. 379).

Sp. gr.	SiO_2	Al_2O_3	FeO	MgO	Total
3·57	1·20	69·80	2·03	27·30	100·33

Minium (244).

It is stated by Greg (*Brit. Min.*, 388) to occur at Leadhills. There is a specimen so labelled in the Scottish Mineral Collection from that locality, which was regarded by Dr. Heddle as belonging to this species. It resembles an impure Limonite.

Psilomelane (269).

Omission was made in the text of reference to the fine coloured figures of the Hoy Psilomelanes, which have been added to the illustrations.

Calcite (270).

A considerable number of beautifully crystallised specimens of Calcite, embracing a great variety of combinations, is to be found in the Scottish Mineral Collection. The majority of these do not appear to have yet been published. Freehand drawings of about two hundred specimens, of which the forms have been determined while the present work was passing through the press, have been made by the Editor, and are placed next the specimens to which they refer.

Hydroplumbite (269).

Heddle (*Min. Mag.*, viii. 201). In minute, crystalline scales (hexagonal), forming thin, white, flakes with pearly lustre, soluble in nitric acid, the solution showing the presence of lead alone. B.B. yields water. Inferred (but on very insufficient grounds) to be $3PbO.H_2O$. Observed with Cerussite and Pyromorphite upon Galena. Locality doubtful, or perhaps from Cumberland or Leadhills. (Taken from Dana, 6th edition, p. 259.)

Smithsonite (275).

Often occurs as an incrustation in the veins of the district Leadhills and Wanlockhead. Memoirs of the Geological Survey, Scotland. Special reports on the Mineral Resources of Great Britain. Vol. XVII., 1921.

Witherite (279).

Occurs in the west branch of the new Glencrieff vein at Wanlockhead. (Memoirs of the Geological Survey. Special reports on the Mineral Resources of Great Britain. Vol. II., Barytes and Witherite, 1922).

Orthoclase (313).

Ayrshire. The felspar obscurely crystallised in geodes in the microgranite of Ailsa Craig much resembles Murchisonite, and is, no doubt, a soda-orthoclase, as suggested by Teall. (James Currie.)

Attention may also be directed here to a paper by Mr. Currie "On the Felspars of Canisp" (*Trans. Geo. Soc. Edin.*, vii. 494) in which the

geognostic relations of this and the associated Albite are described, and with which is given a figure of crystal twined on *m* (110).

Dr. Flett, in the same journal (p. 482), has also described some interesting phenocrysts (or insets) of micropegmatite occurring in a mass of microgranite of Devonian age at Black Hill in the Pentland Hills.

Microcline (315).

(Additional notes supplied by James Currie).

Flannan Islands, nacreous, white (MacCulloch).

St. Kilda. In drusy cavities in the Syenite, imperfectly crystallised and with Smoky Quartz (MacCulloch).

"The Feldspar of the red granite of the Ross of Mull is described by Haughton as Orthoclase: but as his analysis of the granite shows almost equal quantities of potash and soda, it would seem that the feldspar is a Microperthite and most probably a Microcline-Microperthite."

The waxy-lustred variety of Microcline occurs near Birse, micrographic and associated with Andesine, Apatite, and Sphene.

Soda-Microcline (315A).

Microscopic examination by Mr. James Bisset and Mr. Andrew Stenhouse of the large ejected fragments of feldspar included in the agglomerate and other eruptive rocks on the shore between Elie and St. Monance in Fife, has shown that they consist of polysynthetic twins of a triclinic feldspar. This confirmation of a view which many persons have long held, following Dr. Heddle's analysis (*q.v.*), seems to justify the reference of this mineral to Soda-Microcline. Probably this mineral will eventually prove to be of much commoner occurrence in Scotland than has hitherto been supposed. Fine specimens from the localities mentioned, as well as from the east of Fife, are placed in the Scottish Mineral Collection.

Dr. Heddle gave considerable attention to the vitreous and lithoidal states of eruptive rocks, and collected a fine series, which he placed with the Feldspars when he was arranging the Scottish Mineral Collection. Amongst these are fine examples of Pitchstone from almost every known Scottish locality, as well as equally fine specimens of Tachylite. His examples from Loch Scridain, Mull, formed the subject of a paper read before the Glasgow Geological Society (vol. x. pp. 80-91) With these are placed examples of Petrosilex and Petuntze, from Black Hill, Pentlands.

Oligoclase (317).

(Additional analyses). 1. Heddle, *Min. Mag.*, iv. 197.

2 and 3. Haughton, *Phil. Mag.*, xl. 59. (From Hintze, *Handb. d Min*).

	SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	K_2O	Na_2O	H_2O	Total.
1. Geo na Seamraig, .	64·54	24·04	2·31	0·77	1·21	2·59	4·13	0·84	100·43
2. Craigiebuckler, .	62·00	23·20	..	..	4·71	0·43	9·20	..	99·54
3. Rhiconich, . .	61·88	24·80	..	..	4·93	0·98	8·12	..	100·71

Orkney. Sanday, near Saville, in a large boulder (probably a Norwegian erratic), white, penetrated by Actinolite, with Hornblende, Apatite, etc. Stack and Skerry, west of Hoy, in belts in the gneiss, with sericitic gneiss (James Currie).

Leucite (321).

Regarding this mineral, it may be remarked that all the Analcimes which have yet been found in Scotland appear to be secondary products, and formed within pre-existent cavities within the rock in which they occur; and no British example yet known affords any good reason for regarding Analcime as a replacement or pseudomorph of pre-existent Leucite.

Augite (325).

The bright green variety of Augite known as Omphacite occurs in a few localities in Scotland as a constituent of the Garnet-Amphibole-Pyroxene rock called Eclogite. Messrs. Teall and Clough have lately described such from $\frac{1}{4}$ mile N.E. of Loch Coir' an Daimh, 2 miles N.E. of Glenelg. (See also Teall, *Min. Mag.*, ix. p. 217.)

It may be remarked here, that distinctly-terminated crystals of Scottish pyroxenes are of rare occurrence in collections. The Heddle Collection includes only three such of Diopside, none of which appear to have been yet figured. Crystals of Augite weathered out of the Arenig tuffs at Sanquhar, Dumfriesshire, have been obtained by Mr. Macconochie. The combinations are the usual ones of *a*, 100; *b*, 010; *m*, 110; and *s*, $\bar{1}11$, the latter forms nearly all showing strongly-concave surfaces. Except in the idiomorphic Augites abundantly present in so many basic eruptive rocks, these four occurrences represent all that are in the Scottish Collection.

Most of the Diopsides occurring in Scotland are distinctly minerals of secondary origin, developed within marbles by thermo-metamorphic action. Only in very rare cases do they show crystalline terminations although they are all idiomorphic in the prismatic zone.

Ægirine (326).

Mr. Teall has detected Ægirine in an intrusive rock allied to Borolanite from the Coigach district of West Ross-shire. It occurs in long prisms, idiomorphic in the prismatic zone, and is associated with Biotite, Orthoclase, Nepheline, Melanite, etc.

Mr. Cunningham Craig also records Ægirine in granulitic rocks from Glen Lui, Aberdeenshire ; 65 N.W.

Spodumeme (327).

In one of Dr. Heddle's note-books is a record of the occurrence of this mineral " in an east and west quartz-porphyry dyke which cuts the north slope of the Cairnwell just above the col between it and Cairn Geodch and overlooking Loch Bhrotichan."

Wollastonite (329).

Amongst other localities where this mineral has been detected mention may be made of its occurrence in the Borolanite of the neighbourhood of Inchnadamff, where its existence was made known by Mr. Teall (*Trans. Roy. Soc. Edin.*, xxxvii. p 175). It is associated with Orthoclase, Melanite, Nepheline, etc.

Rhodonite (335).

A mineral bearing a strong external resemblance to Rhodonite occurs in the metamorphic marble of Dalnabo, Glen Gairn, Aberdeenshire. Dr. Heddle has, however, shewn that this is really the variety of Sphene known as Greenovite, see *Dufrenoy, Ann. des. M.* 3rd, xxii. 529.

Amphibole (338).

Tremolite.

Inverness-shire. About a quarter of a mile above Roy Bridge, in the bed of the river, in Muscovite schist, with Garnets, some of the crystals over five inches long. Scourvang Hill, south of Fort William, in limestone. Kirnish Burn, south of Fort William (A. Thoms).

Hornblende.

INVERNESS-SHIRE. Fort Augustus railway cutting, below the Free Church, Gairlochy, in terminated crystals, *m c b r n*. In Shingang Burn, in Hornblende schist, about two miles east of Banavie (A. Thoms).

Beryl (344).

Most of the Scottish Beryls in the Collection at the Natural History Museum in the Cromwell Road, London, as well as those in the Edinburgh Museum of Science and Art, are quite devoid of any crystalline terminations (as they are allotriomorphic along (*c*) to other minerals). A very few, only two in the Edinburgh Museum (344 8-9), are terminated, and these are enclosed within dark Cairngorm. They shew the combination *m c p* and a very rough form, which appears to be *r*. They are stated to be from the Cairngorm Mountains. The terminations on all the others are in some cases fractures, in others they are impressed faces from minerals associated with them, especially from Quartz, while in the remainder these surfaces are due to etching by natural solvents.

Sodalite (362).

Mr. Teall, *Trans. Roy. Soc. Edin.*, xxxvii. pt. 1, No. 2, p. 175, records the occurrence of an alteration product after a mineral belonging to the Sodalite Group, in the rock Borolanite, from the neighbourhood of Inchnadamff, Cnoc na Sròine, Loch Borolan, and Ruighe Cnoc, Sutherland & Ross. It is associated with Orthoclase, Nepheline, Melanite, etc.

Garnet (370).

Amongst the fine series of Garnets in the Scottish Mineral Collection are some remarkable crystals from Knock Hill, 4 m. N.E. of Grange Station, Banffshire; 86 N.W. On the *d* faces of these an oscillatory combination of *d r s* builds a step-like face looking somewhat like a low pyramid.

Forsterite (375).

Analysis of Forsterite from Glenelg by Dr. Pollard (*Q.J.G.S.*, lv. p. 379).

Sp. Gr.	SiO_2	Al_2O_3	FeO	CaO	MnO	MgO	Loss, etc.	Total.
3.24	41·16	1·02	2·0	·26	·26	54·86	·70	100·26

Olivine (376).

(Supplementary notes by Mr. James Currie.)

SUTHERLANDSHIRE. An arrowhead twin from Lairg which had the appearance of Keilhauite, proved, on analysis, to have much the composition of Olivine (see *Analysis* 3, p. 51, vol. ii.).

HEBRIDES. In the gabbro of the Cuillins (Zirkel). At Camus Daraich in Sleat, in microscopic crystals, *o n k* (Clough and Harker), at Dunvegan (MacCulloch).

Olivine is found replaced by Prehnite at Dumbarton (Allport), but more usually it passes into Hæmatite on the one hand or Serpentine on the other. Examples of the former change occur at Duncarnock in Lanarkshire, Bowling (Allport) and Calton Hill (Tschermak). Serpentine with the form of Olivine is found at Bowling, Mugdock, Arthur's Seat, and Neilston (Allport). Sometimes the centre of the grains is unaltered Olivine ; sometimes it is serpentine surrounded by Hæmatite.

An intermediate stage in the transition to Hæmatite is shewn by the pseudomorph to which the name *Ferrite* was given by Mr. Wallace Young. This occurs at Kilpatrick, at Gleniffer Braes (J. Young), and at Boyleston H). At the last locality it occurs in the form of Olivine with the combination *a b c d e* (as in fig. 4—*Anal.*). It is remarkable that though Olivine of two quite diverse habits is found at this place, it is altered into Ferrite only when it occurs in the form mentioned.

Analysis :—Heddle, *Min. Mag.*, v. 29.

SiO_2	Ae_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	H_2O	Total.
13·03	13·16	53·47	4·51	·15	·75	6·62	8·39	100·08

Fayalite (377).

Stated by Judd (*Q.J.G.S.*, xlix. 191) to occur microscopically in spherulites within the granite of Druim an Eidhne, Cuillins, Skye. (James Currie).

Phenacite (382).

" A crystal almost identical in appearance with the Uralian phenakite, was found by Dr. Heddle at Hillswickness Point, opposite the Drongs in Shetland. The crystal is embedded in mica slate, so that the faces are rough : it may be merely beryl." Greg & Lettsom's *Brit. Min.*, p. 473.

Scapolite (387).

This has been recorded by Mr. Cunningham-Craig from calc-silicate hornfels from Altt an t' Sionnaich, Aberdeenshire ; 65 S.W. Mr. Clough

records it from some Argyllshire localities, and from near Cnoc na h'Ula, near Laxford, and also from near Shieldaig, Gairloch.

Idocrase (393).

Amongst the specimens of this mineral from the metamorphic marble of Dalnabo, now in the Scottish Mineral Collection, are (393·8) shewing the combination *a m h f p c* ; (393·13), *a m h f c* : (393·20), *a m h f c p e u*.

Zircon (394).

Amongst the Zircons in the Scottish Mineral Collection are two from " Brann a'Bharra " which occur in pegmatite, and shew the combination *m x p* (on 394/9) and *m a x p* (on 394/10) ; (394/4) from Beinn Bhreac *m p v u*.

Danburite (396).

Dr. Heddle at one time regarded the brownish-yellow serpentinous mineral occurring in the Glenelg marble as possibly pseudomorphous after this species See also Totaigite, Chondrodite, Forsterite, etc.

Topaz (397).

The collection of minerals in the Edinburgh Museum of Science and Art contains a good series of crystallised specimens of Scottish Topaz, none of which appear to have been either figured or described. They have no localities attached to them ; but there is some reason to believe that they mostly came from the granite area to the north-west of Invercauld, Aberdeenshire. The Editor has examined and drawn most of these. The combinations include the following :—(O.M.C., 27) *m l n d o f y β* ; (397 17), *m o d v f*, with a broad surface formed by the basal cleavage plane (*c*) ; (397/14), *m l o f d c* (*l* oscillates with three prism faces between *l* and *m*, which may be λ ⅂ M) ; (397/15), *l λ ⅂ m f c d o u* ; (397/16), *m l f c β d o u θ p ω*.

A marked want of symmetry on either side of (*a*) and (*b*) characterises nearly all the crystals. They are all translucent and of a very pale bluish-green colour.

In the General Collection in the same Museum there are other Scottish crystals of Topaz, which shew the following combinations :—*l g n m f y β d o u ϵ* ; *l λ ⅂ f d o* ; *n m z l f X y d o u ϵ* (? *b*).

Andalusite (398).

With reference to this mineral from Clashnarae, Aberdeenshire, Mr. James Currie supplies the following note :- " The crystals rarely, as noticed by Somerby, form a sheath to a central core of Labradorite ; frequently they pass insensibly into the associated Fibrolite. The colour is a uniform dull purplish red ; but the author observed that, when sectioned, they are seen to have a core which is deep purple, and purple spots at the four corners of the transverse section." See also Dr. Heddle's Chapter viii., *Trans. Roy. Soc. Edin.*, xxxix. 343-4 (1898).

Fibrolite (399).

Regarding this mineral from Clashnarae, Mr. Currie also writes :— " Sometimes it occurs at this locality with a different habit, forming a sheath which envelops Labradorite, Quartz, and Andalusite alike. At other times it radiates in bundles or fibres through the Labradorite." See also *op. cit.*, p. 348-9.

Kyanite (400).

The following note by Mr. Currie has been abstracted from Mr. Geo. Barrow's paper, on the thermometamorphism of the rocks of the Scottish Highlands. *Q.J.G.S.*

" At various points in the belt of metamorphic rock, stretching from two miles east of Millden to Millton of Clova and Loch Brandy, the Kyanite occurs either more or less aggregated, or in single crystals scattered through the mass of the gneiss. In many cases these are completely coated with minute crystals of Ilmenite, giving the Kyanite a " black-leaded " appearance. The crystal faces are much rounded, and as a rule only *m* and *t* can be distinguished. The finest crystals occur in Glen Effock, bright blue in Quartz : other localities are Atton and Bonhard in Glen Clova ; head of Water of Saughs ; Loch Brandy ; Loch Lee ; and Bulg." See also Dr. Heddle's Chapter viii., *Trans. Roy. Soc. Edin.*, xxxix. 349-353.

Datolite (401).

The Scottish Mineral Collection includes a large number of well-crystallised specimens of Datolite, from various localities. None of these appear to have been referred to in the body of the work nor to have been figured.

Most of the crystals are of small size ; they are implanted, as a rule, on *c*, 001, and their greatest elongation is parallel to *b*, 010. The most

usual type consists of a combination of *a m m* g c* ϵ. (*b*) is absent. Their geognostic relations are with the Zeolites, as they all occur as minerals of aqueous origin, and of later origin than that of the enclosing rock. They occur in cavities or the sides of fissures. The enclosing rock is invariably one of eruptive origin, and its composition ranges from ultra basic, as it is at Barnton, through basic, as at Corstorphine, to subbasic, as occurs at Glen Farg. The symbols employed are the same as those used by Dana (6th edit.).

Barnton. *m a m* g n* ϵ *ν* U *f v x*; (401/6/3) *a m n x g m** ϵ; (401/10) *a m g m** ϵ.

Bishopton. (401/9/1) *a* ϵ *g m m** ξ Π *θ* Λ *i* W *v c*; (401/29) *a m* ϵ *m* g n c* ξ λ, *m a c g n m*, a m g m* c* ϵ *ν n* ϕ *x*; (401/9) *a m g m* c ν n* ϕ *n* 10, *a m m* g x* 11 *n, m m* a c g n* ϵ, *m a g m* n* ϵ ξ λ.

Glen Farg. (401/3) *m c* λ *t* L *m** ϵ, *a m c m* g* Q *ν*; (401/4) *m t m** ϵ *x* ξ; (401/4a) *m m* t x* ϵ; (401/3) *a m c g m* n* ϵ.

Corstorphine. Characterised by the large size of the *a* face. (401/23) *a m c g m* x* β *n z* ϵ; (401/8) *a m m* g c* and three undetermined faces which are probably *z* λ *i*; (401/14) *a c m m* g n* ϵ L; (401/17-18) *a m m* g.*

Salisbury Crags. (401/1) *m c g m**.

Isle of May. (401/12) ? *m n z ν.*

Gadolinite (404).

Two specimens of a diorite-granite from Criffel, which contain much Sphene, include also some specimens of a mineral which presents a superficial resemblance to Allanite. They were doubtfully referred by Dr. Heddle to Gadolinite, and, as such, are left in the Scottish Mineral Collection.

Zoisite (406).

Amongst the specimens of this mineral, from the metamorphic marble of Dalnabo, Glengairn, in the Scottish Collection, are several minute crystals which show distinct terminations. Some of these have been drawn. They each appear to be built up of a number of acicular crystals, elongated parallel to the *c* axis, which forms the base by which they are attached, and they consist of various combinations of *a*, 100 (oscillating with *k*, 310, *q*, 210, and *n*, 530); *m*, 100 (usually bright and smooth, but in some cases striated through oscillations with *r*, 120 *t*, 130, and *l*, 140), *b*, 010; *d*, 101, *o*, 111 (strongly fluted through oscillations with *v*, 121, and *p*, 131) a trace of *f*, 011 upon one crystal; and two as yet

undetermined and undescribed faces lying between *a* and *d*. The multiple twinning, the strongly-marked oscillations of adjacent forms, and the tendency to unsymmetrical development, are marked characteristics of the specimens in the Scottish Collection. No trace of the *b* cleavage can be made out on any of the specimens. Specimen 406/23A shews *m a o b n p u*; 406/10, *a* (oscillating with *m*, *k*, *q*, *n*), *m* (oscillating with *l*, *p* (oscillating with *o*, *v*), *p* predominating; 406/10[a], multiple twins, *a n m d o*. None of these appear to have been previously either figured or described.

Zoisite appears to be a not uncommon product of the excessive thermo-metamorphism of calcareous strata, and to be confined, at least in Scotland, to rocks with that history. As an additional example, may be mentioned the occurrence of a gneiss contiguous to limestone on the hill nearly two-thirds of a mile slightly south of east of Lochan Cul a' Mhoil (Ross-shire 6-inch map 123), which is stated by Mr. Teall to be formed essentially of layers of Zoisite and Microcline, mixed with other darker layers of Pyroxene, Calcite, and Sphene. [*Q.J.G.S.*, lv. p. 375.] See also Dr. Heddle's Chapter viii., *Trans. Roy. Soc. Edin.*, xxxix. pp. 356-7.

Epidote (407).

The Scottish Mineral Collection in the Edinburgh Museum of Science and Art includes an extensive series of this mineral, including several well-crystallised groups, none of which appear to have been previously figured or described.

(407/25) *m c r a l*; *m c a β r*; *m r c h n l o*; from a cavity in a boulder of decomposed epidiorite, found in the Asylum Grounds at Inverness; (407/57) *m a c r n o*; *n a r c i b*; from rock near metamorphic marble, Crathie, ½ mile E of Balmoral, Aberdeenshire. (407/19) 'Glen Logan,' at the head of Loch Maree, Ross-shire; *r n b c a*. (407/23) Withamite, *a c n r*; Am Bodach, Glencoe. (407/71) Fascicules of slender prismatic crystals attached by (*b*), *m c r a*; Bonawe, Loch Etive. (407/54) *m a c r l e*; *m a c r l e f i h*; *m a c r l h n*; and (407/75-78) *m a r c*; *m a r c o l*; *m a r c o n*. Part of this last Epidote is inclosed, along with acicular crystals of Actinolite, within translucent Quartz, the whole being associated with Chalcopyrites and Pyrites, in a fissure traversing diorite-gneiss.

Tillyfourie, Aberdeenshire. (407/64) *t c e i r l a*, attached by, and elongated parallel to (*b*).

Meall an Damh, Ben More, Mull. Slender fascicles of minute acicular crystals, coating a vapour cavity within a thermo-metamorphosed eruptive rock of Tertiary age.

The majority of Epidotes appear to have been reconstructed from what were originally decomposition products of ferro-magnesian silicates, which were associated with carbonate of lime, and have afterwards been subjected to thermo-metamorphism.

Allanite (409).

The specimens of this mineral in the Scottish Mineral Collection are nearly all idiomorphic along the zone (*c a*), forming prisms of the combinations *a c r*. In many cases the Allanites form nuclei around which crystalline felspar is disposed in radial groups.

In one single specimen of this mineral (409/27), from the Boat of Garten, a distinct termination is seen. It consists of the combination *n a c r d*. It has lately been figured by the Editor.

Unlike Epidote, which is very generally a product of later date, the enclosing rock, Allanite appears to be always an original constituent, and one of the earlier minerals to consolidate. It seems to be chiefly confined to deep-seated rocks or eruptive origin. The other allied and essentially isomorphous mineral Zoisite, appears in Scotland to be usually a secondary product, due to the thermo-metamorphism of rocks contiguous to limestones.

The presence of Allanite in a rock is often revealed by a rusty stain which surrounds the mineral.

Uigite (411).

Heddle, *Edin. New. Phil. Journal*, iv.; *Min. Mag.*, v. 26. "In radiating sheafy clusters of plates, in nests in the amygdaloid of Uig, Skye, along with Analcime and Faroelite. H., 5·5; G., 2·284; lustre pearly; colour white, slightly yellowish.

Comp. according to Heddle:— SiO_2, 45·98, Al_2O_3 21·93, CaO 16·15, Na_2O 4·69, H_2O 11·25. B.B. fuses readily and quietly to an opaque enamel, which is not frothy.

Dana remarks that it is near Prehnite in structure.

Chondrodite (415).

Greg. *Brit. Min.*, p. 223, states that this mineral "occurs in small crystalline masses of a brownish yellow colour in granular carbonate of lime, with magnetite and arsenical pyrites, near Loch Ness in Scotland." The author (of the present work) has in vain searched for it, and believes that the only specimen in existence—that in the British Museum, South Kensington—is merely yellow serpentine. Possibly the origin of the

statement is the occurrence at Millton in Glen Urquhart of the mineral to which the author (Dr. Heddle) has given the name Xantholite (see *Min. Mag.* III. 59) (James Currie).

Part of the minerals from Glenelg, at one time doubtfully referred to Chondrodite, is now recognised as Forsterite (see Teall, *Q.J.G.S.*, lv.).

For the supposed Chondrodite of Rum see "Olivine."

Calamine (423).

ARGYLLSHIRE. Strontian. Botryoidal (A. Thoms).

Staurolite (428).

INVERNESS-SHIRE. Kirnish Burn, south of Fort William (A. Thoms).

Stilbite (443).

Sheaves of crystals of a bright venetian-red or almost vermilion-coloured Stilbite occur in veins and coating the joint faces of basalt lavas (and even, in some cases, of the adjoining tuffs) in the Lower Carboniferous rocks of Pettyeur and Kinghorn on the coast of Fife. The crystals resolve themselves into the usual cruciform penetration twins.

Sphærostilbite (443).

(Note by Mr. Currie.) The *Sphærostilbite* of Beudant, described originally from the Faroes, is mere Stilbite in minute crystals, dropped upon delicate radiating tufts of Mesolite, the presence of which determines the spherical form and causes the gelatinization with acids. It occurs in Skye; at Storr in minute spheres sprinkled over Faroelite, and at Quiraing in spheres the size of a pea with other Zeolites.

Analysis :—

SiO_2	Al_2O_3	CaO	Na_2O	H_2O	Total.
56·64	16·43	8·90	0·46	17·05	99·38

Chlorastrolite (456).

(Note by Mr. Currie.) "A spherulitic mineral occurs upon the north slope of Allival in Rum. It consists of small spheres of a pale olive green colour with dark nucleus. They have a finely radiated structure, and, at the same time, they are concentrically banded. The mineral is not unlike the impure variety of Thomsonite which has been named Chlorastrolite."

Fuchsite (458).

Micas containing various small percentages of Chromium are of not uncommon occurrence in the Highland Metamorphic Series, especially in the altered quartzites, according to Mr. Geo. Barrow. Mr. Barrow

remarks, however, that much of the green micaceous mineral which is commonly referred (on account of its colour) to this species is really one of the Chlorites.

Lepidolite (460).

Is said to have been obtained from " Argyll, in primitive limestone at a quarry on the east side of Loch Leven, opposite the inn at Ballichulish. Reported to occur at Dalmally." Greg & Lettsom, *Brit. Min.*, p. 225.

For Fuchsite, Damourite, Margarodite, and Sericite (see Muscovite 458).

Phlogopite (462a).

There still appears to be some doubt whether some of the light mica, occurring in the marbles of the Highland Metamorphic Series, is really Phlogopite, as it was at one time assumed to be. Dr. Heddle states with regard to the light mica of the Glenelg marble that it is so like a Vosges mica named Phlogopite by Prof. King that it is possible it may prove to be this most highly magnesian species. (See *Trans. Roy. Soc. Edin.*).

Ottrelite (467).

In the *Ann. Rep. Geol. Survey* for 1895, p. 23, Mr. Geo. Barrow records the occurrence of this mineral as a product of the thermo-metamorphism of the ancient sediments of the southern border of the Scottish Highlands. It is associated with Cordierite, Andalusite, etc.

Saponite (488).

5. Additional analyses by Dobbie (*Min. Mag.* v. 131).

	SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	H_2O	Total.
Bowling, . . .	39·90	6·94	3·75	8·91	0·41	3·32	19·28	17·28	99·78
,, . . .	40·81	6·77	4·28	8·73	0·36	2·09	19·76	17·11	99·81
,, . . .	39·98	4·20	6·92	8·71	0·40	2·83	18 62	17 28	98·94
,, . . .	39·38	6·70	3·79	9·45	0·14	1·89	20·39	17·11	98·85
,, . . .	40·44	4·94	..	8·98	0·40	3·05	19·85	17·24	99·90

(Notes by Mr. James Currie), Fife, West of Tayport. " In thin veins, with a pseudo-fibrous structure due to interstitial fibrous Calcite ; in this form it is indistinguishable from the ' Bowlingite ' of Bowling Quarry."

Stirlingshire. At various localities in the Gargunnock Hills ; thus in the gap called the ' Double Crags ' near Fintry, dark-green rosette crystals (Prasilite) in Calcite ; in small druses with Natrolite in the bank of the Endrick. " In the Touch Hills, near Stirling, green, in rosette

crystals, with red Heulandite. Mull. At Maol nan Damh of Ben More, centrally filling druses lined with Celadonite."

Wolfram (812).

MacCulloch states in the *Trans. Geol. Soc. Lond.*, ii. (1814), this mineral which had hitherto not been recorded from Scotland, had been found in the granite veins traversing the gneiss of Rona. But in the *Western Isles*, published in 1819, he appears to have come to the conclusion that the mineral in question was Magnetite—a view which Dr. Heddle endorsed. Raspe also appears to have made the same mistake with reference to Tiree (see *Trans. Roy. Soc. Edin.*, xxx. pp. 452-3).

Rubislite $8(FeO,CaO,MgO,K_2O)SiO_2+3(Al_2O_32Fe_2O_3)SiO_2+16H_2O$
or Atoms $RO8,R_2O_3S,SiO_2,H_2O_{16}$.

Minutely foliated to granular, its particles can be separated from each other by the nail. Colour, dark green. Lustre dull streak paler than the original colour. G. 2·442—Anal. Heddle, *Trans. Roy. Soc. Edin.*, xxix. 112 (1879).

SiO_2	Al_2O_3	Fe_2O_3	FeG	MnO	CaO	M_gO	K_2O	H_2O
37·846	10·924	9·84	9·005	·461	4·22	8·00	3·334	16·132=99·763

Loses in the bath 8·571 of the above water. Before the blow-pipe semi-fused into a vesicular brown slag. Possibly there might have been some slight admixture of Feldspar. The replacement in the protoxides is confused.

This is very like Hullite in which much of the iron is in the ferrous condition. This substance is noticed in the hope of more of it being found ; the quantity obtained of it was very small.

Aberdeenshire. In a deep part of the Quarry of Rubislaw near Aberdeen. Imbedded along with crystals of Muscovite in an exfiltration vein. It occurred in a solid lump, and also forming a " corded structure " pervading Feldspar, identical in appearance with that noted by me in Feldspar : it thus occupied the position of the Oligoclase or Albite which usually forms that structure. (Abstracted by Alex. Thoms.)

Craigtonite.

Dr. Heddle, *Min. Mag.*, v. 30 (1882), from Craigton, its locality. An oxide of iron and manganese, found as a bluish-black coating on granite.

Ellonite.

Dr. Heddle, *Min. Mag.*, v. 30 (1884), from Ellon, its locality. Hydrous silicate of magnesium, containing free silica.

FARGITE.

Dr. Heddle, *Phil. Mag.*, 4th, xiii. 50. (See Natrolite.)

FAROELITE.

Dr. Heddle, *Phil. Mag.*, 4th, xiii. 50. (See Mesolite.)

APPENDIX BY THE AUTHOR.

MINERALS which have been stated to occur in Scotland, but which occurrences are either improbable or not sufficiently authenticated :—

MERCURY. Said to have been found in clay near Berwick ; and to the amount of several pounds in a peat bog near Loch Fyne.

PLATINUM. Said to have been found on a farm near Buittle, near the mouth of the river Urr, in Kirkcudbright. Possibly Molybdenite.

CHRYSOBERYL.

BROOKITE. Some minute crystals upon Ilmenite and also upon Rutile from Creag na Caillich seem to be Brookite, but are too minute for determination.

XANTHOSIDERITE. An ochre-coloured iron ore in fibres of two inches in length, and containing nearly 20 per cent. of water, is found, rarely, in loose pieces along the summit of Hoy Head (St. John's Head, Hoy, Orkney), and may be this mineral. (Possibly also at Achavarasdale in Caithness.)

SYNONYMIC INDEX TO SCOTTISH MINERAL LOCALITIES.

By J. G. GOODCHILD.

The orthography adopted is that used on the maps of the Ordinance Survey: other spellings which have been used being given in quotation marks. Localities as yet unidentified are distinguished by a prefixed †.

Following the name of the locality is given the parish or some other easily-identified district in which the place occurs, then the name of the county, and finally a reference to the Ordinance One-Inch Map (distinguished as O.S.) in which the place is found.

The numbers following (Sp.) refer to the species of minerals known to occur at the places mentioned, and are those under which these minerals are arranged in the body of the book. They are also the same as are used by Dana (Sixth Edition), and in the Collection of Scottish Minerals in the Edinburgh Museum of Science and Art.

Mr. James Currie's information, given while the body of the work was passing through the press, has been freely used in this list, and I have to thank Mr. J. G. Duncan for assisting me in drawing up the lists of minerals from those in the Scottish Collection, and both Mr. Currie and my colleague Mr. Macconochie for valuable help in the revision of the proofs of this list.

A

Abbotrule, Jedburgh, Roxburghshire (O.S. Sh. 17), *Sp.* 45.

Aberdour, Aberdeenshire (O.S. Sh. 97), *Sp.* 398.

—— Fifeshire, *Sp.* 54, 85, 210, 233, 270, 271, 319, 325, 443, 453.

Abergairn, Aberdeenshire (O.S. Sh. 65), *Sp.* 45, 58, 175, 210, 270, 271, 313.

Abernethy, Perthshire (O.S. Sh. 48), *Sp.* 257, 270, 271.

Abriachan, North-west of Loch Ness, Inverness-shire (O.S. Sh. 83), *Sp.* 14, 15, 54, 175, 232, 233, 341, 407.

Achadh a' Phris, "Achadhaphriz." 3½ ms. NW of Lairg, Sutherlandshire (O.S. Sh. 102), *Sp.* 233, 250, 338, 462B, 510, 549.

Achaidh Mhòir, Loch Garve, Ross-shire (O.S. Sh. 83), *Sp.* 370.

Achannachy, Ruthven, Aberdeenshire (O.S. Sh. 86), *Sp.* 484.

Achinah, Naver, Sutherlandshire (O.S. Sh. 115), *Sp.* 34, 210, 313, 407.

Achmithie Bay, Auchmithie, coast of Forfarshire (O.S. Sh. 57), *Sp.* 456.

Achnagonalin = "Alt na Gonolan," ¾ m. NW of Speybridge Station, near Grantown, Inverness-shire (O.S. Sh. 74), *Sp.* 74, 85, 325, 370, 400, 406.

Achvarasdal = Achavarasdal, Caithness (O.S. Sh. 115), *Sp.* 210, 257, 259, 719, H.

Addiewell, West Calder, Edinburghshire (O.S. Sh. 31), *Sp.* 83, 271, 719.

Afton Water, New Cumnock, Ayrshire (O.S. Sh. 15), *Sp.* 45.

Ailnack Water = "Alnack Water," Banffshire (O.S. Sh. 75), *Sp.* 210.

Ailsa Craig, Ayrshire (O.S. Sh. 7), *Sp.* 13, 323, 340, 210, 313, 481.

Airdrie, Lanarkshire (O.S. Sh. 31), *Sp.* 270.
Airidh a' Chreagain, 4 ms. W of Stornoway (O.S. Sh. 105), *Sp.* 210, 408.
Airthrey Castle, 2 ms. NNE of Stirling, Stirlingshire (O.S. Sh. 39), *Sp.* 148.
Aith Hope, Hoy, Orkney (O.S. Sh. 117), *Sp.* 232.
Aithness Hill, Mainland, Shetland (O.S. Sh. 126), *Sp.* 273.
" Aith's Voe " = Wick of Aith, Fetlar, Shetland (O.S. Sh. 130), *Sp.* 237, 481.
" Aldernie (Mill of), Boharm, Banffshire (O.S. Sh. 85), *Sp.* 428, 458.
Alford, Aberdeenshire (O.S. Sh. 76), *Sp.* 83, 237, 338, 447.
" Alie (or Alic) Hill, Aberdeenshire," may be Càrn Ellick, Inveravon, Banffshire (O.S. Sh. 75), *Sp.* 315, 338, 481.
Allanbank, Chirnside, Berwickshire (O.S. Sh. 34), *Sp.* 746.
Allardice, Arbuthnot, Kincardineshire (O.S. Sh. 67), *Sp.* 210.
Allival = " Halival," Rum (O.S. Sh 60), *Sp.* 319, 323, 325, 376, 462.
Allt a' Bhealaich = " Sawmill Burn," Taymouth Burn, Perthshire, (O.S. Sh. 55), *Sp.* 74.
Allt a' Choire Mhòir, Fannich Forest, Contin P., Ross-shire (O.S. Sh. 92), *Sp.* 313.
Allt a' Coileachan, 2 ms. E. of Glenlivet, Banffshire (O.S. Sh. 75), *Sp.* 210.
Allt an t' Fhionnaraidh ? Tuarie Burn, W of Kildonan, Sutherlandshire (O.S. Sh. 109), or the burn N of Benin na h-Urrachd (Ben Uarie), *Sp.* 13.
Allt an Fhionnfhuaraidh, Sutherlandshire (O.S. Sh. 107), *Sp.* 13.
Allt an Uamh, Breabag, Sutherlandshire (O.S. Sh. 101), *Sp.* 316.
Allt Beag, Glen Rinnes, Banffshire (O.S. Sh. 85), *Sp.* 210.
" Allt-bhreach," Allt Breac, 2 ms. E of Kildonan Church, Sutherlandshire (O.S. Sh. 109), *Sp.* 13.
Allt Cailleach, Coyle Hills, 3 ms. SSW of Ballater, Aberdeenshire (O.S. Sh. 65), *Sp.* 325, 462.
Allt ceann a' Phris, " Allt ceann a' Phriz," Kildonan, Sutherlandshire (O.S. Sh. 109), *Sp.* 13.
Allt cille Pheadair, " Kil Pheadar Burn," Helmsdale, Sutherlandshire (O.S. Sh. 109), *Sp.* 13.
Allt Coire Laoigh, Beinn Oss, Killin P., Perthshire (O.S. Sh. 46), *Sp.* 210.
Allt Cuaig, " Allt Cuig," near Lochend Inn, Inverness-shire (O.S. Sh. 83), *Sp.* 232.
Allt Cuigh, Dalwhinnie, Glen Truim, Inverness-shire (O.S. Sh. 64), *Sp.* 210.
Allt Fearnach, see " Glen Fernate," Kirkmichael P., Perthshire (O.S. Sh. 56 and 64).
Allt Ghoiridh, opposite Scalpa, Skye (O.S. Sh. 71), *Sp.* 329.
Allt Glinn, Taitneiche, " Glen Tatnik," Kirkmichel, Perthshire (O.S. Sh. 65), *Sp.* 2.
Allt Graad, Kiltearn, Loch Glass, Rossshire (O.S. Sh. 93), *Sp.* 210, 370.
" Allt Leth Uillt," An Leth Allt, Allt Mòr, Loch Brittle, Skye (O.S. Sh. 70), *Sp.* 270, 438, 454.
Allt Preshal Beg, Talisker, Skye (O.S. Sh. 70). *Sp.* 447.
Allt Mòr = " Big Burn," Invernauld, Rosehall, Sutherlandshire (O.S. Sh. 102). *Sp.* 254.
Allt na Caillich, Strath Mòr, Ben Hope, Sutherlandshire (O.S. Sh. 108), *Sp.* 210.
Allt Toll Easa, 3 ms. ENE of Mam Sodhail, may be " Toulessie," (O.S. Sh. 72), *Sp.* 2.
" Allt-Torrish," Torrish Burn, Helmsdale Sutherland (O.S. Sh. 109), *Sp.* 2.
" Almorness Head," the copper mine on Hestan Island, Kirkcudbrightshire (O.S. Sh. 5), *Sp.* 34, 83, 288.
" Alsait Hill," see Càrn Ealasaid (O.S. Sh. 75), *Sp.* 83, 288.
" Altguish, Alguish," see Aultguish, Contin P., Ross-shire (O.S. Sh. 93), *Sp.* 210, 315, 407, 409, 462, 510.
" Altmarry," Auldmurroch, Stirlingshire.
" Alt na Corleachan, Alt Chanlochan."
" Alt na fluor," perhaps = Na tri Chaochain, Torbain, Banffshire (O.S. Sh. 75), *Sp.* 175.
Alva, Stirlingshire (O.S. Sh. 39), *Sp.* 11, 14, 42, 83, 87, 98, 270, 288, 601.
Alyth, Perthshire (O.S. Sh. 56), *Sp.* 210.
Am Binnean = " Am Binnein," Goat Fell, Arran (O.S. Sh. 21), *Sp.* 210.
" Am Binnean," = Am Binnein, Ben More, Perthshire (O.S. Sh. 46), *Sp.* 210.
Am Bodach, Glen Coe, 2 ms. above Loch Triochatan, Argyllshire (O.S. Sh. 53), *Sp.* 407, 469, 639.
†" Am Castel, Loch Treig," *Sp.* 210.
An Gorm-Loch, Ben Hope, Sutherlandshire (O.S. Sh. 114), *Sp.* 210, 313, 407.
Anguston, 4 ms. W. of Aberdeen city (O.S. Sh. 77), *Sp.* 233, 317, 409, 462A, 510.
An Leth Allt, Loch Duich, Ross-shire (O.S. Sh. 72), *Sp.* 325, 462.
An Riabhachan = " Ryachan," Allt an Riabhach, Sutherland (O.S. Sh. 107).
An Sgùr = The Scuir of Eigg (O.S. Sh. 60).
An Socach, Braemar, Aberdeenshire (O.S. Sh. 65), *Sp.* 210.
Aoineadh Mòr = " Innismore," Carsaig, Mull (O.S. Sh. 44), *Sp.* 270.
Aonach Beag, 2 ms. E of Ben Nevis, Inverness-shire (O.S. Sh. 53), *Sp.* 210.

B

C

Collin Burn (iron mine at), Berwick P., Kirkcudbrightshire (O.S. Sh. 5), *Sp.* 85, 232.

"Colquhanie," Colquhony, Bridge of Strathdon, Aberdeenshire (O.S. Sh. 75), *Sp.* 338, 394, 462A.

Colvend, on the Urr, Kirkcudbrightshire (O.S. Sh. 58), *Sp.* 83.

Conamheall, Durness P., Sutherlandshire (O.S. 114), *Sp.* 315.

Conan Bridge, S of Dingwall, Ross-shire (O.S. Sh. 83), *Sp.* 338, 462.

"Coningsburg, Conningsburgh," Cunningsburg, Shetland (O.S. Sh. 126), *Sp.* 400.

Coniveall, Coinne-mheall, Ben More, Assynt, Sutherlandshire (O.S. Sh. 108), *Sp.* 316.

"Coolax," Coolags, N of Hoy, Orkney (O.S. Sh. 117), *Sp.* 210.

Coolin, Cuchullin or Cuillin Hills, Skye (O.S. Sh. 70), *Sp.* 233, 319, 325.

Corntulloch, "Cairntulloch, Cairntullich," Aboyne, Aberdeenshire (O.S. Sh. 66), *Sp.* 2, 74, 271, 325, 329, 510.

Corrantee Mine, near Coire an t-Suidhe, Strontian, Argyllshire (O.S. Sh. 52), *Sp.* 45, 58, 85, 442, 484.

Correen Hills, Auchindoir P., Aberdeenshire (O.S. Sh. 76), *Sp.* 398, 594.

"Correnny Hill," ¼ m. W of Backhill, NW border of Midmar P., Aberdeenshire (O.S. Sh. 76), *Sp.* 210.

Corrie, Arran (O.S. Sh. 21), *Sp.* 85, 210.

Corrie, Kilsyth, Stirlingshire (O.S. Sh. 31), *Sp.* 210.

"Corriebuie" lead mines, E of Gleann a' Chilleine, Perthshire (O.S. Sh. 47), *Sp.* 13.

"Corriebuie Hill," Meall na Creige, Loch Tay, Perthshire (O.S. Sh. 47), *Sp.* 13, 45, 83.

"Corrie Carr," Lurg Mhòr, Lochalsh P., Ross-shire (O.S. Sh. 82).

"Corrie Lagan," Coire Làbain, Cuillin Hills, Skye (O.S. Sh. 70), *Sp.* 233, 319, 325.

"Corrie na Creich," Coire na Creiche, north of the Cuillins, Skye (O.S. Sh 70), *Sp.* 319, 325.

"Corrie na Peich," Coire na Baich, Glen Creran, Argyllshire (O.S. Sh. 53), *Sp.* 516, 338, 398.

Corrybeg, Abergairn, Aberdeenshire (O.S. Sh. 65), *Sp.* 45, 58, 241, 258, 270, 313.

Corrycharmaig, Glen Lochay, 3 ms. NW of Killin, Perthshire (O.S. Sh. 46), *Sp.* 2, 241, 250, 468A, 481.

"Corry na Creech," see Corrie na Creiche.

Corsie Hill, Kinnoul Hill, Perthshire (O.S. Sh. 48), *Sp.* 210, 488.

Corstorphine, Edinburghshire (O.S. Sh. 32), *Sp.* 83, 210, 233, 270, 319, 325, 330, 376, 401, 411, 441, 442.

Cortachy Bridge, River Esk, Forfarshire (O.S. Sh. 56), *Sp.* 323, 481.

Corwar, Cairnsmore, Kirkcudbrightshire (O.S. Sh. 4), *Sp.* 98.

"Coul Blean," Culblean Hill, Cairngorm, Aberdeenshire (O.S. Sh. 75), *Sp.* 461.

Cousland, Dalkeith, Edinburghshire (O.S. Sh. 32), *Sp.* 270.

Cove, Kincardineshire, coast, 4 ms. S of Aberdeen (O.S. Sh. 77), *Sp.* 315, 462, 549.

Cowden, ? Cowdens, Dunfermline, Fifeshire (O.S. Sh. 40), *Sp.* H.

Cowden, Dalkeith, Edinburghshire (O.S. Sh. 32), *Sp.* 210, 270.

"Cowhead Burn, 1 m. N of Ellemford," Greenhope Burn, Abbey St. Bathans, Berwickshire (O.S. Sh. 33), *Sp.* 232, 259.

Cowhythe Head, coast of Banffshire, 1½ m. E of Portsoy (O.S. Sh. 96), *Sp.* 210, 315, 319, 325, 329, 376, 426.

Coyle Hills, 3 ms. SW of Ballater, Aberdeenshire (O S. Sh. 65), *Sp.* 210, 313, 458.

"Craigan Mora," Creagan Mòra, north coast of Tiree (O.S. Sh. 42), *Sp.* 315.

Craig (Burn of), Rhynie, Aberdeenshire (O.S. Sh. 76), *Sp.* 259.

"Craigan Lochan," Creag an Lochain, 1 m. NNE of Meall nan Tarmachan, Loch Tay, Perthshire (O.S. Sh. 46), *Sp.* 469.

"Craigan Darroch," Craigendarroch, on the Dee, ¾ m. NW of Ballater, Aberdeenshire (O.S. Sh. 65), *Sp.* 210, 313, 458.

"Craig Arus," ? Creag a' Chàise, NW of Beinn Gulabin, head of Glen Shee, Perthshire (O.S. Sh. 65), *Sp.* 2.

"Craig Buroch," Craigbuirach, Marnoch, Banffshire (O.S. Sh. 86), *Sp.* 14, 85, 210, 319, 323, 324, 325, 370, 376, 462A, 481.

Craig Cailleach, ? ¾ m. W of Alltcailleach, Glen Muick, Aberdeenshire (O.S. Sh. 65), *Sp.* 210, 250.

Craig David, SE end of Bervie Brow, Kincardineshire (O.S. Sh. 67).

Craigdornie, River Deveron, Banffshire (O.S. Sh. 85), *Sp.* 370.

Craigellachie, railway junction, 3½ ms. SSW of Rothes, Banffshire (O.S. Sh. 85), *Sp.* 210.

Craigengell, Hill of Cushnie, Towie P., Aberdeenshire (O.S. Sh. 76), *Sp.* 458.

Craig Glas, Logie Coldstone, Aberdeenshire (O.S. Sh. 75), *Sp.* 370.

Craig Hall, Ceres, Fifeshire (O.S. Sh. 49), *Sp.* 450.

Craig Hill, Colmonell, Ayrshire (O.S. Sh. 7), *Sp.* 241.

Craigie Barns, 1 m. NE of Dunkeld, Perthshire (O.S. Sh. 55), *Sp.* 83.

D

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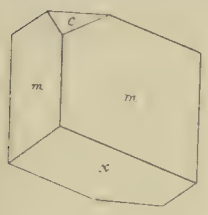
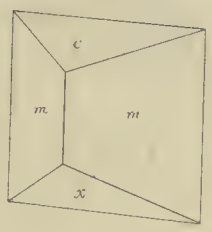
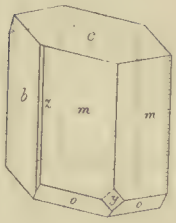
Orthoclase 313 Fig 1



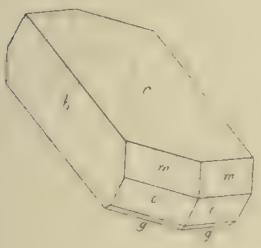
313 Fig. 2



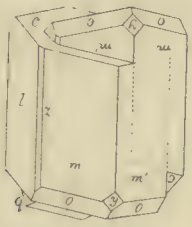
(313) Fig. 3.



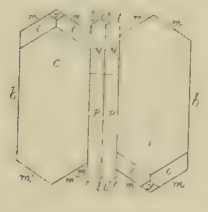
313 Fig 4.



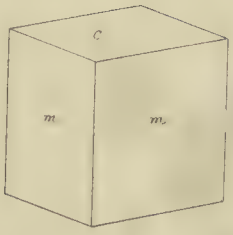
313 Fig 5.



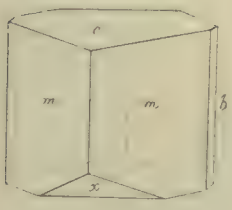
(313) Fig. 6.



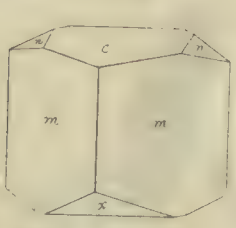
(313) Fig. 7.



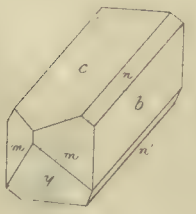
(313) Fig. 8.



313 Fig 9.



(313) Fig. 10.



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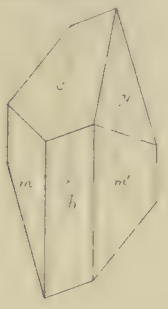
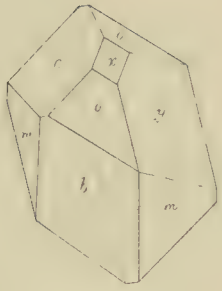
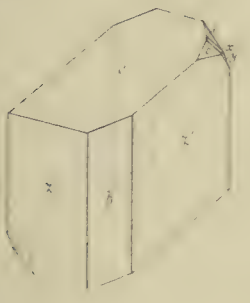
Microcline (315) Fig. 1.



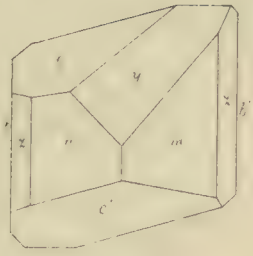
(315) Fig. 2.



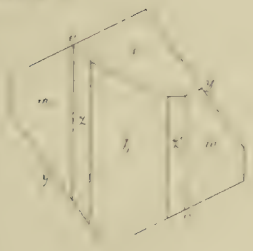
(315) Fig. 3.



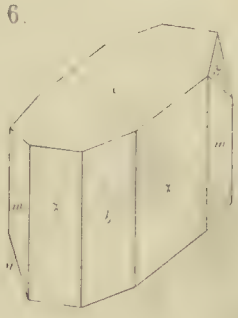
315, Fig. 4.



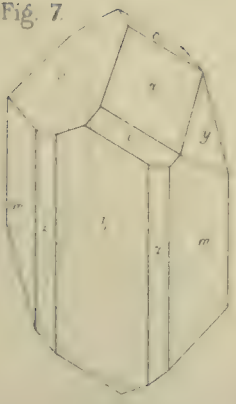
(315) Fig. 5.



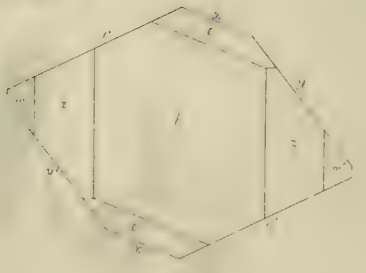
(315) Fig. 6.



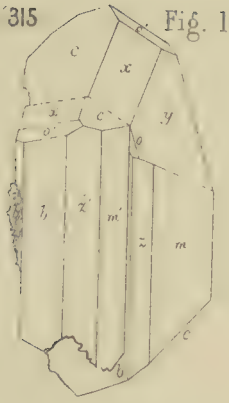
(315) Fig. 7.



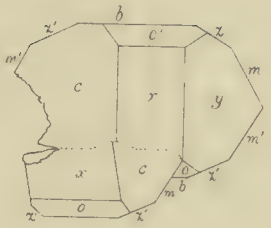
(315) Fig. 8



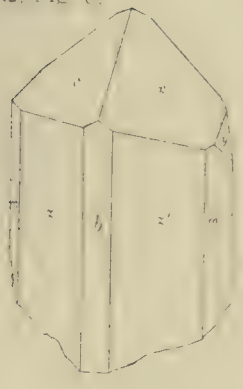
Microcline (315) Fig. 10.



(315) Fig. 11.



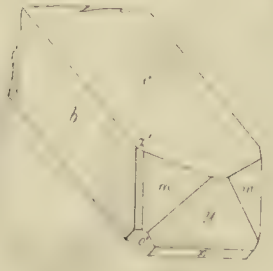
(315) Fig. 9.



(315) Fig. 12.

(315) Fig. 13.

(315) Fig. 14



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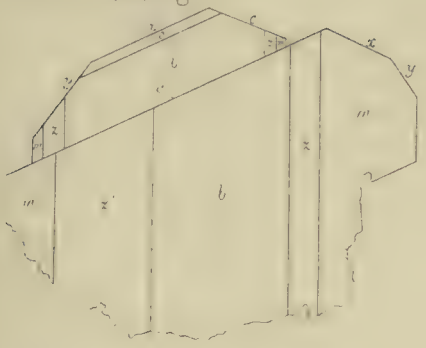
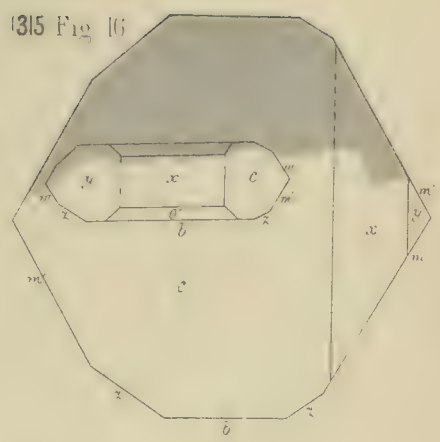
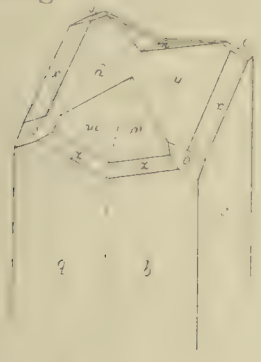
Microcline (315) Fig. 15.



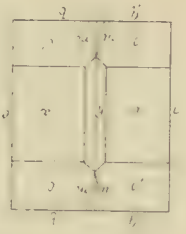
(315 Fig. 16



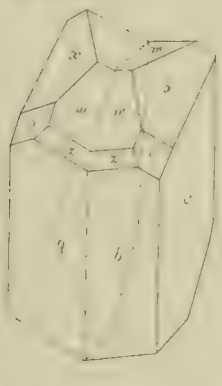
(315) Fig. 17.



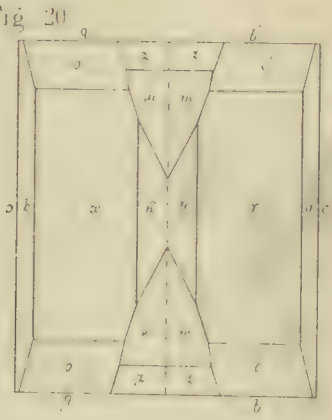
(315) Fig. 18.



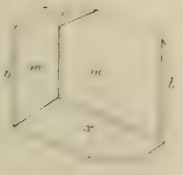
(315) Fig. 19



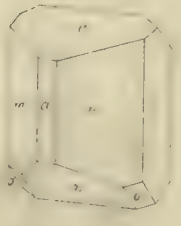
315 Fig. 20



315 Fig. 21

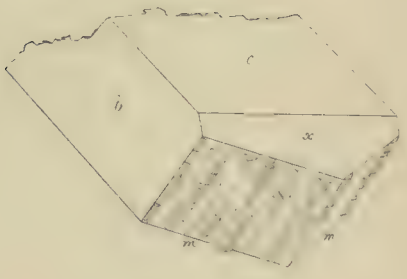


315. Fig. 22



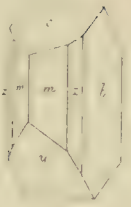
Microcline 315 Fig. 23.

315 Fig. 24.

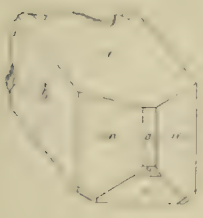


315 Fig. 25

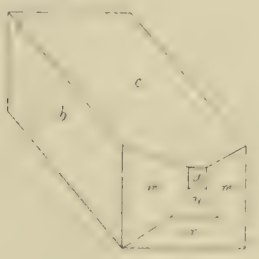
(315) Fig. 26.



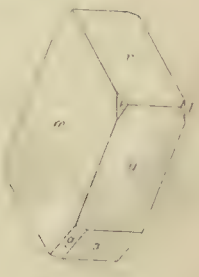
315 Fig. 27



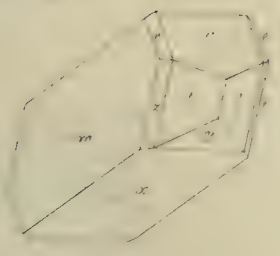
315 Fig. 28



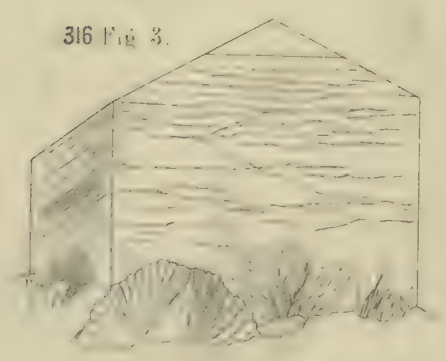
Albite (316) Fig. 1.



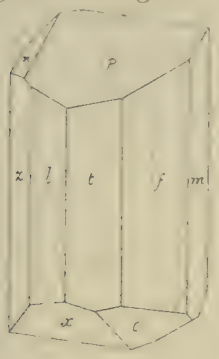
316 Fig. 2.



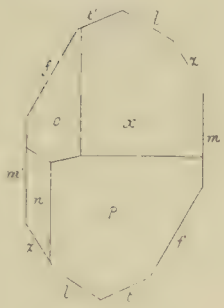
316 Fig. 3.



Oligoclase (317) Fig. 1.

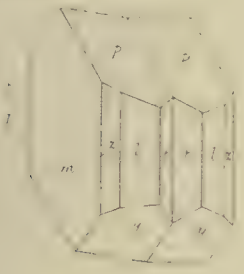


(317) Fig. 2.



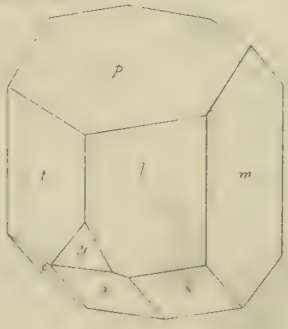
(317) Fig. 3

317 Fig. 5



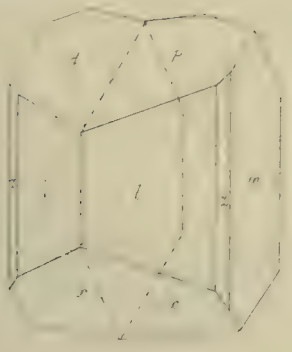
317 Fig. 4

Andesine 318 Fig. 1

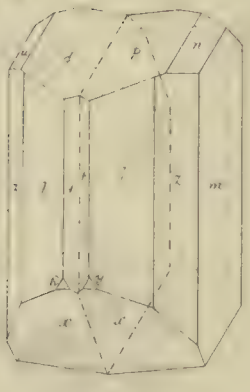


317 Fig. 6

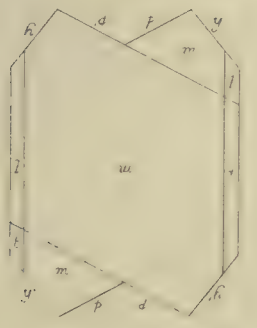
(318) Fig. 2.



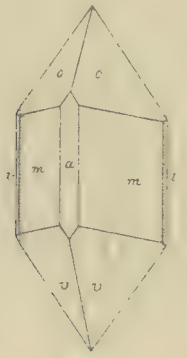
318 Fig. 3



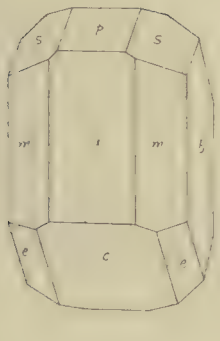
Labradorite (319).



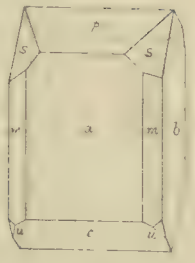
Augite (325) Fig. 1.



(325) Fig. 2.

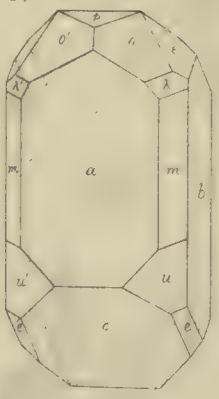


(325) Fig. 3.



325 Fig. 4.

(325) Fig. 5.



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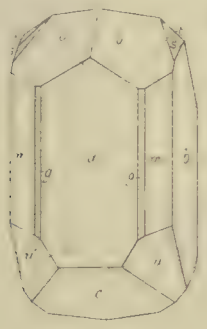
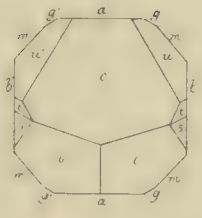
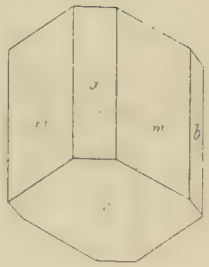
Augite (325) Fig. 6.



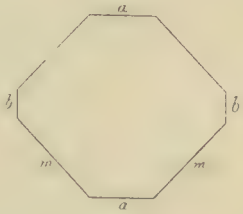
(325) Fig. 7



(325) Fig. 8.

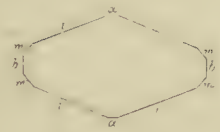


(325) Fig. 9.



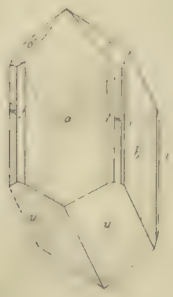
(325) Fig. 10.

(325) Fig. 11.



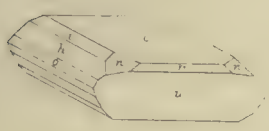
(325) Fig. 12.

(325) Fig. 13.

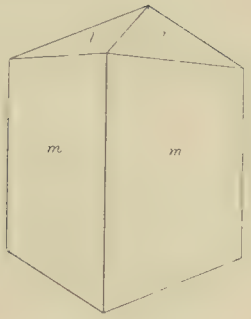


Millerlauer & Krabuhr, Paris

Pectolite (330)

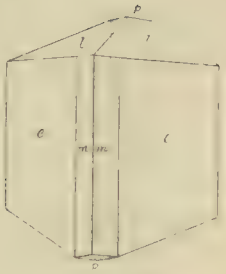


Hornblende (338) Fig. 1.

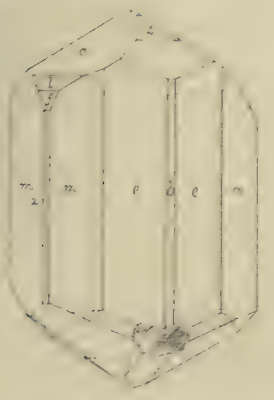


(338) Fig. 2.

(338) Fig. 3



338 Fig. 4



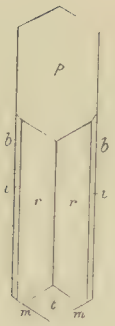
(338) Fig. 5.

Riebeckite (340) Fig. 1.

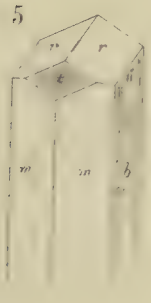
340 Fig. 2

Riebeckite (340) Fig 3

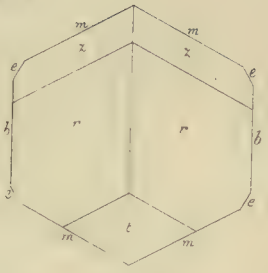
(340) Fig 4.



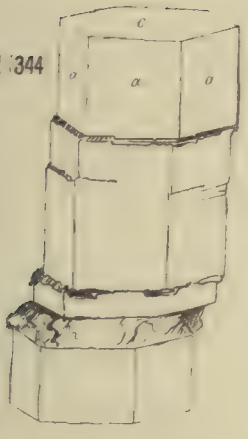
(340) Fig 5



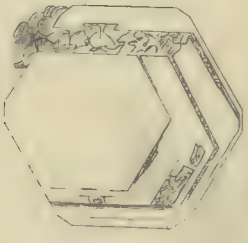
(340) Fig 6



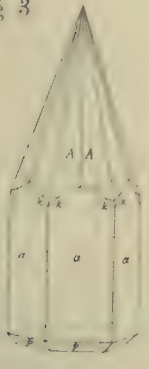
Beryl (344 Fig 1



344 Fig 2.



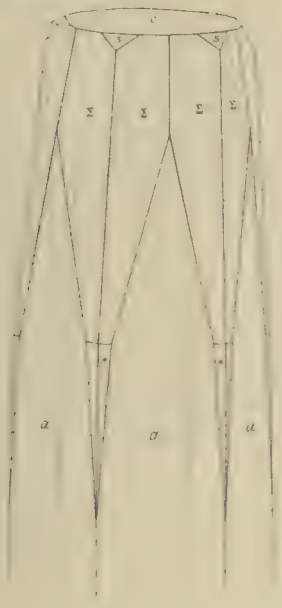
344 Fig 3



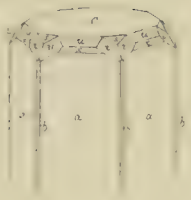
(344) Fig. 4.

M'Farlane & Erskine lith.

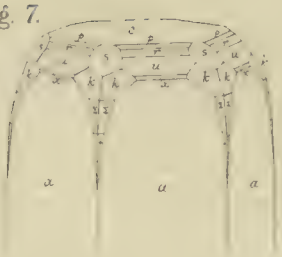
Beryl **344** Fig. 5



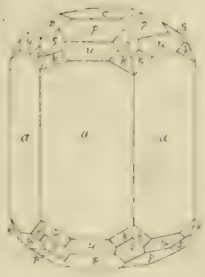
344 Fig. 6.



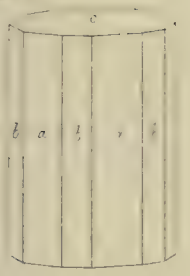
344 Fig. 7.



344 Fig. 8.

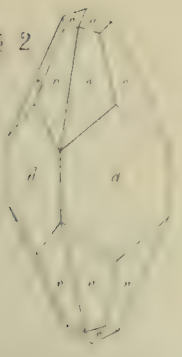


344 Fig. 9

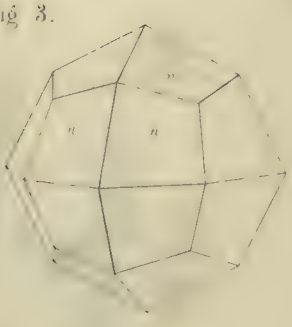


Garnet **370** Fig. 1

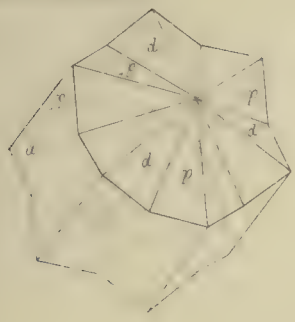
370 Fig. 2



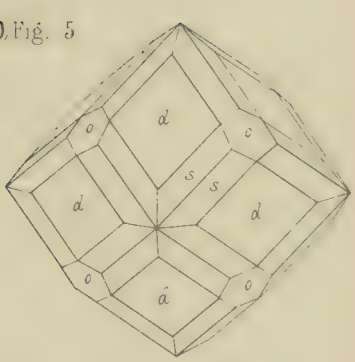
370 Fig. 3.



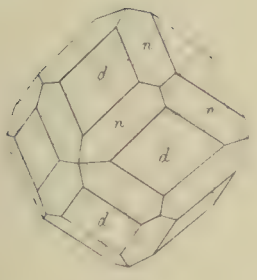
Garnet **370** Fig. 4



370 Fig. 5



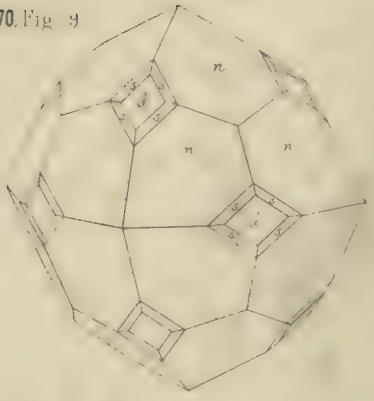
370 Fig. 6



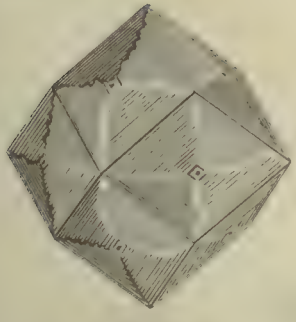
370 Fig. 7.

370 Fig. 8.

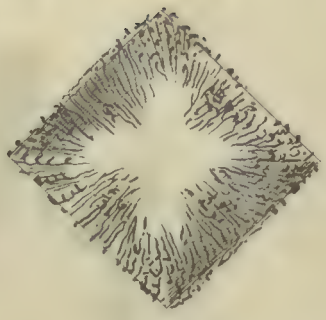
370 Fig. 9



370 Fig. 10.



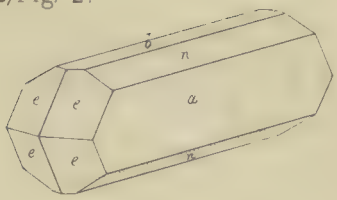
370 Fig. 11.



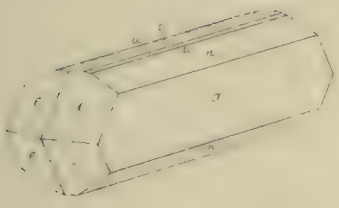
Millar, Shaw & Fergus, Edin.

Chrysolite (376) Fig 1.

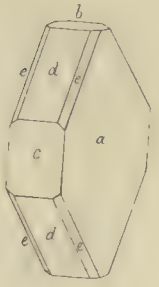
(376) Fig. 2.



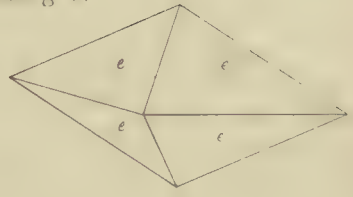
(376) Fig. 3.



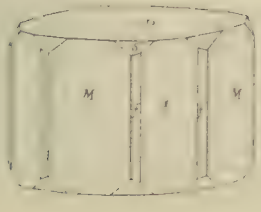
(376, Fig. 4



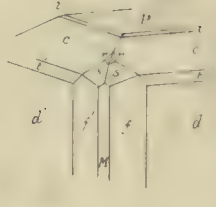
(376, Fig 5.



Idocrase 393 Fig 1

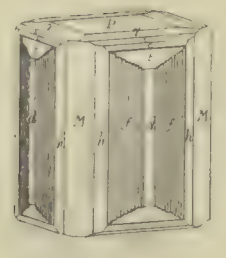


(393) Fig.

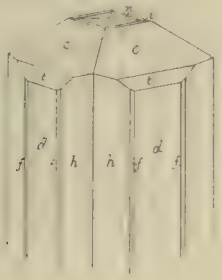


(393) Fig. 2.

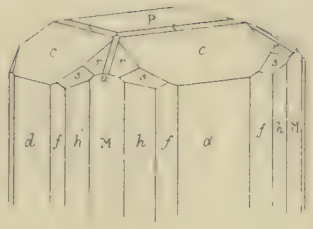
393 Fig 4.



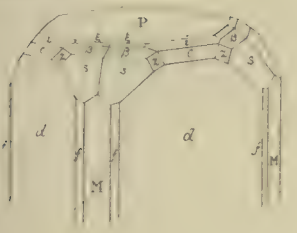
Idocrase (393) Fig. 5.



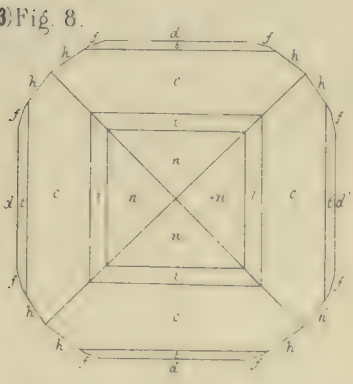
(393) Fig. 6.



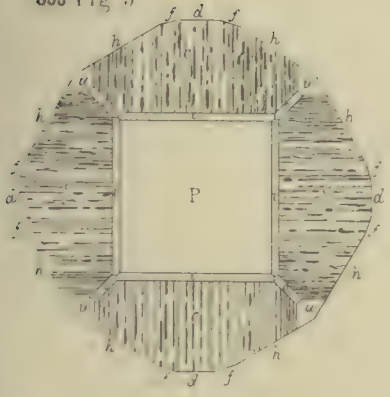
(393) Fig. 7.



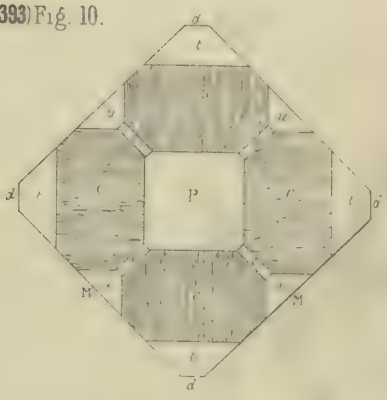
(393) Fig. 8.



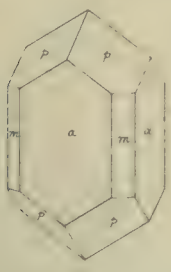
393 Fig. 9



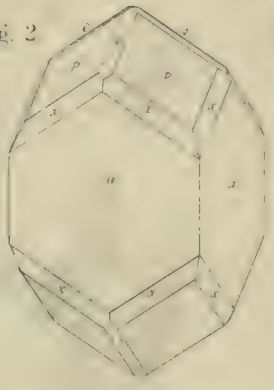
(393) Fig. 10.



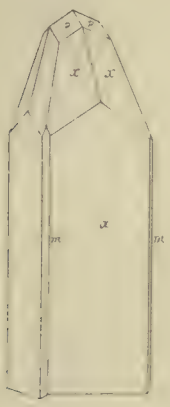
Zircon (394) Fig. 1.



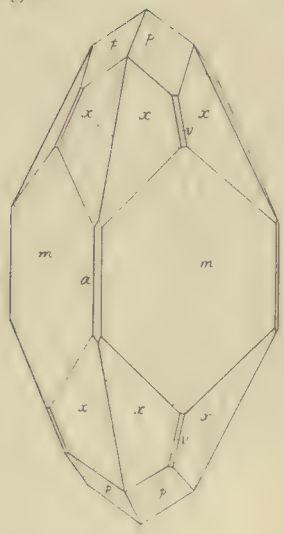
394 Fig. 2



Zircon (394) Fig 3

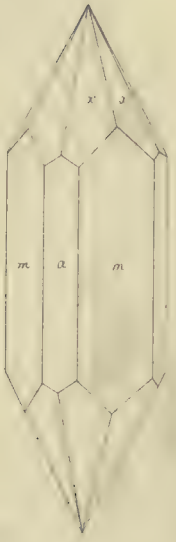


(394) Fig 4

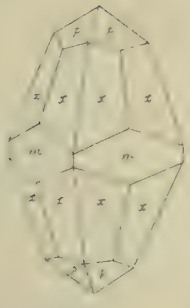


(394) Fig 5.

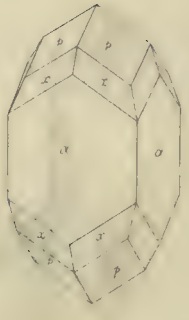
(394) Fig. 6.



(394) Fig. 7.

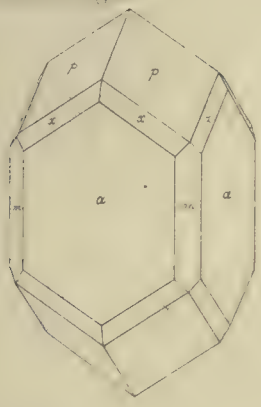


(394) Fig. 8

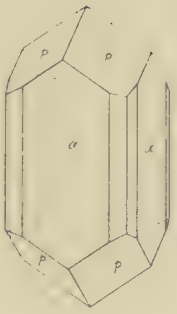


M Farrans & Erskine, edin.

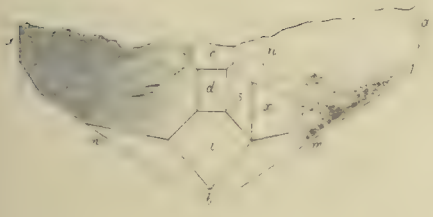
Thorite. 395. Fig. 1



(395) Fig. 2.

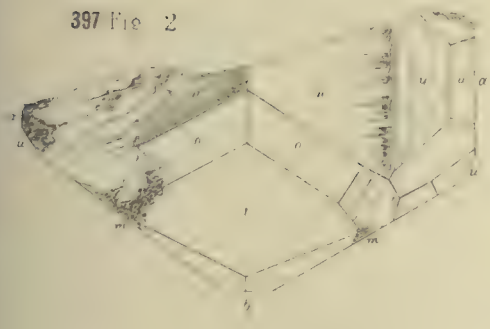


Topaz. 397. Fig. 1

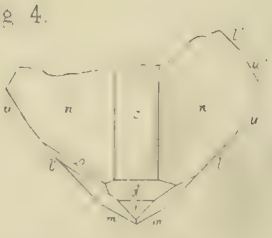


397) Fig. 3.

397 Fig. 2



397) Fig. 4.



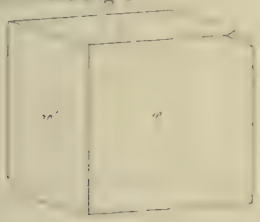
397 Fig. 5

397) Fig. 6.

Topaz (397) Fig. 7.

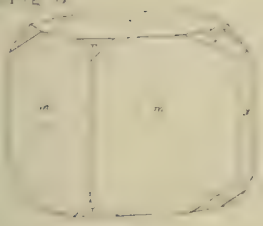
(397) Fig. 8.

Andalusite 398 Fig 1

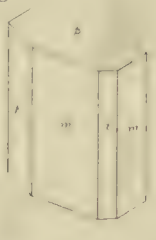


(398 Fig 2

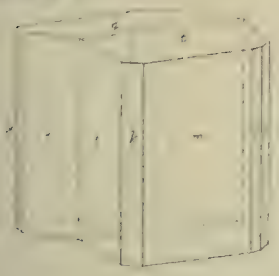
398 Fig 3



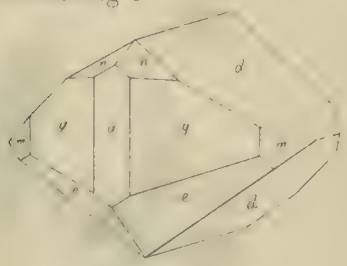
Kyanite (400) Fig. 1.



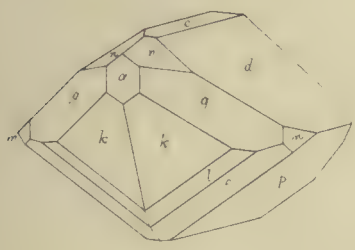
400 Fig 2



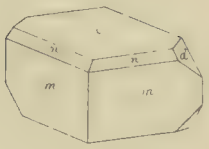
Datholite (401) Fig 1



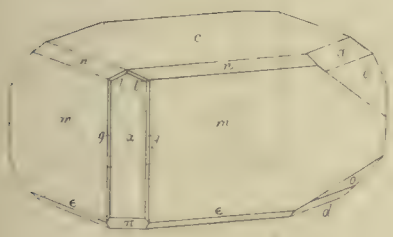
Datholite (401) Fig 2.



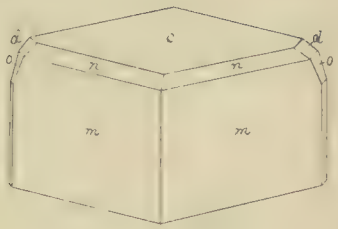
(401) Fig 3



401 Fig 4.



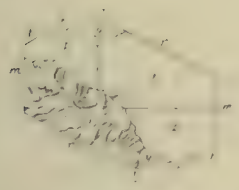
(401) Fig. 5.



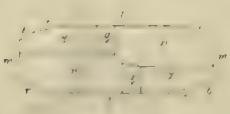
Zoisite (406)

Epidote (407) Fig. 1.

407 Fig 2

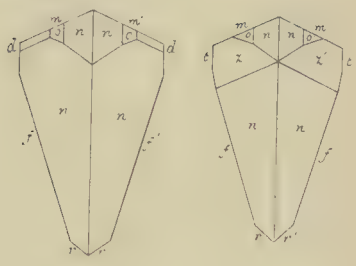


407 Fig 3

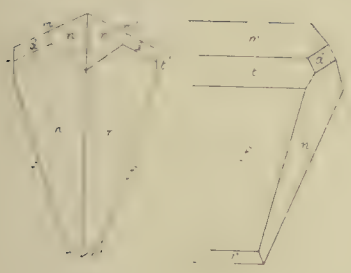


Epidote (407) Fig. 4.

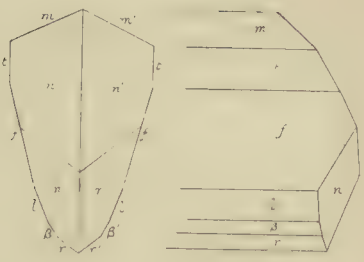
(407) Fig. 5.



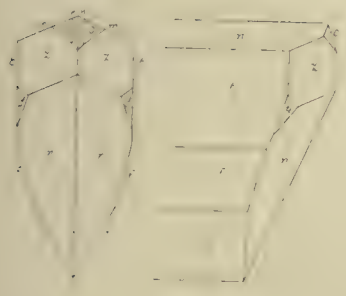
(407) Fig. 6.



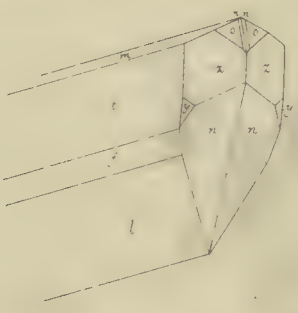
(407) Fig. 7.



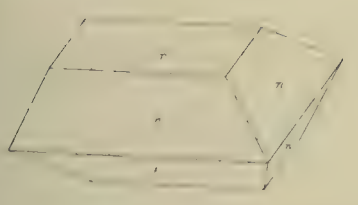
407 Fig. 8



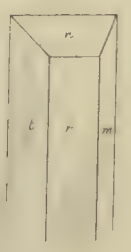
407. Fig. 9



407 Fig. 10.



407. Fig. 11



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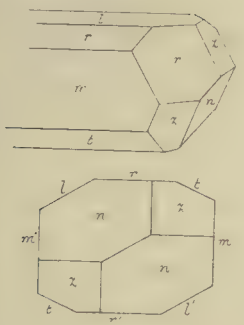
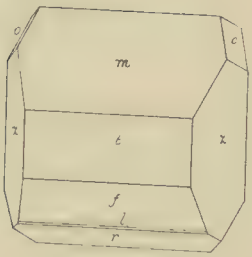
Epidote (407) Fig. 12.

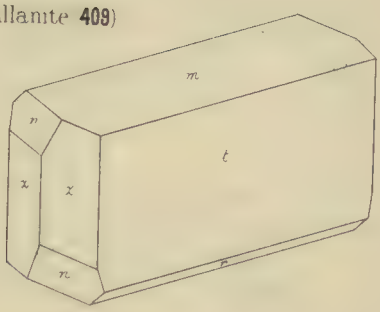


(407, Fig 13.

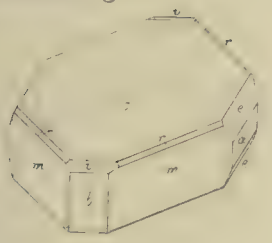


407 Fig 14.

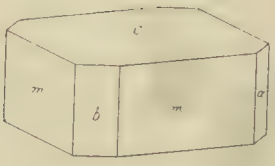
Allanite 409)



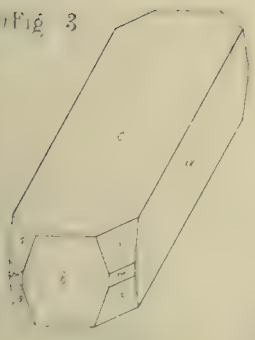
Prehnite (411) Fig. 1.



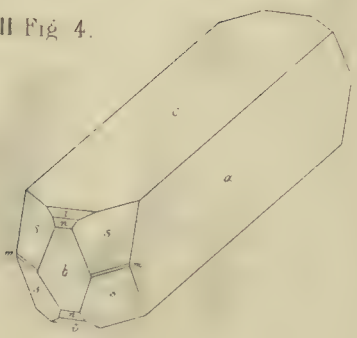
(411) Fig. 2.



411) Fig 3



(411 Fig 4.



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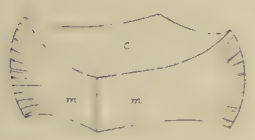
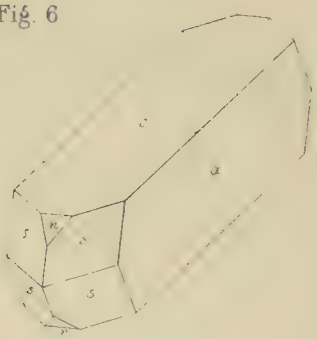
Prehnite 411. Fig 5

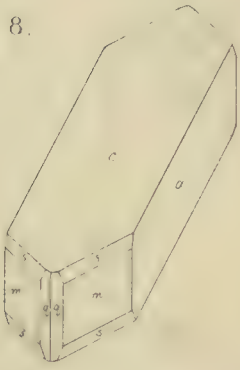


411 Fig. 6



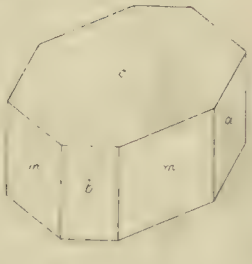
411 Fig. 7

411 Fig. 8.

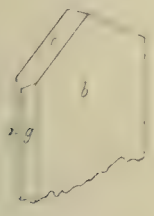


411 Fig. 9

411 Fig. 10



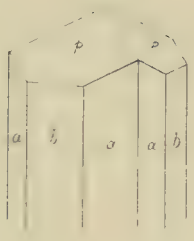
Calamine 423. Fig 1



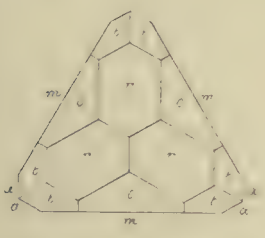
423 Fig. 2.

Leucite (426) Fig. 1.

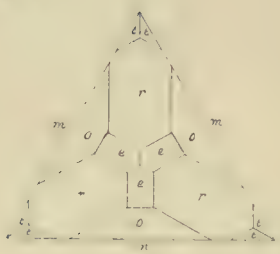
(426) Fig. 2.



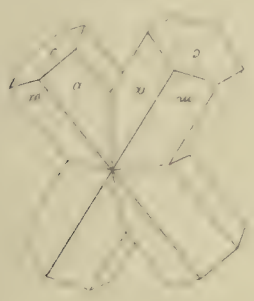
(426) Fig. 3.



(426) Fig. 4.

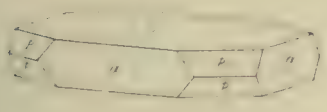


Staurolite (428) Fig. 1.

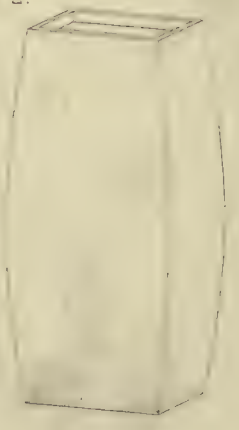


(428) Fig. 2.

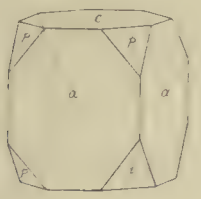
Apophyllite (435) Fig. 1.



(435) Fig. 2.



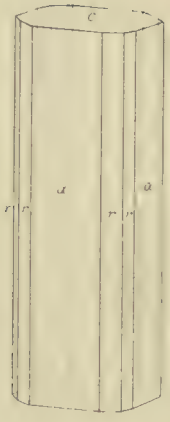
Apophyllite (435. Fig. 3.



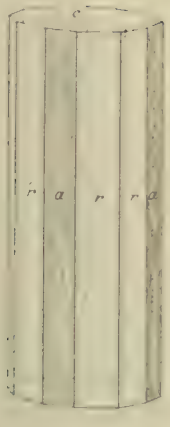
(435) Fig. 4

(435) Fig. 5.

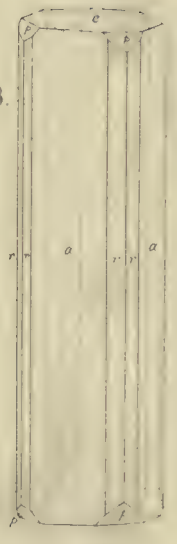
(435) Fig. 6.



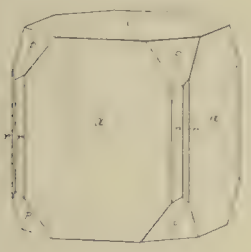
(435) Fig. 7.



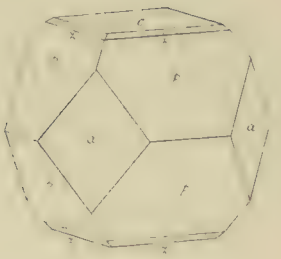
435) Fig. 8.



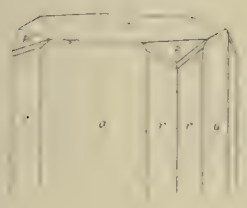
Apophyllite 435. Fig. 9.



435 Fig. 10.



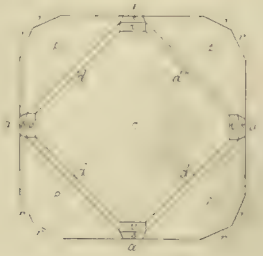
435 Fig. 11



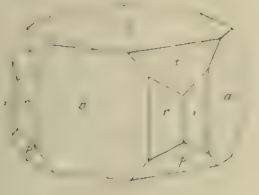
435 Fig. 12.

435 Fig. 13

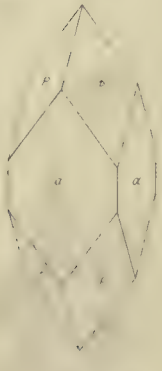
435. Fig. 14



435 Fig. 15

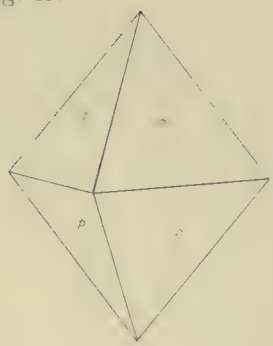


435 Fig. 16.

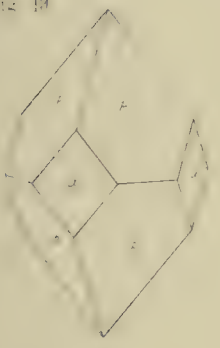


Apophyllite 435 Fig. 17

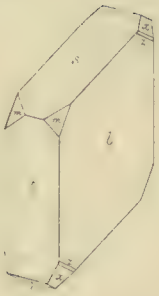
435 Fig. 18.



435 Fig. 19



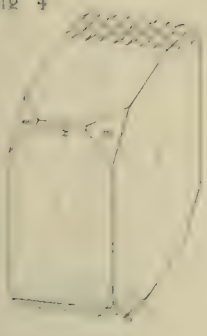
Heulandite 438 Fig. 1.



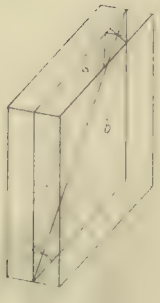
438 Fig. 2.

438 Fig. 3.

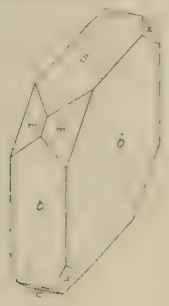
438 Fig. 4



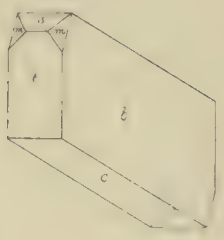
438 Fig. 5.



Heulandite (438) Fig. 6.

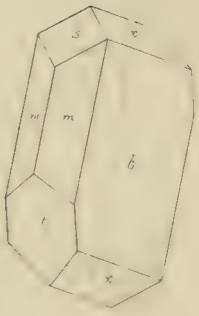


(438) Fig. 7.

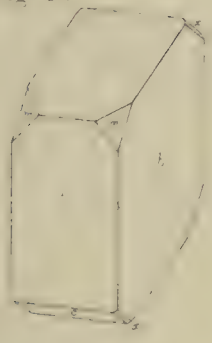


438 Fig. 8.

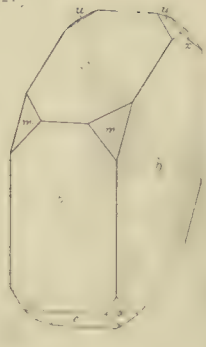
(438) Fig. 9.



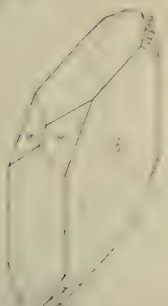
438 Fig. 10.



(438) Fig. 11.

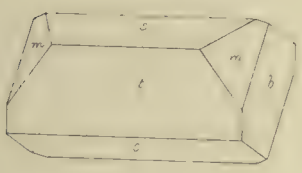


438 Fig. 12

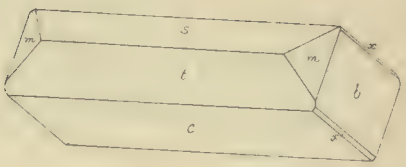


(438) Fig. 13.

Heulandite **438** Fig. 14.

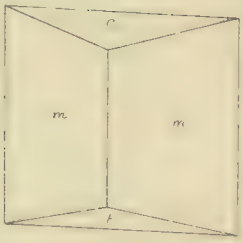


(**438**) Fig. 15.

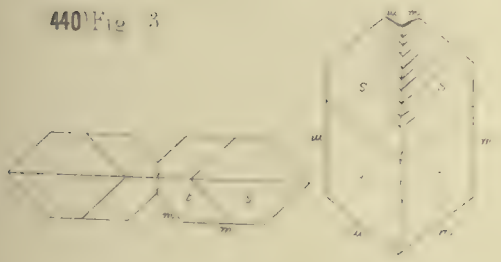


Epistilbite **440** Fig. 1.

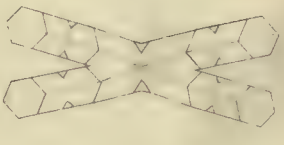
(**440**) Fig. 2.



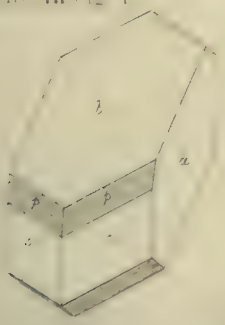
440 Fig. 3



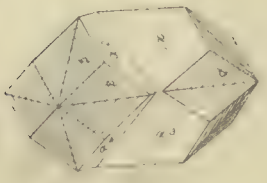
440 Fig. 4



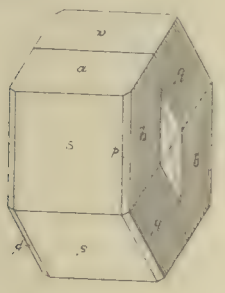
Phillipsite **441** Fig. 1.



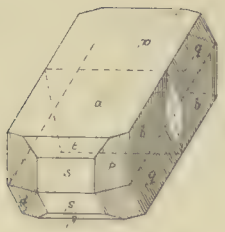
441 Fig. 2.



Harmotome (442) Fig 1.



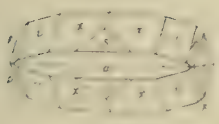
(442) Fig 2.



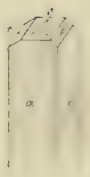
(442) Fig 3

(442) Fig. 4.

(442) Fig 5



(442 Fig 6



(442) Fig 7

(442) Fig 8

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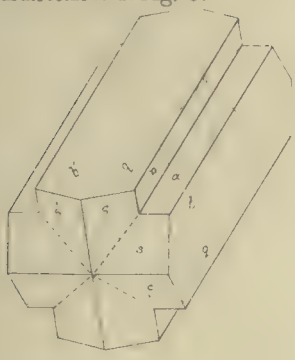
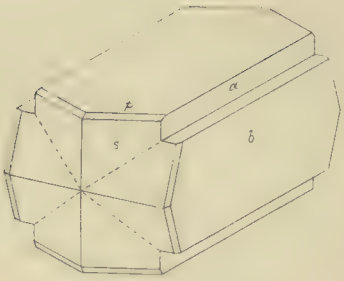
Harmotome (442) Fig. 9.

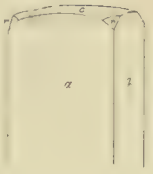


(442) Fig. 10.

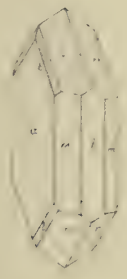


Stilbite (443) Fig. 1.

(443) Fig. 2.

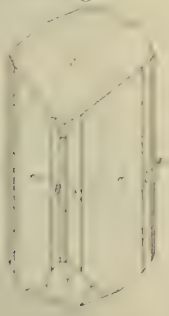


(443) Fig. 3.

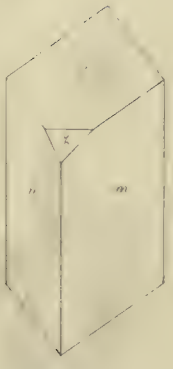


(443) Fig. 4.

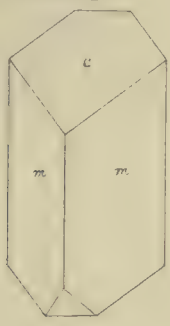
Laumontite (445) Fig. 1.



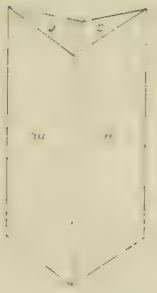
(445) Fig. 2.



Laumontite (445) Fig. 3.

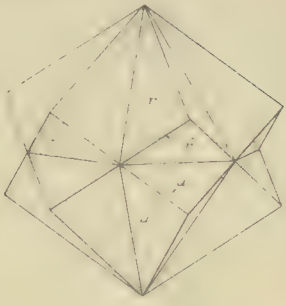


445 Fig. 4

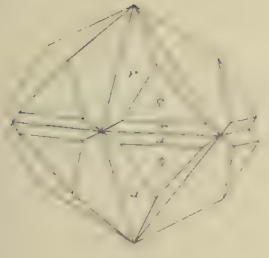


445 Fig. 5

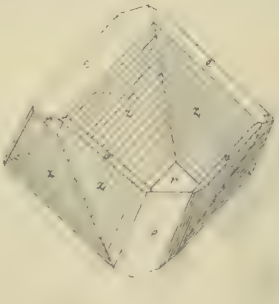
Chabazite (447) Fig. 1.



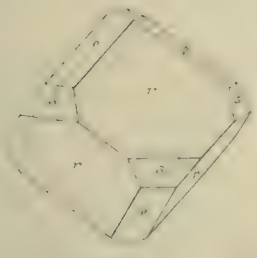
447 Fig. 2



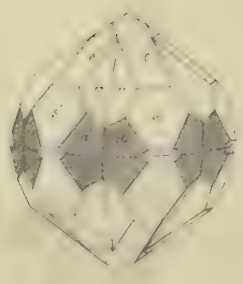
447 Fig. 3.



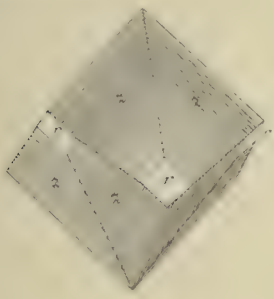
447 Fig. 4



447 Fig. 5



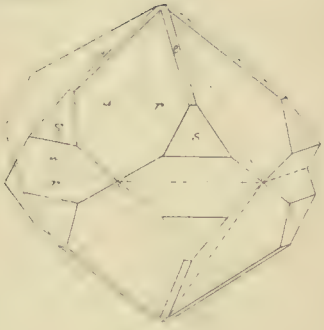
Chabazite (447) Fig. 6.



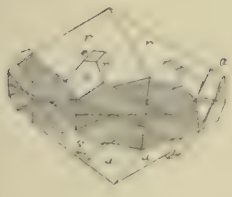
(447) Fig. 7.

447 Fig. 8

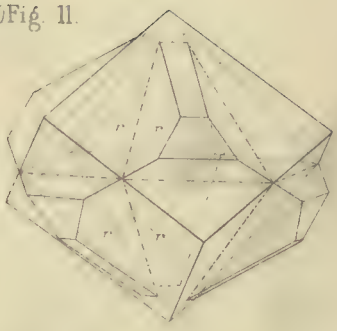
(447) Fig. 9



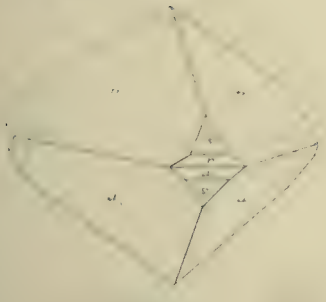
447 Fig. 10



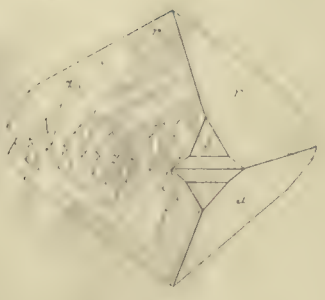
(447) Fig. 11.



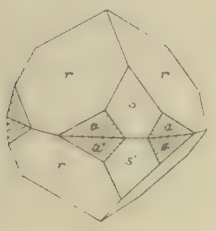
(447) Fig. 12.



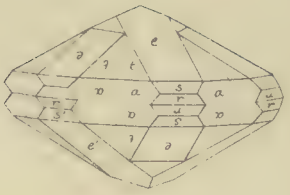
(447) Fig. 13



Chabazite (447) Fig. 14.

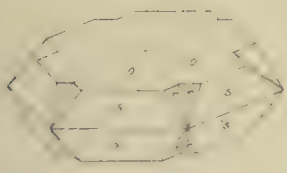


(447) Fig. 15.

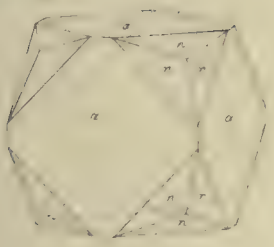


Analcime (450) Fig. 1.

Levyne (449)

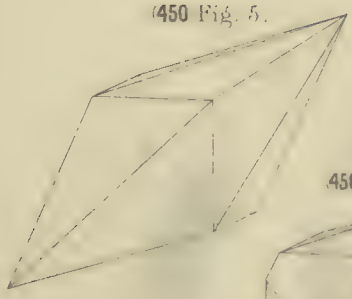


(450) Fig. 2.

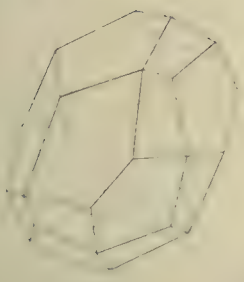


(450) Fig. 3

(450) Fig. 5.



(450) Fig. 4



(450) Fig. 6.

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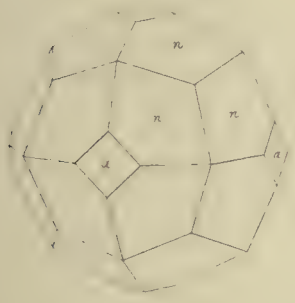
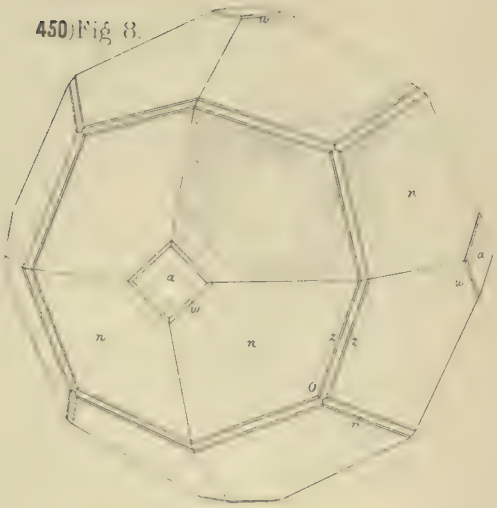
Analcime (450) Fig. 7.

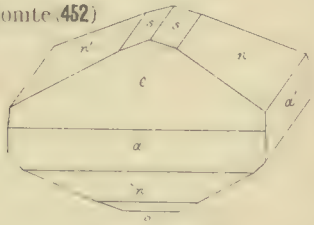


450) Fig. 8.

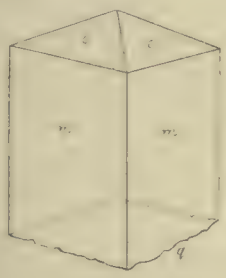


450) Fig. 9.

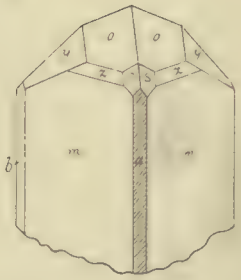
Edingtonite (452)



Natrolite (453) Fig. 1.

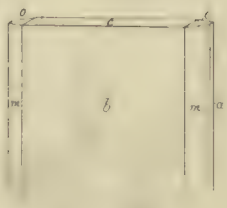


453) Fig. 2.

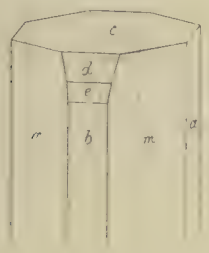


Thomsonite (456) Fig. 1.

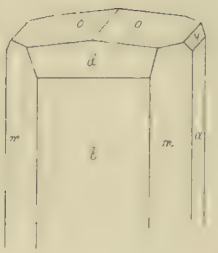
456) Fig. 2



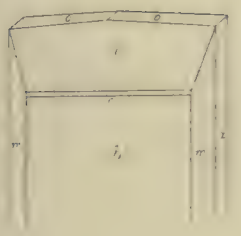
Thomsonite (456) Fig. 3



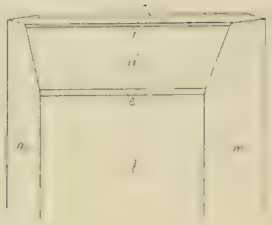
(456) Fig. 4



(456) Fig. 5.



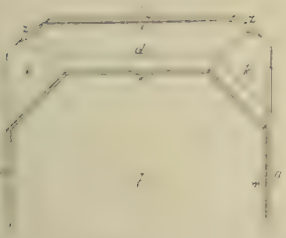
(456) Fig. 6



(456) Fig. 7.

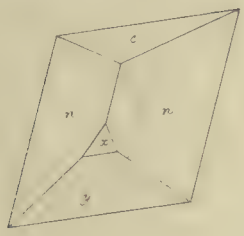
456 Fig. 8

456 Fig. 9

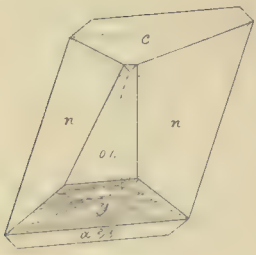


Zinnwaldite 461)

Sphene (510) Fig. 1.



(510) Fig. 2.



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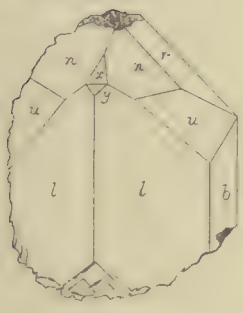

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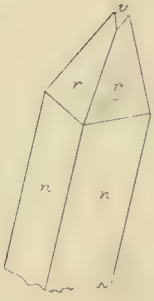
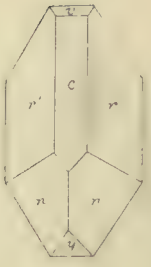
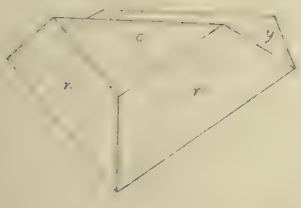


(510) Fig. 5.

(510) Fig. 6.

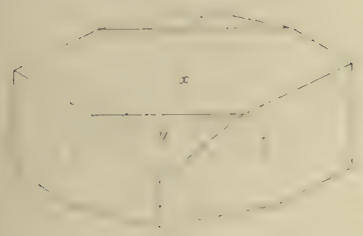


510 Fig 7



(510) Fig 8

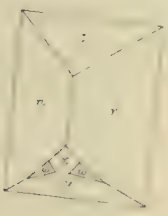
Sphene (510) Fig. 9



(510) Fig. 10.

(510) Fig. 11.

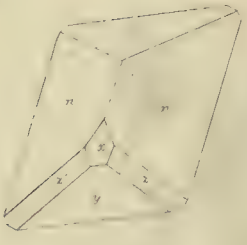
510 Fig. 12.



510) Fig. 13.

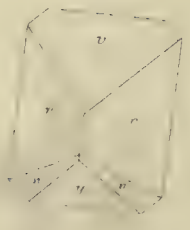
510 Fig. 14

510) Fig. 15.



510) Fig. 16

510 Fig. 17



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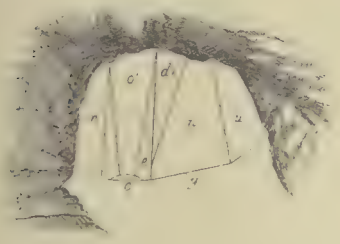
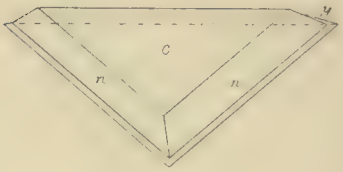
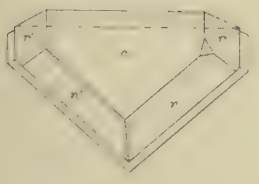


(510) Fig. 19.



(510) Fig. 20.



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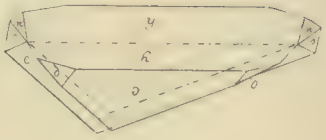
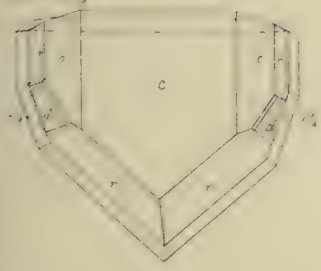


(510) Fig. 22



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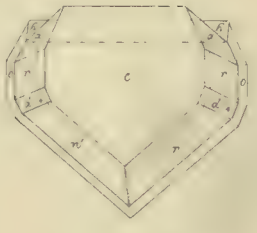
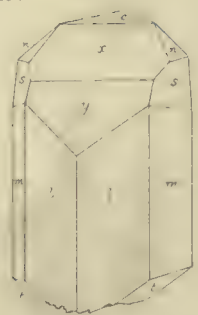


(510) Fig. 24

(510) Fig. 25.



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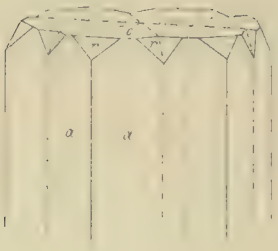
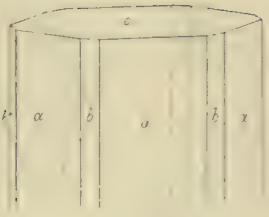
Sphene (510) Fig 26.

Apatite (549) Fig 1

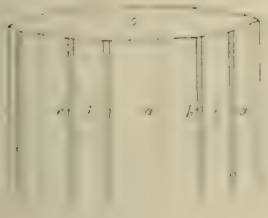


549 Fig 2

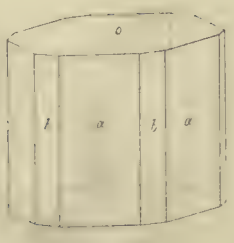
549 Fig 3



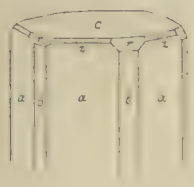
549 Fig 4



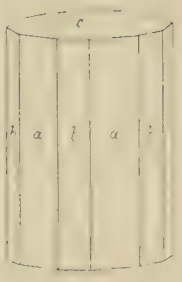
549 Fig 5



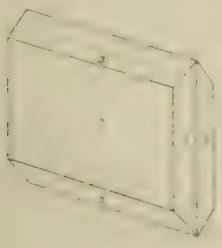
Apatite (549) Fig. 6.



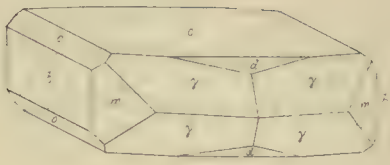
(549) Fig. 7



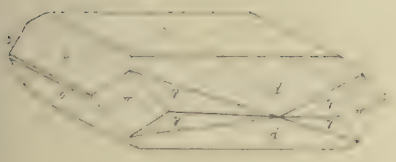
Baryte (719) Fig. 1



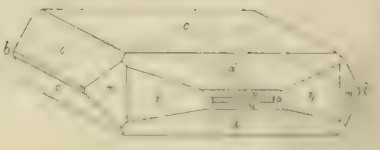
(719) Fig. 2.



719 Fig. 3

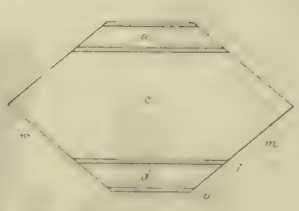


719 Fig. 4

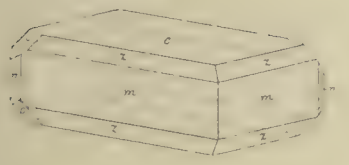


719 Fig. 5.

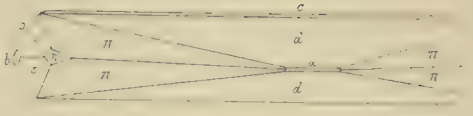
(719 Fig. 6



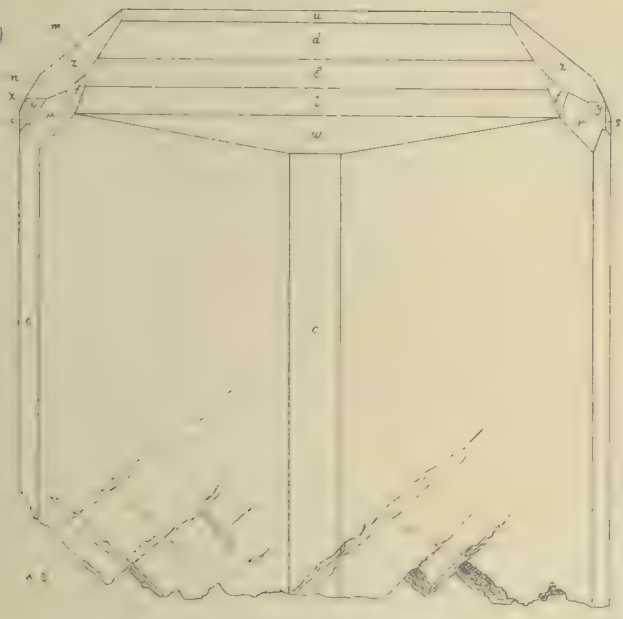
Barytes (719) Fig. 7.



(719) Fig. 8.

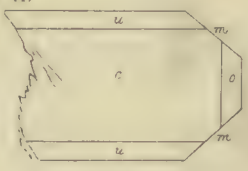


719 Fig. 10

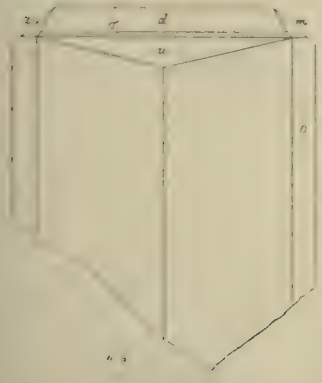


719 Fig. 9

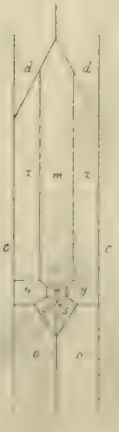
(719) Fig. 11.



719 Fig. 12



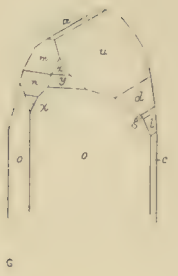
(719) Fig. 13



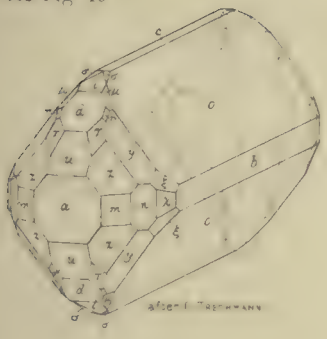
M'Farlane & Erskine Edin'

Barytes (719) Fig. 14.

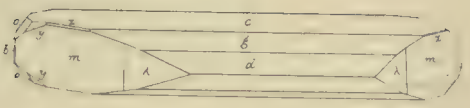
(719) Fig. 15.



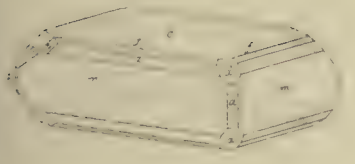
(719) Fig. 16



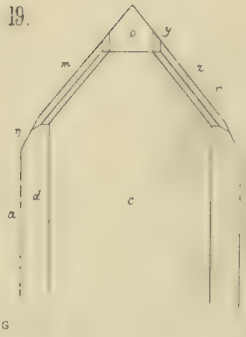
(719) Fig. 17.



(719) Fig. 18.



(719) Fig. 19.



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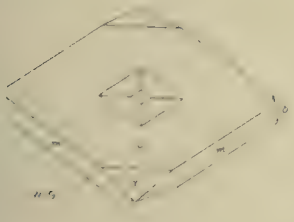

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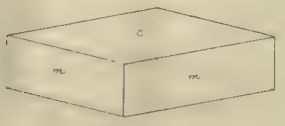
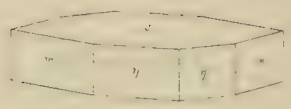
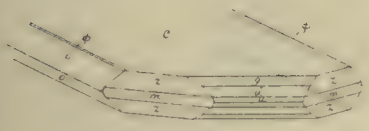


Barytes (719) Fig. 22.

(719) Fig. 23



(719) Fig. 24



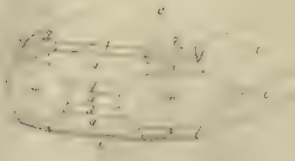
(719) Fig. 25.

(719) Fig. 26.

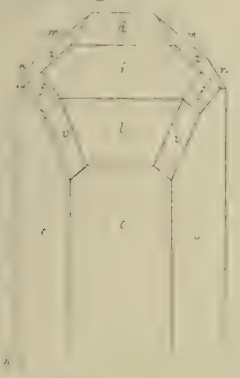
(719) Fig. 27.

(719) Fig. 28

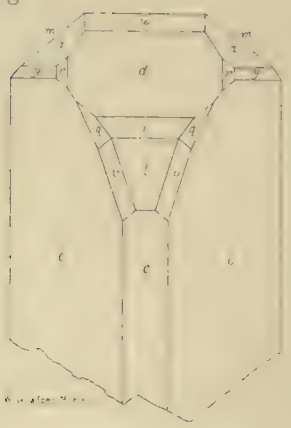
(719) Fig. 29



Barytes (719) Fig. 30.

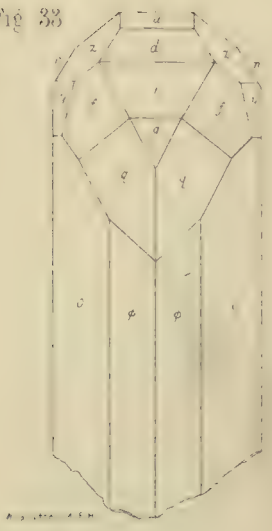


(719) Fig. 31.



719 Fig. 32.

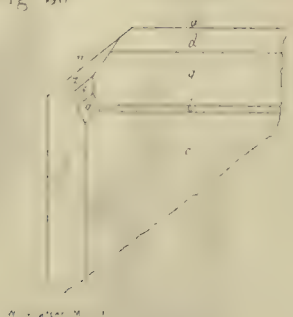
(719) Fig. 33



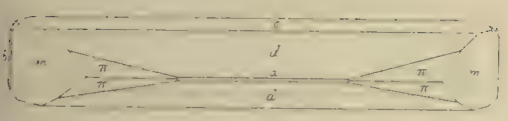
719 Fig. 34

719 Fig. 35

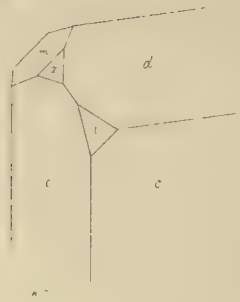
(719) Fig. 36



Barytes(719)Fig. 37.

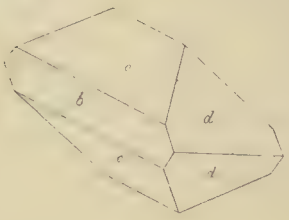


(719)Fig. 38

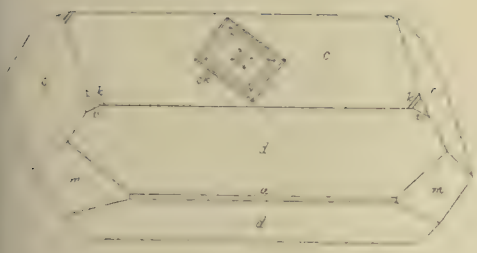


719 Fig. 39

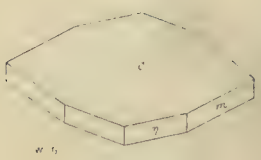
(719)Fig. 40.



(719)Fig. 41.

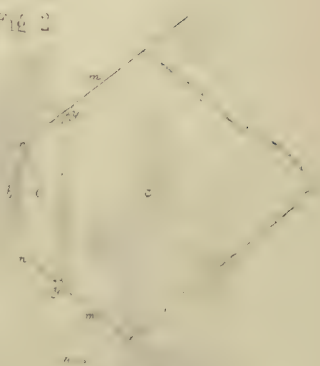


719 Fig. 42.

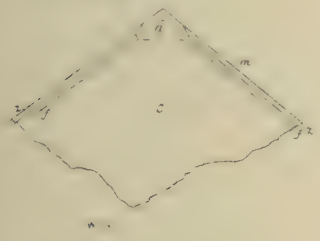


Celestine(720) Fig. 1

(720) Fig. 2



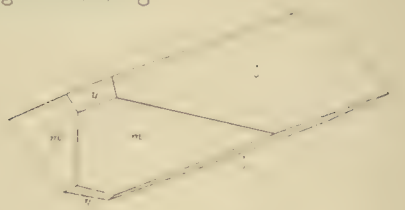
Celestine (720) Fig. 3.



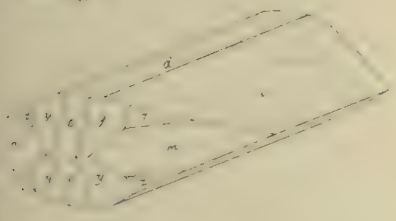
(720) Fig. 4

(720) Fig. 5.

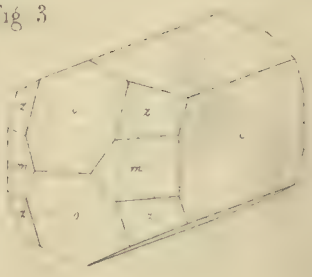
Anglesite (721) Fig. 1.



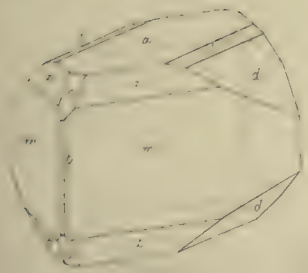
721 Fig. 2



(721) Fig. 3

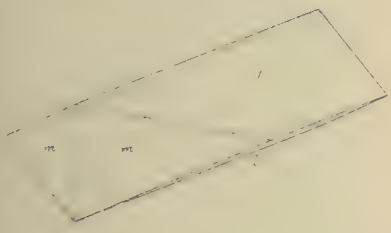


(721) Fig. 4



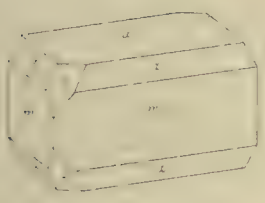
721 Fig. 5

Anglesite **721** Fig. 6

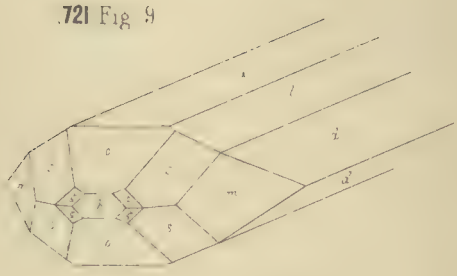


(721) Fig. 7.

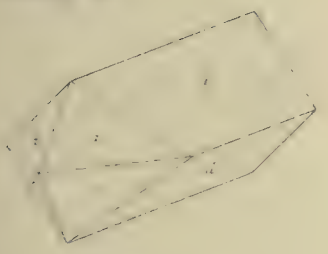
721 Fig. 8



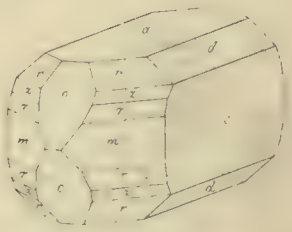
721 Fig. 9



721 Fig. 10



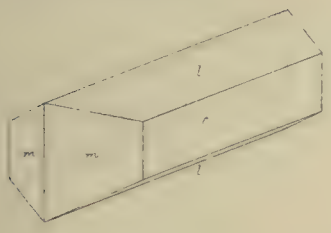
(721) Fig. 11.



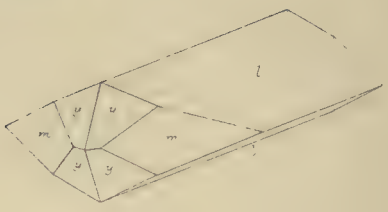
721 Fig. 12

(721) Fig. 13.

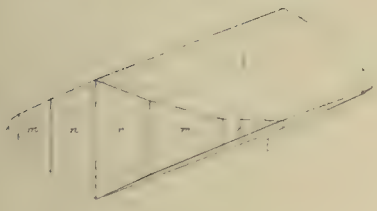
Anglesite (721) Fig. 14.



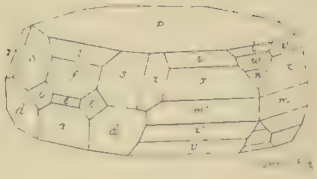
(721) Fig. 15.



(721) Fig. 16.

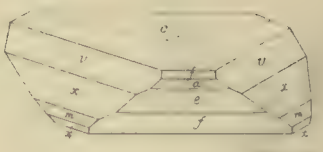


Leadhillite (734) Fig. 1.

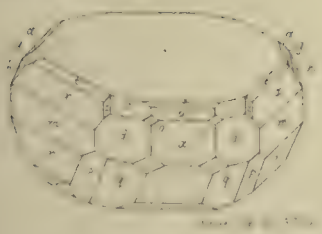


734 Fig. 2

734 Fig. 3.

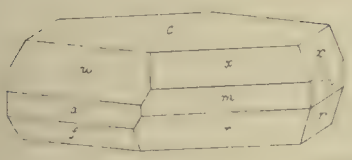


734 Fig. 4

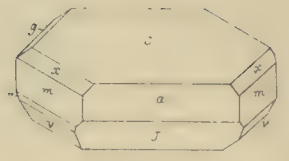


734 Fig. 5

Leadhillite (734) Fig. 6.

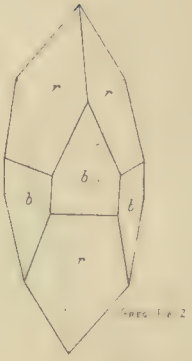


734) Fig. 7



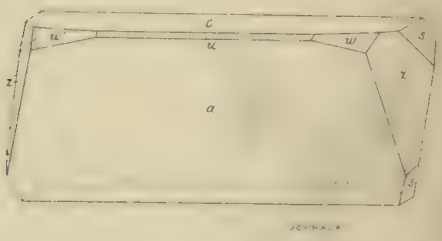
Susannite (734a) Fig. 1.

(734a) Fig. 2.



(734a) Fig. 3.

Lanarkite (737) Fig. 1

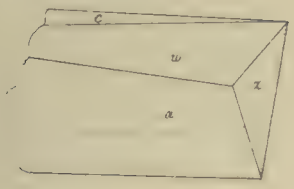


737 Fig. 2

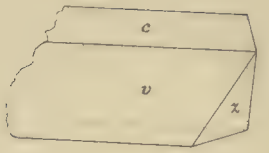
737) Fig. 2″

M'Farlane & Erskine Edin.

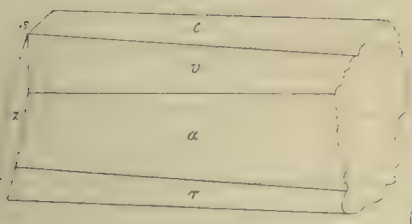
Lanarkite (737) Fig. 3.



(737) Fig. 4.

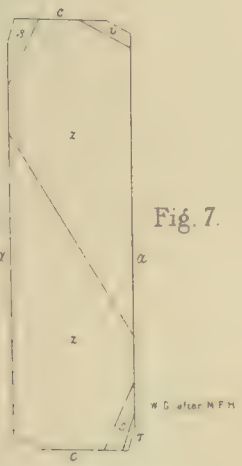


737. Fig. 5

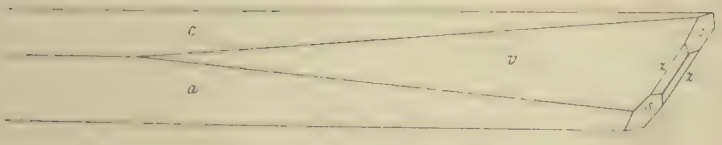


(737) Fig. 6.

(737) Fig. 7.



737. Fig. 8.

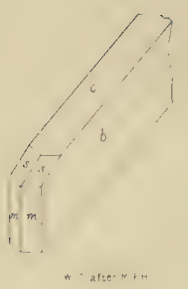


(737) Fig. 9.

M'Farlane & Erskine Edin.

Caledonite (739) Fig. 1.

(739) Fig. 2.



(739) Fig. 3.

(739) Fig. 4.

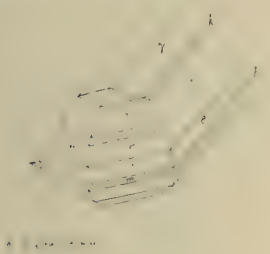
(739) Fig. 5.

(739) Fig. 6.

(739) Fig. 7

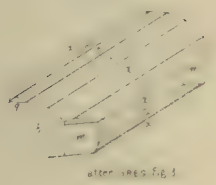
(739) Fig. 8

Caledonite **739** Fig. 9



739 Fig. 10

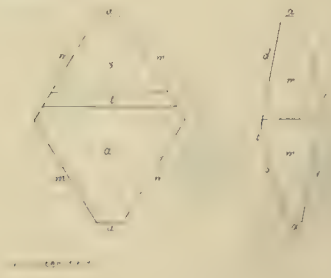
Lunarite **741** Fig. 1



741 Fig. 2.

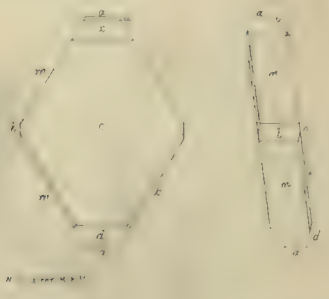
741 Fig. 3

741 Fig. 4



741 Fig. 5

741 Fig. 6.

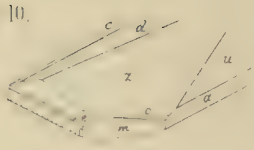


Linarite (741) Fig. 7.

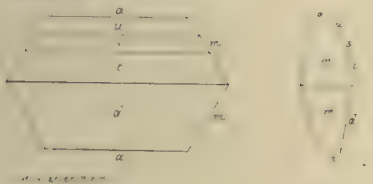
(741) Fig. 8.

741 Fig. 9

741 Fig. 10.

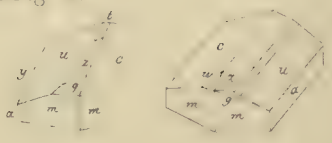


741 Fig. 11

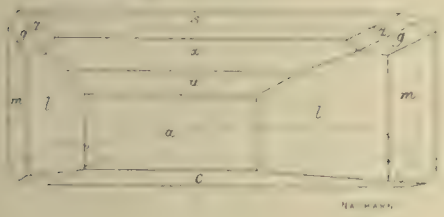


(741) Fig. 12.

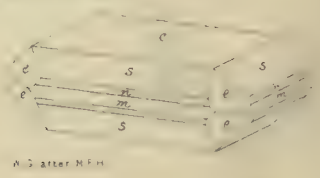
741 Fig. 13.



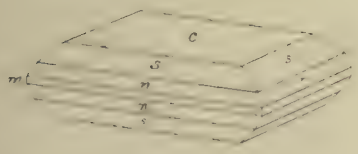
741 Fig. 14



Wulfenite 818 Fig. 1



818 Fig. 2



Eosite 819)