XXVI. *Description and Analysis of some Minerals.* By THOMAS THOMSON, M. D., F. R. S. L. & Ed. &c., Professor of Chemistry, Glasgow.

(Read 21st April 1828.)

1. *Anhydrous Silicate of Iron.*

THIS mineral was given me for examination by PATRICK DORAN, an Irish mineral-dealer, who discovered it in Slavcorrach, one of the Morne Mountains, on the north-east coast of Ireland, forming so conspicuous an object at the southern extremity of the county of Down.

The colour is dark brown, with something of the metallic lustre.

The mineral is foliated, and breaks easily into four-sided prisms, seemingly right ; though the summits are very obscure.

The fragments are strongly attracted by the magnet, but they have no poles.

Hardness 4.

Opaque.

Easily frangible.

Specific gravity 3.8846.

When heated in a glass-tube, it gives out ammoniacal vapours, and loses 1.97 per cent. of its weight.

Infusible *per se* before the blowpipe, but in the reducing flame acquires the metallic lustre, and assumes very much the appearance of magnetic iron-ore.

In muriatic acid it dissolves by the assistance of heat, without effervescence, leaving behind a quantity of silica in fine flocks,

but not gelatinous ; 20 grains being treated in this manner, left a quantity of white siliceous matter, which, after ignition, weighed 5.535 grains. This matter being fused with twice its weight of carbonate of soda, dissolved in muriatic acid, and treated in the usual way, was found composed of,

Silica,	4.861
Peroxide of iron, . . .	0.290
Red oxide of manganese,	0.384
	<hr/>
	5.535

The muriatic solution was evaporated to dryness, and the dry residue digested in water, acidulated with muriatic acid, till every thing soluble was taken up. There remained undissolved a quantity of silica, which weighed after ignition 1.059 grains.

Suspecting the presence of manganese in the muriatic acid solution, I neutralized it with ammonia, and threw down the iron (it had been peroxidized by digestion with nitric acid), by benzoate of ammonia.

The benzoate of iron, after edulcoration and drying, was burnt in an open crucible, and kept red hot till the iron was brought into the state of peroxide. It weighed 14.95 grains, equivalent to 13.46 grains of protoxide of iron.

The residual liquid was mixed with an excess of carbonate of soda, and boiled in a flask. Nothing was obtained except a trace of alumina too small to be weighed.

Thus the constituents of the mineral, by this analysis, are,

Silica,	9.92	or	29.60
Protoxide of iron, . .	13.460		67.30
Peroxide of iron, . .	0.290		1.45
Red oxide of manganese,	0.384		1.92
	<hr/>		<hr/>
	20.054		100.27

There is a slight excess, which would be diminished by reducing the peroxide of iron and the red oxide of manganese to protoxides ; for that is the state in which they probably exist in the mineral. This reduction being made, the constituents of the mineral will be

Silica,	29.60
Protoxide of iron, . . .	68.605
Protoxide of manganese, . .	1.857
	<hr/>
	100.062

This is equivalent to

14.8 atoms silica,
15.24 atoms protoxide of iron,
6.40 atoms protoxide of manganese.

If we admit the 0.4 oxide of manganese to have been united with 0.4 protoxide of iron, there will remain

14.8 atoms silica,
14.8 atoms protoxide of iron.

It is obvious from this that the mineral is a simple anhydrous silicate of iron, composed of

1 atom silica,	2
1 atom protoxide of iron, . .	4.5
	<hr/>
	6.5

This mineral adds another species to the family of silicated iron already so numerous ; though there can be little doubt that many more species will be added hereafter. The following

enumeration of the species at present known may not be unacceptable to mineralogists :

1. Sp. *Sideroschisohite*, or disilicate of iron, discovered in Brazil, and described by Dr WARNEKINK*. It is composed of

1 atom silica,	2
2 atoms protoxide of iron, . .	9
1 atom water,	1.125
	<hr/>
	12.128

2. Sp. *Chamoisite*, occurring in beds at Chamoisin, in the Valois, and described and analyzed by Berthier†. Its constituents are,

1 atom silica,	2
2 atoms protoxide of iron, . .	9
2 atoms water,	2.25
	<hr/>
	13.25

3. Sp. *Cronstedtite*, discovered at Przibram in Bohemia, described by ZIPPE, and analysed by Professor STEINMANN‡. Its constituents are,

1 atom silica,	2
1 atom protoxide of iron, . .	4.5
1 atom water,	1.125
	<hr/>
	7.625

* POGGENDORFF'S Annalen, i. 387.

† Ann. des Min. V. 393.

‡ SCHWEIGGER'S Jahrbuch, ii. 69.

4. Sp. Anhydrous silicate of iron from the Morne Mountains, described and analyzed in this paper.

5. Sp. *Hedenbergite*, found at Tunaberg, in Sodermanland, Sweden, and described and analyzed by HEDENBERG *. Its constituents seem to be,

3 atoms silica,		6
1 atom protoxide of iron,		4.5
2 atoms water,		2.25
		<hr/>
		12.75

6. Sp. *Chloropal*, discovered by JOSEPH JONAS, near Unghwar, in Hungary, along with the opal, and described and analyzed by BERNHARDI and BRANDES †. Its constituents are,

3 atoms silica,		6
1 atom protoxide of iron,		4.5
2½ atoms water,		2.8125
		<hr/>
		13.3125

7. *Arfwedsonite*, so called by Mr BROOKE, but formerly known by the name of *Ferruginous Hornblende*, brought from Kargardluar duk in Greenland, by Sir CHARLES GIESECKE'. It was analyzed several years ago in my laboratory, and found composed of

15 atoms silica,
4 atoms peroxide of iron,
1 atom deutoxide of manganese.

* *Afhandlingar*, ii. 154.

† SCHWEIGER'S *Jahrbuch*, v. 29.

It is therefore a compound of

4 atoms pertersilicate of iron,
1 atom tersilicate of manganese.

8. Sp. *Hisingrite*. This mineral was discovered in the iron mine of Gillinge, in Södermanland, and was first described and analyzed by HISINGER in 1810*.

Its constituents are,

4 atoms persilicate of iron,
1 atom silicate of alumina,
4 atoms water.

9. Sp. *Knebite*. This is a name given by DOBEREINER to a mineral of unknown locality, which he described and analyzed †. Its constituents are,

1 atom silicate of iron,
1 atom silicate of manganese.

10. Sp. *Pyrosmalite*. Discovered in the iron mine of Bjelke, Nordmark in Wermland, Sweden, described by HAUSSMANN, and analyzed by BERZELIUS and HISINGER ‡, is composed of,

14 atoms sesquisilicate of iron,
5 atoms sesquisilicate of manganese,
1 atom sesquichloride of iron.

* *Afhand.* iii. 304.

† SCHWEIGGER'S *Journ.* xxi. 49.

‡ *Afhand.* iv. 317.

Or, if we consider the sesquichloride as replacing a certain portion of sesquisilicate of iron, then the constituents will be,

3 atoms sesquisilicate of iron,
1 atom sesquisilicate of manganese.

11. Sp. *Nontronite*. Discovered at Nontron, in the Department of Dordogne, France, and described and analyzed by BERTHEIM *. Its constituents are,

7 atoms terpersilicate of iron,
2 atoms bisilicate of alumina,
1 atom silicate of magnesia.

It might be considered as a compound of two distinct minerals.

The first composed of

1 atom terpersilicate of iron.
1 atom silicate of magnesia.

The second of

3 atoms terpersilicate of iron.
1 atom bisilicate of alumina.

One integrant particle of the first of these, combined with two integrant particles of the second, would constitute nontronite. On this view of its constitution, nontronite might be represented by the following formula :

* Ann. de Chim. et de Phys. xxxvi. 22.

2. *Hydrolite.*

This mineral seems to have been first discovered by LEMAN, in the cavities of amygdaloidal rocks, in the Vicentine. These specimens were analyzed by VAUQUELIN, under the name of *Sarcolite*; and HAÜY considered them as mere varieties of analcime. Some years ago the mineral was discovered in the county of Antrim, Ireland, lodged in amygdaloidal rocks, precisely as in the Vicentine. The specimens in my possession were procured from PATRICK DORAN, an Irish mineral-dealer, who had collected them in this locality. Dr BREWSTER gave an account of the physical properties of this mineral in his scientific Journal *, under the name of *Gmelinite*; and HAIDINGER has described it under the same name, in an appendix added to his English translation of MOHS' Mineralogy †.

Colour snow-white.

All the specimens which I have seen, are in double six-sided truncated pyramids, with a short six-sided prism between them. The inclination of y on y' , according to Dr BREWSTER'S measurement, is $83^{\circ} 36'$.

Translucent.

Hardness 3.5. Scratches calcareous spar, but not fluor-spar.

Lustre vitreous.

Specific gravity 2.054.

Very easily frangible.

Before the blowpipe, swells out and assumes the appearance of an enamel; but does not fuse into a transparent glass.

* Vol. ii. p. 262.

† Vol. iii. p. 174.

When exposed to a red heat, it gives out water, and nothing else, and loses 29.866 per cent. of its weight.

I subjected it to analysis; but, as the quantity of it in my possession only amounted to 5.3 grains after ignition, it will be necessary to state the steps of the analysis, to enable the reader to judge of the degree of confidence to which my experiments are entitled.

The 5.3 grains of the ignited mineral, after having been reduced to a fine powder, were intimately mixed with 30 grains of carbonate of barytes, in a platinum crucible, and the mixture was exposed to a strong red heat, and kept at that temperature for an hour. The whole was then dissolved in dilute muriatic acid. The undissolved portion having the appearance of hydro-lite undecomposed, was mixed with 30 grains of carbonate of barytes, and kept in a strong heat for two hours. It was then dissolved in dilute muriatic acid. A few flocks remained undissolved; but they were light and loose, indicating that they had been acted upon by the barytes. The two solutions were mixed together, and evaporated to dryness in a porcelain basin. The dry mass was digested for some time in water acidulated with muriatic acid. The whole was then thrown on the filter, to separate the undissolved silica from the solution. The silica on the filter being washed, dried, and ignited, weighed 4 grains. It was laid aside for examination.

The muriatic acid solution was neutralized by caustic ammonia added slightly in excess. A brown precipitate fell, weighing, after ignition, 1.08 grains. Being digested in muriatic acid, it left undissolved 0.055 grains of a grey matter, which, tested by the blowpipe, proved to be silica very slightly tinged with iron.

The muriatic solution thus freed from silica was mixed with potash-ley in considerable excess, and heated in a flask. There was precipitated a quantity of peroxide of iron, weighing, af-

ter edulcoration, drying, and ignition, 0.44 grain. The potashley had dissolved the alumina of the precipitate, which obviously amounted to 0.585 grain. Thus the brown precipitate thrown down by caustic ammonia, was composed of,

Silica,	0.055
Peroxide of iron, . . .	0.440
Alumina,	0.585
	<hr/>
	1.080

The muriatic solution was now mixed with a sufficient quantity of carbonate of ammonia, to throw down the whole of the barytes. The filtered liquid was evaporated to dryness, and exposed to a graduated heat, to drive off the ammoniacal salts. The residue was found to contain lime derived from the filter. To get rid of it, I added some carbonate of ammonia, heated the liquid in a flask, then left it in a small glass cylinder till the carbonate of lime subsided; drew off the clear supernatant liquid by a sucker, edulcorated the carbonate of lime by distilled water, which was drawn off in like manner by a sucker. The liquid was evaporated to dryness in a platinum vessel, and the ammoniacal salt driven off. There remained behind a little saline matter, which weighed, after ignition, 0.84 grain. It was soluble in water, and the aqueous solution was abundantly precipitated by muriate of platinum. Hence the salt was chloride of potassium, and contained 0.41 potassium, equivalent to 0.53 potash.

The 4 grains of silica, obtained at the beginning of the analysis, were mixed with thrice their weight of anhydrous carbonate of soda, and exposed to a strong heat in a platinum crucible. The mass, which had undergone fusion, was dissolved in muriatic acid, and the solution was evaporated to dryness. The dry residue was digested in dilute muriatic acid, and thrown upon a filter, to se-

parate the silica. The silica, after edulcoration, drying, and ignition, weighed 2.96 grains. It was a fine white powder, and was perfectly pure.

The muriatic solution, thus freed from silica, was mixed with caustic ammonia slightly in excess; a greyish-brown precipitate fell, weighing, after ignition, 0.58 grain. By solution in muriatic acid, and mixing the solution with caustic potash in considerable excess, it was resolved into

Peroxide of iron, . . .	0.185
Alumina,	0.395
	<hr/>
	.580

Thus, from the 4 grains of the siliceous-looking matter, separated from the hydrolite, when it was treated with carbonate of barytes and muriatic acid, were obtained,

Pure silica,	2.96
Peroxide of iron, . . .	0.155
Alumina,	0.395
	<hr/>
	3.54
Loss,	0.46
	<hr/>
	4.00

This loss could have been owing to nothing but the presence of a little potash in the siliceous matter (the liquid was carefully examined, but nothing found), which I could not obtain, because I had fused the 4 grains of siliceous matter with carbonate of soda.

If we now add together all the constituents, we shall find that 5.3 grains of anhydrous hydrolite are composed of

Silica,	3.015
Alumina,	0.980
Peroxide of iron,	0.625
Potash,	0.530
	<hr/>
	4.95

As hydrolite contains 29.866 per cent. of water, it is obvious, that if the 5.3 grains analyzed had retained their water, the weight would have been 7.53 grains. Consequently the constituents, according to the preceding analysis, considering the loss as potash, and converting the peroxide of iron into protoxide, are as follows :

Silica,	3.015	or	39.896
Alumina,	0.980	. .	12.968
Protoxide of iron,	0.5625	. .	7.443
Potash,	0.7425	. .	9.827
Water,	2.2050	. .	29.866
	<hr/>		<hr/>
	7.5050		100.

This is equivalent to

14 atoms silica,
 4 atoms alumina,
 1 atom protoxide of iron,
 1 atom potash,
 18 atoms water.

We may therefore consider hydrolite as a compound of

4 atoms bisilicate of alumina,
 1 atom bisilicate of potash,
 1 atom quatersilicate of iron,
 18 atoms water.

So that every integrant particle of the mineral is combined with three atoms of water.

III. *Supersulphuretted Lead.*

The first specimen of this mineral which I had an opportunity of seeing, was one said to have been brought from Caithness by Sir JOHN SINCLAIR. This was more than twenty years ago. I had no opportunity of analyzing it ; but, when held in the flame of a candle, it burnt with a blue flame, and emitted a strong odour of sulphurous acid. I have been told by the overseers of the lead mines in the north of England, that this kind of ore is not uncommon in their district ; but I never was so lucky as to get a specimen of it till August 1828, when Captain LEHUNT brought several pieces of it from Ireland, which he got from a mineral-dealer in Dublin ; but unluckily the locality of these pieces is unknown ; though I am in hopes soon of getting some accurate information on the subject.

The mineral has much the appearance of fine grained galena. Colour blue.

Lustre metallic.

Texture fine granular ; opaque.

Scratches common galena ; but, as it is not free from grains of quartz, it may owe its apparent hardness to these grains.

Sectile.

Specific gravity 6.713.

Before the blowpipe, burns with a blue flame, decrepitates, melts, and, on charcoal, is reduced to a button of lead.

100 grains, when heated, gave out sulphur, and were reduced to 98.206 grains.

20 grains of this mineral, as free from impurities as possible, were digested in nitro-muriatic acid, till every thing soluble was

taken up. The undissolved matter, after ignition, weighed 0.25 grain. It was white and transparent, and, when viewed through a glass, proved to be small grains of quartz, which had been mechanically mixed with the mineral.

The solution, while hot, was mixed with an excess of bicarbonate of potash, previously dissolved in water, and the mixture was digested on the sand-bath for 24 hours. The precipitated carbonate of lead was then separated by the filter : after being washed and dried, it was exposed to a red heat. It melted, assumed a yellow colour, and weighed 18.52 grains. Being digested in nitric acid, it dissolved, with the exception of a few white flocks, which weighed, after ignition, 0.44 grain, and proved, when examined by the blowpipe, to be silica. Hence the oxide of lead was 18.08 grains, equivalent to 16.79 grains of metallic lead.

The alkaline solution, from which the carbonate of lead had been thrown down, was evaporated to dryness, and the residue digested in water. A small white powder remained undissolved. By ignition it became yellow. It dissolved completely in nitric acid, and the solution was precipitated orange by chromate of potash. It was therefore oxide of lead. It weighed, after ignition, 0.48 grain, equivalent to 0.445 grain lead.

The alkaline solution was supersaturated with nitric acid, and the sulphuric acid thrown down by muriate of barytes. The sulphate of barytes, obtained after edulcoration and ignition, weighed 21.254 grains, equivalent to 2.881 grains of sulphur.

Thus the constituents of the ore were,

Lead,	17.235	or	86.175
Sulphur,	2.881	. . .	14.405
Silica,	0.690	. . .	3.450
	<hr/>		<hr/>
	29.806		104.030

I do not know to what the excess is to be ascribed in this analysis. I repeated the analysis, and obtained similar results, and an excess which amounted to 2.5 per cent. The silica is an accidental impurity. The ore is obviously a compound of

Lead,		86.175	or	78	or	156
Sulphur,		14.405	. .	13.04	.	26.08

The atom of lead being 13, and that of sulphur 2, it is obvious that 156 lead is equal to 12 atoms; while 26.08 sulphur is almost exactly equal to 13 atoms. The supersulphuret of lead, therefore, which I analyzed, is a compound of

12 atoms lead,
13 atoms sulphur.

This is an unexpected combination, nothing similar to which I have met with before. I have not made any experiments to ascertain whether lead be susceptible of combining with sulphur in various proportions. Analogy would lead us to suppose that it is; for we generally find, that oxygen and sulphur enter into the same number of combinations with most of the metals. There probably, then, exists a sesquisulphuret of lead; if so, we may consider the supersulphuret of lead just analyzed, as a compound of

5 atoms sulphuret of lead,
1 atom sesquisulphuret of lead.

This at least would accord with the results obtained.

V. *Chabasite.*

This mineral, as is well known to mineralogists, exists rather abundantly in the neighbourhood of Glasgow. The finest spe-

cimens have been found at Kilmacolm in Renfrewshire ; and I am indebted to my friend and pupil Mr BROWN, for a very fine collection of chabasites from that locality. It is in large transparent rhomboidal crystals, constituting the well known primary form of this mineral. Chabasite has been analyzed thrice by BERZELIUS, and once by ARFWEDSON. The following table exhibits the results of these analyses :

Silica,	50.65	48.30	48.00	49.17
Alumina,	17.00	19.28	29.00	18.90
Lime,	9.73	8.70	8.35	
Magnesia,			0.40	
Potash,	1.70	2.50	0.41	
Soda,			2.75	12.19
Water,	19.50	20.00	19.30	19.73
	<u>98.58*</u>	<u>98.78†</u>	<u>99.21‡</u>	<u>99.99</u>

The last analysis in the table was made by BERZELIUS upon a specimen from Scotland. It is very remarkable, from the total absence of lime, which occurs as a constituent in every other chabasite hitherto subjected to analysis. BERZELIUS informs us, that under the soda a little potash is included.

It was this last analysis that induced me to introduce chabasite into this paper. BERZELIUS has given no other locality except Scotland. Nor has he favoured us with any description of the mineral subjected to analysis ; both of which would have been very desirable. That the chabasite of Scotland is not always composed, as BERZELIUS has found it in the specimen which

* BERZELIUS ; Afhadl. vi. 190. The specimen was from Jutland.

† ARFWEDSON ; Kong. Vet. Acad. Handl. 1824, p. 356. From Faroe.

‡ BERZELIUS ; *Ibid.* The variety called Leveyne, and from Faroe.

he analyzed, will appear from the following table, exhibiting the constituents of a very fine specimen of chabasite from Kilmacolm, which I subjected to a very careful analysis :

Silica,	48.756
Alumina,	17.440
Lime,	10.468
Potash,	1.548
Water,	21.720
	<hr/>
	99.932

The potash was carefully examined for soda, but none was found in it. It will appear from this analysis, that the Kilmacolm chabasite, so far from containing no lime, contains in fact a greater proportion of that substance than any other specimen hitherto analyzed. Is it not possible that the Scottish specimen analyzed by BERZELIUS may turn out to be a new species ?

The formula for chabasite seems to be,

Or it is composed of

- 1 atom bisilicate of lime, with some potash,
- 3 atoms bisilicate of alumina,
- 6 atoms water.

The excess of lime in the Kilmacolm chabasite, prevents this formula from applying quite accurately to its constituents *.

* Since this paper was read to the Society, I have analyzed a flesh-coloured chabasite from the north of Ireland, and found it composed of

V. *Wollastonite.*

This name was given by LEMAN to a mineral which occurs in the lava of Capo di Bone, near Rome. I have never seen a specimen of it; but Mr W. PHILIPS informs us, that, by mechanical division, it yields a crystal precisely the same with the primary form of table-spar or bisilicate of lime, of which it can scarcely be said to be a variety*. But there is a mineral which occurs in the rock of Edinburgh Castle, to which the Edinburgh mineralogists have given the name of Wollastonite, probably from a notion that it is the same with LEMAN's mineral. I had an opportunity of seeing and examining some specimens of this mineral last September, and was surprised to find it to be a mineral very different indeed from table-spar, being in fact very pure *prehnite*. The total want of the shade of green which usually characterizes prehnite, seems to have prevented the true nature of this mineral from being recognised. But abundance of prehnite, quite free from every tint of green, is met with in the neighbourhood of

Silica,	48.988
Alumina,	19.774
Soda,	6.066
Lime,	4.068
Peroxide of iron,	0.404
Water,	20.700
	<hr/>
	100.

This approaches BERZELIUS' specimen, and shews us, that the lime in chabasite may be replaced by soda. The formula is,

* PHILIP'S Mineralogy, p. 211.

Glasgow. The following comparison between the Castlehill mineral and prehnite will leave no doubt about its nature.

It is composed of fibres slightly diverging, so is fibrous prehnite.

Translucent, so is prehnite.

Lustre vitreous, so is that of prehnite.

The hardness is the same as that of prehnite.

Specific gravity 2.900. I found that of a fine specimen of prehnite from Kilpatrick 2.901.

Before the blowpipe it behaves exactly as prehnite.

Captain LEHUNT, at my request, analyzed the Castlehill mineral. The following table contains the result of his analysis. I have placed, in a second column, the analysis of a pure specimen of prehnite from the hills behind Port-Glasgow, which I made some years ago, to show the identity of the two minerals.

	Castlehill Prehnite.	Kilmacolm Prehnite.
Silica,	43.084	42.22
Alumina,	23.840	23.68
Lime,	26.164	23.52
Protoxide of iron, . . .	0.640	3.06
Protoxide of manganese, .	0.416	
Potash and soda, . . .	1.028	
Water,	4.600	5.58
	<hr/> 99.772	<hr/> 98.06

Potash and soda had been already found in prehnite by LAUGIER. They probably existed in the specimen analyzed by me. The loss being only 2 per cent. I did not suspect the presence of an alkali, and, therefore, did not search for it. In the specimens of prehnite analyzed by GEHLEN, the lime amounted

to 26 per cent., as well as in the Castlehill specimen analyzed by Captain LEHUNT.

If we admit a small excess of silica, and consider the oxides of iron, manganese, and the potash and soda, as accidental ingredients, the composition of prehnite will be

10 atoms silicate of alumina,
7 atoms silicate of lime.

Reckoning from the Castlehill variety, all the other Scottish prehnites, so far as I have analyzed them, contain rather less lime. The surplus of silica amounting to about one-seventh of the whole, is probably, in the mineral, united to the oxides of iron and manganese, and to the potash and soda. How far these may be essential ingredients remains still to be discovered*.

* The name *Wollastonite* was given by HAUY to *table-spar*, or *bisilicate of lime*; but mineralogists in general have refused to adopt this appellation. I have been induced, therefore, in order to commemorate the many obligations which mineralogy owes to Dr WOLLASTON, to apply the term *Wollastonite* to a mineral which I believe to be new, and which has a very close relation to the species which HAUY designated by that name.

It occurs in veins in a greenstone which is situated near Kilsyth, on the banks of the Forth and Clyde Canal, and possesses the following characters:

Its colour is white, with a slight shade of green. Its texture is fibrous, and the fibres are in tufts diverging from a centre, thus exhibiting marks of an imperfect crystallization. The mineral is translucent on the edges, and has a lustre inclining to silky. The fracture is splintery, and the fragments are sharp-edged.

The hardness is intermediate between that of selenite and calcareous spar. Its specific gravity is 2.8760.

Before the blowpipe it melts with some difficulty into a white enamel. This fusion is not accompanied by any frothing. With borax it fuses into a bead-yellow, while hot, but becoming colourless on cooling. With biphosphate of soda in considerable excess, it fuses into a colourless bead, leaving a silica skeleton. With carbonate of soda it effervesces, and fuses into an opaque bead, with a reddish-blue colour.

VI. *Sulphate of Alumina.*

The specimen of this mineral in my possession comes from Rio Soldana in South America. I am indebted for it to the kindness of CHARLES MACINTOSH, Esq. of Crossbasket, who had got it from the late Sir RALPH WOODFORD, Governor of Trinidad. There is a notice respecting it in the *Annales de Chimie et de Physique* *, by M. BOUSSINGAULT, from which we learn that it occurs in the transition-slate of the Andes of Columbia, either in a state of efflorescence or in crystallized masses. HUMBOLDT observed it in the clay-slate of Araya near Cumana. It is found also in the clay-slate of Socono, and in many other places of South America. It occurs in commerce, in spherical masses, and in the

The constituents of this mineral I found to be,

Silica,	52.744
Lime,	31.684
Soda,	9.600
Magnesia,	1.520
Peroxide of iron,	1.200
Alumina,	0.672
Water,	2.000
	<hr/>
	99.420

If we suppose the magnesia to have replaced a little lime, this mineral is a compound of

4 atoms bisilicate of lime,
1 atom tersilicate of soda.

Thence its symbol is $4CS^2 + NS^3$, and it differs from table-spar, by containing 1 atom of tersilicate of soda united to 4 atoms bisilicate of lime; whereas table-spar is pure bisilicate of lime.

* Tom. xxx. p. 109.

country is called *alumbre* (alum), and applied to the same uses as that salt. BOUSSINGAULT has analyzed a specimen from the same locality as mine. He gives its constituents as follows :

Sulphuric acid,	36.4
Alumina,	16.0
Water,	46.6
Oxide of iron,	0.4
Lime,	0.2
Clay,	0.4
	<hr/>
	100.0

The colour of the specimen is white, here and there tinged yellow, obviously from external impurities.

In fine crystalline scales.

Lustre silky.

Taste that of alum, but stronger.

Translucent.

Very soft.

Specific gravity 1.6606.

Before the blowpipe behaves like alum.

Being subjected to a careful analysis, its constituents were found as follows :

Sulphuric acid,	35.872
Alumina,	14.645
Water,	46.375
Peroxide of iron,	0.500
Soda,	2.262
Mechanical impurity *,	0.100
	<hr/>
	99.754

* It was very ferruginous silica.

This does not differ very far from the analysis of BOUSSINGAULT. It is equivalent to

1 atom sulphate of alumina.

6 atoms water.

$\frac{7}{100}$ atom sulphate of soda.

$\frac{1}{80}$ atom per-sulphate of iron.

If we allow the small quantity of sulphate of soda and per-sulphate of iron found in this mineral to be accidental ingredients, then the salt is composed of

1 atom sulphate of alumina,	7.25
6 atoms water,	6.75
	<hr/>
	14.

VII. *Sulphate of Alumina*—From Campsie.

Mr MACINTOSH has an alum-work at Campsie, near Glasgow. The alum is obtained from the shale of the old abandoned coal beds in the neighbourhood. At first, nothing more was necessary than to lixivate the shale, concentrate the liquid, and add sulphate or muriate of potash in order to obtain alum. This process being continued for a considerable number of years, a great quantity of shale thus washed had accumulated in the neighbourhood of the work. Mr MACINTOSH found, that, by burning this washed shale, it might be made to yield a new crop of alum. In one of my visits to this manufactory, Mr MACINTOSH pointed out to me thin white bands, which occasionally present themselves in this burnt shale, and he mentioned how very productive these bands were when employed in the manufac-

turing of alum. After having examined the sulphate of alumina from Rio Soldano, it occurred to me that the white bands at Campsie bore a certain resemblance to it. I, therefore, requested Mr MACINTOSH to procure me a specimen of it for examination, which, with his usual polite kindness, he speedily did.

Its colour is greyish-white, intermixed with portions having a yellow colour, and which are unequally distributed.

Fracture earthy.

Opaque.

Friable.

Taste acid, astringent, and sweet.

Specific gravity 1.887.

When digested in water it dissolved, with the exception of a white powder, which amounted to 15.31 per cent. of the whole. This white powder proved, on examination, to be a subsulphate of alumina.

When heated, it melts somewhat like alum, and gives out pure water. When heated to redness, it swells up like alum, and finally leaves a yellowish-white, porous, tasteless matter, nearly similar to what would be left by alum, making allowance for the colour.

Being carefully analyzed, its constituents were found to be,

1. Matter insoluble in water 15.31, composed of

Sulphuric acid,	10.2
Alumina,	5.11

2. Matter soluble in water composed of

Sulphuric acid,	30.225
Alumina,	5.372
Peroxide of iron,	8.530
Potash,	1.172
Water,	36.295
	<hr/>
	81.594
Insoluble matter,	15.310
	<hr/>
Total,	96.904
Loss,	3.096
	<hr/>
	100.000

This loss was doubtless water. For the 36.295 per cent. of water were obtained by simply exposing the matter to heat on the sand bath. I had ascertained, by previous experiments, that it is impossible to deprive sulphate of alumina of the whole of its water, without at the same time driving off some of the sulphuric acid.

The constituents thus found are equivalent to

- 24 atoms sulphate of alumina.
- 9 atoms bipersulphate of iron.
- 1 atom bisulphate of potash.
- 42 atoms water.

The American sulphate of alumina differs from that of Campsie in three remarkable particulars. It contains soda, while the alkali in the Campsie mineral is potash. The Campsie mineral contains a notable quantity of bipersulphate of iron, while, in the American mineral, the quantity is trifling. In the American mineral, all the saline contents were neutral, while in the Campsie mineral almost one-half of the saline contents are in the state of bisulphates.

VIII. *Soda-Alum.*

Some years ago Dr HOOKER received several specimens of native alum from Dr GILLIES, who resided at the time at Mendoza, a city near the foot of the Andes, and about 800 miles west from Buenos Ayres. Dr HOOKER was so good as to put some of the specimens into my possession that they might be analyzed, and their constitution determined. The specimens were ticketed, "Native alum from the province of St Juan." They are in irregular nodules, rather smaller than a hen's egg. From the rocky fragments occasionally attached to them, they seem to have been imbedded in a slate, having a blue colour, very soft, and bearing some resemblance to the slate-clay usually accompanying the coal beds in this country. But these stony fragments are too minute to enable us to determine with accuracy the true position of the rock to which they belong.

The alum is white, and composed of fibres adhering longitudinally, and having some breadth, but very little thickness. It bears some resemblance to fibrous gypsum, but is much harder, not being scratched by the nail, though it is readily enough by the knife. It is sectile, the outer fibres are white and opaque, as if they had lost a portion of their water. But internally the fibres are transparent, and have a glossy or rather silky aspect, shewing that they retain a good deal of water of crystallization. The specific gravity of the transparent portion is 1.88. It tastes precisely like alum, but is much more soluble in water. For 100 parts of water, at the temperature of 62°, dissolve 377.3 parts of it, and boiling water takes up any quantity of it whatever. When heated it behaves precisely like common alum. 100 parts of it exposed to a red heat lose 46.55 parts of their weight. But this is not pure water, but water holding some sulphuric acid in solution.

By a careful analysis, I found that 53.25 grains of it could be resolved into the following constituents.

Sulphuric acid,	20.000
Alumina,	6.360
Soda,	4.000
Water,	22.209
Silica,	0.012
Lime,	0.136
Peroxide of iron,	0.110
Protoxide of manganese, with a little magnesia,	0.423
	<hr/>
	53.250

It will be observed that the sulphuric acid corresponds exactly with four atoms. Hence it is probable, that the bases which saturate this acid in the salt amount also to exactly four atoms. Four constitutes an atom of soda. But the atom of alumina being 2.25, three atoms of that earth will amount to 6.75; whereas only 6.36 were found in the salt. There is, therefore, a deficiency of 0.39 grains of alumina. But the lime, iron, and manganese, (if the magnesia contained in it be reckoned 0.12), are together exactly equivalent to 0.39 alumina. Thus, it appears, that these substances replace a small portion of the alumina in the salt. 22.209 approaches very nearly to twenty atoms of water. We may, therefore, neglecting the minute quantity of silica, lime, iron, manganese, and magnesia, consider the salt as composed of

4 atoms sulphuric acid,	20
3 atoms alumina,	6.75
1 atom soda,	4.0
20 atoms water,	22.5
	<hr/>
	53.25

Or we may state the composition this way :

3 atoms sulphate of alumina, . . .	21.75
1 atom sulphate of soda, . . .	9.0
20 atoms water,	22.5
	<hr/>
	53.25

The only difference between native and artificial soda-alum is in the water of crystallization. In the former it amounts only to twenty atoms, while in the latter it is twenty-five atoms. Artificial soda-alum crystallizes in regular octahedrons like common alum. But the native seems to crystallize in prisms. At least that is the natural inference from its fibrous structure. I made some attempts to obtain it in more regular crystals, but they were unsuccessful, owing, I believe, to the heat of the weather when the trial was made.

IX. *Siliceous Hydrate of Magnesia*.—From Haboken, New Jersey. *Nemalite* of NUTALL.

This mineral was sent me some years ago by Mr NUTALL, among many other interesting magnesian minerals from the same locality of which he had some time before given an account to the American public.

The mineral which I am going to describe occurs in veins in serpentine, and was taken for amianthus till its true nature was discovered by Mr NUTALL *.

The colour is white, with a slight shade of yellow.

Composed of elastic fibres, easily separable, and bearing a striking resemblance to the fibres of amianthus.

* See SILLIMAN'S Journal, iv. 19.

Soft enough to be scraped by the nail of the thumb.
Opaque.

Specific gravity 2.353.

By exposure to a red heat its colour was changed into brown. It retained its asbestous structure, but had become brittle and easily reducible to powder. 12 grains by this treatment lost 3.56 grains, which is equivalent to 29.66 per cent. This loss was pure water.

It dissolved in nitric acid, without effervescence, leaving a little silica.

On subjecting it to analysis, I obtained the following constituents,

Magnesia,	51.721
Silica,	12.568
Peroxide of iron,	5.874
Water,	29.666
	<hr/>
	99.829

This is equivalent to

20.75 atoms magnesia,
6.25 atoms silica,
1 atom peroxide of iron,
26.333 atoms water.

This might be considered as,

20.75 atoms protohydrate of magnesia, mixed with
6.25 atoms silica,
1 atom peroxide of iron,
5.58 atoms water.

But, probably, the silica is in chemical combination with the magnesia. I am disposed to consider this curious mineral as composed of

5 atoms silicate of magnesia,
12 atoms bihydrate of magnesia,
1 atom ferrate of magnesia.

Its symbol, on that supposition, will be,

X. *Brownspar and Pearlspar.*

These names have been applied to a variety of mineral species, which have a considerable resemblance to each other, and the crystalline form of which approaches more or less to that of calcareous spar. MOHS and HAIDINGER have done a good deal to disentangle this chaos, and have constituted several well defined species out of minerals hitherto confounded under the common name of Brownspar. But it is doubtful whether the external characters alone afford sufficiently distinctive marks in all cases, at least, for arranging the different brownspars under their respective species. At any rate, it would be proper to subject them, in the first place, to a careful chemical analysis, in order to discover with accuracy the number of true species under which they should be arranged. It is with a view of forwarding this desirable object that I shall here state the composition of such species of brownspar in my own collection as I have hitherto subjected to chemical analysis.

First Variety.

It is composed of plates which break into rhomboids, similar in appearance to calcareous spar. But the angle, as has been

long ago shown by Dr WOLLASTON, is $106^{\circ} 15'$, instead of $105^{\circ} 5'$ as in calcareous spar.

Colour white, with a shade of red.

Translucent.

Hardness rather exceeds that of calcareous spar.

Specific gravity 2.815.

Dissolves slowly in muriatic acid, unless heat be applied.

A careful analysis of this mineral gave its composition as follows :

Carbonate of lime, . . .	54.256
Carbonate of magnesia, . . .	47.428
Alumina,	0.680
Protoxide of iron, . . .	1.692
	<hr/>
	104.056

Excluding the alumina and oxide of iron as accidental, the mineral is obviously a compound of

1 atom carbonate of lime,	6.25
1 atom carbonate of magnesia,	5.25
	<hr/>
	11.5

I have found several specimens of the magnesian limestone from Sunderland exactly similar in composition. This is the case also with several specimens of Dolomite which I have analyzed.

This variety of brownspar, then, constitutes a well defined species, to which the name of Magnesio-carbonate of Lime may be given. It has been long distinguished as peculiar in mineralogical systems. Yet nothing is more common than to find in cabinets varieties of it arranged under the name of brown spar.

Second Variety.

I got this variety from the neighbourhood of Alston Moor, under the name of *Brown Spar*.

It has a dirty brown colour. Streak brown.

Consists of small irregular rhomboids, with curve faces, and entangled in each other.

Lustre pearly, nearly dull.

Opaque.

Scratched by calcareous spar.

Rather brittle.

Specific gravity 3.404.

The crystals were attached to a thin crust of brown matter, having a pearly and splendid lustre. It was of the same nature as the crystals, but had not like them been altered by exposure to the weather.

This specimen being subjected to a careful analysis, its constituents were found to be,

Carbonic acid,	18.50
Protoxide of iron, . .	30.27
Peroxide of iron, . . .	37.65
Deutoxide of manganese,	4.75
Water,	8.30
	<hr/>
	99.47

If we allow the manganese to be accidental, then the constitution of the mineral will be,

1 atom carbonate of iron, . .	7.25
1 atom perhydrate of iron, . .	6.125
	<hr/>
	12.375

It therefore constitutes a new species of iron-ore, which may be distinguished by the name of Hydro-carbonate of iron.

It is unfortunate that the crystals in the specimen which I possess do not admit of measurement. The angle of the rhomboid constituting common carbonate of iron is known to be 107° . Probably the measurement of the present species will deviate somewhat.

Third variety.

This variety is implanted in small sphericles on the points of long crystals of quartz. Its colour is brownish, and its lustre rather inclined to pearly. But in every other respect its characters are those of calcareous spar. Its specific gravity is 2.727. Its constituents were found to be,

Carbonic acid, . . .	44.405
Lime,	56.090
Magnesia,	1.650
Protoxide of iron, . .	1.465
Alumina,	1.120
	<hr/>
	104.73

The carbonic acid is little more than sufficient to saturate the lime ; I have little doubt, however, that the magnesia is also in the state of carbonate. The iron and alumina were probably only accidental. It is obvious that this mineral is not a true species, but merely a variety of common carbonate of lime. Its locality was Transylvannia. It was marked *Globular Brown Spar*.

Fourth variety.

It was composed of a congeries of small rhomboids with curved faces.

Lustre pearly.

Surface brown ; but the interior of the mineral which had not been exposed to the weather snow-white.

Scratches calcareous spar, but not fluor-spar. Hardness 3.5.

Opaque, or only slightly translucent on the edges.

This mineral was from Traversella in Piedmont. I got it under the name of Convex Rhomboidal Pearl-Spar. Unfortunately the rhomboids are not susceptible of measurement. This puts it out of our power to determine whether its shape be precisely the same with that of the first variety or not.

The constituents of this variety were found to be,

Carbonic acid, . . .	47.
Lime,	29.072
Magnesia,	14.140
Protoxide of iron, . .	13.392
Alumina,	0.720
	<hr/>
	104.324

This is equivalent to

8 atoms carbonate of lime,
5 atoms carbonate of magnesia,
3 atoms carbonate of iron.

We may consider it as composed of two different minerals, united together. The first mineral is common carbonate of lime; the second a compound of

5 atoms carbonate of magnesia,
3 atoms carbonate of iron.

This compound we may represent thus,

1 atom carbonate of lime,
1 atom carbonate of ($\frac{5}{8}$ magnesia + $\frac{3}{8}$ iron).

This specimen constitutes a peculiar species, not hitherto noticed by mineralogists, which may be termed Calcareo-carbonate of Magnesia-and-Iron.

IX. *Killinite.*

This mineral was discovered some years ago by Dr TAYLOR, in coarse granite veins in fine-grained granite at Killiney, Dublin Bay. In the veins it is mixed with a good deal of spodumene. It was analyzed at the time by Dr BARKER and Dr TAYLOR, who found the constituents as follows :

Silica,	52.49
Alumina,	24.30
Potash,	5.00
Protoxide of iron, . .	2.49
Lime,	0.50
Oxide of manganese, .	0.75
Water,	0.50
	<hr/>
	90.53

But I have reason to suspect, both from the description and from the specimens which I saw some years ago in Dublin, that the specimens in the possession of these gentlemen were rather impure.

Captain LEHUNT and Dr STOKES *junior* visited Killiney during the summer of 1828, and procured abundance of very good specimens. Captain LEHUNT was so obliging as to present me with a very pure crystallized specimen of a large size, and seemingly quite pure. This, together with a good many other specimens already in my possession, puts it in my power to describe Killinite with more precision than has yet been done.

The usual colour is brownish-yellow ; though occasionally it has a tint of green. I have seen specimens of a green colour, but they are comparatively rare. When heated to redness, some specimens become snow-white, while others assume a reddish

tinge; this may probably depend upon the proportion of iron which they respectively contain.

Texture foliated. Sometimes it is crystallized. I possess a crystal 4 inches long, 1.3 inch broad, and 0.9 inch thick. It constitutes a four-sided prism, which appears perfectly rectangular, by the most careful measurement. But the crystal has no regular summit, nor will it cleave in the direction perpendicular to the axis. We have no means of knowing, therefore, whether the prism be right or oblique.

Lustre waxy, dull, except when particles of foreign matter are mixed with it.

Opaque, or only slightly translucent on the edges.

Hardness 3.5 to 6.

Streak yellowish-white.

Specific gravity 2.598, as determined in my laboratory. Dr BARKER states it to be 2.698.

Before the blowpipe becomes white and friable, and gradually fuses into a white opaque bead, but not nearly so readily as spodumene. With carbonate of soda it fuses into a transparent glass; with borax or biphosphate of soda, into a colourless glass, leaving a silica skeleton.

It was twice analyzed in my laboratory, first by Captain LEHUNT, and then by Mr WILLIAM BLYTHE. The constituents were as follows,

Silica,	49.08	47.925
Alumina,	30.60	31.041
Potash,	6.72	6.063
Protoxide of iron,	2.27	2.328
Lime,	0.68	0.724
Magnesia with some manganese,	1.08	0.459
Protoxide of manganese,		1.255
Water,	10.00	16.000
	<hr/>	<hr/>
	100.43	99.795

These constituents are equivalent to

22 atoms silica,
12 atoms alumina,
1 atom potash,
8 atoms water.

Killinite therefore may be considered as a compound of

12 atoms sesquisilicate of alumina,
1 atom quatersilicate of potash,
8 atoms water.

Its symbol is $12A/S^{1\frac{1}{2}} + KS^4 + 8Aq$.

The alkali was examined with great care, and was found to be pure potash. This was requisite, because in the vein, killinite is intermixed with spodumene, the alkali of which we found to be lithia, without any admixture of potash or soda. I was disposed at first to suspect that killinite might be only a variety of spodumene. But the external characters and the constituents are both incompatible with such a supposition. It must therefore be admitted into the system as a distinct species.

The spodumene which accompanies the killinite was analyzed two different times by Captain LEHUNT. The constituents found were almost identical with the specimen from Utö, in Sweden, analyzed by STROMEYER *. I subjoin both, to enable the reader to compare the two.

* Untersuchung, p. 426.

	<i>Spodumene from Utö.</i>	<i>Spodumene from Killiney.</i>
Silica,	63.288	63.312
Alumina,	28.776	28.508
Lithia,	5.626	5.604
Lime,	...	0.728
Protoxide of iron, . .	0.794	0.828
Protoxide of manganese, .	0.204	
Water,	0.775	0.366
	<hr/> 99.463	<hr/> 99.840