Nov. 18, 1850.

RICHARD PHILLIPS, Esq., President, in the Chair.

The following presents were announced :

“The Improvement of Land, by Warping, Chemically considered by Thornton J. Herapath :” by the Author.

A donation of 199 volumes : by Mr. Griffin ; see page 412 ?

The following Papers were read :

“On the claims of the elementary substances, Silicon and Selenium, to be ranked among metals :” by Mr. Richard Adie, of Liverpool.

“On the existence of Copper and Lead in the Blood, and in other portions of the Animal Organism :” by Mr. J. Denham Smith.

XXVIII.—*On Potasso-gypsite, a double Sulphate of Potash and Lime.*

By J. ARTHUR PHILLIPS, Esq.

This substance is obtained as a secondary product in the manufacture of tartaric acid, and it will therefore be necessary to describe the circumstances under which it is produced, before detailing the properties and composition of the salt itself. Tartaric acid is, as is well known, made from the impure bitartrate of potash, which reaches this country in such a state as to yield, on an average, 72 per cent of crystallized acid.

The processes employed in the manufacture are briefly as follows : Into a large tun, capable of containing about three thousand gallons of water, are thrown from fourteen to fifteen hundred pounds of mashed chalk, which is agitated by means of a revolving arm, until the water and carbonate of lime have become perfectly incorporated, and a finely-divided mixture is obtained. When this is effected, about two tons of crude tartar are added, by means of an air-tight trap on the top of the vessel, and by the aid of heat, obtained by blowing

a jet of steam into the mixture, and constant agitation of the mass, the bitartrate of potash is made to transfer its free atom of acid to the lime, giving rise to the formation of insoluble tartrate of lime, soluble tartrate of potash, and the evolution of carbonic acid, which is conveyed away in leaden pipes to be employed in making bicarbonate of soda. As soon as the decomposition is completed, a sufficient portion of sulphate of lime, from a preceding operation, is added, for the purpose of decomposing the neutral tartrate of potash in solution. By the aid of heat and long-continued agitation, this is at length effected, and the vessel then contains a solution of sulphate of potash, together with the insoluble tartrate of lime, and small portions of the carbonate and sulphate of the same base, arising from the excess of these reagents originally employed. At this period of the manufacture, the agitation is arrested, the liquor is allowed to settle down, and the sulphate of potash drawn off from the tartrate of lime, which remains at the bottom of the tub. This is subsequently washed with three successive waters, which are added to the solution of sulphate of potash at first obtained. The insoluble tartrate of lime is afterwards decomposed by sulphuric acid, with formation of sulphate of lime and production of free tartaric acid, which is crystallized in the usual way, whilst the sulphate of potash, with which we are at present most interested, is conveyed away by large leaden gutters for evaporation.

At the manufactory of the Messrs. Pontifex, these liquors are first drawn into a large tubular steam-boiler, heated by the waste heat escaping from a set of coke-ovens. In this the potash solution is concentrated to about two thirds of its original volume, and then allowed to run into a series of large bacs containing coils of iron pipe, which are supplied with steam by means of the boiler in which the liquor is concentrated, and in these the evaporation is completed.

This boiler for concentration and supplying the steam-coils, gradually becomes coated by a hard deposit, in order to remove which, it becomes necessary, at intervals of about three months, to stop the ovens and run out the liquor. On these occasions, the cooling of the boiler and its contents is extremely slow, as the mass of brickwork which surrounds it renders the loss by radiation very inconsiderable. When it has sufficiently cooled, and the liquor has been run off, the greater part of its internal surface is found to be covered with transparent lamellar crystals, formed on a hard crystalline gangue. These are sparingly soluble in water, but are easily dissolved by dilute hydrochloric acid.

A qualitative analysis showed them to consist of lime, potash,

water, and sulphuric acid, and a quantitative examination gave the following results :

FIRST ANALYSIS.

10.05	grs. gave	14.85	grs.	platinum-salt.
"	"	3.05	"	carbonate of lime.
9.28	"	0.51	"	water.
"	"	13.22	"	sulphate baryta.

SECOND ANALYSIS.

10.23	grs. gave	15.10	grs.	platinum-salt.
"	"	3.10	"	carbonate of lime.
5.81	"	0.33	"	water.
"	"	8.21	"	sulphate baryta.

These numbers afford the following percentage results :

Potash	.	.	.	.	28.52	28.57
Lime	.	.	.	.	16.99	16.96
Sulphuric acid	.	.	.	.	48.94	48.55
Water	.	.	.	.	5.51	5.67
					<hr/>	<hr/>
					99.96	99.75

The above relations would lead to the empirical formula $\text{KO}, \text{SO}_3 + \text{CaO}, \text{SO}_3 + \text{HO}$, as may be seen by comparison with the following calculated amounts :

	No. of eqs.		Amounts.	Percentage.
Potash	1	=	47	28.67
Lime	1	=	28	17.02
Sulphuric acid . .	2	=	80	48.82
Water	1	=	9	5.49
				<hr/>
				100.00

Since, however, a variety of sulphate of lime, expressed by $2(\text{CaO}, \text{SO}_3) + \text{HO}$, has been found under nearly similar circumstances,* it appears probable that, in reality, the water is divided between the sulphates of lime and potash, and that the crystals are composed of a double di-hydrated salt, of which the true formula is

* Johnston, Phil. Mag. J. XIII. 325; also J. Pr. Chem. XVI, 100.

represented by $2 (\text{KO}, \text{SO}_3) + \text{HO} + 2 (\text{CaO}, \text{SO}_3) + \text{HO}$, and to this I propose to give the name of *Potasso-gypsite*.

Professor W. H. Miller, of Cambridge, who has had the kindness to examine the crystals of this substance, describes them as follows :

PRISMATIC.

Symbols of the simple forms :

a 100, e 101, u 102, m 110.

Angles between normals to the faces :

$e a$	.	.	.	46^0	$28'$
$e e'$	.	.	.	87	4
$u a$	.	.	.	76	38
$u u'$	.	.	.	26	44
$m a$	.	.	.	52	58
$m m'$	.	.	.	74	4

The crystals exhibit faint indications of cleavage parallel to a plane perpendicular to the faces a , m .

The faces a , are striated parallel to their intersections with the faces m . The crystals are very thin in a direction perpendicular to the faces a .

The optic axes lie in a plane perpendicular to the faces a , m . Seen in air, through the faces a , they appear to make angles of $22^0 45'$, with a normal to a , and an angle of $45^0 30'$ with each other.

The crystalline gangue, on which the regular crystals are formed, was found, on analysis, to yield the following results :

FIRST ANALYSIS.

28.95	grs. gave	0.23	grs. of	silica.
"	"	12.49	"	carbonate of lime.
"	"	1.19	"	phosphate of magnesia.
37.86	"	2.95	"	carbonic acid.
"	"	41.96	"	sulphate of baryta.
"	"	39.63	"	platinum-salt.
"	"	0.31	"	chloride of sodium.
24.12	"	0.30	"	oxide of iron.
"	"	0.18	"	alumina.
75.83	"	0.58	"	phosphate of magnesia.

SECOND ANALYSIS.

26·23	grs. gave	0·25	grs. of	silica.
"	"	0·28	"	oxide of iron.
"	"	0·21	"	alumina.
25·57	"	0·87	"	phosphate of magnesia.
24·12	"	1·90	"	carbonic acid.
"	"	26·20	"	platinum-salt.
"	"	0·30	"	chloride of sodium.
"	"	9·34	"	sulphate of baryta.
"	"	0·17	"	phosphate of magnesia.

	I.	II.
Potash	20·18	20·93
Soda	0·43	0·61
Lime	24·16	"
Magnesia	1·50	1·24
Alumina	0·74	0·80
Oxide of iron	1·24	1·06
Silicic acid	0·79	0·80
Sulphuric acid	38·08	38·66
Phosphoric acid	0·49	0·42
Carbonic acid	7·79	7·87
Water	4·31	"
Organic matter	traces	traces

 99·71

These numbers indicate that the uncrystallized portion of the deposit consists of the same substances as the crystals themselves ; and if, in the first analysis, we so arrange them as to form the double sulphate above-described, the following percentages will be obtained :

	I.	II.
New salt	64·76	
Sulphate of lime	11·57	
Carbonate of lime	14·06	
Phosphate of lime	1·06	
Carbonate of magnesia	3·10	
Silicate of potash	2·42	
Oxide of iron	1·24	
Alumina	0·74	
Water	0·76	
Organic matter	traces	

 99·71

In the analysis of the crystals of the pure salt, the water was estimated by heating to redness, in a platinum crucible, a portion of the substance which had been kept until it ceased to lose weight under the receiver of the air-pump, in which was placed a dish of strong sulphuric acid. The same portion of substance was then dissolved in dilute hydrochloric acid, and the sulphuric acid thrown down as sulphate of baryta by chloride of barium in the usual way. A second quantity of substance was then taken, and after dissolving it in dilute hydrochloric acid, and adding ammonia, the lime was precipitated in the form of oxalate, and weighed as carbonate. The filtrate from the oxalate of lime was then evaporated to dryness, and the residue heated to redness to expel the ammoniacal salts. A slight excess of hydrochloric acid was afterwards added, and the potash estimated as platino-chloride of potassium.

In the investigation of the uncrystallized deposit, the ordinary routine of chemical analysis was employed, the phosphoric acid being estimated by the method of Fresenius, and the alkalis separated from the alkaline earths by the use of hydrate of baryta.