ART. XX.—*On a new Lead-Salt, corresponding to Cobalt Yellow;*
by S. D. HAYES, of Boston.

IN the course of some investigations on the cobalto-cyanid compounds, I was obliged to use a quantity of cobalt yellow, the pigment discovered by M. Saint Evre in 1852.* All the methods described for preparing this salt are very tedious, so that it became an object to find a more ready means. The best method, which has heretofore been given, is to precipitate a solution of nitrate of cobalt, with an excess of potash; then by passing a current of deutoxyd of nitrogen (NO^2) through the mass, the cobalt yellow is obtained; but the greater part of the NO^2 passes through, without being absorbed; the experiment requires hours; and the amount of salt so obtained is very small.

As the composition of this body is considered doubtful, it occurred to me that it might be made from peroxyd of nitrogen (hyponitric acid, NO^4), and after a few trials, I obtained it by this

* Annal. Ch. Phys., 3d series, xxxviii, 177.

agent very readily, in large quantities, and found that all the cobalt contained in a solution may thus be converted into cobalt yellow. Two bottles, connected, and supplied with funnel tubes, are about half filled with a solution of nitrate of cobalt, to which potash, slightly in excess, is added. On passing through the solution a brisk current of NO^4 , the mass in the first bottle soon changes color, and the pigment begins to fall; by adding small quantities of potash, occasionally, through the funnel tubes, all the cobalt may be removed. The NO^4 is most readily prepared, by allowing a current of NO^2 made from copper and diluted nitric acid, in a small flask, to mix with a current of common air from a gasometer, in a dry empty bottle, before passing into the cobalt solutions. The current of air can be regulated at the gasometer, and the flask for generating NO^2 can be easily removed, and replenished when necessary. A solution of the carbonate of potash may be used, instead of caustic potash, for precipitating the cobalt solutions, with the same result.

A. Stromeyer, when working upon this salt, endeavored to obtain an analogous body with lead; he succeeded in getting a yellow solution, by means of nitrite of potash, and acetic acid, in a solution of lead, but he then added cobalt, which gave a precipitate.*

On treating a solution of nitrate of lead with potash and passing through it a current of NO^4 , precisely as in making the cobalt-yellow, I found that all the NO^4 was absorbed, and as the oxyd of lead disappeared, the solution became very yellow; on evaporating, and crystallizing this, I obtained large, yellow, prismatic crystals; nitrate of potash crystallizes at the same time, and if the NO^4 has been passed through the lead oxyd mixture too long, nitrate of lead is formed.

The yellow salt was easily separated and recrystallized. The bases were determined as sulphates, with the following results:

I. 0.7462 grms. pure salt gave 0.4200 grms. sulphate of lead, and 0.0097 grms. lead = 0.3195 grms. oxyd of lead, and 0.2472 grms. sulphate of potash = 0.1335 grms. potash.

II. 1.459 grms. gave 0.6387 grms. oxyd of lead, and 0.2593 grms. potash.

III. 1.0271 grms. gave 0.43745 grms. oxyd of lead, and 0.1881 grms. potash.

The nitrogen was determined as gas; metallic copper reduced from the *fine* oxyd, being used in the combustion tube with a little oxyd at the fore end; the gas was collected, and washed in a small apparatus, then transferred to the eudiometer, where it was measured.

I. 0.1926 grms. salt gave 45.6277 cubic centimeters, nitrogen, temperature 60°C. ; pressure 277.5 millimetres = 16.30 c. c., at 0°C. and 760 mm. pressure = 0.2048 grms.

* Ann. Ch. und Pharm., xcvi, 228

II. 0.1958 grms. gave 16.23 c. c. at 0° C. and 760 mm. pressure = 0.0226 grms.

The water was determined by combustions with metallic copper.

I. 0.7834 grms. gave 0.0274 grms. water.

II. 0.9145 grms. gave 0.0314 grms. water.

III. 0.4735 grms. gave 0.0177 grms. water.

These results sum up as follows.

	I.	II.	III.	IV.
Oxyd of lead, - - -	42.81	43.08	42.59	43.22
Potash, - - -	17.90	17.77	18.31	"
Nitrogen, - - -	10.63	"	10.35	"
Water, - - -	3.49	3.43	3.73	"
Oxygen, by difference, -	25.16	"	25.02	"
	100.00		100.00	

The above analyses correspond to the following calculated formula:

PbO, - - -	111.56	42.98
KO, - - -	47.	18.10
N ₂ , - - -	28.	10.78
O ₃ , - - -	64.	24.67
HO, - - -	9.	3.47
	259.56	100.00

As this salt crystallizes out with nitrate of potash, it is of about the same degree of solubility, in either hot or cold water, and the solution may be boiled for some time, without any decomposition: but it is readily decomposed by sulphuric, hydrochloric, or nitric acid, giving off red fumes. With the common reagents, it acts as nitrate of lead, but with a solution of sulphate of cobalt, it gives cobalt yellow, which goes down with the sulphate of lead. It loses its atom of water at 100° C., but if the temperature be raised a few degrees higher, the red fumes are given off abundantly. The crystals are of a bright yellow color, and remain unaltered in the air.

I am not yet prepared to give this salt any decided *rational* formula, but its composition may be expressed in several ways, as below. When 2NO₄ are passed over 2KO, we get KONO₃ and KONO₃, two distinct salts, but if 2NO₄ be passed over CoO and KO, as in the case of cobalt yellow, or over PbO and KO as in this salt, we get only one salt of a double composition which we must write—

But there are objections to this: cobalt yellow is almost or quite insoluble in water. These salts may also be looked upon as double per-oxyds, in which two equivalents of oxygen have been replaced by two equivalents of NO₄; but from the nature of the salts, I hardly think that NO₄ exists in them. How-

ever, Gmelin describes a salt to which he gives the formula $2\text{PbO}, \text{NO}_4 \text{ Aq.}^*$ and we express the composition of these salts quite as well, by writing them thus,

This subject will be pursued, and I hope to get several other salts, which must give some reactions that will lead to the right rational formulæ.

Heidelberg, Baden, Dec. 5th, 1860.