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XXII. *On the Decomposition of the Neutral Sulphate of the Peroxide of Iron by boiling its Solution.* By TH. SCHEERER.*

A CONCENTRATED solution of the neutral sulphate of iron may be heated to boiling without becoming opake, but if one part of this salt be dissolved in 40 parts of water, continued boiling precipitates traces of a basic salt, which increase so as to form a considerable precipitate the more the solution is diluted with water.

This salt is a combination of sulphuric acid, peroxide of iron and water, in the following proportions:

74·70 peroxide of iron.
12·57 sulphuric acid.
12·70 water.

99·97

Thus it consists of 6 atoms of the peroxide of iron, 2 atoms of sulphuric acid, and 9 atoms of water; the theoretical composition, therefore, would be

74·46
12·71
12·83——100·00

and accordingly the formula of Berzelius is $2 \text{Fe}^3 \text{S} + 9 \text{H}$,
or $2 (\text{Fe} \text{S} + 8 \text{Fe}) + 27 \text{H}$.

According to the nomenclature of Berzelius, this salt may be called the eight-fold basic sulphate of the peroxide of iron. The oxygen of the water amounts to the half of that in the oxide, being quite analogous to the five-fold basic salt which is produced by the oxidation of a solution of sulphate of iron in the open air.

Dried at 212° Fahr., this salt forms a dark orange yellow powder, its colour being lighter in proportion as the solution is previously diluted, and the less it is boiled. It is not dissolved by water, but pretty readily by acids. At a temperature below a dull red heat, it loses its water and becomes of a dark brown colour. At a red heat the sulphuric acid is expelled and the peroxide of iron is left behind.

Experiments were made to discover how much of the sulphate of iron was decomposed by various degrees of dilu-

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tion, which may be determined by the quantity of the salt precipitated. The results were as follows: dissolved in

100 parts of water, 0.309 precipitated.				Opacity commenced at 203°F.		
200	—	—	0.558	—	—	158
400	—	—	0.749	—	—	137
800	—	—	0.806	—	—	122
1000	—	—	0.912	—	—	117.

If 1 part of the sulphate of iron was dissolved in 10.000 parts of water, the solution became opaque even at the temperature of about 63° F. which was that of the water employed; but if it was afterwards heated to boiling, not a trace of iron could be detected in the solution filtered from the precipitate either by ammonia or by tincture of galls. The above quantities are mere approximations to accuracy, as in the first place, during the boiling of the solution, more or less water is evaporated, by which the degree of dilution is altered; 2ndly, the water which is condensed in the upper part of the tube again falling down, causes a momentary increased dilution, and consequently an increased quantity of the precipitate; and 3rdly, the boiling point is heightened the greater the quantity of salt of iron dissolved in the water. Nevertheless the result of the experiments is sufficiently accurate to allow of our establishing the following law with respect to the relative quantities of the peroxide of iron remaining in solution after boiling: *With a 200-fold and greater dilution, the quantities of the peroxide of iron remaining in solution are in inverse ratio to the dilution.* Indeed if these quantities are calculated according to the above-mentioned proportions, we find approximately that,

With a 200-fold dilution,		$\frac{1}{2}$	of the peroxide of iron remains dissolved.	
—	400	—	$\frac{1}{4}$	—
—	800	—	$\frac{1}{8}$	—
—	1000	—	$\frac{1}{10}$	—

This progression, however, is not generally exact, for instance by a 100-fold dilution $\frac{2}{3}$ ds of the iron should remain dissolved. The law therefore is approximative only for the central members.

If a solution of the neutral sulphate of the peroxide of iron is mixed with a solution of the neutral sulphate of potash, the same basic salt is precipitated without any part of the potash entering into the combination. The properties of the solution of sulphate of iron now described may be employed to separate the peroxide of iron from some salts. The neutral sulphates of manganese, nickel and cobalt have no acid reaction upon litmus paper like the neutral sulphate of the per-

oxide of iron. If therefore one of these sulphates is mixed with the latter in solution, by far the greater portion of the iron may be precipitated by saturating, as nearly as possible, the solution with potash, and the remaining portion of iron may be thrown down by dilution and boiling. It remains only to be observed that no other acid than sulphuric acid must be present, and that the solution nearly saturated must be diluted with at least twice or three times its quantity of water.

This method may not only be employed with advantage in preparing pure oxide of cobalt, but also in analysis. When no error has occurred, the iron is perfectly free from cobalt, although the cobalt may sometimes contain a slight trace of iron.

During the preparation of pure oxide of cobalt from the roasted ores, arsenious or arsenic acid is constantly present. This need not first be separated by sulphuretted hydrogen, for it is precipitated, on treating it in the manner above described, as arseniate or arsenite of iron. It is, however, better in this case to add to the solution previously to saturation a quantity of the sulphate of the peroxide of iron, as otherwise there might not be a sufficient quantity of iron present to take up the whole of the arsenious acid, and then arseniate or arsenite of cobalt would also be thrown down.

XXIII. *A Method of determining by mere Inspection the derivatives from two Equations of any degree.* By J. J. SYLVESTER, F.R.S. and R.A.S., Professor of Natural Philosophy in University College, London.*

LET there be two equations, one of the n th, the other of the m th degree in x ; let the coefficients of the first equation be $a_n \ a_{n-1} \ a_{n-2} \ \dots \ a_0$, each power of x having a coefficient attached to it, a_n belonging to x^n and a_0 to the constant term.

In like manner let

$b_m \ b_{m-1} \ \dots \ b_0$ be the coefficients of the second equation.

I begin with

A Rule for absolutely eliminating (x).

Form out of the (a) progression of coefficients (m) lines, and in like manner out of the (b) progression of coefficients form (n) lines in the following manner:

* Communicated by the Author. See the December and January Numbers of this Magazine.