III.—*Action of Pentachloride of Phosphorus on Tartaric Acid.*

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IN a paper on malic acid, published last April in the Philosophical Magazine, we mentioned that we were engaged with the study of the influence of pentachloride of phosphorus on Tartaric acid; our time, however, having been much occupied by other subjects, we have as yet been unable to investigate the matter thoroughly, but, having obtained some peculiar results, we take this opportunity of laying them before the Society.

On gently heating a mixture of pentachloride of phosphorus and tartaric acid, hydrochloric acid is evolved in abundance, and a perfectly liquid mixture is formed consisting of oxychloride of phosphorus and an oil. To obtain the latter in quantity we have found it best to operate in the following manner.

One part of pulverized tartaric acid and five or six of pentachloride of phosphorus are mixed and introduced into a retort and gradually heated until perfectly liquid. The temperature is then elevated and the liquid allowed to distil until it reaches 120° ; it is maintained at this point, and dry air passed through the remaining liquid for five or ten minutes, so as to separate as much of the remaining oxychloride of phosphorus as possible.

This product, which is the chloride of a diatomic acid radical, sinks as an oil, when thrown in water, and gradually dissolves. It also dissolves in alcohol, forming an ethereal body. If projected into strong aqueous ammonia, a violent action ensues, chloride of ammonia and a new crystalline compound, very soluble in alcohol and water, being produced. With phenylamine this body reacts most energetically. It decomposes partially on being distilled.

As mentioned above, this substance gradually dissolves in water. If a considerable quantity is mixed with water, it becomes warm, and, on cooling, deposits a white, slightly crystalline acid. If exposed to the moist atmosphere for a day or two, it becomes a white solid mass.

This acid, after being well pressed between bibulous paper and recrystallized from water, presents itself as a white, almost amorphous, mass: but, when viewed under the microscope, appears as small transparent needles. It is very soluble in water and alcohol,

has a very acid taste, melts when heated, and solidifies into a crystalline mass on cooling. It is bibasic.

Acid potassium-salt. This is best obtained by taking a solution of the acid and dividing it into two equal portions, neutralizing one with carbonate of potassium and then adding the other to it. If not too dilute, the new salt immediately makes its appearance as a crystalline precipitate, which, after washing with cold water and recrystallizing once or twice, is obtained quite pure. It crystallizes in plates. It is more soluble than the acid tartrate of potassium. It contains chlorine. The following carbon, hydrogen, chlorine, and potassium determinations have been made :

- I. ·3290 of substance gave
 ·3033 of carbonic acid, and
 ·0329 of water.
- II. ·2064 of substance gave
 ·1567 of chloride of silver.
- III ·69525 of substance gave
 ·271 of chloride of potassium.

Percentage composition :—

Carbon	.	.	.	.	25·14
Hydrogen	.	.	.	.	1·11
Chlorine	.	.	.	.	18·82
Potassium	.	.	.	.	20·45

which agrees with the formula $\text{KH}_2\text{C}_8(\text{HCl})\text{O}_8$ as may be seen from the following table :—

		Theory.		Exp.
Carbon	8 equiv. .	48	25·4	25·14
Hydrogen	2 „ .	2	1·05	1·11
Chlorine	1 „ .	35·5	18·81	18·82
Potassium	1 „ .	39·2	20·77	20·45
Oxygen	8 „ .	64·0	33·97	
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		188·7	100·00	

The *neutral potassium-salt* is crystalline, and much more soluble than the former.

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Silver-salt.—On adding nitrate of silver to a solution of either of the above salts, a white precipitate is immediately formed, this, when washed with cold water and dried in vacuo over sulphuric acid is fit for analysis. It is very slightly soluble in water. When viewed under a powerful lens, it presents a slightly crystalline appearance. On being heated on platinum foil, it decrepitates, leaving a residue of metallic silver and chloride of silver. The subjoined determinations were made :—

- I. .2655 of substance gave
 .210 of chloride of silver.
- II. .29325 of substance gave
 .17375 of metallic silver, and
 .117 of chloride of silver.

Percentage composition :—

	I.	II.
Silver . . .	59.5 . .	59.25
Chlorine. . .	— . .	9.50

These numbers agree with the formula $\text{Ag}_2\text{C}_8(\text{HCl})\text{O}_8$ as may be seen from the following table :—

		Theory.	Exp.
Carbon	8 equiv. . .	48	13.16
Hydrogen	1 „ . .	1	.27
Chlorine	1 „ . .	35.5	9.74
Silver	2 „ . .	216.0	59.23
Oxygen	8 „ . .	64.0	17.60
		364.5	100.00

Lead-salt. This salt is obtained by adding acetate of lead to a solution of the potassium salt. It is a crystalline substance difficultly soluble in water.

From the foregoing it evidently appears that the new acid has the composition $\text{C}_8(\text{H}_3\text{Cl})\text{O}_8$, and the chloride from which it is derived, the formula $\text{C}_8(\text{HCl})\text{O}_4\text{Cl}_2$. This acid in composition represents maleic or fumaric acid, in which one equivalent of hydrogen is replaced by chlorine; but, as it is a very soluble substance, it would appear that if derived from either of the above, it would be from maleic acid, therefore we give it the provisional

name of *chloromaleic acid*. We hope shortly to be able to replace the chlorine in this acid by hydrogen, and then to ascertain whether it might be viewed as a derivative of maleic acid or not, because this is important, as it may show us the relation which tartaric acid bears to malic.

The action of pentachloride of phosphorus may be explained thus:—

Then—

This appears to show that tartaric acid represents four molecules of water and that part of the hydrogen and oxygen exist in the same peculiar condition as in glycolic and lactic acid.

The formula of tartaric acid appears to be $\left. \begin{array}{c} \text{C}_8\text{H}_2\text{O}_4 \\ \text{H}_4 \end{array} \right\} \text{O}_8$

We have obtained some very interesting substances by digesting the bromacetic ethers with sulphocyanides, acetates, succinates, &c., the study of which we are now engaged with.