ART. XXX.—*Formic versus Carbonous acid*; by GEORGE F. BARKER.

IN studying the primary oxyds of the negative simple radicals, (the acids) for the purpose of classification, it is evident that the equivalence of the radical varies in each of the acids which it forms. In sulphuric acid, sulphur is a hexad, while in sulphurous acid it is a tetrad and in hyposulphurous acid a dyad. Conversely we may expect to find as many acids as the radical by such changes in its equivalence, can produce. Phosphoric acid contains phosphorus as a pentad; but since this radical may act as a triad, phosphorous acid is thus predicted. In the case of the tetrad carbon we have carbonic acid; but since carbon may act as a dyad, carbonous acid is also possible. I propose to give here some of the arguments which may be adduced to show that formic acid is the acid in question.

1. The formula of formic acid, usually written $\left(\begin{smallmatrix} \Theta \text{H} \Theta \\ \text{H} \end{smallmatrix} \right) \left\{ \Theta \right.$, may equally well be written $\left(\begin{smallmatrix} \Theta'' \\ \text{H}_2 \end{smallmatrix} \right) \left\{ \Theta_2 \right.$, both being equal to $\text{H}_2\Theta\Theta_2$, corresponding to carbonic acid $\text{H}_2\Theta\Theta_3$. Potassic formate $\left(\begin{smallmatrix} \Theta \text{H} \Theta \\ \text{K} \end{smallmatrix} \right) \left\{ \Theta \right.$ equals $\left(\begin{smallmatrix} \Theta \\ \text{HK} \end{smallmatrix} \right) \left\{ \Theta_2 \right.$, and the ethers $\left(\begin{smallmatrix} \Theta \text{H} \Theta \\ \Theta_n \text{H}_{2n+1} \end{smallmatrix} \right) \left\{ \Theta \right.$ may be $\text{H} \left(\begin{smallmatrix} \Theta \\ \Theta_n \text{H}_{2n+1} \end{smallmatrix} \right) \left\{ \Theta_2 \right.$.

2. Hofmann's formamid $\left(\begin{smallmatrix} \Theta \text{H} \Theta \\ \text{H} \end{smallmatrix} \right) \left\{ \text{N} \right.$ may be viewed as $\left(\begin{smallmatrix} \Theta'' \\ \text{H}_2 \text{N} \\ \text{H} \end{smallmatrix} \right) \left\{ \Theta \right.$ carbimic acid, corresponding to carbamic acid $\left(\begin{smallmatrix} \Theta \Theta \\ \text{H}_2 \text{N} \\ \text{H} \end{smallmatrix} \right) \left\{ \Theta \right.$. Especially since ethyl-formamid $\left(\begin{smallmatrix} \Theta \text{H} \Theta \\ \Theta_2 \text{H}_5 \\ \text{H} \end{smallmatrix} \right) \left\{ \text{N} \right.$ may be ethylic carbimate $\left(\begin{smallmatrix} \Theta'' \\ \Theta_2 \text{H}_5 \\ \text{H}_2 \text{N} \end{smallmatrix} \right) \left\{ \Theta \right.$.

* Near the last of June, Prof. G. Hinrichs, of Iowa University, published in German a memoir on *Atom Mechanics*, which, while the views are widely different, has some points of agreement with my paper in the July number of this Journal. A copy of the memoir reached this place July 2d, after my paper was printed, but nearly three weeks before the July number was issued. I had intended to have an abstract of it in this number, but am unable to accomplish it, and therefore defer it to our next.

3. The radical formyl ($\text{CH}\Theta$), unlike acetyl ($\text{C}_2\text{H}_3\Theta$), is not required to formulate the derivatives of the acid. Moreover, no chlorid or hydrid of this radical exists. The anhydrous acid (formylic oxyd), too, $\left\{ \begin{smallmatrix} \text{CH}\Theta \\ \text{CH}\Theta \end{smallmatrix} \right\} \Theta$ is unknown. If, however, the acid be $\left\{ \begin{smallmatrix} \text{C} \\ \text{H}_2 \end{smallmatrix} \right\} \Theta_2$, then its secondary oxyd would be $\text{C}'' \left\{ \begin{smallmatrix} \text{C} \\ \text{H}_2 \end{smallmatrix} \right\} \Theta$, carbonic oxyd.

4. Its synthesis. We have—*a*, Berthelot's method,
 $\text{HK}\Theta + \text{C}\Theta = \text{HKC}\Theta_2$; just as $\text{HK}\Theta + \text{S}\Theta_2 = \text{HKS}\Theta_3$.

b, Kolbe's method by deoxydizing $\text{H}_2\text{C}\Theta_3$,
 $(\text{H}_2\text{C}\Theta_3)_2 + \text{Na}_2 = \text{HNaC}\Theta_2 + \text{HNaC}\Theta_3 + \text{H}_2\Theta$.

c, Dupré's method, $\text{H}_2\text{C}\Theta_3 + \text{C} + \text{H}_2\Theta = (\text{H}_2\text{C}\Theta_2)_2$; similar to
 $\text{H}_2\text{S}\Theta_3 + \text{S} + \text{H}_2\Theta = (\text{H}_2\text{S}\Theta_2)_2$.

d, Chapman's method, partial oxydation of carbon,
 $\text{C} + \Theta + \text{H}_2\Theta = \text{H}_2\text{C}\Theta_2$.

5. Its preparation. *a*, from oxalic acid $\text{H}_2\text{C}_2\Theta_4 = \text{H}_2\text{C}\Theta_2 + \text{C}\Theta_2$, as well as the reverse action; *b*, from cyanhydric acid

And in general its production from the oxydation of carbonaceous materials. In no case is the intermediate body formic aldehyd, obtained; this anomalous result is accounted for if the acid be $\left\{ \begin{smallmatrix} \text{C}'' \\ \text{H}_2 \end{smallmatrix} \right\} \Theta_2$.

6. Its decompositions. Like sulphurous and similar acids, it readily reduces metallic salts; it is oxydized readily by platinum black; by action of $\text{H}_2\text{S}\Theta_4$, $\text{H}_2\text{C}\Theta_2$ gives $\text{H}_2\Theta$ and $\text{C}\Theta$, the anhydrid; the action of PCl_5 produces no formylic chlorid, $\text{H}_2\text{C}\Theta_2 + \text{PCl}_5 = \text{PCl}_3\Theta + \text{C}\Theta + (\text{HCl})_2$; chlorine gives $\text{H}_2\text{C}\Theta_2 + \text{Cl}_2 = \text{C}\Theta_2 + (\text{HCl})_2$.

7. Its acknowledged divergence from the acetic or fatty acid series, in which it is usually classed. These acids resist the oxydizing action of dilute chromic acid, while formic acid on the other hand is a powerful reducing agent.

From the above statements, it is clear that this question turns on the fact whether this acid is mono or dibasic. Just now, the former has the preference. True we may view the formates as acid carbonites, but the anomaly of an acid, all of whose salts are acid salts, remains. A basic plumbic formate $\text{H} \left\{ \begin{smallmatrix} \text{Pb}'' \\ \text{C} \end{smallmatrix} \right\} \Theta$,

corresponding to the acetate $\text{H} \left\{ \begin{smallmatrix} \text{Pb}'' \\ \text{C}_2\text{H}_3 \end{smallmatrix} \right\} \Theta$, if known, might have the formula $\text{Pb}''\text{C}\Theta_2 + \text{H}_2\Theta$, plumbic carbonite.

The fact of its formation by the partial oxydation of carbon, and also, by the deoxydation of carbonic acid, are however, most cogent arguments in favor of the acid of bivalent carbon.

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