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XVII.—*On the Amides.*

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(FROM A LETTER TO DR. WILLIAMSON.)

In my paper on the anhydrous acids, I have advanced the opinion that the majority of organic compounds hitherto well known may be derived from a very small number of types, belonging to mineral chemistry—such, for instance, as water, hydrochloric acid, ammonia, &c. Considered as terms of a series, the bodies derived from each of these types have not identical properties; their properties are, in fact, progressive, the difference between them increasing with the interval between the places in the series which they occupy. According to this view, we may comprehend under *one type*, acids, bases, and neutral bodies, the acids being placed at one end of the series, the bases at the other, and the neutral bodies which form the transition between the two extremes occupying the middle place. If, for the sake of simplification, we designate the two extremes by the words positive and negative, we may say that there are groups, or organic radicals, such as methyl, ethyl, phenyl, which being substituted for the hydrogen of the preceding types, produce *positive derivatives*—that is to say, bodies more or less resembling bases; whilst other groups or radicals, such as othyl* (or *acetyl*), benzoyl, cumyl, give rise, by a similar substitution, to *negative derivatives*, or bodies more or less

* The term "othyl" has been substituted for "acetyl" at the suggestion of Dr. Williamson, to avoid confusion between the oxygen-radical C_2H_3O and the hydrocarbon C_2H_5 , to which the name of "acetyl" has long been applied.

analogous to acids. This point appears to me to be now completely established with regard to the derivatives of the water or oxide type, including the alcohols, ethers, hydrated acids and anhydrous acids; and it is no less evident in the derivatives of the hydrochloric acid type, comprising the chlorides which correspond to these different organic oxides.

With respect to the derivatives of the ammonia type, chemists, doubtless relying on the constancy of chemical characters exhibited by the derivatives of the same type, have regarded ammonia as the type of those bodies only which have strongly marked alkaline properties. In this point of view, the beautiful researches of Dr. Hofmann on the organic bases have enriched science with a considerable number of compounds. But these occupy only one extremity of the series—that is to say, the positive extremity, already occupied by alcohol and ether, or in general by those organic oxides which are similar to bases, and contain the same radicals as the alkaline ammonias themselves. But if, as I suppose, the properties of the derivatives of the same type, instead of being constant, vary in regular series, then there must also exist ammonias occupying the negative extremity of the series, together with the hydrated and anhydrous acids; in other words, the same groups or radicals which, by substitution for 1 or 2 atoms of hydrogen in water, give rise to hydrated or anhydrous acids, must also be able to take the place of 1, 2 or 3 atoms of hydrogen in ammonia, and thus produce neutral ammonias, and ammonias more or less acid. From this point of view, the already known amides of monobasic acids may, I think, be regarded as realizing the substitution of the first atom of hydrogen in ammonia by an acidifying group (benzoyl, othyl, cumyl); we know, in fact, that these amides are feeble acids, in which an atom of hydrogen may be replaced by mercury, silver, &c. But to complete the demonstration, it still remains to effect the same substitutions on the other 2 atoms of hydrogen in ammonia. This is, in fact, what M. Chiozza and myself have endeavoured to do, by the experiments which I proceed to describe.

At the commencement of this research an important point demanded our attention—namely, the preparation of the amides required for our experiments—preparations often lengthy and tedious when carried on by the usual processes. These we replace by a very simple and expeditious method, which consists in treating the solid commercial carbonate of ammonia directly with the chloride corresponding to the acid whose amide we wish to obtain. The action is immediate, carbonic acid is disengaged, and a simple washing with cold water dissolves

the chloride of ammonium formed in the reaction. In this manner, large quantities of benzamide, cuminamide, sulphophenylamide,* &c., may be obtained with the greatest ease. The negative chlorides required for these preparations are obtained by means of the perchloride or oxychloride of phosphorus. In place of the chlorides, the corresponding anhydrous acids may be used.

The amides thus produced, which we shall call *primary amides*, represent a molecule of ammonia in which 1 atom of hydrogen is replaced by the negative radicals, benzoyl, cumyl, othyl, salicyl, sulphophenyl, &c.

To convert the preceding compounds into *secondary amides*, or amides representing a molecule of ammonia in which 2 atoms of hydrogen are replaced by the negative radicals, we heat these primary amides with an equivalent quantity of chloride of benzoyl, of cumyl, sulphophenyl, &c. Abundant fumes of hydrochloric acid are disengaged, and a residue is left consisting of the secondary amide. These operations must be conducted at a determinate temperature; for some primary amides, when heated too strongly, spontaneously suffer a secondary decomposition, resulting in the formation of nitriles (cyanides of the alcohol-radicals). This secondary decomposition often interferes considerably with the results of these experiments, and renders their execution much more difficult than would at first be supposed. The secondary amides may likewise be produced, in certain cases, by the action of the anhydrous acids on the primary amides.

With regard to the *tertiary amides*, representing a molecule of ammonia in which the 3 atoms of hydrogen are replaced by negative groups, their preparation is generally easier than that of the secondary amides; for these, having much more strongly marked acid properties than the primary amides, form metallic salts more easily, and these are acted upon, even in the cold, by the chlorides of benzoyl, cumyl, &c.

It is then by double decomposition that we produce our new

* The amide of Mitscherlich's sulphobenzidic acid.

Among the new compounds which we have already obtained, I may mention

is obtained in beautiful colourless needles, soluble in boiling water.

forms beautifully brilliant needles, slightly soluble in cold alcohol.

We are at present engaged in the study of the preceding bodies, and of many similar compounds. The number of the organic acids which form chlorides and anhydrous acids being very large, we may vary almost infinitely the substitutions by negative radicals, and thus form a vast number of new bodies. There is little doubt that many of the nitrogen-acids contained in plants exhibit a constitution similar to that of our new amides.

In a future communication I propose to speak of the *Diamides* (amides of bibasic acids), such as oxamide, of the *Acid Amides*, and the *Hydramides* (such as hydrobenzamide). The acid amides evidently correspond to the hydrated oxide of ammonium; they occupy one extremity of the series, at the other end of which are found the alkalies discovered by Dr. Hofmann (hydrated oxide of tetrethyl-ammonium), &c.