formula for chlorophyll *a* seems to offer the best explanation at present of the transformations of the predominant form and to allow for the existence of a second similar form with the methoxyl group in a different position.

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Notes

The Intramolecular Rearrangement of Phenyl Ethers with the Aid of Aluminum Chloride

BY RICHARD A. SMITH

The literature contains reports concerning the rearrangement of alkyl phenyl ethers to substituted phenols through the agencies of heat, zinc chloride, hydrogen chloride, sulfuric acid, sulfuric and glacial acetic acids, boron fluoride, etc.

Due to the fact that rearrangement of *m*-cresyl isopropyl ether leads to the formation of the commercially important thymol (and its isomers), this transformation has received careful study.[1] Niederl and Natelson first effected the reaction with a sulfuric–glacial acetic acid solution; the same products were obtained by Sowa, Nieuwland and Hinton using boron fluoride as the rearranging agent. The same products obtained by these workers are also obtained when aluminum chloride is used in the role of the agent favoring the intramolecular rearrangement. This agent simplifies the experimental procedure. It is believed that this type of rearrangement holds promise for further study into the interesting field of ether rearrangement, and a more comprehensive study is contemplated.

Procedure.—One mole of aluminum chloride was slowly added (twenty minutes) to one mole of *m*-cresyl isopropyl ether contained in a flask surrounded by a cooling bath. Heat was evolved, and the liquid became discolored. The mixture was allowed to stand for twenty-four hours and then hydrolyzed with ice water. The organic liquid which then separated was water washed and distilled. Practically all the liquid came over between 228 and 224°; it has been shown in the previous rearrangements that such a fraction consists of thymol and the para substituted isomer, *p*-isopropyl-*m*-methylphenol. The product was alkali soluble and ferric chloride colored its alcohol solution; n_D^{22} 1.5274. The yield of redistilled product was 65%. There was no unrearranged ether and no *m*-cresol.

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(1) Niederl and Natelson, THIS JOURNAL, **53**, 1928 (1931); **54**, 1063 (1932); Niederl, Natelson and Smith, Indianapolis Meeting of the American Chemical Society, 1931; Sowa, Nieuwland and Hinton, THIS JOURNAL, **54**, 2019 (1932).

The Absence of Fatty Acids Associated with Potato Starch

BY LEO LEHRMAN AND ELVIN KABAT

In the course of some work on potato starch[1] it was necessary to know the amount of fatty acid, if any, associated with the starch. Though 0.04% "fat by hydrolysis," has been reported in this starch,[2] Taylor and other workers in this field now believe that it is fat free.

To establish this point definitely we extracted a 50-g. sample of potato starch with petroleum ether for several hours and found 0.02% extraneous extractable material. Then we hydrolyzed[3] 2000 g. of the starch and found approximately 0.02% "fat by hydrolysis."

Thus potato starch does not contain fatty acids associated with it and is the best whole starch to use as carbohydrate.

(1) The authors wish to thank Stein Hall & Co., Inc., N. Y. C., for their kindness in supplying this material.

(2) Taylor and Nelson, THIS JOURNAL, **42**, 1726 (1920).

(3) Lehrman, *ibid.*, **51**, 2185 (1929).

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COMMUNICATIONS TO THE EDITOR

AN EQUATION RELATING DENSITY AND CONCENTRATION

Sir:

Redlich and Rosenfeld [*Z. physik. Chem.*, **A155**, 65 (1931)] have shown on the basis of the Debye–Hückel theory that the partial molal volume of an electrolyte in dilute aqueous solution is proportional to the square root of the normality. This gives a theoretical basis for Masson's empirical rule [*Phil. Mag.*, (7) **8**, 218 (1929)] connecting the apparent solution volume of a salt with its concentration in the solution.

$$\phi = \phi_0 + K\sqrt{N}$$

The relation between the concentration and density of a salt solution and the apparent solution volume of the salt can be shown to be

$$\phi = \frac{\text{Eq. Wt}}{D_{\text{H}_2\text{O}}}\text{ salt} - \frac{1000}{D_{\text{H}_2\text{O}}}\left[\frac{D_{\text{soln.}} - D_{\text{H}_2\text{O}}}{N}\right]$$

By combining these two equations one obtains for the equation relating the density and normality of a solution of a strong electrolyte in water

$$D = D_0 + c_1N + c_2N^{3/2}$$

where c_1 and c_2 are constants, and D_0 is the density of pure water.