Wyman VI. It is readily seen that the theoretically important factor $\left[1 + \frac{T}{D}\frac{\mathrm{d}D}{\mathrm{d}T}\right]$ is extraordinarily sensitive to small differences in $\mathrm{d}D/\mathrm{d}T$. The good agreement of V and VI at 25° is fortuitous, as is seen from an examination of the various factors at other temperatures. III and IV must be regarded as incorrect not only because of poor agreement with the other measurements but also in view of the improbable value given for $\left[1 + \frac{T}{D}\frac{\mathrm{d}D}{\mathrm{d}T}\right]$, a value not easily reconciled with the experimental measurements of V_c. It would seem that the exact values of $\mathrm{d}D/\mathrm{d}T$ lie between those of measurements I, II and V, VI; at any rate it cannot be said, unfortunately, that we have obtained more probable values of these theoretically important factors in spite of the several comprehensive series of newer measurements. For a comparison of measured and calculated integral heats of dilution it is necessary that $\mathrm{d}D/\mathrm{d}T$ be known with an accuracy of ±0.5%, an accuracy which has probably not yet been reached in these difficult measurements.[8]

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Inorganic Lubricants. II. Phosphoric Acid Mixtures.—The use of moistened phosphorus pentoxide, boiled orthophosphoric acid and similar materials as inorganic lubricants on glass stopcocks and ground connecting tubes has been more or less common practice[1] wherever organic lubricants must be avoided. Such materials, however, have the disadvantage of being markedly hygroscopic in moist air, and eventually become thin, watery and of lower lubricating value.

Stephens' recently described phosphoric acid mixture[2] is a lubricant of superior physical properties, but this product also is freely hygroscopic in air of moderate humidity.

Phosphoric acid mixtures containing chiefly metaphosphoric acid, on the other hand, are not markedly hygroscopic in air of even as high humidity as 80%, except after exposure of weeks or months, and then only slightly. The following procedure yields a satisfactory lubricant of this nature.

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[8] A more detailed discussion of these various series of dielectric constant measurements will be included in a paper to be read at the Heidelberg meeting of the Bunsen Society, May 29–31. The paper will be published in *Z. Elektrochem.*, **36**, (1930).

[1] See, for example, Baxter and Chapin, *Proc. Am. Acad. Arts Sci.*, **46**, 239 (1910); Richards and Krepelka, THIS JOURNAL, **42**, 2226 (1920).

[2] Stephens, *ibid.*, **52**, 635 (1930).

Dissolve 10 g. of metaphosphoric acid (glacial phosphoric acid in fused sticks) in 100 cc. of distilled water, add 2 g. of boric acid crystals and stir until dissolved. Evaporate this mixture on the steam-bath to about 25 cc. and add 1 cc. of 85% orthophosphoric acid. Boil gently and stir with a thermometer until the temperature reaches 122°. Cool somewhat and transfer to a bottle.

The product is a transparent, colorless, viscous sirup that, in addition to being reasonably stable in air, does not set or crystallize over a period of several months. Moreover, it is sufficiently thermoplastic to become markedly less viscous when heated gently. The boric acid appears to increase the viscosity somewhat and to aid in preventing crystallization. The viscosity can be further increased by boiling to a higher temperature.

A lubricant of similar properties containing chiefly water-soluble sodium metaphosphate may be prepared as follows.

Ten grams of the sodium metaphosphate (prepared by heating monosodium phosphate or sodium ammonium phosphate in platinum over a blast lamp until a quiet melt at redness is obtained) is dissolved in 50 cc. of distilled water. Two grams of borax is added and dissolved and the solution evaporated on the steam-bath to a volume of about 25 cc. and then boiled over a small free flame until the temperature reaches 106°. Such a mixture may become slightly cloudy on standing, but this does not appear to affect its usefulness.

These lubricants may be used with organic vapors and liquids, some acid vapors and with neutral gases, but crystallization may develop in the presence of alkaline vapors. There is little tendency to freeze or "grab." They have a low but definite aqueous vapor pressure and so may not be employed when water vapor must be strictly excluded.

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