from the work of La Mer, Eichelberger and Urey [*ibid.*, **56**, 248 (1934)] on the freezing points of isotopic mixtures. Experience in the concentration of D_2O from tap water has shown that the ratio D_2O/H_2O in natural water is about 1 in 5 or 6 thousand, in agreement with the mass spectrographic study of Bleakney and Gould [*Phys. Rev.*, **41**, 265 (1933)].

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RECEIVED MARCH 21, 1934

THE NATURAL SEPARATION OF THE ISOTOPES OF HYDROGEN

Sir:

The densities of water obtained from the Atlantic Ocean,[1] from the Dead Sea and the Great Salt Lake and from the hydrated mineral rasorite are greater than that of fresh water by several parts per million, thus indicating a natural isotopic fractionation of water presumably by distillation.[2] The discoveries of Lewis and of Taylor, Swingle, Eyring and Frost[3] of the inability of living organisms to live or to grow in deuterium oxide have suggested the possibility of a natural selection of protium in preference to deuterium in the animal and vegetable kingdom. On the other hand, dilute solutions of deuterium oxide seem to stimulate physiological activity,[4] a fact which would lead one to predict that deuterium could possibly be concentrated physiologically. Washburn and Smith[5] have found that in the case of a growing willow tree an isotopic fractionation of hydrogen in the direction of a preferential selection of deuterium does occur.

Before this interesting work of Washburn and Smith was known to me, I had begun an investigation of the relative abundance of deuterium in organic compounds by burning the compounds in air or oxygen, condensing the resulting water vapor and measuring the density of the water after purification. Kerosene from the Oklahoma oil fields and Mallinckrodt thiophene-free benzene obtained in the destructive distillation of coal were separately burnt at the surface of a sintered glass wick in an atmosphere of dried air until 600 cc. of water had been condensed in each case. After careful purification the water from kerosene had a density seven parts per million greater than that of ordinary water while the benzene water was about eight parts per million heavier. Water obtained from the combustion of honey was four parts per million heavier than that of ordinary water. These data are comparable to the results of Washburn and Smith, who found that water from the combined hydrogen in the willow tree was between five and six parts per million more dense than ordinary water. I hope to investigate natural products of an animal origin in the near future.

The data for kerosene may shed some light on the origin of petroleum.

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RECEIVED MARCH 21, 1934

ACCELERATED DIFFUSION IN DYE SOLUTIONS

Sir:

In a recent paper [THIS JOURNAL, **56**, 52 (1934)], McBain and Dawson give striking illustrations of accelerated diffusion, of electrolytes in aqueous solution, through a porous glass membrane. We wish to draw attention to another type of accelerated diffusion which has recently been observed in this Laboratory. Our observations are for the free diffusion of azo dyes in the presence of electrolytes as determined by the Fürth [*Kolloid-Z.*, **41**, 300 (1927)] micro-diffusion method. This method is particularly adaptable to observation of effects arising from rapid motion of color ions, and gives results with an average experimental variation of less than 5%.

When an aqueous solution of the sodium salt of *p* - sulfobenzene - azo - benzene - azo - 6 - benzoylamino-1-naphthol-3-sulfonic acid and sodium chloride is allowed to stand for a month at 25°, the rate of diffusion of the color ion is markedly affected by the presence of sodium chloride in the solution into which diffusion occurs. The results are summarized in Table I.

Numerous attempts were made to carry out diffusion from dye solutions containing 1.0 g./l. of sodium chloride, into sodium chloride solutions varying from 0.75–1.0 g./l. concentration. In every instance, measurement of the diffusion constant proved impossible owing to an accel-

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[1] E. S. Gilfillan, Jr., THIS JOURNAL, **56**, 406 (1934).

[2] Bur. Standards Tech. News Bull. 196, August, 1933.

[3] G. N. Lewis, THIS JOURNAL, **55**, 3503 (1933); H. S. Taylor, W. W. Swingle, Henry Eyring and A. A. Frost, *J. Chem. Physics*, **1**, 751 (1933).

[4] T. C. Barnes, THIS JOURNAL, **55**, 4332 (1933); *Am. J. Bot.*, **20**, 681 (1933); S. L. Meyer, *Science*, **79**, 210 (1934); O. W. Richards, *Am. J. Bot.*, **209**, 679 (1933).

[5] E. W. Washburn and E. R. Smith, *Science*, **79**, 188 (1934).