six similar glass tubes and added to each of three tubes 0.02 cc. of ordinary distilled water and to each of the other three tubes 0.02 cc. of pure H^2H^2O. The six tubes were then hermetically sealed and placed in a thermostat at 25°. The three pairs of seeds in ordinary water began to sprout in two days and at the end of two weeks formed the well-developed seedlings shown in Fig. 1. The three pairs of seeds in H^2H^2O showed, at least macroscopically, no development. These three pairs alternate with the seedlings in Fig. 1. These undeveloped seeds have now been restored to ordinary water and it will be interesting to see whether their development has been only inhibited or whether they have been killed.

Six entirely similar tubes, each containing two seeds, were filled alternately with ordinary distilled water and with water in which one-half of the hydrogen is H^2, thus corresponding, on the average, to the formula H^1H^2O. At the end of four days all six of the seeds in ordinary water gave well-developed seedlings, while those in the heavier water all showed about the same degree of sprouting as occurs in ordinary water in two days. Whether the seeds will continue to develop in water containing 50% of H^2 remains to be seen. The present development is shown in Fig. 2. I am greatly indebted to Mr. J. A. Gullberg for making the photographs.

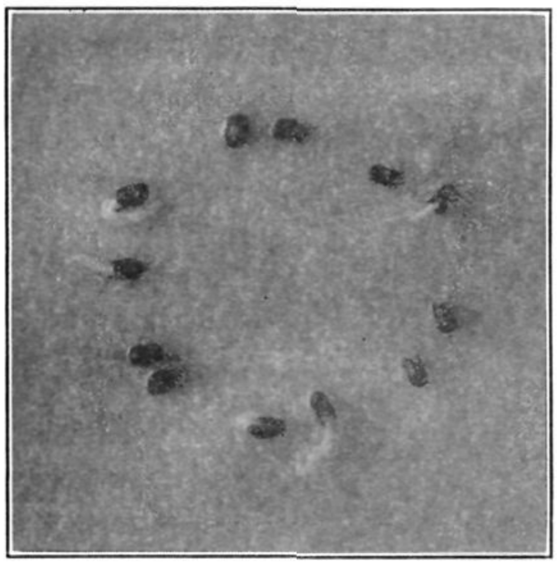
Fig. 2.

I have long desired to determine the proportions of isotopes in living matter, in order to see whether the extraordinary selective power of living organisms, which is exemplified by their behavior toward optical isomers, might lead to a segregation of isotopes in some of the substances which are necessary to growth. The marked biochemical differences between the two isotopes of hydrogen lends a further incentive to this search.

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THE MOBILITY OF IONS IN H^2H^2O

Sir:

We have compared the conductivity of hydrogen and potassium chlorides in ordinary water and in nearly pure H^2H^2O. Since only about 0.3

cc. of the latter was available, a cell containing 0.25 cc. was constructed with electrodes of bare platinum wire and gave excellent results. To equal quantities of the two kinds of water one cubic millimeter of ordinary constant-boiling hydrochloric acid was added by means of a buret made from the capillary of a broken Beckmann thermometer and accurate to 0.000001 cc. The addition of this small amount of ordinary hydrochloric acid solution is equivalent to adding H^1 to the extent of 0.4 per cent. of the total hydrogen present. The measured resistance of the cell with these solutions (approximately 0.017 *M*) in ordinary and in heavy water at various temperatures is shown in Curves B_1 and B_2 of Fig. 2.

The solution in heavy water was neutralized with dry sodium carbonate and distilled. Its density showed it to be 97% H^2H^2O. Equivalent solutions (approximately 0.086 *M*) of potassium chloride in this and in ordinary water were then made up, the salt being weighed out with a microbalance. The resistance of these two solutions is shown by the Curves A_2 and A_1 of Fig. 2.

Taking the data from the curves, at even temperatures, and making a slight extrapolation to pure H^2H^2O, assuming that the resistance changes linearly with the isotopic content of the solvent, we obtain the values given in Table I, where x(KCl) is the ratio of the equivalent conductance of potassium chloride in ordinary water to that in pure H^2H^2O and x(HCl) is the ratio of the equivalent conductance of H^1Cl

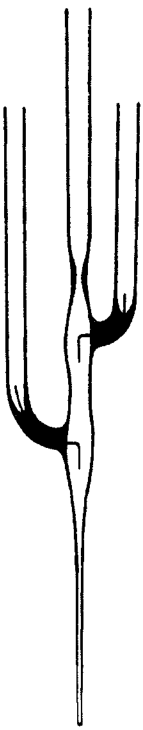

Fig. 1.

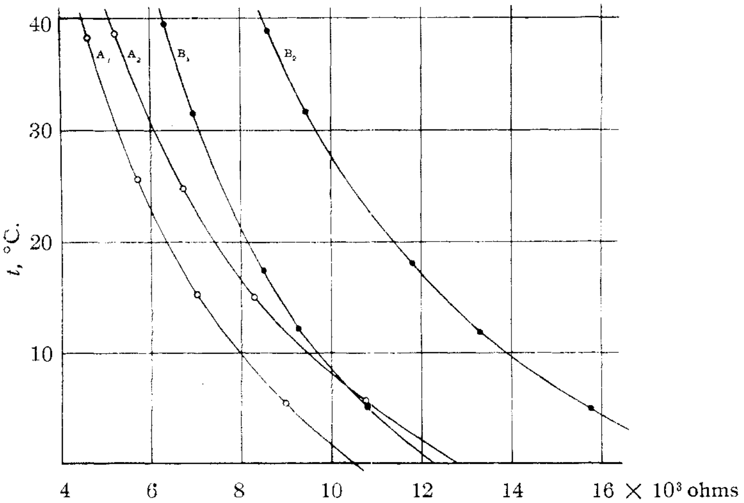

Fig. 2.

in ordinary water to that of H^2Cl in pure H^2H^2O. We believe these figures to be accurate to 0.5%.

TABLE I

t, °C.	5	15	25	35	18
x(KCl)	1.212	1.180	1.162	1.152	1.173
x(HCl)	1.476	1.426	1.390	1.362	1.414

It seems safe to assume that the ratio of equivalent conductance to equivalent conductance at infinite dilution is the same for each electrolyte in the two solvents, and further, that the ratio of the mobilities of K^+ and Cl^- is the same in both solvents. We then obtain the mobilities at 18° of H^{2+}, K^+ and Cl^- in pure H^2H^2O as 213.7, 54.5 and 55.3 if we take the corresponding mobilities of H^{1+}, K^+ and Cl^- from the "International Critical Tables" as 315.2, 64.2 and 65.2.

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THOMAS C. DOODY

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VESICANT ACTION OF CHLOROALKYL SULFIDES

Sir:

I realize that the first published statement on the relationship between beta substitution of chloroalkyl sulfides and vesicant action was made by Kirner [THIS JOURNAL, **50**, 2446 (1928)] and deeply regret that the statement in my recent article [*ibid.*, **55**, 2070 (1933)] was not so phrased as to indicate clearly the limitation I had in mind, which was the application of this principle to the condensation theory of vesicant action.

It has been current knowledge at Edgewood Arsenal for many years that the vesicant action of mustard gas and its homologs is limited to those substituted on the beta carbon atom. This information was unpublished and detracts in no way from Kirner's recognition of the fact. However, it was this knowledge, coupled with certain difficulties in accepting completely the hydrochloric acid theory of vesicant action, that led Lawson and Reid [*ibid.*, **47**, 2821 (1925)] to bring up again the condensation theory and to suggest the possibility of thiazane formation as an important factor. The results published in my recent paper demonstrate that thiazane formation is not essential to vesicant action and indicate that if the condensation theory is to be retained it must assume an additional limitation, a reactive halogen on the beta carbon atom.

EDGEWOOD ARSENAL, MD.
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