literature descriptive of the method and a trained observer is essential. For such an observer this is indeed a comparatively easy method of analysis.

We were interested in the application of this method to uranium because we wished to study the distribution in the blood, urine and various organs of a foreign material injected into the blood of animals. This we were able to do with satisfaction and we believe that we have given the method a fair and thorough test, as all the 126 samples of which analyses were made were unknowns to the observer. We are also of the opinion that it can be used advantageously by chemists and biological chemists, as well as by physicists, especially if dealing with very small quantities. The details of this work will be published in full in the *American Journal of Physiology.*

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THE VESICANT ACTION OF HALOGENATED SULFIDES

Sir:

Dawson, in an article entitled, "Reactions of Certain Halogen Substituted Aryl, Alkyl and Di-alkyl Sulfides with Benzylamine. I" [THIS JOURNAL, **55**, 2070 (1933)], discusses the mechanism of vesicant action of halogenated sulfides and states, "The data obtained from these reactions may be regarded as further substantiating the condensation theory of vesicant action, but they entirely eliminate thiazane formation as an important factor and appear to demand a new limitation, that of a reactive halogen on the beta carbon atom."

In 1928 I published an article [*ibid.*, **50,** 2446 (1928)] dealing with the synthesis of β-chloroethyl and γ-chloropropyl *methyl* sulfides. The vesicant action of these compounds was studied and the following conclusion was drawn: "It is quite apparent that *only when the halogen is in the β position with respect to the sulfur atom will the resulting compound possess vesicant properties.*" This conclusion was confirmed in a study I made of the vesicant action of the analogous β-chloroethyl and γ-chloropropyl *phenyl* sulfides [Kirner and Richter, *ibid.*, **51,** 3413 (1929)] and also, later, by Gilman and Hewlett [*ibid.*, **52,** 2141 (1930)] in a study of the vesicant action of β-chloroethyl and γ-chloropropyl *furfuryl* sulfides.

In connection with the synthesis of β- (and γ)-chloropropyl *ethyl* sulfides, Dawson used a modification of the method I described for the abovementioned methyl sulfides and gave a reference to my work, but he apparently overlooked the conclusions which were drawn in this paper regarding the vesicant action of these compounds.

I would like to point out that the "new limitation, that of a reactive halogen on the beta carbon atom," just suggested by Dawson, was first presented in my paper of five years ago.

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A SIMPLE TYPE OF ISOTOPIC REACTION

Sir:

It was shown by Lewis and Cornish [THIS JOURNAL, **55,** 2616 (1933)] that when water is distilled through a fractionating column, a large separation of the isotopes of hydrogen and oxygen can be effected, especially if the distillation is carried out under reduced pressure. In order to concentrate considerable amounts of these isotopes, Professor Merle Randall has now designed and constructed, in this Laboratory, a large still which has been in operation for about two months. The density of the water at the bottom of the still has been steadily increasing and it is important to know how much of the increase in density is due to H^2 and how much to O^{18}. The method used by Lewis and Macdonald [*J. Chem. Phys.*, **1,** 341 (1933)] for separating the hydrogen and oxygen of a given sample of water, which consisted in passing the steam over hot iron, is cumbrous. I have therefore sought some simpler process depending upon the interchange of isotopes in an aqueous solution, such as may be exemplified by the reaction

$$H^1H^2O + NH^1H^1H^1 = H^1H^1O + NH^1H^1H^2$$

Ammonia in water may be regarded as forming ammonium hydroxide, and again dehydrating, this process proceeding back and forth with very great velocity. Now the fourth hydrogen of the ammonium group is exactly like the others and when the dehydration occurs, each of the four hydrogens has an equal chance of being lost. Therefore there must be a rapid interchange of such hydrogen isotope as is present so as to give almost immediately a nearly random distribution of the isotope between NH_3 and H_2O. When ammonia gas is passed into water at 0°, one mole of water absorbs nearly one mole of ammonia and since ammonia has three hydrogen atoms, while water has two, more than half of the H^2 in the system will escape when the ammonia is pumped off.

A sample from the still which showed an excess density (over ordinary water) of 0.000182 was saturated with ammonia at 0° and then the ammonia was pumped off at room temperature. This process was performed six times, at the end of which all but about one per cent. of the accumulated H^2 should have disappeared if saturation and exhaustion had been complete in each step. However, no pains were taken in these respects