able, it seems that these disintegrations are not of this type.

Taken together, (A) and (B) seem to indicate that these disintegrations actually occur by capture, and that non-capture disintegrations are absent.

The evidence is extremely weak for non-capture disintegration by α-particles or by protons and is shown above to be invalid for neutrons, the only projectile for which the evidence had apparent strength, due to a neglect of the mechanics involved. Thus there seems to be no basis for the idea that any nucleus whatever has been disintegrated by a process in which the projectile was not captured. Obviously this does not prove that such disintegrations cannot be discovered in the future.

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CHICAGO, ILLINOIS DAVID M. GANS

RECEIVED MARCH 26, 1934

PREPARATION OF CYSTINEHYDANTOIN

Sir:

Using the method advocated by Dakin [*J. Biol. Chem.*, **8**, 25 (1910)] for the preparation of tyrosinehydantoin, cystinehydantoin has been prepared in practically quantitative yields and of a high order of purity. Two grams of cystine is suspended in 10 cc. of boiling water and 1.5 g. of potassium cyanate is added. The solution is then acidified with 25 cc. of 10% hydrochloric acid and heated with a reflux condenser for thirty minutes. The cystinehydantoin separates in diamond-shaped plates; yield 2.2 g., 91%. *Anal.* Calcd. for $C_8H_{10}N_4S_2O_4$: N, 19.17; S, 22.09. Found: N, 19.30; S, 21.96. It begins to decompose at 310° and has no definite melting point. It is insoluble in ordinary organic solvents, insoluble cold and slightly soluble in hot water. Alkalies dissolve the hydantoin with decomposition. Using the loosely bound sulfur procedure of Sullivan and Smith [*U. S. Pub. Health Repts.*, **43**, 1334 (1928)] it forms lead sulfide in twenty seconds.

Cystinehydantoin gives a negative Sullivan cystine reaction. The nitroprusside reaction for a disulfide, using sodium cyanide as the reducing agent, is positive. The Okuda [*J. Biochem. (Tokyo)*, **5**, 201 (1925)] method gives the theoretical cystine equivalent. The Folin–Marenzi [*J. Biol. Chem.*, **83**, 103 (1929)] cystine method gives the same amount of color with the hydantoin as the equivalent weight of cystine. As in the case of cystine [Folin–Looney, *ibid.*, **51**, 421 (1922)] sodium cyanide will inhibit the color production. In all the colorimetric work a solution containing 24.2 mg. of the hydantoin in 100 cc. of a 0.1 *N* hydrochloric acid equivalent to a 200 parts per million cystine solution was used.

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RECEIVED MARCH 26, 1934

OPTICAL ROTATION AND ATOMIC DIMENSION

Sir:

It has been established in the writer's previous investigations on this subject [fifth article, THIS JOURNAL, **47**, 1285 (1925), and the ninth article, *Bureau of Standards Journal of Research*, **7**, 573 (1931)] that certain halogen derivatives may be divided into two classes. Those compounds which constitute the first class have the halogen directly attached to an asymmetric carbon atom and differ only in having one halogen replaced by another. For these substances the *specific rotations* have the ratio 41:17:21, which agrees closely with the ratio 41:16:21 for the differences in atomic diameter of the respective neutral atoms. Those in the other class have the halogens attached indirectly (by a chain of atoms) to the asymmetric carbon. For these substances the *molecular rotations* have a ratio which likewise agrees with the ratio of the diameters of the respective neutral atoms. All the investigated compounds were carbohydrate derivatives which contain several asymmetric carbon atoms, so it was found desirable to prepare the halogen derivatives of two active amyl alcohols, 2-methylbutanol (1) and methylpropylcarbinol, for testing the above regularities, as these compounds are simple in structure and contain only one asymmetric carbon atom. The halogen derivatives of one of these alcohols, the negative rotating 2-methylbutanol (1) (in which the halogen is indirectly attached to the asymmetric carbon), have now been prepared in pure condition. The rotational values obtained are:

	$[\alpha]_D^{20}$ Specific rotation	$[M]_D^{20}$ Molecular rotation
1-Fluoro-2-methylbutane	−8.87	− 799.1
1-Chloro-2-methylbutane	+1.68	+ 179.0
1-Bromo-2-methylbutane	+4.04	+ 610.1
1-Iodo-2-methylbutane	+5.68	+1124.7

The chlorine, bromine and iodine derivatives were prepared by the action of hydrogen halides on the pure active negative rotating 2-methylbutanol (1), whereas the negative rotating fluorine derivative was prepared from the bromine derivative by the action of silver fluoride, as will be described in detail later. The similar procedure used for preparing the chlorine, bromine and iodine derivatives makes it very probable that these derivatives are of the same form whether or not a Walden inversion is involved in their preparation. It is immaterial for our present purpose whether this form fits into any particular scheme of classification as a *d*-form or as an *l*-form. In the case of the fluorine derivative, however, it is not certain whether the *negative* rotating form must be classified with the other halogen derivatives, which are positive rotating (Possibility I), or whether the *positive* rotating one must be taken (Possibility II). If we test both possibilities in regard to the above stated atomic dimension relationship we obtain, using the molecular rotations, for the ratio Cl-F, Br-Cl and I-Br for the first possibility, 41:18.1:21.6. This agrees very well with the ratio for the respective atomic diameters. For the second possibility no regularity is obtainable if the fluorine derivative is included. This will be observed from the rotations given above which show first a decrease and then an increase in value. Further work will be done in connection with the conclusion that the negative rotating fluorine derivative is of the same form as the positive rotating chlorine, bromine and iodine derivatives.

Further, it is obvious from these data that the ratio for the differences in weight (Guye's hypothesis) does not fit in both possibilities, as theory would require for Cl-F, Br-Cl and I-Br the ratio 16.5:44.4:47.0. This differs greatly from the observed ratios. The results of an investigation of the halogen derivatives of methylpropylcarbinol will be given in the near future. This will be of interest in connection with the present subject as the possibility exists that the relationship which involves the specific rotations is due to the arrangement of the asymmetric carbons in a ring.

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RECEIVED APRIL 14, 1934

THE BIOLOGICAL SEPARATION OF HEAVY WATER

Sir:

Eyring and Sherman [*J. Chem. Physics*, **1**, 345 (1933)] have pointed out that reactions in biological processes may fractionate the isotopes of hydrogen. In view of this, we considered that the concentrations of heavy water in the urine and in the milk of the same animal might possibly be different from each other and from that of normal water.

We have compared, by the method of the temperature of floating equilibrium [Richards and Harris, THIS JOURNAL, **38**, 1000 (1916)], the specific gravities at 24.50° of water prepared from cow's milk and from urine, with that of pure tap water. The samples of water were obtained by distilling a liquid fraction from four liters of milk, of urine and of the control water, until the dry residue of solids was left. The liquid fractions, including some volatile organic material which had been carried over during the first distillations, were distilled successively from acid and alkaline permanganate, leaving in each case approximately the same volume as residue at the end of each distillation. After six distillations, the distillates were refluxed for twenty-four hours in the presence of alkaline permanganate and finally distilled carefully through a block-tin condenser fitted with a specially constructed spray trap.

The temperature of the thermostat could be controlled to within $\pm 0.001°$. The movement of the thin-walled glass float, 6.24 ml., was observed with a reading telescope. The correction to the temperature of floating equilibrium due to changing barometric pressure was determined by artificially adjusting the pressure over a sample of water containing the float and Beckmann thermometer. This was found to be $-0.001°$ per cm. change in pressure.

The temperatures of floating equilibrium in water from milk, tap water and urine were identical to within a maximum deviation of $\pm 0.001°$. The pressure corrections to the temperatures were negligible, as the maximum variation in atmospheric pressure during the measurements was 0.74 cm. From these results it can be concluded definitely that the isotopic concentration of deuterium in the samples of water obtained from the liquid fraction of milk and urine does not differ from that of normal water.

We appreciate the fact that the isotopic composition of the total hydrogen in milk and in urine may not be identical, as a considerable portion of the hydrogen was left in the first organic