58, 535 (1936)] that while there is no exchange between radioactive iodine and ethyl iodide when heated together for fifteen minutes at 87°, as determined by the subsequent measurement of the activities of the two substances, yet in alcoholic solution at 100° a ready exchange takes place between sodium iodide and ethyl iodide. Further experiments on this latter reaction have shown the existence of a marked temperature effect.

The general procedure in these experiments has been as follows: A solution of 50 micro-moles of iodine in a liter of iodobenzene is irradiated with the neutrons from a Rn–Be source for a period of one and one-half hours or longer. After removal of the neutron source, the iodine is extracted and precipitated as silver iodide, which is then transformed into dry sodium radio-iodide. This is dissolved in 1–2 cc. of ethyl alcohol and mixed with 100 micro-moles of inactive ethyl iodide. This mixture is heated to the desired temperature for a stated interval of time and then quickly cooled. (In the one experiment carried out below room temperature both solutions were cooled before being mixed.) The two iodides are separated by shaking the solution with excess ether and water, and are transformed into silver iodide for measurement. The activity of each precipitate is measured by means of a tube counter. The results obtained in a series of experiments at different temperatures are given in tabular form.

Temp., °C.	Time, min.	Exchange
100	5	Complete
100	1	Complete
80	5	Complete
29	5	Partial
29	1	None
24	5	None
19	5	None

The authors are grateful to Dr. K. W. Stenstrom of the University Hospital for the gift of 150 millicuries of radon, and to Dr. J. H. Williams of the Department of Physics for the use of a low resistance amplifier [of the type described by Neher and Harper, *Phys. Rev.*, **49,** 940 (1936)], without which it would not have been possible to carry on this work during the recent hot weather.

SCHOOL OF CHEMISTRY
UNIVERSITY OF MINNESOTA
MINNEAPOLIS, MINN.

D. E. HULL**
C. H. SCHIFLETT
S. C. LIND

** National Research Fellow.

RECEIVED AUGUST 22, 1936

THE PHOTOCHEMICAL DECOMPOSITION OF METHANE

Sir:

Methane at atmospheric pressure is photochemically decomposed when irradiated with the light which is transmitted by a thin fluorite window from a hydrogen discharge tube. The effective radiation would appear to lie near the limit of transmission of fluorite. Although no direct measurements of quantum yield have been made, a crude estimate based on a comparison with the rate of the ozone synthesis in the same cell indicates a value of the order of unity.

Among the products we have identified hydrogen and unsaturated hydrocarbons (probably ethylene) in the approximate molecular ratio of 4:1. Higher saturated hydrocarbons may also be produced but have not been detected. The large ratio of hydrogen to unsaturation in the products indicates that the decomposition

$$CH_4 + h\nu \longrightarrow CH_2 + H_2$$
$$2CH_2 \longrightarrow C_2H_4$$

cannot be the only process involved.

DEPARTMENT OF CHEMISTRY
STANFORD UNIVERSITY, CALIF.

PHILIP A. LEIGHTON
ARNOLD B. STEINER

RECEIVED JULY 28, 1936

NEW SYNTHESIS OF GLYCOFURANOSIDES

Sir:

In the last decade considerable progress in sugar chemistry had been made from the study of the glycopyranosides. Further developments can likely be expected from a greater than our present knowledge of the glycofuranosides, or, as E. Fischer originally named them, γ-glycosides. The physical, chemical and biological properties, the conversion into the pyranosides under certain conditions, and the chemical structure in general, of these γ-glycosides should be thoroughly investigated. To be sure, such studies have already been made in the past, in a few isolated instances. However, a review of the literature reveals that only five or six γ-glycosides are known in pure crystalline form obtained mostly in small yields by cumbersome methods. The majority of the γ-glycosides described in the literature were prepared by the original method of E. Fischer [*Ber.*, **28,** 1145 (1895); **47,** 1980 (1914)] yielding only sirupy mixtures that could not be separated. Obviously, a general method which leads to well-defined, crystalline products, would constitute the first step toward a more extensive study of this class of sugar derivatives. We believe that we have found such a method. It represents a modification of a previous general procedure of one of us [Pacsu, *ibid.*, **58**, 509 (1925); Pacsu and Ticharich, *ibid.*, **62**, 3008 (1929)] by which the α-alkylpyranosides were prepared from the sugar mercaptals and mercuric chloride in the *boiling* solutions of the different alcohols. Taking, *e. g.*, galactosediethylmercaptal and ethanol, the reaction can be expressed by the following summary equation

$$C_6H_{12}O_5\cdot(SC_2H_5)_2 + 2HgCl_2 + C_2H_5OH = 2HCl + 2C_2H_5S\cdot HgCl + C_6H_{11}O_5\cdot OC_2H_5$$

This method was shown to yield almost pure (up to 92%) α-alkylpyranosides accompanied only by a slight quantity of the β-isomers. Now we have found that if the same reaction be carried out *at low temperature*, and the hydrochloric acid formed be neutralized at the moment of its development, an excellent yield of crystalline β-ethylgalactofuranoside can be obtained. The substance had m. p. 84.5–86° and $[\alpha]^{25}\text{D}$ −100.1° in water solution. Schlubach and Meisenheimer [*ibid.*, **67**, 429 (1934)] reported m. p. 86° (corr.) and $[\alpha]^{20}\text{D}$ −97.2° for the same compound obtained by a lengthy synthesis from the β-pentaacetate of galactofuranose of Hudson and Johnson. So far it has not been possible to find any isomer in the mother liquor. The same furanoside was obtained when dibenzylmercaptal had been used as starting material. For the instantaneous neutralization of the hydrochloric acid we have found the use of an excess of yellow mercuric oxide to be most excellent. It keeps the reaction mixture neutral during the whole process, and it provides for a desirable excess of the mercuric chloride up to the end of the reaction. For the removal of the mercuric chloride from the solution we have found that pyridine can be used most successfully. It seems very likely that these modifications can also be used with advantage in the procedures developed for the preparation of the open-chain methylated (Levene, 1926) and acetylated (Wolfrom, 1929) aldoses.

Since the formation of glycopyranosides by the original method has proved to be of general validity, we believe that by this modified procedure it will be possible to prepare the hitherto unknown or only difficultly available furanosides of the carbohydrates. It is our purpose to prepare by this method the alkylfuranosides and -thiofuranosides of the aldoses and ketoses from their mercaptals and acetonylated mercaptals. In the forthcoming first paper of this series of investigations conducted in this Laboratory, a detailed description of the procedure will be given.

FRICK CHEMICAL LABORATORY
PRINCETON UNIVERSITY
PRINCETON, NEW JERSEY

EUGENE PACSU
JOHN W. GREEN

RECEIVED AUGUST 14, 1936

NEW BOOKS

Colorimetric Methods of Analysis, Including Some Turbidimetric and Nephelometric Methods. Vol. I. Inorganic. By FOSTER DEE SNELL and CORNELIA T. SNELL. D. Van Nostrand Company, Inc., 250 Fourth Avenue, New York, N. Y., 1936. 766 pp. Illustrated.

In this second edition of Dr. Snell's treatise a much more comprehensive treatment of the field of colorimetry has been made. The book has been divided. This first volume covers general colorimetry and inorganic determinations; a second will deal with organic, biological and miscellaneous methods.

In its general plan and scope the book closely resembles Yoe's "Photometric Analysis." It differs in that nephelometric methods are treated with the colorimetric ones instead of in a separate volume and in that the bibliography occurs in footnotes instead of as a separate section at the end of the book. It contains, of course, methods and references which have appeared in the seven years since the publication of Yoe's book.

In the first nine chapters the general methods of colorimetry are discussed and the multitudinous forms of apparatus which have been devised for the measurement of color and of turbidity are illustrated and explained. Fifty-four chapters are then devoted to different methods for the determination of seventy-four elements or simple inorganic compounds. The last four chapters deal with