a similar procedure and shown to be identical with the higher-melting isomer B from streptomycin B by melting point (161–162°, no depression on admixture of isomer B), rotation ($[\alpha]^{25}D$ −65° (*c*, 1.1 in chloroform)), and analysis (C, 49.19; H, 5.98; S, 8.41; CH_3CO, 44.7). The dextrorotatory isomer A from streptomycin B presumably represents the previously unknown anomeric α-thioethyl-tetracetyl-D-mannoside.

Dihydrostreptomycin B trihydrochloride[1], m. p. 194–5° (cor. dec.), $[\alpha]^{25}D$ −55° (*c*, 0.9 in water), on treatment with 3% methanolic hydrogen chloride for forty hours at room temperature and subsequent acetylation yielded α-methyl pentaacetyl dihydrostreptobiosaminide[4,5] m. p. 192–3° (cor.), $[\alpha]^{25}D$ −119° (*c*, 0.49 in chloroform) and β-methyl tetraacetyl D-mannopyranoside, $[\alpha]^{25}D$ −50° (*c*, 0.69 in chloroform), m. p. 160–161° (cor.), unchanged on admixture of an authentic specimen.

Anal. Calcd. for $C_{15}H_{22}O_{10}$: C, 49.72; H, 6.12; OCH_3, 8.56; CH_3CO, 47.5. Found: C, 49.61; H, 6.08; OCH_3, 8.35; CH_3CO, 48.5.

These results together with analytical data previously reported[1] for the reineckate[1] and hydrochloride of streptomycin B indicate that streptomycin B is made up of streptidine, streptobiosamine and D-mannose joined glycosidically to form a triacidic base of the composition $C_{27}H_{49}O_{17}N_7$.

Anal. Calcd. for $C_{27}H_{49}O_{17}N_7 \cdot 3HCr[(NH_3)_2(SCN)_4] \cdot 2H_2O$: C, 26.97; H, 4.29; N, 20.15; S, 22.11; Cr, 8.98. Found[1] (after drying *in vacuo* at 80° for two hours): C, 26.89; H, 4.24; N, 20.1; S, 22.2; Cr, 8.70. Calcd. for $C_{27}H_{49}O_{17}N_7 \cdot 3HCl \cdot H_2O$: C, 37.26; H, 6.24; N, 11.25; Cl, 12.23. Found (after drying *in vacuo* at 140° for two hours): C, 36.85; H, 6.11; N, 11.3; Cl, 12.83.

(4) J. Fried and O. Wintersteiner, THIS JOURNAL, **69**, 79 (1947).

(5) Q. R. Bartz, J. Controulis, H. M. Crooks, Jr., and M. C. Rebstock, *ibid.*, **68**, 2163 (1946).

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RECEIVED MAY 19, 1947

THE REACTION OF IODONIUM SALTS WITH THIOL COMPOUNDS

Sir:

In the interesting paper by Freedlander and French[1] on the chemotherapy of certain iodonium compounds, they have suggested tentatively that the activity of the iodonium compounds may, in some cases, be due to a reaction with certain thiol groups essential to the microörganisms.

For some time we have been engaged in the study of the reactions which occur between iodonium salts and sulfhydryl compounds. We have found, for example, that diphenyliodonium chloride reacts in an aqueous solution with thioglycolic acid (kept neutral with sodium carbonate) to produce phenyl iodide and S-phenylthioglycolic acid (21% yield), m. p. 58–60° (lit. 61–63°[2]); sparingly soluble in water, soluble in benzene. This reaction is a rapid one at the boiling point of the solution. It also proceeds at room temperature but at a reduced rate. When thioglycolic acid dissolved in water is shaken with diphenyliodonium chloride, sodium carbonate, tellurium and ether at room temperature, diphenyltellurium is formed. The latter compound can be isolated from the ether layer as the yellow dibromide, m. p. 199–200°. The reaction with tellurium is an interesting one because of the possibility of a free radical mechanism, although other interpretations are possible.[3]

It has also been found that diphenyliodonium chloride reacts with other thiol compounds, such as thiophenol and cysteine. In the latter case the product is S-phenylcysteine, m. p. 200° (lit. 201–202°)[4]; calcd. for $C_9H_{11}O_2SN$: S, 16.3. Found: S, 16.2. All the iodonium reactions show a characteristic transient yellow color or precipitate.

The above reactions should be of interest from the standpoint of enzyme studies. Further work is in progress and we hope to communicate full details at a later date. We are very grateful to the Alberta Branch of the Canadian Cancer Society for financial aid in support of this work.

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RECEIVED MAY 14, 1947

(1) Freedlander and French, *Proc. Soc. Exptl. Biol. Med.*, **63**, 319 (1946); *C. A.*, **41**, 2115 (1947).

(2) Gilman and Webb, THIS JOURNAL, **62**, 987 (1940).

(3) Sandin, McClure and Irwin, THIS JOURNAL, **61**, 2944 (1939); Sandin and Brown, unpublished work.

(4) Clarke and Inouye, *J. Biol. Chem.*, **94**, 541 (1931).

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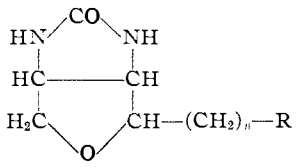
FURAN AND TETRAHYDROFURAN DERIVATIVES. VIII. THE SYNTHESIS OF THE SULFONIC ACID ANALOGS OF OXYBIOTIN AND HOMOOXYBIOTIN

Sir:

In connection with our studies on the relationships of chemical structure and biological activity in the biotin and oxybiotin series,[1] we became interested in *dl*-oxybiotin sulfonic acid (I) and *dl*-homoöxybiotin sulfonic acid (II), the sulfonic acid analogs of *dl*-oxybiotin (III) and *dl*-homoöxybiotin (IV), respectively. In this communication we wish to record the synthesis of these two compounds.



	n	R
(I)	4	SO_3H
(II)	5	SO_3H
(III)	4	COOH
(IV)	5	COOH

(1) Hofmann, Chen, Bridgwater and Axelrod, THIS JOURNAL, **69**, 191 (1947).

dl - Hexahydro - 2 - oxo - 4 - (4 - hydroxybutyl)-1-furo-(3,4)-imidazole (V), m. p. 154–155° (*Anal.* Calcd. for $C_9H_{16}O_3N_2$: C, 53.98; H, 8.05; N, 13.99. Found: C, 54.12; H, 7.81; N, 13.80) was obtained from 2-furanbutanol[2] (α-naphthylurethan, m. p. 72–73°; *Anal.* Calcd. for $C_{19}H_{19}O_3N$: C, 73.76; H, 6.19; N, 4.53. Found: C, 73.82; H, 6.17; N, 4.71) by the procedures developed in these laboratories for the synthesis of similar compounds.[1,3] Treatment of (V) with thionyl chloride gave *dl*-hexahydro-2-oxo-4-(4-chlorobutyl)-1-furo-(3,4)-imidazole (VI), m. p. 124–126° (*Anal.* Calcd. for $C_9H_{15}O_2N_2Cl$: C, 49.38; H, 6.90; N, 12.80; Cl, 16.22. Found: C, 49.16; H, 6.84; N, 12.54; Cl, 16.27), which on reaction with sodiobenzyl mercaptide was converted into the corresponding benzyl thioether (VII), m. p. 76–79° (*Anal.* Calcd. for $C_{16}H_{22}O_2N_2S$: C, 62.73; H, 7.24; N, 9.14; S, 10.46. Found: C, 62.54; H, 6.96; N, 9.31; S, 10.32). Reductive cleavage of (VII) yielded *dl*-hexahydro-2 - oxo - 4 - (4 - mercaptobutyl) - 1 - furo - (3,4)-imidazole (VIII), which on oxidation with barium permanganate was converted into the crystalline barium salt of oxybiotin sulfonic acid (I). (*Anal.* Calcd. for $C_9H_{15}O_5N_2S$ Ba/2: C, 32.53; H, 4.55; N, 8.44; S, 9.66; Ba, 20.69. Found: C, 32.58; H, 4.74; N, 8.18; S, 9.43; Ba, 20.33.) The configuration of (I) must be identical with that of *dl*-oxybiotin (III), since (VI) upon reaction with potassium cyanide followed by hydrolysis gave (III).

Similarly, *dl*-homoöxybiotin sulfonic acid (II) was prepared from *dl*-hexahydro-2-oxo-4-(5-chloropentyl)-1-furo-(3,4)-imidazole[1] through the corresponding benzyl thioether (IX), m. p. 66–68° (*Anal.* Calcd. for $C_{17}H_{24}O_2N_2S$: C, 63.73; H, 7.55; N, 8.74; S, 10.00. Found: C, 63.24; H, 7.36; N, 8.89; S, 10.30), and the mercaptopentanol (X). As in the case of the lower homolog (II) was also isolated in the form of its crystalline barium salt. (*Anal.* Calcd. for $C_{10}H_{17}O_5N_2SBa/2$: C, 34.70; H, 4.95; N, 8.10; S, 9.27; Ba, 19.86. Found: C, 34.37; H, 5.20; N, 8.14; S, 9.30; Ba, 19.60.) Compounds (I), (VII), (VIII), (IX), and (X) were found to have pronounced antibiotin and antioxybiotin activity for a number of microörganisms, in contrast to substance (II), which had a slight stimulatory effect. A detailed description of the synthesis and microbiological activity of these compounds will be presented in the near future.

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ANNA BRIDGWATER
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RECEIVED MAY 9, 1947

(2) Hofmann, Bridgwater and Axelrod, unpublished results.
(3) Hofmann, THIS JOURNAL, **67**, 1459 (1945).

FISSION OF BETA-OXYGENATED ORGANOSILICON COMPOUNDS

Sir:

Gilman and Clark in THIS JOURNAL, **69**, 967 (1947), quite naturally assume that the formation of acetone from the reaction product of triethylchlorosilane and sodioacetoacetic ester proves the absence of $Et_3SiCH(COCH_3)CO_2Et$. While that substance is likely absent, many studies in progress in this Laboratory on related β-oxygenated silicon compounds convince us that their reasoning is unsafe. Thus, we find that reactions expected to form $R_3SiCH_2COCH_3$ and $R_3SiCH_2CO_2H$ actually give acetone and acetic acid, respectively. Moreover, $R_3SiCH_2CHOHCH_3$ is sensitive to acid, giving propylene readily. In each case most of the silicon appears as $(R_3Si)_2O$.

Acetyl chloride and the Grignard reagent (I) from chloromethyltrimethylsilane[1] gave a yellow solid which, on decomposition with water, formed a variety of products including acetone. The latter was identified by conversion to dibenzalacetone, m. p. and mixed m. p. 111–113°.

Addition of carbon dioxide to (I) formed a colorless gel which, on steam distillation, gave hexamethyldisiloxane. The residue was acidified with dilute sulfuric acid and steam distilled. The distillate smelled strongly of acetic acid. This was identified as the *p*-phenylphenacyl derivative, m. p. 110–111°.

Acetaldehyde and (I) gave β-hydroxypropyltrimethylsilane, b. p. 48° at 10 mm., $n^{20}D$ 1.4281. *Anal.* Calcd. for $C_6H_{16}SiO$: Si, 21.2. Found: Si, 2.4. Warming with a few drops of 10% sulfuric acid gave a stream of gas which was converted to propylene dibromide, b. p. 139° at 728 mm., $n^{20}D$ 1.5196.

Other studies point to similar conclusions on the sensitivity to hydrolytic agents of the grouping Si—C—C—O in which the last two atoms may be singly or doubly bound in alcohols, ketones, acids, esters and the like. The resulting fissions are not surprising in view of the ease with which silicon can give an electron pair to an electronically deficient carbon atom in the position beta to it.[2]

(1) Whitmore and Sommer, THIS JOURNAL, **68**, 481 (1946).
(2) *Cf.* Whitmore, *ibid.*, **54**, 3277 (1932); **55**, 4153 (1933); Sommer, *et al.*, *ibid.*, **68**, 1083 (1946).

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RECEIVED MAY 13, 1947

SYNTHESIS OF PROTEIN ANALOGS

Sir:

We wish to record what we believe to be the first successful synthesis of molecules having, like fibrous proteins, the structure

$$HOOC\text{-}CH(R_1)\text{-}NH\text{-}(COCH(R_i)NH)_n\text{-}COCH(R_{n+2})NH_2$$
I

with very large values of n.