Anal. Calcd. for $C_{16}H_{22}$: C, 89.35; H, 10.65. Found: C, 89.51; H, 10.52.

Oxidation.—Seven-tenths gram of the product of b. p. 124–128° at 6 mm. was heated at 160° for two hours in a 60-cc. sealed tube with 12 cc. of 77% nitric acid and 24 cc. of water, according to the procedure recently described.[9] Terephthalic acid was obtained (40% yield). The dimethyl ester of the acid had a melting point of 140° and showed no depression in melting point when mixed with an authentic sample.

Anal. Calcd. for $C_{10}H_{10}O_4$: C, 61.83; H, 5.19. Found: C, 61.60; H, 5.13.

Fraction 3.—B. p. 155–182° under 8 mm., $n^{20}D$ 1.5342.

Anal. Calcd. for $C_{21}H_{30}$: C, 89.29; H, 10.71. Found: C, 89.31; H, 10.42.

Preparation of 1-Methyl-1-cyclohexylcyclobutane.—Nine grams of 1-methyl-1-phenylcyclobutane was dissolved in 10 cc. of *n*-pentane and hydrogenated in a 125-cc. autoclave in the presence of nickel–kieselguhr catalyst[10] at 65° and under the initial hydrogen pressure of 100 atmospheres. The hydrogenated product did not react with nitrating mixture, which indicates the absence of an aromatic ring. The hydrogenated product distilled at 72–73° at 9 mm., 201.5° at 760 mm. dt/dp (752–739 mm.) = 0.08°/mm.; $n^{20}D$ 1.4662; d^{20}_4 0.8595.

Anal. Calcd. for $C_{11}H_{20}$ (1-methyl-1-cyclohexylcyclobutane): C, 86.75; H, 13.25. Found: C, 86.56; H, 13.45.

Dehydrogenation.—1-Methyl-1-cyclohexylcyclobutane was passed over platinized aluminum oxide at 250°. Details have been given in another paper.[11] Aromatic hydrocarbons were obtained distilling at 187 to 192° at 741 mm. and having $n^{20}D$ 1.4861.

A diacetamino derivative[8] was prepared which melted at 144–145°. It consisted of equimolal proportions of *t*-amylbenzene and 2-phenylpentane. This was proved by preparing a melting point curve of the two amylbenzenes and by taking a mixed melting point of the unknown with a mixture of the authentic diacetamino derivatives of the amylbenzenes.

Acknowledgment.—The authors wish to express their thanks to Mr. M. Savoyias for the assistance which he rendered in the laboratory operations.

Summary

A mixture consisting of methylcyclobutene and methylenecyclobutane reacts with benzene in the presence of sulfuric acid to yield: (a) 1-methyl-1-phenylcyclobutane, characterized by solid mono- and diacetamino derivatives; (b) *p*-di-(1¹-methylcyclobutyl)-benzene, isolated as a crystalline compound; and (c) tri-(1¹-methylcyclobutyl)-benzene.

Hydrogenation of 1-methyl-1-phenylcyclobutane yielded 1-methyl-1-cyclohexylcyclobutane. The latter on dehydrogenation decomposed into *t*-amylbenzene and 2-phenylpentane.

The cyclobutyl ring becomes very stable toward sulfuric acid or nitrating mixture when a phenyl group is attached to it.

RIVERSIDE, ILLINOIS RECEIVED OCTOBER 5, 1939

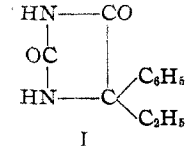
(9) Pines, Grosse and Ipatieff, THIS JOURNAL, **61**, 641 (1939).
(10) Ipatieff and Corson, *Ind. Eng. Chem.*, **30**, 1039 (1938).
(11) Pines and Ipatieff, THIS JOURNAL, **61**, 1077 (1939).

[CONTRIBUTION NO. 169 FROM THE DEPARTMENT OF CHEMISTRY AND CHEMICAL ENGINEERING, THE UNIVERSITY OF TEXAS]

5-[α-(*s*-Butoxy)]-ethyl-5-alkyl Hydantoins

BY ROBERT J. SPEER AND HENRY R. HENZE

During the past few years in this Laboratory considerable attention has been given to the synthesis of hydantoins, a few of which have been shown to possess sufficient physiological activity to warrant continued research in this field. Previous papers of this series have reported extended use of Bucherer's[1] method for the production of substituted hydantoins by interaction of an aqueous alcoholic solution of potassium cyanide and ammonium carbonate with appropriate ketones. The latter have included examples of alkoxymethyl alkyl (or aryl) ketones, phenoxymethyl alkyl (or aryl) ketones, 1,3-dichloroisopropoxyethyl alkyl (or aryl) ketones, dialkylaminoacetones, alkyl nitroaryl ketones, and β-chloroethoxyalkyl alkyl ketones.[2] Although, as yet, but two 5,5-disubstituted hydantoins, namely, Nirvanol (I)[3] and Dilantin (II),[4] have found actual clinical use,



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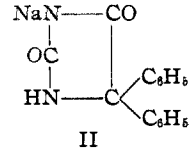


II

the hydantoin nucleus offers potentiality as an innocuous heterocycle to which may be attached

(1) Bucherer and Lieb, *J. prakt. Chem.*, [2] **141**, 5 (1934).
(2) Preceding paper in this series, Lingo with Henze, THIS JOURNAL, **61**, 1574 (1939).
(3) Swiss Patent 72,561 (1916).
(4) Putnam and Meritt, *Science*, **85**, 526 (1937).

groupings appropriate to produce additional derivatives of importance as soporifics or anticonvulsants. Since it is known that the ethyl and *s*-butyl groups are of special physiological potency, it seemed of interest to prepare a series of hydantoins containing these groups connected in an alkoxyalkyl linkage, namely, as the *s*-butoxyethyl grouping. While the preparation of analogous and in a few cases isomeric hydantoins has been accomplished previously, the procedure of Bucherer[1] has not been utilized for the synthesis of 5-(*s*-butoxyethyl)-5-alkyl (or aryl) hydantoins.

Experimental

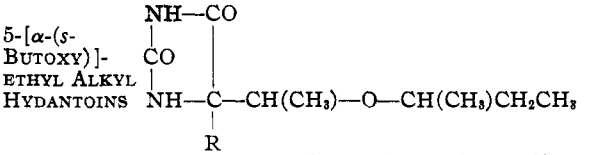
Preparation of α-(*s*-Butoxy)-ethyl Alkyl Ketones.—The nine ketones used as intermediates in the production of the butoxyethyl hydantoins were prepared by the interaction of the appropriate Grignard reagents and *s*-butyl α-cyanoethyl ether as described previously.[5]

Synthesis of 5-[α-(*s*-Butoxy)]-ethyl-5-Alkyl Hydantoins.—The production of nine members of this series of compounds was accomplished by the interaction of an aqueous alcoholic solution of potassium cyanide and ammonium carbonate with the appropriate butoxyethyl alkyl ketones. One part (0.05 mole) of a ketone was mixed with a suspension of 1.25 parts of potassium cyanide and 3.0 parts of ammonium carbonate in 7–8 volumes of 50% alcohol. Upon warming the mixture to 55–60° for five to six hours, the solids gradually dissolved with evolution of gas, followed in most cases with the separation of the solid reaction product from the warm solution. At the termination of this period of warming the mixture was cooled and the product removed by filtration. Concentration of the filtrate with subsequent acidification yielded additional crystalline material, although in the cases of the *s*-propyl and *s*-butyl derivatives there was considerable tendency toward the formation of oily material. However, in these instances, after solidification of the oil no trouble was experienced in purification by further crystallization.

All of the hydantoins of this series are white crystalline solids soluble in alcohol, acetone, benzene, and chloroform but insoluble in water and petroleum ether. Purification was effected by recrystallization from 50–60% ethyl alcohol or from a benzene–petroleum ether mixture. In some instances treatment with Norite was necessary for complete removal of color. These compounds, in general, possess sharp melting points, fusing to form light straw colored liquids without decomposition. Data for melting points, percentage yields, and the analyses for nitrogen content of these hydantoins are presented in Table I.

TABLE I

5-[α-(*s*-Butoxy)]-ethyl Alkyl Hydantoins



	—R	M. p., °C. (corr.)	Yield, %	Nitrogen, % Calcd.	Found
1	—CH_3[a]	203–204	36	13.08	13.14
2	—CH_2CH_3	190	41	12.27	12.19
3	—$CH_2CH_2CH_3$	205–206	24	11.56	11.70
4	—$CH(CH_3)_2$	196–197	22	11.56	11.70
5	—$CH_2CH_2CH_2CH_3$	204–205	36	10.93	11.01
6	—$CH_2CH(CH_3)_2$	192	44	10.93	11.00
7	—$CH(CH_3)CH_2CH_3$	189–190	30	10.93	10.89
8	—$CH_2CH_2CH_2CH_2CH_3$	178	31	10.36	10.36
9	—$CH_2CH_2CH(CH_3)_2$	177	40	10.36	10.58

[a] Calcd. for $C_{10}H_{18}N_2O_3$: C, 56.05; H, 8.47. Found: C, 56.13; H, 8.65.

Summary

The series of 5,5-disubstituted hydantoins, potentially important as soporifics or anti-convulsants, has been extended to include nine new *s*-butoxyethyl alkyl hydantoins.

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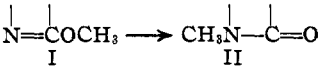
(5) Speer with Henze, THIS JOURNAL, **61**, 1226 (1939).

[CONTRIBUTION FROM THE DEPARTMENT OF CHEMISTRY, KWANGSI UNIVERSITY, CHINA]

Researches on Pyrimidines. The Molecular Rearrangement of 4-Methyl-5-*n*-propyl-2,6-dimethoxypyrimidine[1]

BY YUOH-FONG CHI, SHAO-SENG WEI AND MEI-SENG LIANG[2]

Previous publications by Hilbert and Johnson from the Yale laboratories,[3] and later by Chi, Wei and Pan[4] have shown that pyrimidine lactim-ethers of configuration I undergo rearrangement to their isomeric and stable lactam forms II. For example, 2,6-dimethoxypyrimidine and 2-oxy-3-methyl-6-methoxypyrimidine on heating both



I II

underwent rearrangement to 1,3-dimethyluracil. Under similar conditions 4-methyl-5-*n*-butyl-2,6-dimethoxypyrimidine and 2-oxy-3,4-dimethyl-5-*n*-butyl-6-methoxypyrimidine are converted to 1,3,4-trimethyl-5-*n*-butyluracil.

(1) This paper is constructed from a dissertation presented by Shao-Seng Wei and Mei-Seng Liang to the Faculty of Kwangsi University as partial fulfilment of the requirements for the degree of Bachelor of Science in June, 1938.

(2) The authors desire to express their appreciation to Professor Treat B. Johnson of Yale University for his assistance in preparing this paper for publication.

(3) Hilbert and Johnson, THIS JOURNAL, **52**, 2001 (1930).

(4) Chi, Wei and Pan, *ibid.*, **60**, 1719 (1938).