Anal. Calcd. for $C_{10}H_{14}N_2O_2$: C, 61.7; H, 7.22; N, 14.45. Found: C, 61.8; H, 7.18; N, 14.53.

Methyl ester of N-(5-methyl-2-pyridyl)-β-alanine. Boiling point 130–135° at 0.5 mm., m.p. 34–35° after recrystallization from benzene-hexane mixture.

Anal. Calcd. for $C_{10}H_{14}N_2O_2$: C, 61.7; H, 7.22; N, 14.45. Found: C, 61.6; H, 7.28; N, 14.61.

Methyl ester of N-(4-methyl-2-pyridyl)-β-alanine. Boiling point 140–145° (0.5 mm.), m.p. 43–44° after recrystallization from benzene-hexane mixture.

Anal. Calcd. for $C_{10}H_{14}N_2O_2$: C, 61.7; H, 7.22; N, 14.45. Found: C, 61.7; H, 7.26; N, 14.40.

6-Methyl-3,4-dihydro-2H-pyrido[1,2-a]pyrimidin-2-one. Melting point 195–196° after recrystallization from chloroform-hexane mixture.

Anal. Calcd. for $C_9H_{10}N_2O$: C, 66.8; H, 6.17; N, 17.28. Found: C, 66.7; H, 6.13; N, 17.36.

7-Methyl-3,4-dihydro-2H-pyrido[1,2-a]pyrimidin-2-one. Melting point 167–169° after recrystallizztion from chloroform-hexane mixture.

Anal. Calcd. for $C_9H_{10}N_2O$: C, 66.8; H, 6.17; N, 17.28. Found: C, 66.5; H, 6.23; N, 17.33.

8-Methyl-3,4-dihydro-2H-pyrido[1,2-a]pyrimidin-2-one. Melting point 230–232° after recrystallization from chloroform-hexane mixture.

Anal. Calcd. for $C_9H_{10}N_2O$: C, 66.8; H, 6.17; N, 17.28. Found: C, 66.8; H, 6.10; N, 17.39.

Methanolysis of 3,4-dihydro-2H-pyrido[1,2-a]pyrimidin-2-one. Fifty g. (0.338 mole) of I (R = H) and 16 g. (0.50 mole) of absolute methanol was heated on the steam bath for 20 hr. The excess methanol was removed under vacuum. The residue was diluted with 150 ml. of benzene and chilled at 10° for 6 hr. Filtration gave 7.0 g. of recovered pyrimidinone, m.p. 184–187°. The filtrate was distilled under vacuum through a 6-in. Vigreux column to give 6.5 g. (23% yield) of 2-aminopyridine, b.p. 80–85° (0.5 mm.), m.p. 55–56°, and 34 g. (63% yield) of methyl ester of N-(2-pyridyl)-β-alanine, b.p. 120–125° (0.4 mm.), m.p. 49–50°, m.p. of mixture with authentic sample 50–51°.

N-(2-pyridyl)-β-alanines. The methyl ester of *N*-(2-pyridyl)-β-alanine (5.0 g.) was refluxed with 50 ml. of water for 16–20 hr. The water was then removed by evaporation on the steam bath and the residue was recrystallized from ethyl alcohol. The amino acid was obtained in nearly quantitative yield. The following new compounds were prepared in this manner.

N-(2-pyridyl)-β-alanine. Melting point 144–145°.

Anal. Calcd. for $C_8H_{10}N_2O_2$: C, 57.8; H, 6.03; N, 16.86. Found: C, 57.8, H, 5.94; N, 16.89.

N-(6-methyl-2-pyridyl)-β-alanine. Melting point 155–156°.

Anal. Calcd. for $C_9H_{12}N_2O_2$: C, 60.0; H, 6.67; N, 15.56. Found: C, 59.9: H, 6.72; N, 15.61.

N-(5-methyl-2-pyridyl)-β-alanine. Meling point 198–200°.

Anal. Calcd. for $C_9H_{12}N_2O_2$: C, 60.0; H, 6.67; N, 15.56. Found: C, 59.8; H, 6.80; N, 15.42.

N-(4-methyl-2-pyridyl)-β-alanine. Meling point 134–136°.

Anal. Calcd. for $C_9H_{12}N_2O_2$: C, 60.0; H, 6.67; N, 15.56. Found: C, 59.8, H, 6.77; N, 15.46.

Reaction of aminopyridines with alkyl 3-halopropionates. A mixture of 0.25 mole of the aminopyridine and 0.25 mole of the alkyl 3-halopropionate was heated on the steam bath in a flask fitted with a short Vigreux column topped by a Dry Ice-cooled trap to collect the volatile products. In every case a vigorous reaction occurred within a few minutes, and the reaction mixture solidified. Heating was continued for 4 hr. The solid residue was then pulverized and heated at 100° and 0.5 mm. pressure for 4 hr. The volatile material removed during this heating was collected in a Dry Ice–cooled trap and was added to the volatile products collected during the reaction. The relative proportion of methanol and alkyl acrylate in this liquid product was determined by infrared analysis. The ratio of pyrido[1,2-*a*]pyrimidin-2-one hydrohalide to aminopyridine hydrohalide in the solid product was calculated from its elemental analysis. In all cases the ratios given by the two methods were in good agreement.

Repeated crystallization of the crude solid product from ethyl alcohol gave relatively pure 3,4-dihydro-2*H*-pyrido-[1,2-*a*]pyrimidin-2-one hydrohalides in 50–80% recovery of the amount calculated from elemental analysis to be in the crude product. These hydrohalides were all white, crystalline solids that decomposed above 300°. These salts were converted to the free bases in 70–80% yield by dissolving them in excess cold, saturated, aqueous potassium carbonate solution, then extracting the mixture with chloroform. The dihydro-2*H*-pyrido[1,2-*a*]pyrimidin-2-ones were shown by mixture melting point to be identical with the cyclic products obtained by the reaction of the aminopyridine with methyl acrylate.

KINGSPORT, TENN.

[CONTRIBUTION FROM THE RESEARCH DIVISION, BRISTOL LABORATORIES, INC.]

Basic Ethers Derived from β-Hydroxyphenethylamines

WILLIAM B. WHEATLEY, WILLIAM E. FITZGIBBON, JR.,[1] WILLIAM F. MINOR, RICHARD R. SMITH, AND LEE C. CHENEY

Received April 3, 1958

A series of basic ethers represented by the general formula I has been prepared. Several of these compounds, which are derivatives of *N,N*-disubstituted β-hydroxyphenethylamines, have local anesthetic activity.

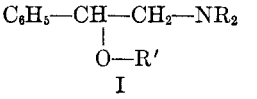
Derivatives of β-hydroxyphenethylamine have long been known to possess marked physiological activity, the nature of this activity being dependent on the type and number of substituents present. Many of the sympathomimetic amines contain this fundamental structure; other derivatives are central nervous system stimulants or local anesthetics.[2]

Some years ago we began the investigation of some compounds derived from β-hydroxyphenethylamine, and selected a series of aryl and aralkyl ethers of *N,N*-disubstituted β-hydroxyphenethylamines as a starting point. This series had at that

(1) Present address: Southern Research Institute, Birmingham, Ala.

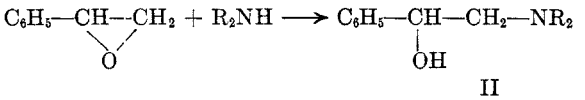
(2) W. H. Hartung, *Ind. Eng. Chem.*, **37**, 126 (1945).

time not been described,[3] and the commercial availablity of styrene oxide made the synthesis of the intermediate amino alcohols much simpler than before.[4] The compounds to be described are depicted by the general formula I, in which NR_2 represents a dialkyamino group, either cyclic or acyclic, and R′ may be aryl or aralkyl.

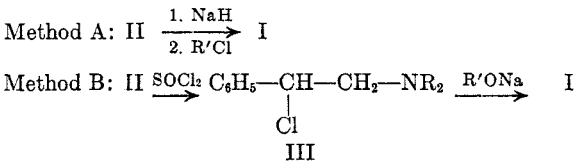


I

Styrene oxide and the secondary amines reacted smoothly to give the amino alcohols (II) in high yields.[4] From these amino alcohols, *via* the Williamson synthesis, were obtained the basic ethers (I) as described in Method A. This route proved quite satisfactory when the halide was an aralkyl halide, or a reactive aryl halide such as 2-choro-



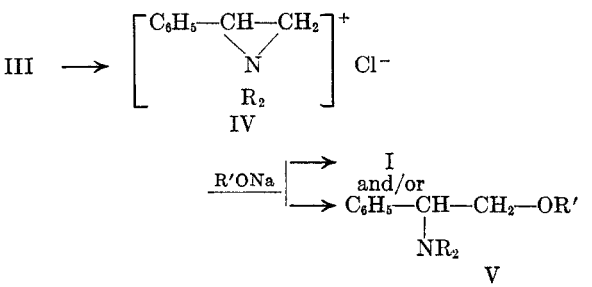
II



III

pyridine. For the preparation of a phenyl ether Method B was used, wherein II was converted to the chloride (III) with thionyl chloride and then caused to react with sodium phenoxide. This procedure was also used for the preparation of the benzylthio ether, using the sodium salt of benzyl mercaptan.

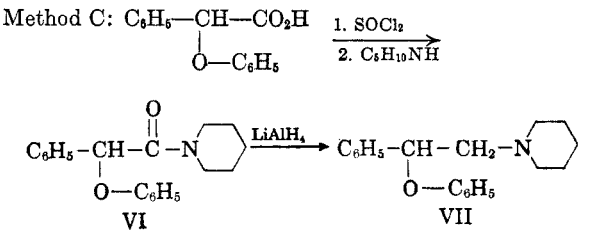
In this connection, the question arose as to the structure of the basic ether obtained by Method B. If it is assumed that during the reaction of III with sodium phenoxide, the cyclic imonium ion (IV) is formed, and there are indeed anlaogous cases in the literature,[5] then the product could be either I or V,



IV

V

or a mixture of the two. The fact that homogenous material was obtained in high yield from β-chloro-β-phenethylpiperidine and sodium phenoxide indicates that one isomer is formed almost exclusively. The proof of structure of this ether is outlined in Method C: α-phenoxyphenylacetic acid was converted to the piperidide (VI) through standard



VI VII

procedures with thionyl chloride and then piperidine; lithium aluminum hydride reduction of VI gave authentic β-phenoxy-β-phenethylpiperidine (VII). The identity of VII and the basic ether I (R′ = phenyl; NR_2 = piperidino) prepared by Method B was established by the absence of a depression in melting point of a mixture of their hydrochlorides and the superimposition of their infrared spectra. Our experimental data do not allow a decision as to whether a direct replacement of chloride by the phenoxide ion occurs or the intermediate ethylenimonium ion is involved, or both. If the cyclic ion is involved, the attack of the phenoxide ion obviously must be at the carbon atom bearing the phenyl group. In any event, the over-all course of the reaction from III to I has been established.

Pharmacology. A number of these basic ethers (Table I) show local anesthetic activity, β-benzyloxy-β-phenethylpiperidine being one of the more potent. Assayed by means of the rabbit cornea test, it is more active than procaine.

EXPERIMENTAL[6]

N,N-Disubstituted β-hydroxyphenethylamines (II). The general procedure used was to add styrene oxide dropwise to a 10–50% excess of the amine at reflux temperature, and continue refluxing for a total of 7–8 hr. The product was then isolated directly by distillation. With dimethylamine, a benzene solution of the amine and styrene oxide was allowed to stand at room temperature for three days; with diisopropylamine, the reaction mixture was refluxed for 7 days. The specific amino alcohols made are listed below.

N,N-Dimethyl-β-hydroxyphenethylamine. B.p. 90–91° at 1 mm. (84% yield).[7]

N,N-Diisopropyl-β-hydroxyphenethylamine. B.p. 102–105° at 1 mm., n_D^{25} 1.5004 (81% yield).

Anal. Calcd. for $C_{14}H_{23}NO$: C, 76.0; H, 10.5. Found: C, 75.9; H, 10.5.

(3) Since this work was completed, references to a few basic ethers of this type have come to our attention: (a) B. F. Hoffert, *Iowa State Coll. J. Sci.*, **26**, 219 (1952) [*Chem. Abstr.*, **47**, 8672 (1953)]; (b) J. O. Jilek and M. Protiva, *Chem. Listy*, **47**, 1814 (1953) [*Chem. Abstr.*, **49**, 249 (1955)]; (c) J. W. Cusic, U. S. Patent **2,683,742** (1954); (d) I. A. Kaye and I. C. Kogon, *J. Am. Chem. Soc.*, **73**, 4893 (1951).

(4) W. S. Emerson, *J. Am. Chem. Soc.*, **67**, 516 (1945).

(5) *cf.* W. R. Brode and M. W. Hill, *J. Am. Chem. Soc.*, **69**, 724 (1947); E. M. Schultz, C. M. Robb, and J. M. Sprague, *J. Am. Chem. Soc.*, **69**, 2454 (1947).

(6) Melting points and boiling points are uncorrected. We are indebted to Mr. Richard M. Downing for the analytical data and to Dr. Frank M. Palermiti for infrared spectra.

(7) Prepared by F. E. King and D. Holmes [*J. Chem. Soc.*, 164 (1947)] by reduction of $C_6H_5—CO—CH_2—N(CH_3)_2$.

TABLE I

$C_6H_5—CH(OR')—CH_2—NR_2$

R'	NR_2[a]	Method	Yield, %	B.P., °C./Mm.	Formula	Analyses: Carbon Calcd.	Carbon Found	Hydrogen Calcd.	Hydrogen Found
$C_6H_5CH_2$	NC_4H_8	A	59	170–172/1	$C_{19}H_{23}NO$	81.1	81.1	8.2	8.2
C_6H_5	NC_5H_{10}	B	74	146–147/0.8	$C_{19}H_{23}NO$[b]	81.1	80.9	8.2	8.3
C_5H_4N[c]	NC_5H_{10}	A	87	164–166/1.1	$C_{18}H_{22}N_2O$	76.6	76.6	7.8	7.8
$C_6H_5CH_2$	NC_5H_{10}	A	49	178–180/2	$C_{20}H_{25}NO\cdot HCl$[d]	72.4	72.6	7.9	7.9
$C_6H_5CH_2$[e]	NC_5H_{10}	B	50	180–187/1	$C_{20}H_{25}NS$[f]	77.1	77.2	8.1	8.1
$4\text{-}ClC_6H_4CH_2$	NC_5H_{10}	A	80	174–180/1	$C_{20}H_{24}ClNO\cdot HCl$[g]	65.6	65.6	6.9	7.0
$4\text{-}CH_3OC_6H_4CH_2$	NC_5H_{10}	A	65	177–184/0.2	$C_{21}H_{27}NO_2$	77.5	77.3	8.4	8.1
$3,4\text{-}(CH_3O)_2C_6H_3CH_2$	NC_5H_{10}	A	30[h]	220–230/2	$C_{22}H_{29}NO_3$	74.3	74.6	8.2	8.2
$3,4,5\text{-}(CH_3O)_3C_6H_2CH_2$	NC_5H_{10}	A	68	223–226/1	$C_{23}H_{31}NO_4$	71.7	72.0	8.1	8.4
$C_4H_3SCH_2$[i]	NC_5H_{10}	A	47	181–185/2.5	$C_{18}H_{23}NOS$[j]	71.7	72.2	7.7	8.0
$C_6H_5CH_2$	NC_6H_{12}	A	76	168–169/0.9	$C_{21}H_{27}NO\cdot HCl$[k]	72.9	72.9	8.2	8.3
$C_6H_5CH_2$	NC_7H_{14}	A	85	[l]	$C_{22}H_{29}NO\cdot HCl$[m]	73.5	73.5	8.4	8.5
C_5H_4N[c]	NC_4H_8O	A	56	169–173/1.5	$C_{17}H_{20}N_2O_2$	71.8	71.9	7.1	6.8
$C_6H_5CH_2$	NC_4H_8O	A	80	153–156/0.6	$C_{19}H_{23}NO_2\cdot HCl$[n]	68.4	68.3	7.3	7.4
$2\text{-}ClC_6H_4CH_2$	NC_4H_8O	A	59	191–195/1.5	$C_{19}H_{22}ClNO_2\cdot HCl$[o]	62.0	61.6	6.3	6.2
$2,4\text{-}Cl_2C_6H_3CH_2$	NC_4H_8O	A	82	[l]	$C_{19}H_{21}Cl_2NO_2\cdot HCl$[p]	56.6	56.7	5.5	5.6
$C_4H_3SCH_2$[i]	NC_4H_8O	A	43	178–180/2	$C_{17}H_{21}NO_2S$[q]	67.3	66.7	7.0	6.7
$C_6H_5CH_2$	$NC_6H_{12}O$	A	73	[l]	$C_{21}H_{27}NO_2\cdot HCl$[r]	69.7	69.8	7.8	7.9
C_6H_5	$N(CH_3)_2$	B	55	175–177/0.7	$C_{16}H_{19}NO$[s]	79.6	79.5	7.9	8.3
$4\text{-}CH_3OC_6H_4CH_2$	$N(i\text{-}C_3H_7)_2$	A	77	191–197/1.3	$C_{22}H_{31}NO_2$	77.4	77.3	9.2	8.9

[a] NC_4H_8 = 1-pyrrolidino; NC_5H_{10} = 1-piperidino; NC_6H_{12} = 2-methyl-1-piperidino; NC_7H_{14} = 2,6-dimethyl-1-piperidino; NC_4H_8O = 4-morpholino; $NC_6H_{12}O$ = 2,6-dimethyl-4-morpholino. [b] Hydrochloride: m.p. 196.0–197.5° (isopropyl alcohol–ether). *Anal.* Calcd. for $C_{19}H_{23}NO\cdot HCl$: C, 71.8; H, 7.6. Found: C, 71.6; H, 7.6. [c] C_5H_4N = 2-pyridyl. [d] Hydrochloride: m.p. 184.5–186.5° [methyl isobutyl ketone (MIBK)]. [e] O replaced by S. [f] Hydrochloride: m.p. 158.5–160.0° (MIBK). *Anal.* Calcd. for $C_{20}H_{25}NS\cdot HCl$: C, 69.0; H, 7.5. Found: C, 69.3; H, 7.5. [g] Hydrochloride: m.p. 194.0–196.0° (isopropyl alcohol). [h] The low yield may be due in part to the use of crude 3,4-dimethoxybenzyl chloride. [i] $C_4H_3SCH_2$ = 2-thenyl. [j] Hydrochloride: m.p. 163.5–165.5° (MIBK). *Anal.* Calcd. for $C_{18}H_{23}NOS\cdot HCl$: C, 64.0; H, 7.2. Found: C, 64.0; H, 7.3. [k] Hydrochloride: m.p. 171.5–173.5° (isopropyl alcohol–ether). [l] The hydrochloride of the basic ether crystallized on attempted extraction with dilute hydrochloric acid on working up the reaction mixture. The yield represents unrecrystallized hydrochloride. [m] Hydrochloride: m.p. 236.0–237.5° (methanol-ether). [n] Hydrochloride: m.p. 173.0–175.5° (isopropyl alcohol–petroleum ether, 60–71°). [o] Hydrochloride: m.p. 156.5–157.5° (MIBK). [p] Hydrochloride: m.p. 182.5–183.5° (MIBK). [q] Hydrochloride: m.p. 185.0–186.0° (acetonitrile). *Anal.* Calcd. for $C_{17}H_{21}NO_2S\cdot HCl$: C, 60.1; H, 6.5. Found: C, 60.2; H, 6.8. [r] Hydrochloride: m.p. 184.0–186.0° (MIBK). [s] Hydrochloride: m.p. 201.0–202.0° (isopropyl alcohol–ether). *Anal.* Calcd. for $C_{16}H_{19}NO\cdot HCl$: C, 69.2; H, 7.3. Found: C, 68.9; H, 7.5.

1-(β-Hydroxyphenethyl)pyrrolidine. M.p. 57.5–59.5° (petroleum ether, 28–38°) (73% yield).[8]

1-(β-Hydroxyphenethyl)piperidine. B.p. 125–127° at 1 mm., m.p. 71.0–72.5° (petroleum ether, 60–71°) (93% yield).[9]

1-(β-Hydroxyphenethyl)-2-methylpiperidine. B.p. 123–125° at 1 mm. (90% yield).

Anal. Calcd. for $C_{14}H_{21}NO$: C, 76.7; H, 9.6. Found: C, 76.7; H, 9.7.

2,6-Dimethyl-1-(β-hydroxyphenethyl)piperidine. M.p. 76.5–78.5° (petroleum ether, 60–71°) (55% yield).

Anal. Calcd. for $C_{15}H_{23}NO$: C, 77.2; H, 10.0. Found: C, 77.4; H, 9.9.

Hydrochloride: m.p. 245.5–246.5° (ethanol).

Anal. Calcd. for $C_{15}H_{23}NO\cdot HCl$: C, 66.8; H, 9.0. Found: C, 66.9; H, 8.9.

4-(β-Hydroxyphenethyl)morpholine. M.p. 83.0–84.0° (petroleum ether, 60–71°) (90% yield).[4]

2,6-Dimethyl-4-(β-hydroxyphenethyl)morpholine. B.p. 148–151° at 2 mm. (91% yield).

Anal. Calcd. for $C_{14}H_{21}NO_2$: C, 71.4; H, 9.0. Found: C, 71.1; H, 8.9.

Hydrochloride: m.p. 197.5–199.5° (isopropyl alcohol–ethyl acetate).

Anal. Calcd. for $C_{14}H_{21}NO_2\cdot HCl$: C, 61.9; H, 8.1. Found: C, 62.2; H, 8.2.

N,N-Dialkyl-β-chlorophenethylamines (III). Treatment of the amino alcohols with thionyl chloride as described by Cheney[10] yielded the basic chloride hydrochlorides.

N,N-Dimethyl-β-chlorophenethylamine hydrochloride. M.p. 202–205° (isopropyl alcohol).

Anal. Calcd. for $C_{10}H_{14}ClN\cdot HCl$: C, 54.6; H, 6.9. Found: C, 54.7; H, 6.9.

Basic ethers (I). One example will be given to illustrate each method of preparation; the individual compounds prepared are listed in Table I.

Method A. A solution of 0.25 mole of II in 100 ml. of toluene was added dropwise to a stirred suspension of 0.25 mole of sodium hydride in 100 ml. of toluene. After 5 hr. refluxing, all of the sodium hydride had dissolved; to this clear solution, stirred and maintained at reflux, was added a solution of 0.25 mole of the aralkyl chloride in 50 ml. of toluene. After refluxing overnight, the reaction mixture was cooled and water added to dissolve the inorganic salt. The toluene layer was extracted three times with dilute hydrochloric acid; the acid extracts were combined and made strongly basic with potassium hydroxide. Extraction of the liberated organic base with several portions of ether, followed by drying of the extracts over anhydrous potassium carbonate and distillation *in vacuo* yielded the basic ether I. This

(8) C. T. Bahner, M. Fielden, L. M. Rives, and M. D. Pickens, *J. Am. Chem. Soc.*, **73**, 4455 (1951).

(9) Prepared by R. E. Lutz, R. H. Jordan, and W. L. Truett [*J. Am. Chem. Soc.*, **72**, 4085 (1950)] by reduction of $C_6H_5—CO—CH_2—NC_5H_{10}$ in 60% yield.

(10) L. C. Cheney, U. S. Patent 2,548,652 (1951) [*Chem. Abstr.*, **45**, 8039 (1951)].

procedure was used in cases where R′ = aralkyl and 2-pyridyl; 2-chloropyridine is sufficiently reactive to participate in the Williamson synthesis. In certain cases, as noted in Table I, the hydrochloride of the product precipitated on extraction of the toluene solution with acid; the salt was collected by filtration and purified by recrystallization.

Method B. β-Chlorophenethylpiperidine hydrochloride[10] (72.0 g., 0.28 mole) was stirred at room temperature with an equivalent amount of 56% potassium hydroxide and the liberated base extracted with two portions of toluene. The combined extracts (150 ml.) were dried by shaking for 2 hr. with anhydrous potassium carbonate. The filtered toluene solution was then added dropwise to a hot, stirred, suspension of sodium phenoxide. This suspension had been prepared by adding 26.0 g. (0.28 mole) of phenol to 6.7 g. (0.28 mole) of sodium hydride in 150 ml. of toluene. After the reaction mixture had been refluxed for 16 hr., it was cooled and shaken with 10% hydrochloric acid. The aqueous layer was made strongly basic and extracted several times with benzene. The benzene extracts were dried and distilled to give 57.3 g. of I (R′ = phenyl, NR_2 = piperidino).

α-Phenoxy-α-phenylacetopiperidide (VI). A solution of 44.0 g. (0.19 mole) of α-phenoxyphenylacetic acid[11] and 34.5 g. (0.29 mole) of thionyl chloride in 150 ml. of ether to which 3 drops of pyridine had been added was stirred at reflux for 4 hr. The residue which remained on evaporation of the solvent was taken up in 150 ml. of Skellysolve B. A solid separated, and was collected by filtration. This solid was identified as recovered acid; 18.8 g., 43% recovery. The solvent was evaporated from the filtrate, leaving a residue of 28.7 g. which failed to crystallize. This crude acid chloride was taken up in 100 ml. of benzene and added dropwise to a stirred solution of 25.5 g. of piperidine in 100 ml. of benzene. Heat was evolved, and a white solid formed. After the addition had been completed, the reaction mixture was stirred at reflux for 1 hr., then allowed to stand overnight at room temperature. The mixture was then poured in water (solid dissolved); the benzene layer was separated and extracted twice with saturated sodium bicarbonate solution. Evaporation of the solvent from the dried benzene solution left a residue which spontaneously solidified. Two recrystallizations from dilute methanol gave 25.7 g. of VI, m.p. 115.0–117.0°. An analytical sample melted at 116.0–117.0°.

Anal. Calcd. for $C_{19}H_{21}NO_2$: C, 77.3; H, 7.2. Found: C, 77.2; H, 7.2.

1-(β-Phenoxyphenethyl)piperidine (VII). A suspension of 5.9 g. (0.02 mole) of VI and 3.7 g. (0.1 mole) of lithium aluminum hydride in 300 ml. of ether was stirred at reflux for 2 hr., then allowed to stand overnight at room temperature. The mixture was hydrolyzed by cautious addition of ice; the white solid which formed was collected by filtration and washed several times on the filter with fresh ether. The filtrate and washings were combined and the solvent evaporated. Distillation at 0.8 mm. gave 4.8 g. of colorless liquid, b.p. 158–159° (86% yield).

Anal. Calcd. for $C_{19}H_{23}NO$: C, 81.1; H, 8.2. Found: C, 81.3; H, 8.3.

Hydrochloride: melting point alone and when mixed with a sample prepared by the alternate route (Method B), 196.5–198.0°.

Anal. Calcd. for $C_{19}H_{23}NO{\cdot}HCl$: C, 71.8; H, 7.6. Found: C, 71.8; H, 7.6.

Further evidence for the identity of the basic ethers prepared by the two routes was afforded by the infrared spectra, which were indistinguishable.

SYRACUSE 1, N. Y.

(11) C. O. Guss, *J. Am. Chem. Soc.*, **71**, 3460 (1949).

[CONTRIBUTION FROM THE DEPARTMENT OF CHEMISTRY, IOWA STATE COLLEGE]

Some Organosilicon Compounds Derived from Phenyl Ether

HENRY GILMAN AND DAVID MILES

Received April 24, 1958

This article reports the preparation of several organosilicon compounds derived from either *o*- or *p*-phenoxyphenyllithium, or from (oxydi-*o*- or oxydi-*p*-phenylene)dilithium. These compounds are of interest as synthetic lubricants or hydraulic fluids because of their low melting points and relatively high volatilization points.

The preparation in this laboratory of several organosilicon compounds derived from aryl ethers has already been reported.[1–3] These compounds were prepared, as a part of a current research problem, for the purpose of finding thermally stable organosilicon compounds for possible use as synthetic lubricants or hydraulic fluids. A second aim of this research is to develop such thermally stable compounds which are also low-melting, preferably being liquids at room temperature.

Among the phenyl ether derivatives previously reported are two complete series of compounds of the general formula $(C_6H_5)_xSiR_{(4-x)}$; where x is 0, 1, 2 or 3, and R is either *o*-phenyloxyphenyl[1] or *p*-phenoxyphenyl[2] except for the compound where x is 3 and R is *p*-phenoxyphenyl. In addition, *n*-dodecyltris(*p*-phenoxyphenyl)silane was prepared.[2] The compounds were prepared by reaction of organolithium compounds with chlorosilanes. The preparations of the organolithium compounds were carried out by either halogen-metal interconversion or metalation reactions using *n*-butyllithium[4,5] as the metalating agent.

In another study, dimetalation of phenyl ether using slightly more than two equivalents of *n*-butyllithium to one equivalent of phenyl ether was

(1) K. Oita and H. Gilman, *J. Org. Chem.*, **21**, 1009 (1956).

(2) H. Gilman and J. J. Goodman, *J. Org. Chem.*, **22**, 45 (1957).

(3) K. Oita and H. Gilman, *J. Am. Chem. Soc.*, **79**, 339 (1957).

(4) W. Langham, R. Q. Brewster, and H. Gilman, *J. Am. Chem. Soc.*, **63**, 545 (1941).

(5) H. Gilman and R. L. Bebb, *J. Am. Chem. Soc.*, **61**, 109 (1939).