Experimental

Preparation of Benzilic Acid Morpholinoethyl-Amide.—A solution of 7.3 g. (0.03 mole) of benzilic acid methyl ester and 6.5 g. (0.05 mole) of morpholinoethylamine in 100 cc. of methanol was refluxed for 24 hours on a steam-bath. After evaporating solvent the residual product was purified by crystallization from ethyl acetate; yield 9.5 g. (95%); m.p. 127–128°. This product was also recrystallized from water, ethyl acetate and from mixtures of ethyl acetate or benzene with Skellysolve B.

The other tertiaryamino amides of Table I were obtained by similar procedures. They were quaternized by refluxing with methyl iodide in methanol solution.

THE WELLCOME RESEARCH LABORATORIES
TUCKAHOE 7, NEW YORK

β-Pyrrolidinoethyl *p*-Alkoxybenzoates[1]

BY J. STANTON PIERCE, MICHAEL J. FLETCHER AND SAMUEL L. COOKE, JR.

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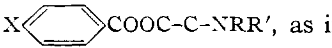
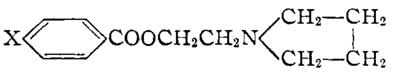
In a recent survey of substituted aminoethyl benzoates with the same skeleton formula,  as in Einhorn's β-diethylaminoethyl-*p*-aminobenzoate,[2] out of over 450 compounds tabulated, only six are esters of β-pyrrolidinoethanol (A). The repeated use of diethylaminoethanol in the preparation of local anesthetics, the relationship of this compound to A and the present low cost of pyrrolidine suggest the desirability of the synthesis of a series of compounds of the structure,

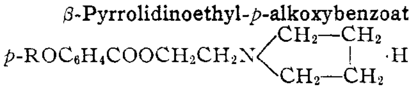


with considerable variation in X. To date, esters have been prepared of A with benzoic acid,[3] *p*-nitrobenzoic and *p*-aminobenzoic acids,[4] *p*-*n*-butylaminobenzoic acid[5] and cinnamic acid.[5]

The β-pyrrolidinoethyl benzoates in the present study were prepared by condensation of the benzoyl chlorides with A, usually in benzene solution, and were isolated as the hydrochlorides. The pyrrolidinoethanol was prepared by the reaction of a methanol solution of pyrrolidine with ethylene oxide[3,6] at 45–60°.[7] The alkoxybenzoyl chlorides were prepared by the reactions[8]

$$p\text{-HOC}_6\text{H}_4\text{COOC}_2\text{H}_5 \longrightarrow p\text{-ROC}_6\text{H}_4\text{COOC}_2\text{H}_5 \longrightarrow p\text{-ROC}_6\text{H}_4\text{COOH} \longrightarrow p\text{-ROC}_6\text{H}_4\text{COCl}$$

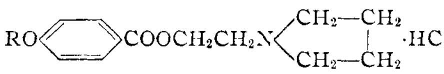
Experimental

β-Pyrrolidinoethyl-*p*-alkoxybenzoate Hydrochloride,  ·HCl.—In a typical run a solution of *p*-alkoxybenzoyl chloride, dissolved in approximately 2.0 volumes of benzene, was treated slowly with an equimolar quantity of A, in benzene. The mixture was refluxed for 0.5 hour and allowed to stand overnight. The crystalline product was filtered with suction, washed with anhydrous ether, dissolved in water and extracted with isopropyl ether, the ether being discarded. The aqueous solution was made basic with sodium carbonate solution and the oil which separated was dissolved in isopropyl ether. The isopropyl ether solution was filtered and treated with hydrogen chloride. The precipitate which formed was filtered with suction, washed with anhydrous ether, recrystallized from benzene, washed with absolute ether and recrystallized from absolute alcohol.

If crystallization did not occur in the original reaction mixture, the benzene solution was extracted with approximately 4 volumes of 0.5 *N* hydrochloric acid and the aqueous layer was made basic with sodium hydroxide solution. The oil which separated was dissolved in isopropyl ether and converted to the hydrochloride as above. If the hydrochloride did not crystallize readily it was converted into a crystalline solid by trituration with dry ether or absolute alcohol.

TABLE I

β-PYRROLIDINOETHYL *p*-ALKOXYBENZOATE HYDROCHLORIDES[a,b,c]



R	M.p. (uncor.), °C.	Yield, % crude	Chlorine, % Calcd.	Chlorine, % Found
Ethyl	174–174.5	74	11.83	11.36
n-Propyl	147–148	47	11.29	11.43
n-Butyl	157–158	48	10.81	10.74
n-Amyl	136–137	90	10.37	10.32
n-Hexyl	132.5–133	36	9.96	9.65
Cycloamyl	141.5–143	45	10.43	10.52
Cyclohexyl	158.5–160	49	10.02	10.00

[a] β-Pyrrolidinoethyl *p*-chlorobenzoate hydrochloride, m.p. 194–196°, was prepared from *p*-chlorobenzoyl chloride purchased from Distillation Products Industries. *Anal.* Calcd. for $C_{13}H_{17}O_2NCl_2$: Cl (ionized), 12.22. Found: Cl, 12.36. [b] β-Pyrrolidinoethyl *p*-amyloxycinnamate hydrochloride, m.p. 160–160.5°, was prepared from *p*-amyloxycinnamoyl chloride, which was prepared from *p*-hydroxybenzaldehyde by way of *p*-amyloxycinnamic acid.[9] *Anal.* Calcd. for $C_{21}H_{30}O_3NCl$; Cl, 9.65. Found: Cl, 9.64. [c] The activities of these compounds as local anesthetics are being determined by Dr. Harvey B. Haag of the Medical College of Virginia.

DEPARTMENT OF CHEMISTRY
UNIVERSITY OF RICHMOND
RICHMOND, VIRGINIA

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[1] Acknowledgment is made to Dr. E. Emmet Reid, Research Advisor to the Chemistry Department of the University of Richmond, for his advice in this work.

[2] A. Einhorn and E. Uhlfelder, *Ann.*, **371**, 131 (1909).

[3] J. von Braun, O. Braunsdorf and K. Räth, *Ber.*, **55B**, 1666 (1922).

[4] J. Supniewski, *Roczniki Chem.*, **7**, 163 (1927); *C. A.*, **22**, 666 (1928).

[5] R. O. Clinton, U. J. Salvador, S. C. Laskowski and J. S. Buck, THIS JOURNAL, **72**, 1331 (1950).

[6] New Products Bulletin No. 28, E. I. du Pont de Nemours and Co., Inc.

[7] For a similar preparation of diethylaminoethanol, see W. H. Horne and R. L. Shriner, THIS JOURNAL, **54**, 2925 (1932).

[8] J. Stanton Pierce, J. M. Salsbury and J. M. Fredericksen, *ibid.*, **4**, 1691 (1942).

[9] J. S. Pierce, R. D. Gano and J. M. Lukeman, *ibid.*, **70**, 255 (1948).

Elimination Reactions on 1,4-Systems. II. Use of Metals to Prepare 1,3-Butadiene and Derivatives[1]

BY W. M. SCHUBERT AND WAYNE A. LANKA

RECEIVED DECEMBER 9, 1953

In an earlier report on the possible extent of the general reaction 1 in which $n > 0$, it was shown that 1,4-dibromo-2-butyne and 1-bromo-4-phenoxy-2-butyne yielded butatriene when treated with zinc in the solvent diethylene glycol–diethyl ether or acetonitrile.[2] Other examples of the reaction 1 in which $n > 0$ include: the preparation of 1,3-buta-

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[1] Supported in part by a Cottrell grant of the Research Corporation.

[2] W. M. Schubert, T. H. Liddicoet and W. A. Lanka, THIS JOURNAL, **76**, 1929 (1954).