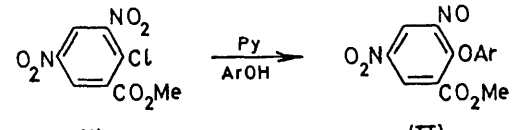
# Aromatic Nucleophilic Substitution: Unusual Course of Hems' Synthesis of Diaryl Ethers

By R. MUTHUKRISHNAN, R. KANNAN, and S. SWAMINATHAN*
(*Department of Organic Chemistry, University of Madras, Madras–25, India*)

*Summary* Methyl-2-chloro-3,5-dinitrobenzoate (I) condenses with hindered phenols to give aryl-3,5-dinitrosalicylates, possibly *via* a β-lactone (VII).

INTEREST in the stereochemistry of hindered diaryl ethers prompted us to condense the benzoate (I) with phenols in hot pyridine, in an extension of Hems' synthesis.[1,2] The expected aryloxy-esters [type (II)] were obtained in the condensations with various unhindered phenols. However, condensation with (IIIa) furnished a pale yellow product (IV), m.p. 193—194°, (85%) inferred to be a demethylated product on the basis of analytical data† and its molecular weight (474; mass spectrum). Condensations with (IIIb) and (IIIc) gave demethylated products (V), m.p. 147—148° (15%) and (VI), m.p. 224—225° (49%), respectively.

These products could possibly be the acids corresponding to the expected esters of type (II), which, like other reported bis-(*o*-substituted-phenyl) ethers[3] have no strong u.v. absorptions whereas (IV), (V), and (VI) showed absorptions around 365 nm (ε 16,000). Comparison with methyl 3,5-dinitrosalicylate ($\lambda_{max}$ 368 nm; ε 18,000) and phenyl 3,5-dinitrosalicylate ($\lambda_{max}$ 360 nm; ε 7350) suggested that these products might be aryl 3,5-dinitrosalicylates. This was confirmed by acylation of the appropriate phenols in pyridine with 3,5-dinitrosalicyl chloride which gave the same compounds (IV), (V), and (VI) in good yields.



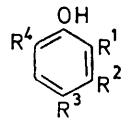

(I) (II)

(VIII) Ar = 2,4-$Br_2$,6-Me-$C_6H_2$

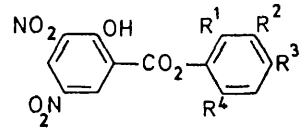
The formation of the aryl salicylates must involve participation of the *o*-methoxycarbonyl group. Methyl–oxygen cleavage at some stage was evident from the fact that the reaction mixture containing (I) and (IIIa) had a strong absorption at 258 nm characteristic[4] of the *N*-methyl pyridinium ion.

With the hindered phenols, the normal intermolecular displacement may be slow and be preceded by a more rapid demethylation and internal displacement to transform the ester (I) into the β-lactone (VII) which can acylate the phenols. Alternatively, the normal product (VIII) can re-

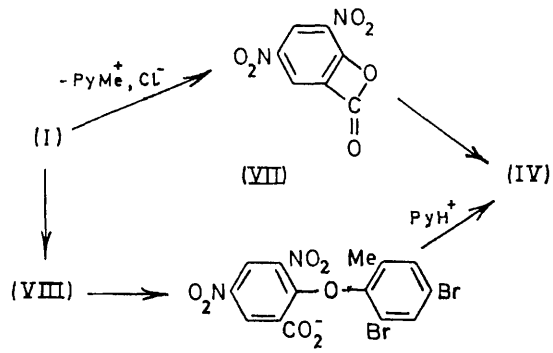
† Satisfactory analyses were obtained for new compounds.



(III)



a; $R^1 = R^3 = Br$, $R^2 = H$, $R^4 = Me$ (IV; $R^1 = R^3 = Br$, $R^2 = H$, $R^4 = Me$)
b; $R^1 = R^3 = Bu^t$ $R^2 = H$, $R^4 = Me$ (V; $R^1 = R^3 = Bu^t$ $R^2 = H$, $R^4 = Me$)
c; $R^1 = R^2 = R^4 = Br$, $R^3 = Me$ (VI; $R^1 = R^2 = R^4 = Br$, $R^3 = Me$)



arrange to the salicylate (IV) by demethylation followed by a Smiles rearrangement.[5]

The ester (VIII),† m.p. 96·2–97·8°, obtained by conventional Williamson synthesis from the sodium salt of (IIIa) and (I) was heated in pyridine in the presence of a proton donor like pyridine hydrochloride or (IIIa) itself. Only a poor yield (*ca.* 5%) of (IV) resulted, in contrast to the excellent yield in the direct condensation between (I) and (IIIa) and, in addition, *N*-methylpyridinium 3,5-dinitrosalicylate, m.p. 181—182°, was isolated (28%). Though the isolation of this product implies ready demethylation of (VIII), the intermediacy of (VIII) itself in the formation of (IV) seems ruled out. Further work is in progress to obtain more conclusive evidence for the participation of the β-lactone intermediate (VII).

We thank Mr. R. Balasubramanian for elemental analyses, Professor T. R. Govindachari, CIBA Research Centre, Bombay and Merck, Sharp and Dohme Research Laboratories, Rahway, New Jersey, for spectra, and Dr. K. V. Narayanan for helpful discussions. R.M. and R.K. thank the University of Madras for financial support.

(*Received*, 3*rd January* 1972; *Com.* 006.)

[1] E. J. Borrows, J. C. Clayton, B. A. Hems, and A. G. Long, *J. Chem. Soc.*, 1949, 190.
[2] W. D. Chandler, W. M. Smith, and R. Y. Moir, *Canad. J. Chem.*, 1964, **42**, 2549 and references cited therein.
[3] M. Dahlgard and R. Q. Brewster, *J. Amer. Chem. Soc.*, 1958, **80**, 5861.
[4] P. Krumholz, *J. Amer. Chem. Soc.*, 1951, **73**, 3487.
[5] W. E. Truce, E. M. Kreider, and W. W. Brand, *Org. Reactions*, 1970, **18**, 99.