CXXXIII.—1-*Methoxydiphenyl*-1'-*carboxylic Acid and its Demethylation with Thionyl Chloride.*

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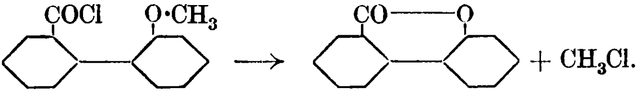
1-METHOXYDIPHENYL-1'-CARBOXYLIC acid is readily obtained by methylating the lactone of 1-hydroxydiphenyl-1'-carboxylic acid, but the latter substance is unfortunately only available in poor yield (Richter, *J. pr. Chem.*, 1883, **28**, 284; Graebe, *Annalen*, 1895, **284**, 316; Borsche, *Annalen*, 1900, **312**, 225). The reaction between *o*-iodophenyl *o*-iodobenzoate and copper powder at 250° gave very little of the lactone, and under the same conditions, the corresponding bromo-compound failed to react at all. A modification of Borsche's method in which the diazonium sulphate of phenyl *o*-aminobenzoate was warmed in aqueous solution with copper powder produced the lactone in only 14% yield and therefore offers no advantage over that of Borsche (*loc. cit.*).

An unexpected reaction was encountered in an attempt to esterify 1-methoxydiphenyl-1'-carboxylic acid by way of the acid chloride —warming for a few minutes with thionyl chloride demethylated the methoxy-acid quantitatively to the lactone of the hydroxy-acid:



A similar, although less complete, change occurred when the acid was kept for 2 or 3 days with excess of thionyl chloride at room temperature, and when the dried sodium salt was allowed to react at a low temperature with thionyl chloride.

The ease with which this reaction proceeds is remarkable and is presumably due to the close proximity of the –COCl and –OMe groups. Numerous examples of demethylation are recorded in the literature, but these commonly require for their completion several hours' heating at temperatures ranging from 120° to 200°.

EXPERIMENTAL.

Preparation of the Lactone of 1-*Hydroxydiphenyl*-1'-*carboxylic Acid from Phenol and Anthranilic Acid.*—The lactone was prepared according to the directions of Borsche (*loc. cit.*), but the purification was more effective when the dark red product was dissolved in ether and washed several times with ammonia, which also completely removed the colouring matter. After being dried with calcium chloride, the ethereal solution gave the lactone, which, after recrystallisation from light petroleum, melted at 94—95°. The yield from 60 g. of anthranilic acid and 220 g. of phenol varied from 8·0 to 11·3 g.

Preparation of the Lactone from Phenyl o-*Aminobenzoate.*—Phenyl *o*-aminobenzoate was prepared in 76% yield by reducing phenyl *o*-nitrobenzoate in alcoholic solution with tin and hydrochloric acid. The reduction is complete in 5 minutes; longer treatment results in loss, owing to hydrolysis of the ester.

The diazotisation also is best conducted in alcoholic solution with amyl nitrite. A solution of phenyl *o*-aminobenzoate (10 g.) in absolute alcohol (120 c.c.) containing the necessary amount of concentrated sulphuric acid (5·0 g.) was cooled to 5°, when crystals of the sulphate separated, and amyl nitrite (5·4 g.) was added. After 2 hours the diazonium sulphate was precipitated with ether (240 c.c.), filtered off, and dried (yield, 13·6 g.).

To a solution of the diazonium salt in 100 c.c. of water, 50 g. of copper powder were slowly added, evolution of nitrogen occurring; the temperature was then raised to 40° during 4 hours. When no more diazonium compound could be detected, the mixture of solids was filtered off, dried, and extracted with chloroform. The solvent was then removed from the extract, the residue hydrolysed with alcoholic potash, and the alkaline liquid acidified. From the mixture of lactone, phenol, and salicylic acid thus obtained, phenol was removed by rapid distillation in steam, which also carried over a little of the lactone, and the liquid was made alkaline with sodium carbonate and extracted with ether. The solution was dried, and on removal of the solvent gave the pure lactone, m. p. 93—94°.

The yield varied with the nature of the copper powder. Ten g. of amino-ester, after diazotisation, gave no lactone at all on treatment with Kahlbaum's "Naturkupfer C." Copper powder which had been prepared according to Gattermann (*Ber.*, 1890, **23**, 1218) and had been dried before use gave 0·8 g. of lactone, whereas the freshly prepared moist powder gave a yield of 1·3 g. (14% of the theoretical).

1-*Methoxydiphenyl*-1′-*carboxylic Acid.*—The solution obtained by heating 10 g. of the lactone with 20 g. of 30% aqueous sodium hydroxide was cooled and shaken for 1 hour with 19 c.c. of methyl sulphate. The methyl ester of the methoxy-acid that separated as an oil was extracted with ether. The aqueous solution deposited on acidification a mixture of the methoxy-acid with a little lactone, from which the pure acid was extracted with sodium carbonate. The *methoxy-acid* crystallised from benzene as a white, crystalline powder, which is very sparingly soluble in water; m. p. 152—153°

(corr.) (yield, 3·5 g.) (Found: C, 73·7; H, 5·5. $C_{14}H_{12}O_3$ requires C, 73·65; H, 5·3%).

The *methyl* 1-*methoxydiphenyl*-1′-*carboxylate* obtained from the above methylation formed a colourless, viscous liquid, b. p. 181—182°/13 mm. (yield, 6·0 g.). It was readily hydrolysed to the methoxy-acid (Found: C, 74·3; H, 6·0. $C_{15}H_{14}O_3$ requires C, 74·35; H, 5·8%).

Reaction with Thionyl Chloride.—The thionyl chloride employed was the purified product supplied by the British Drug Houses, Ltd. For confirmatory experiments it was again purified by successive distillations over quinoline and beeswax.

(1) The methoxy-acid (3·10 g.) was heated for a few minutes with an equal weight of thionyl chloride. A considerable quantity of hydrogen chloride was evolved and the excess of thionyl chloride was then removed by warming in a vacuum. The residual crystalline mass, alone or mixed with the pure lactone, melted at 92—93° (yield, 2·63 g. Theoretical yield, 2·69 g.).

(2) The dried, finely powdered sodium salt (12 g.) of the methoxy-acid was added in small portions to 15 g. of thionyl chloride, cooled in ice. On allowing the temperature to rise to that of the room, a slow reaction took place, accompanied by a small evolution of gas. After 3 hours, the thionyl chloride was removed in a vacuum, the residue extracted with benzene at 35°, and the extract treated with menthol and pyridine at 100° for several hours. No menthyl ester could be isolated from the reaction mixture, but 6 g. of crude lactone were recovered, m. p. 85—87°. (A further small quantity was carried over during the steam distillation of the menthol.) A mixture of this with the pure lactone melted at 91—92°.

(3) The methoxy-acid (3·90 g.) was kept for 2—3 days at room temperature with thionyl chloride (10 c.c.), and the unchanged thionyl chloride was then removed in a vacuum, without heating. The residue was a crystalline mass of m. p. 78·5—91·5°, a portion of which, after being warmed for a few minutes in air at 40—45°, melted at 87—91·5° (yield, 3·43 g. Lactone formation requires 3·35 g.). A few decigrams of crude methoxy-acid, together with crude lactone, were recovered by treating part of the product, which still smelt of acid chloride, with water and shaking the mixture with sodium carbonate. Altogether about 2 g. of the pure lactone were recovered. A very small quantity of an unidentified acidic compound containing sulphur was also isolated.

The methoxy-acid was not changed by boiling it for several hours with a saturated aqueous-alcoholic solution of hydrochloric acid, and esterification could be effected in the usual way with dry hydrogen chloride as catalyst.

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