

two hours' boiling, additional phthalic anhydride was added and boiling continued for two hours. It is known from Nos. 1-3 that these preparations would have yielded no diphenylphthalide at the end of the first two hours' boiling and would have given a 97% yield of orthobenzoyl-benzoic acid, so that the diphenylphthalide obtained must have been due to the action of the additional phthalic anhydride on the intermediate compound. No. 13 shows that increasing the amount of aluminium chloride produces no diphenylphthalide, No. 14 that beginning with a small amount of the aluminium chloride and increasing it during the course of the reaction does not prevent the formation of diphenylphthalide, and in No. 15 only one-quarter of the usual amount of aluminium chloride was used and the yield of orthobenzoyl-benzoic acid was very small.

Since the diphenylphthalide is shown to be produced by the action of the phthalic anhydride on the intermediate product which would have given orthobenzoyl-benzoic acid, experiments were made to see whether other acid anhydrides would have a similar effect.

Expt. 16.—Twenty grams of phthalic anhydride, 80 cc. benzene and 18 g. aluminium chloride, boiled for two hours, then 13.6 g. succinic anhydride added and boiling continued for two hours, gave 11 g. diphenylphthalide and not more than a trace of orthobenzoyl-benzoic acid.

Expt. 17.—Fourteen and eight-tenths grams of phthalic anhydride, 80 cc. benzene and 13.3 g. aluminium chloride, boiled for two hours, then 10.2 g. acetic anhydride added and boiling continued for two hours, gave 8.8 g. diphenylphthalide and no orthobenzoyl-benzoic acid.

Von Pechmann¹ found that in the preparation of orthobenzoyl-benzoic acid some diphenylphthalide was found and he also states that diphenylphthalide may be prepared from orthobenzoyl-benzoic acid, aluminium chloride and benzene, but that a better yield was obtained from the mixed anhydride of orthobenzoyl-benzoic and acetic acids.

Expt. 18.—Seven and four-tenths grams of orthobenzoyl-benzoic acid, 20 cc. benzene and 9 g. aluminium chloride were boiled for two hours and gave 0.1 g. diphenylphthalide. This experiment may be compared with Experiment 13, in which an excess of aluminium chloride was used and there must have been present the intermediate compound and aluminium chloride, so that although orthobenzoyl-benzoic acid with aluminium chloride will give a small quantity of diphenylphthalide the intermediate compound with aluminium chloride will give none unless an acid anhydride is present.

Experiments were also made, along the same line, in the preparation of benzophenone from benzoyl chloride, benzene and aluminium chloride. The benzoyl chloride was dissolved in benzene and powdered aluminium chloride added. It is not necessary to add the aluminium chloride grad-

¹ *Ber.*, 14, 1865 (1881).