

The Preparation of Heterocyclic Materials from 2-Isocyanatobenzoyl Chloride and Difunctional Nucleophiles

Charles F. Beam

Department of Chemistry, Newberry College, Newberry, South Carolina, 29108

Ned D. Heindel, Maria Chun, and Anthony Stefanski

Department of Chemistry, Lehigh University, Bethlehem, Pennsylvania, 18015

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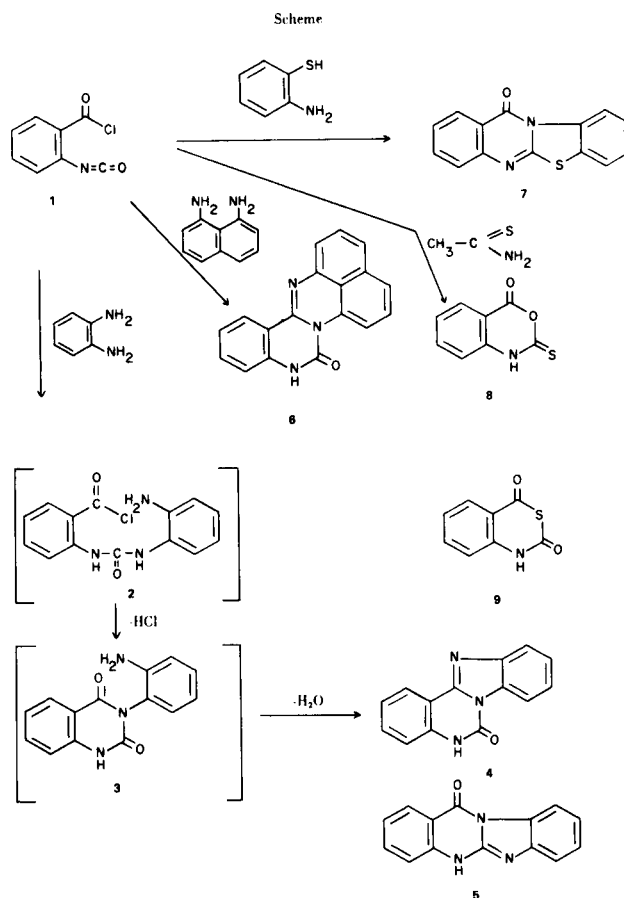
2-Isocyanatobenzoyl chloride was treated with difunctional nucleophiles such as *o*-phenylenediamine, 1,8-diaminonaphthalene, *o*-aminothiophenol, and thioacetamide. The diamino-nucleophiles gave intermediates which were thermally cyclized, and the other nucleophilic reagents gave heterocyclic materials directly.

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Sir:

Several papers on the preparation of 2-isocyanatoalkancarboxylic acid chlorides and 2-isocyanatobenzoyl chloride have appeared in recent years, and these materials have been treated with *monofunctional* nucleophiles, such as aromatic and aliphatic amines to give ureido amides and benzoxazinones, respectively (1-4). We wish to report preliminary results and some mechanistic observations on the reaction of 2-isocyanatobenzoyl chloride with *difunctional* nucleophiles as illustrative of its versatile application to heterocyclic syntheses.

When **1** was heated with *o*-phenylenediamine, an unstable intermediate, **2**, was isolated and tentatively assigned the structure illustrated (see Scheme) on the basis of the disappearance of the isocyanato band (2270 cm^{-1}) but the retention of the acyl chloride absorption (1760 cm^{-1}). On warming in refluxing benzene **2** yielded another transient intermediate assigned structure **3** on the basis of the absence of both NCO and COCl bands but the presence of primary amine absorptions (3200 and 3300 cm^{-1}). Interestingly, however, other workers have reported (3), with good evidence, that the COCl functional group of **1** was more reactive than the NCO group. When **3** was refluxed in decalin, it gave **4**, m.p. $330\text{-}333^\circ$ (23% overall), which was characterized by analysis, infrared spectra, and comparison with authentic material by an independent synthesis (5). It might be expected that the major product would result from thermal dehydration of the aromatic amine with the imide carbonyl (carbon



-4) rather than the urea carbonyl (carbon -2) of the quinazolidinedione ring. In a similar manner, **1** was heated with 1,8-diaminonaphthalene, which was cyclized to give **6**, m.p. 291-293° (58%, analysis, infrared).

When **1** was treated with 2-aminobenzenethiol, thermal cyclization was not necessary, and **7** resulted directly, m.p. 186-187° (29%). Its properties agreed with those reported for this material, with the advantage that this new and simpler synthesis involves more readily available starting materials (6-9).

It was of additional interest to treat **1** with thioacetamide, and here again thermal cyclization was not necessary for the preparation of the heterocyclic material **8**, m.p. 239-241° (51%) (10). Compound **8** was distinguished from its isomer **9** by mass spectrum (eq., M-44).

In a typical experiment, 0.05 mole of **1** dissolved in 50 ml. of benzene was added to a solution containing 0.05 mole of the difunctional nucleophile (200 ml. of benzene), and the mixture was heated under reflux for several hours. The benzene was removed, and the product was recrystallized. If thermal cyclization was required, as in the case of the diamines, 100 ml. of decalin was added and the mixture was heated under reflux for 1 hour. After cooling the mixture the solid was separated and recrystallized.

It is surprising to note the limited number of additional literature citations found for reactions of 2-isocyanatobenzoyl chloride with nucleophilic reagents (11-14). This dielectrophilic reagent offers the potential for preparation of other heterocyclic materials by reaction with other difunctional nucleophiles, and such a study is currently in progress. In addition, a complete study of the mechanism is anticipated.

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