

Reaction of 3-Alkyl-2-benzyl-1,4-naphthoquinones with *t*-Butylamine: Isolation of Epoxides and Heterocycles

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Summary Compounds (Ia), (II), and (IIIa) have been isolated from the reaction of *t*-butylamine with 2-benzyl-3-methyl-1,4-naphthoquinone; a similar reaction with 2,3-dibenzyl-1,4-naphthoquinone gave compounds (Ib) and (IIIb).

ETHANOLIC *N*-methylcyclohexylamine reacts with 2-benzyl- and 2-ethyl-1,4-naphthoquinones to yield quinone dimers,¹ and we have now found that *t*-butylamine will also effect this reaction. In the hope of extending the scope of this process to 2,3-dialkyl-1,4-naphthoquinones, we have investigated the reactions of certain 3-alkyl-2-benzyl-1,4-naphthoquinones with *t*-butylamine. Chandrasenan and Thomson² have shown that 2-benzyl-3-methyl-1,4-naph-

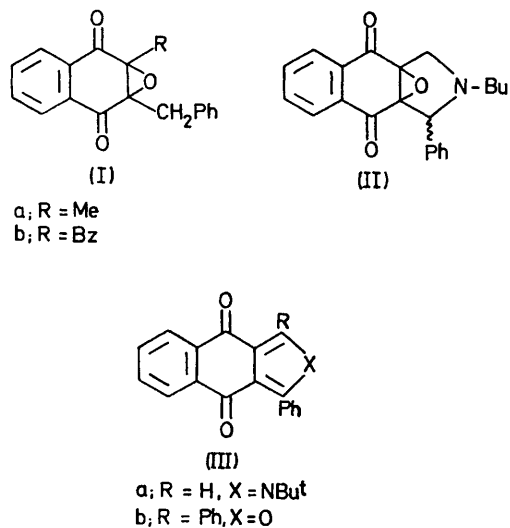
thoquinone undergoes ready reaction in aqueous ethanolic sodium hydroxide to yield the dimer, 1,2-bis-(3-benzyl-1,4-naphthoquinon-2-yl)ethane and phthiocol.

Treatment of 2-benzyl-3-methyl-1,4-naphthoquinone with ethanolic *t*-butylamine in air at room temperature for prolonged periods in the dark yields several products among which we have identified epoxides (Ia) and (II) and naphtho[2,3-*c*]pyrrole (IIIa). No dimeric material was isolated. The structure of the epoxide (Ia) (28%), m.p. 142–143°, was confirmed by synthesis from 2-benzyl-3-methyl-1,4-naphthoquinone and alkaline hydrogen peroxide. The structures of the epoxide (II) (9%), m.p. 223–225°, and the pyrrole (IIIa) (2%), m.p. 269–270°, were assigned on the basis of spectral data.

Compounds (II) and (IIIa) may result from a sequence of reactions involving side-chain mono-amination, oxidation, intramolecular amination, and subsequent epoxidation or aromatisation. Examples of side-chain amination of 2,3-dimethyl-1,4-naphthoquinone by secondary amines³ and formation of quinone epoxides in reactions involving quinones and amines in air have been reported.^{1,4}

Reaction of 2,3-dibenzyl-1,4-naphthoquinone, m.p. 92°, prepared from 1,4-naphthoquinone and phenylacetic acid,⁵ with t-butylamine under the above conditions again led to a complex mixture of products from which were isolated the acylquinone epoxide (Ib) (15%), m.p. 147—148°, and the known⁶ naphtho[2,3-*c*]furan (IIIb) (1%), m.p. 220—222°. These products may arise through the intermediacy of a hydroperoxide formed by reaction of a benzylic anion with oxygen. Chandrasenan and Thomson have tentatively suggested the intervention of such a species to account for the formation of phthiocol from 2-benzyl-3-methyl-1,4-naphthoquinone and base.² It is also possible that compounds (IIIa) and (IIIb) arise from a common type of intermediate.

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¹ I. Baxter, D. W. Cameron, J. K. M. Sanders, and R. B. Titman, *J.C.S. Perkin I*, 1972, 2046.

² K. Chandrasenan and R. H. Thomson, *Tetrahedron*, 1971, 25, 2529.

³ D. W. Cameron, R. G. F. Giles, and R. B. Titman, *J. Chem. Soc. (C)*, 1969, 1245.

⁴ I. Baxter and W. R. Phillips, *J.C.S. Perkin I*, 1973, 268.

⁵ Cf. N. Jacobsen and K. Torsell, *Annalen*, 1972, 763, 135.

⁶ E. Müller and E. Langer, *Tetrahedron Letters*, 1970, 735.