Ipso-substitution Reactions of 3-Substituted Indoles with Benzoyl t-Butyl Nitroxide

By CORRADO BERTI,* MARTINO COLONNA, LUCEDIO GRECI, and LEONARDO MARCHETTI
(*Istituto Chimico, Facoltà Ingegneria,* 40136 *Bologna, Italy*)
and M. JOHN PERKINS
(*Department of Chemistry, Chelsea College, Manresa Road, London* SW3 6LX)

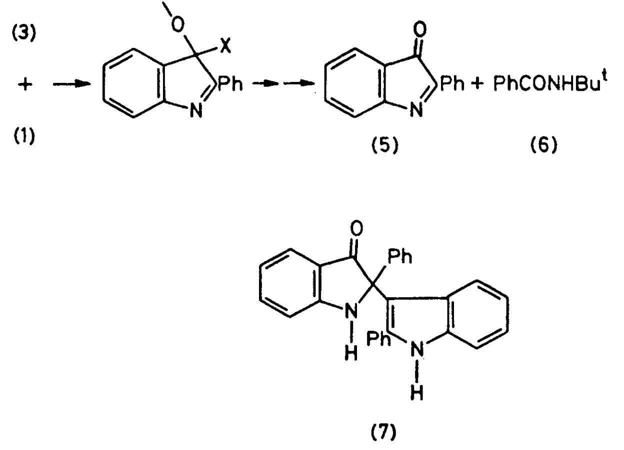
Summary Reactions between benzoyl t-butyl nitroxide and certain 2-phenylindoles carrying a substituent at C-3 give 2-phenyl-3*H*-indol-3-one; 2-phenylindole itself gives compound (**7**).

DURING the past decade several examples of free-radical *ipso*-substitution reactions in various substituted aromatic compounds have been described.[1] We now report examples of *ipso*-substitution by an acyl nitroxide.

Benzoyl t-butyl nitroxide[2] (**1**) (representative of the isolable acyl tertiary-alkyl nitroxides, which are excellent selective oxidising agents for a wide variety of organic substrates[3]) was allowed to react in benzene with a series of 3-substituted 2-phenylindoles (**2**). Major products isolated in each case were the indolone (**5**), *N*-t-butylbenzamide (**6**), and the hydroxamic acid (**4**). The reactions were carried out using indole to nitroxide ratios of 1 : 2·2. The indolone partially decomposed during chromatographic isolation, and its yield from each indole was therefore determined by h.p.l.c. (Table).

TABLE. Formation of 2-phenyl-3*H*-indol-3-one (**5**) from 3-substituted 2-phenylindoles (**2**) in benzene.

Substituent X	Yield/%	T/°C	t/h
N=NPh	80	25	24
CH_2OH	70	"	"
Cl	25	"	"
$N{=}NC_6H_4NO_2$-*p*	70	Reflux	2
SMe	20	"	"
SCN	20	"	"



SCHEME

A reaction sequence which partially accomodates the formation of the identified products is outlined in the Scheme. The initial step is consistent with the fact that the *N*-methyl derivative of (**2**) did not react with the nitroxide. No other products were isolated, and the fates of the original 3-substituents are unknown.

When compound (**1**) reacted with 2-phenylindole itself, (**5**) was apparently not formed; instead, a major product was compound (**7**), whose structure was confirmed by comparison with an authentic sample.[4] This result has a precedent in the oxidation of 2-methylindole by Fremy's radical,[5] but reaction of 2,3-disubstituted indoles with Fremy's radical has apparently not been investigated. It should, however, be noted that oxidation by Fremy's radical of phenols having a bromine or chlorine atom in the *para* position is accompanied by displacement of the halogen in the intermediate phenoxyl radical in a process similar to that outlined here.[6]

The variant of *ipso*-substitution which is exemplified by the present results, in which a radical derived from an aromatic substrate couples with a second radical species at the position which bears the substituent that is displaced, may account for some of the more surprising examples of free-radical *ipso*-substitution recorded in the literature.[7]

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