Oxidation of 2-Ethylthioindoles with Hydrogen Peroxide. Oxidative Migration of the Ethylsulphonyl Group

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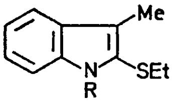
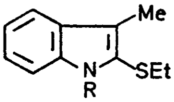
Summary 2-Ethylsulphonyl-3-methylindoles (**4**) were converted into 3-ethylsulphonyl-3-methyloxindoles (**5**) on treatment with hydrogen peroxide in acetic acid.

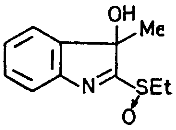
We reported previously that the autoxidation of 2-ethylthio-3-methylindole (**1a**) in hexane or cyclohexane gave the sulphoxide (**2a**) and 3-hydroxyindolenine (**3**) in quantitative yield.[1] We have now examined the oxidation of (**1a**) and (**1b**) with hydrogen peroxide, and found that the sulphonyl group undergoes migration. When an acetic acid solution of (**1a**) was treated with 1 mol of 30% H_2O_2 at room temperature the sulphoxide (**2a**)[1] was obtained in 77% yield together with the sulphone (**4a**),[2] m.p. 77—78°, in 6% yield. The sulphone was obtained as the main product by the oxidation of (**1a**) with 3 mol of H_2O_2 under similar conditions. Two other products were also isolated in minor amounts. The structure of one of the minor products (6% yield), m.p. 200—201°, was assigned as (**5a**) from spectral data: λ_{max} (EtOH) 255·5 (ϵ 5030), 266sh (3680), 295 nm (1390); ν_{max} (KBr) 3276 (NH), 1720, 1714 (C=O), 1298, 1135 cm^{-1} (SO_2); *m/e* 239 (M^+, 6%), 146 ($M - SO_2Et$, 100%); n.m.r. ($CDCl_3$) δ 1·37 (t, CH_2CH_3), 1·88 (s, 3-Me), 3·0—3·5 (m, CH_2CH_3), 8·70 p.p.m. (br s, NH).



(1)



(2)



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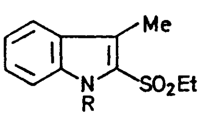
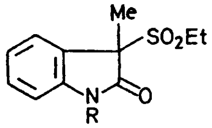
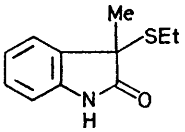


(4)

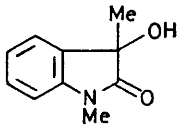


(5)

a; R = H
b; R = Me



(6)



(7)

The structure of (**5a**) was confirmed by direct comparison with the sample obtained by the H_2O_2 oxidation of 3-ethylthio-3-methyloxindole (**6**), m.p. 111—112°, prepared by the reaction of 3-methyloxindole with ethanesulphenyl chloride.[3]

(**4a**) was stable in acetic acid, but was converted into (**5a**) in 20% yield by the addition of 1 mol of H_2O_2 to the solution. This indicates that the reaction involves the oxidative rearrangement of the sulphonyl group.

The oxidation of 2-ethylthio-1,3-dimethylindole (**1b**) which was stable to autoxidation, with 1 mol of H_2O_2 in acetic acid gave the sulphoxide (**2b**), m.p. 97—97·5°, in high yield. With 3 mol of H_2O_2 (**1b**) gave the sulphone (**4b**), m.p. 84—85°, the oxindole (**5b**), m.p. 128—130°, and the dioxindole (**7**)[4] in 30% yield, respectively. The structures of (**4b**) and (**5b**) were proved by i.r., n.m.r., and mass spectral data.

This is the first example of migration of the sulphonyl group. The mechanism of this reaction may be similar to that suggested by Acheson *et al.*[5] for the comparable 1,2-migration of a methoxycarbonyl group in indole derivatives.

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[1] T. Hino, M. Nakagawa, and S. Akaboshi, *Chem. Comm.*, 1967, 656; M. Nakagawa and T. Hino, *Tetrahedron*, 1970, **26**, 4491; M. Nakagawa, H. Yamaguchi, and T. Hino, *Tetrahedron Letters*, 1970, 4035.

[2] H. Faulstich and T. Wieland, *Annalen*, 1968, **713**, 186. They reported that the suphoxide (**2a**) was obtained by the oxidation of (**1a**) with 3 mol of H_2O_2 in acetic acid and the sulphone (**4a**), m.p. 113°, was obtained with an excess of H_2O_2.

[3] T. Wieland and D. Grimm, *Chem. Ber.*, 1965, **98**, 1727.

[4] P. L. Julian and J. Pikl, *J. Amer. Chem. Soc.*, 1935, **57**, 539.

[5] R. M. Acheson, R. W. Snaith, and J. M. Vernon, *J. Chem. Soc.*, 1964, 3229; *cf.* R. M. Acheson, *Accounts Chem. Res.*, 1971, **4**, 177.