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HEMITHIO-ANALOGUES OF MEISENHEIMER COMPLEXES AND SULPHIDE GROUP ACTIVATION OF AROMATIC SUBSTITUTION BY ALKOXIDES

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Summary EtO^- in DMSO adds to ethylthiopicrate at C-3 to generate an ephemeral σ-adduct which ends into 1-ethylthio-4-ethoxy-2,5-dinitrobenzene, whilst ethyl picrate gives two adducts of attack of EtS^- at C-3 or C-1.

We report that sulphide group activation of aromatic substitution of para-ortho nitro groups by thiolates[1] (recently rediscovered[2]) is a more general phenomenon than was thought hitherto, extending to weaker nucleophiles such as alkoxides. Our study reveals also the novel hemithio-analogues of Meisenheimer complexes.[3]

Thus, when ethylthiopicrate[1] (1) in dried $(CD_3)_2SO$ was mixed under N_2 at room temp. with either solid EtONa (2) or a 2 M solution of 2 in dried ethanol, in order to have both reagents 0.28 M, a deep-red colour [λ_{max} 478 and 540 nm] immediately developed. This is typical of 1:1 Meisenheimer complexes,[1,4] and, in fact, quick ^1H n.m.r. analysis of the mixture revealed the signals attributable to 3, [q, 2.82, J 7.5; t, 0.97 (SEt); q, 3.45, J 7.0; t, 1.12 (OEt); d, 6.25, J 1.7 (CHO); d, 8.40 (CH)] besides those for 4 [s, 8.57] and 6,[1] while those for the reagents were absent (Scheme 1).[+] While 3 slowly decayed, disappearing after 20h, 5 became noticeable after 40 min, thereafter increasing in intensity. Neutralization of the mixture after 7 days and water addition, followed by $CHCl_3$ extraction and HPLC separation, gave 4 (35%), 5, m.p. 80-81°, (38%), and 6 (24%).

Clearly, decay of 3 is due both to substitution of the 4-nitro group of 1 by ethoxide, specifically activated by the p-sulphide group,[1] and to the formation of 4 and 6. While 6 must arise from attack on 1 by ethanethiolate,[1] the origin of the latter is uncertain. It may be either attributed to basic hydrolysis of 1 by traces of moisture or to substitution by 2 of the ethylthio group from 1, followed by β-elimination.[‡] Both routes also account for the formation of 4.

Whilst not detectable in the system in Scheme 1, the hemithio-analogue 9 of Meisenheimer complexes[3] was revealed by n.m.r. [q, 3.25, J 7.4 (OEt); q, 2.34, J 7.5 (SEt); s, 8.48 CH] in a ca 1:1 ratio with respect to 10,[◇] [q, 4.06, J 7.1 (OEt); q, 2.55, J 7.0 (SEt); d, 5.39, J 1.7 CHS; d, 8.34 CH] on mixing ethyl picrate (7) with sodium ethanethiolate (8), both 0.3 M (Scheme 2). Also, residual signals for 7 were detectable, [q, 4.27, J 7.0; t, 1.32 (OEt); s, 9.09 CH] together with those for both picrate (4) (in ca 1:5 ratio with respect to 9) and 6 (traces). The concentration of both 4 and, more markedly, 6 increased with time, while 9, 10, and residual 7

very slowly disappeared.

Clearly, 3 is preferred to 9 in the mixture at Scheme 1 owing to a favoured equilibrium.

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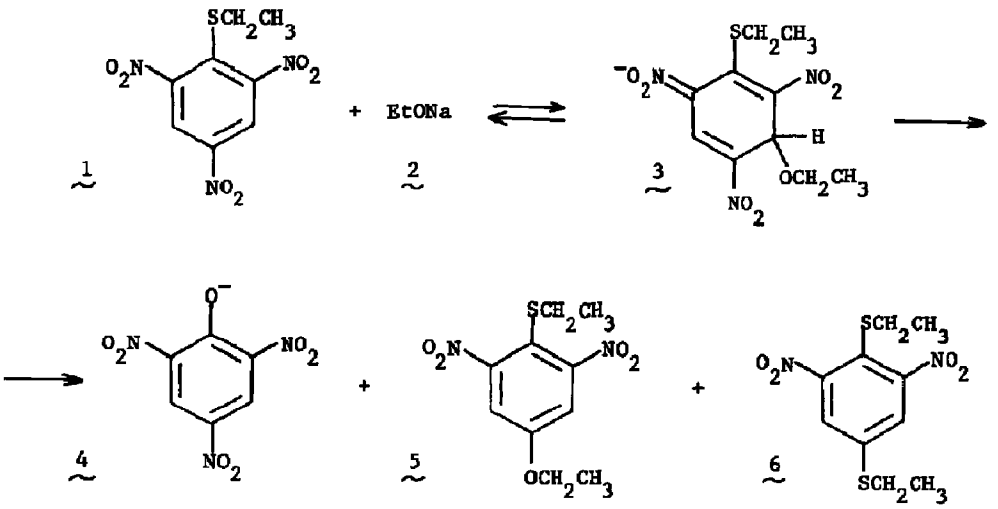
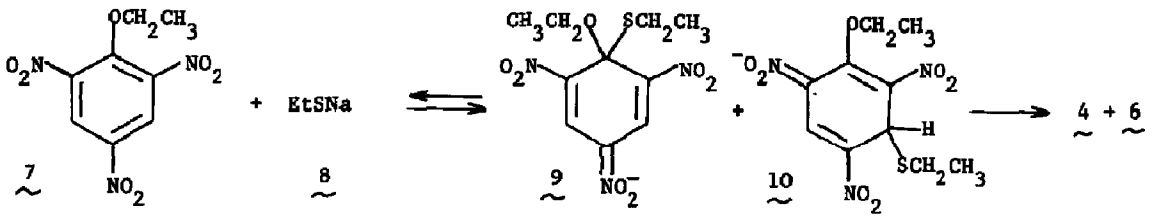
Scheme 1



Scheme 2



FOOTNOTES AND REFERENCES

+ ^{1}H n.m.r. chem. shifts are given in δ with respect to int. $SiMe_4$, while J is given in Hz.

‡ ^{1}H n.m.r. investigation of the reaction of 7 with 2 in dried $(CD_3)_2SO$ (where residual water was not detectable) revealed the presence of 4 alongside the two σ-adducts of EtO^- attack on 7 at C-1 and C-3. In contrast, 4 was not detected in the reaction of methyl picrate with methoxide in $(CD_3)_2SO$ (M.R. Crampton and V. Gold, J. Chem. Soc. (B), 1966, 893; K.L. Servis, J. Amer. Chem. Soc., 1967, 89,1508). This points to the origin of 4 in our cases at Schemes 1 and 2 via β-elimination from 7, though hydrolytic routes are probably also operative.

◊ Coupling between cyclohexadienide protons in 10 was unexpected.[1] Methyl protons for both 9 and 10 are grouped together at δ 0.9-1.4.

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4) M.J. Strauss, Chem. Rev., 70, 667 (1970).

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