Optical Rotatory Dispersion of Methyl Alkyl Sulphoxides: Structural and Solvent Effects

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METHYL ALKYL SULPHOXIDES exhibit Cotton effects at 205—210 nm. of sign related to chirality at sulphur.[1,2] The utility of this relationship is impaired by other Cotton effects of varying amplitude centred near 230 nm., which in some cases dominate the o.r.d. spectra.[2] They are strongest when the alkyl groups are dissymmetric, and have been attributed to the asymmetric perturbation of the sulphinyl chromophore as a consequence of restricted rotation about a C–S bond.[2] Verification of this postulate is important to establish the scope of the o.r.d. method for allocating chirality.

The o.r.d. curves in hexane of four 6-methylsulphinyl-5α-cholestanes [(Ia), (Ib), (Ic), and (Id)] were almost enantiomeric with those of the 4-methylsulphinyl-5α-cholestanes[2] [(IIb), (IIa), (IId), and (IIc)] respectively (Figure 1). The same relationship pertained in certain features of their n.m.r. spectra, the 19-methyl group resonating (60 MHz) at 9 Hz to lower field in the (*S*)-6β-sulphoxide [(Ib); τ 8·80] than in the (*R*)-6β-sulphoxide [(Ia); τ 8·95] whereas in the (*S*)-4β-sulphoxide [(IIb); τ 8·95] it resonated at 8 Hz to higher field than in the (*R*)-4β-sulphoxide [(IIa); τ 8·82]; in the 6α-sulphoxides [(Ic) and (Id)] and the 4α-sulphoxides [(IIc) and (IId)] the differences were 5 Hz [(*R*)-isomer at lower field] and 4 Hz [(*S*)-isomer at lower field] respectively. These phenomena are rational if there is restricted rotation about the bond connecting sulphur to the steroid nucleus, so that the respective pairs of sulphoxides are pseudo-enantiomeric [*e.g.* (Ia) and (IIb); Figure 2] and if the anisotropy of the sulphinyl bond is of the acetylenic type. This confirms previous evidence concerning the nature of its anisotropy.[3] The asymmetric perturbation of the sulphinyl chromophore is equal and opposite in each pair of sulphoxides.

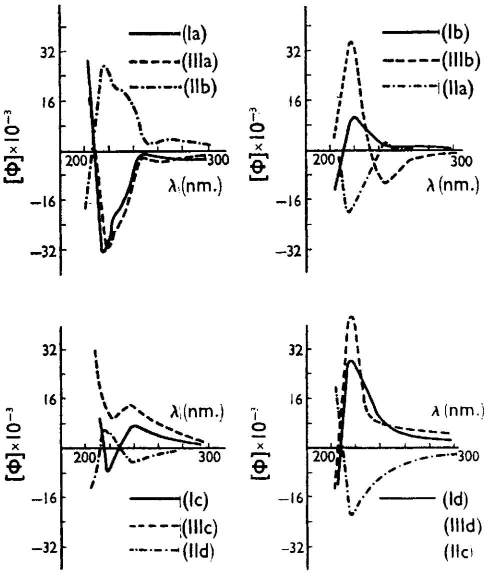


FIGURE 1. *O.r.d. curves of 4-, 6-, and 7-methylsulphinyl-5α-cholestanes in hexane.*

The o.r.d. curves in hexane (Figure 1) of the 7-methylsulphinyl-5α-cholestanes (IIIa—d) showed the same general features as those of the C-6 sulphoxides (Ia—d) respectively. These pairs of sulphoxides have similar proximate asymmetric environments [*e.g.* (Ia) and (IIIa); Figure 2] if there is restricted rotation about the C-7–S bond. These results further substantiate the initial postulate. The least similar of the curves are those of (Ib) and (IIIb) which is consistent with the extra perturbing effect of the adjacent ring D in the latter; the 19-methyl group is apparently not a dominating influence although it is situated very close to sulphur in the 6β-sulphoxides [(Ia) and (Ib)].

The o.r.d. curves had the same shape in ethanol as in hexane, but the extrema for (Ib), (Ic), and (Id) underwent red shifts of *ca.* 10 nm. This is probably a consequence of the variation in relative amplitude of the two Cotton effects, since blue shifts were observed in the corresponding u.v. maxima. The negative extremum near 228 nm. for the (*R*)-6α-sulphoxide was almost obscured by the background curve, indicating the unsuitability of ethanol as solvent in the o.r.d. method for allocating configuration in dialkyl sulphoxides, particularly when the alkyl groups are themselves chiral. All the sulphoxides displayed u.v. maxima near 210 nm. in hexane, and all except (Ic) exhibited shoulders near 230 nm. The blue shifts in ethanol (maxima below 200 nm. with shoulders near 220 nm.) characterised both transitions as $n \rightarrow \pi^*$ in type. In contrast, the longer wavelength band in methylsulphinylbutane has been reported to be solvent insensitive.[1a] The sulphoxides were monomeric in hexane (according to osmometry) at the concentrations used for o.r.d. determinations.

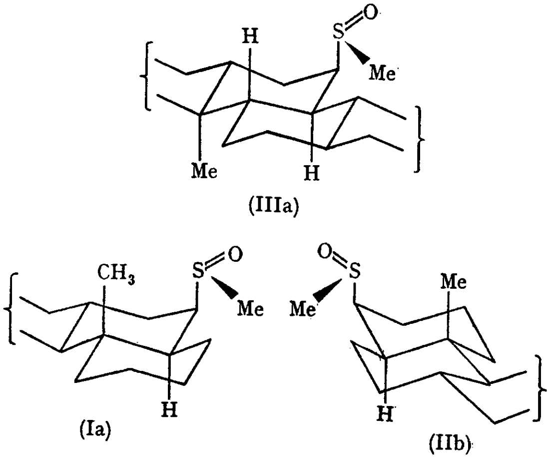
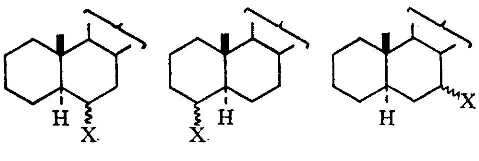


FIGURE 2.



X = —SOMe

	(I)	(II)	(III)
a:	(*R*) - 6β - X	(*R*) - 4β - X	(*R*) - 7α - X
b:	(*S*) - 6β - X	(*S*) - 4β - X	(*S*) - 7α - X
c:	(*R*) - 6α - X	(*R*) - 4α - X	(*R*) - 7β - X
d:	(*S*) - 6α - X	(*S*) - 4α - X	(*S*) - 7β - X

The C-6 and C-7 sulphoxides were prepared from 6α- and 7β-methanesulphonyloxy-5α-cholestanes respectively by methods analogous to those described for the 4-methylsulphinyl-5α-cholestanes.[2] Chirality at sulphur was established by the pyrolytic method,[4] the (*R*)-sulphoxides (Ia) and (IIIa) being characterised by decomposition to 5α-cholest-6-ene in boiling toluene after 24 hr., whereas the respective sulphoxides (Ib) and (IIIb) diastereomeric at sulphur were inert.

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[3] A. B. Foster, T. D. Inch, M. H. Qadir, and J. M. Webber, *Chem. Comm.*, 1968, 1086, and references cited therein.

[4] D. N. Jones and M. J. Green, *J. Chem. Soc.* (*C*), 1967, 532.