A Large "Steric" Secondary Hydrogen Isotope Effect in the *E*1 Degradation of a Quaternary Ammonium Salt

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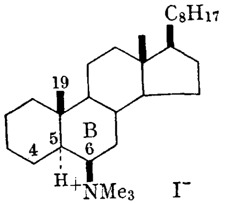
EVEN if the extreme interpretation recently[1] adumbrated by H. C. Brown and his co-workers may not appear convincing, the force-constant changes between reactants and transition states responsible for an increasing number of secondary hydrogen kinetic isotope effects are, by general agreement, aptly ascribed to "steric" factors. In the most significant such examples[2] to date, compressive force fields affecting the H- or D-containing groups are steeper for the transition states; the observed isotope effects are therefore "inverse" ($k_H/k_D < 1$). By useful contrast, we have observed a large "normal" effect in the *E*1 degradation of 5α-cholestan-6β-yl trimethylammonium iodide (I) and the tris-trideuteromethyl analogue. In 98·6% ethanol at 70°, first-order rate constants for the degradation of these salts (initially ~ 0·03 M) to cholest-5-ene and $N(CH_3)_3HI$ or $N(CD_3)_3HI$ are $6{\cdot}4 \times 10^{-5}$ and $4{\cdot}0 \times 10^{-5}$ sec.$^{-1}$ respectively, giving $k_H/k_D = 1{\cdot}6$. This ratio does not appear to be particularly sensitive to temperature.

Since the instability of these salts is due[3] to exceptionally strong compressive interactions between the trialkylammonium group and the 19-methyl and 4-methylene groups (not, apparently,* relieved by ring-B assuming a twist-boat conformation) we believe that the observed isotope effect is best described as "steric" in origin and that it is not primarily due to the different inductive effects of hydrogen and deuterium. Both interpretations are ultimately related, but in quite different ways, to the difference in effective dynamic sizes of H- and D-containing groups. Further work with isomeric salts and other degradative procedures is in hand.



(I)

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* The half-intensity width of the 6α-H multiplet in the n.m.r. spectrum of the trimethylammonium salt in $CDCl_3$ is ~9 c./sec.

[1] H. C. Brown and G. J. McDonald, *J. Amer. Chem. Soc.*, **1966**, **88**, 2514; H. C. Brown, M. E. Azzaro, J. G. Koelling, and G. T. McDonald, *ibid.*, p. 2520.

[2] *Inter alia*, K. Mislow, R. Graeve, A. J. Gordon, and G. H. Wahl, Jr., *J. Amer. Chem. Soc.*, **1963**, **85**, 1199; **1964**, **86**, 1733; L. Melander and R. E. Carter, *ibid.*, **1964**, **86**, 295.

[3] *c.f.*, B. B. Gent and J. McKenna, *J. Chem. Soc.*, **1959**, 137.