

Quaternisation of Reduced Heterocyclic Bases with Triethyloxonium Fluoroborate: Failure of Predictions based on "Hammond's Postulate"

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WE have previously¹ questioned the validity of other authors' use of "Hammond's postulate" in interpreting the preferred steric course of quaternisation of *N*-alkyl heterocyclic bases. The arguments employed² have taken the general form: faster quaternisation: more reactant-like transition state: longer partial N ··· C (in attacking electrophile) bond: more axial quaternisation (and *vice versa* for slower quaternisation). We describe results which support our previous theoretical objections: we have found that reaction of certain reduced cyclic *N*-methyl bases with the extremely rapid ethylating agent triethyloxonium fluoroborate³ in dichloroethane gives more equatorial (or *trans*, for 1,2-dimethylpyrrolidine) relative to axial (or *cis*, for 1,2-dimethylpyrrolidine) quaternisation than is observed with ethyl iodide in acetone.

Quaternisations were effected at room temperature with a slight excess of alkylating agent; the crystalline quaternary fluoroborate mixtures were produced in quantitative yields. To obtain the comparative ratios shown in the Table it was necessary to relate the quaternary fluoroborate and the corresponding¹ quaternary iodide mixtures *via* the mixed quaternary chlorides, produced in each case by quantitative anion exchange; all mixed samples were examined by n.m.r. spectroscopy, and ratios of appropriate signals (usually *N*-methyl) taken. From further work in progress it appears that the change in alkylating agent, rather than in solvent, is mainly responsible for the variations in ratios.

The results are in direct opposition to predictions based on "Hammond's postulate", or rather, as we argued,¹ predictions based on the apparently illegitimate use of this

Ratios of axial (or *cis*) to equatorial (or *trans*) quaternisation with Et₃O⁺BF₄⁻ in CH₂Cl₂ and with EtI in Me₂CO

Base	Ethylating agent ^a	
	Et ₃ O ⁺ BF ₄ ⁻	EtI
1-Methyl- <i>trans</i> -decahydroquinoline	0.5 : 1	1.0 : 1
1,2-Dimethylpyrrolidine	1.5 : 1	2.5 : 1
1,2-Dimethylpiperidine	0.6 : 1	1.0 : 1
<i>N</i> -Methylcamphidine	~2-4 : 1 ^b	~2-4 : 1 ^b
1-Methyl-4-phenylpiperidine	1.0 : 1	1.5 : 1

^a All reactions with triethyloxonium fluoroborate and first three given with ethyl iodide run at room temperature; remaining two reactions with ethyl iodide at reflux temperature.

^b Ratios approximate because of overlapping signals in the n.m.r. spectra (J. K. Becconsall, Richard A. Y. Jones, and J. McKenna, *J. Chem. Soc.*, 1965, 1726.)

postulate. It remains to be seen whether an interpretation will be possible on the basis of more elaborate theories⁴ of variation in transition-state geometries with structure currently under development.

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