Tetrahedron Letters No. 14, pp 1301 - 1304, 1972. Pergamon Press. Printed in Great Britain.

ASYMMETRICAL NONBRIDGEHEAD NITROGEN. III[I]

APPLICATION OF THE OCTANT RULE AND THE COMPLETE ABSOLUTE CONFIGURATION OF 1-CHLORO-2-METHYLSUBSTITUTED AZIRIDINES AND AZETIDINE

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(Received in UK 10 February 1972; accepted for publication 24 February 1972)

Substituted aziridines of the type  are separable into cis- and trans-isomers when they have a high nitrogen inversion barrier (X = Cl[2,3], Fig.1-a). When the inversion barrier is low (X = R, COR, Fig.1-b) only the trans-isomers were assumed to exist in this system since their ORD curves and those of trans-compounds with X=Cl, Br have a positive sign whereas the sign is the negative in 1R,2S-1-azabicyclo (3.1.0) hexane[4].

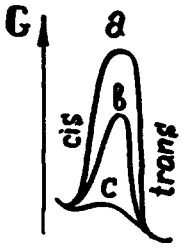


Fig.1

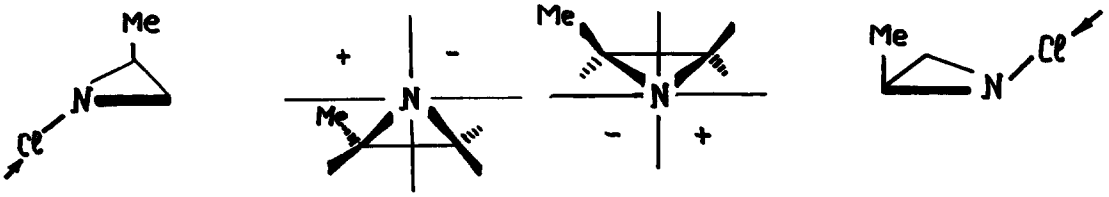
Since even the N-chlorosubstituted azetidines[5,6] have a low nitrogen inversion barrier the energy of a system of type  may be roughly described by the curve shown in Fig.1-c, from which the trans-configuration alone is to be expected at room temperature taking account of the small value of ΔS[7].

We have synthesized the optically active 2-methylazetidines (Table 1) and compared them with the corresponding aziridines (Table 2).

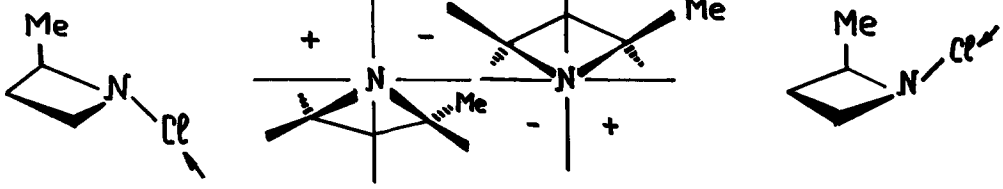
The 1S,2S-(trans) and 1R,2S-(cis)-configuration of the 1-chloro-2-methylaziridine is established because the starting 2-methylaziridine was prepared from S-alanine and the nitrogen configuration follows from NMR [3,6] and epimerization [2,3] studies.

A Cotton effect of negative sign in the 1S,2S-isomer and positive in the 1R,2S-isomer are found in the ORD[3a] and CD (Fig.2). Application of the octant rule (or the quadrant rule in the simplest cases) is possible since the

optically active band of the N-Cl chromophor corresponds to an n ⟶ 6* transition[8]. In such cases the octant rule is as follows:



The 2R-configuration of (+)-2-methylazetidine (Table 1) can be inferred from the fact that its ORD curves and those of R(+)-conidine[9] are similar[10] (Fig.4). A positive Cotton effect is observed for R(+)-1-chloro-2-methylazetidine (Fig.2,3, Table 2). In this case the octant rule predicts the 1R,2R-trans-configuration[11]:



In 1-chloro-2-methylpyrrolidine one may also expect the rule of octants to be at work and a configuration with close to trans-orientation of the Cl- and Me-groups to be realized[12].

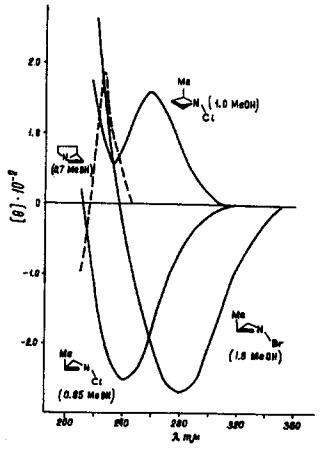


Fig.2

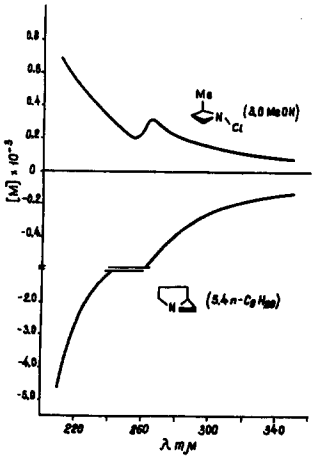


Fig.3

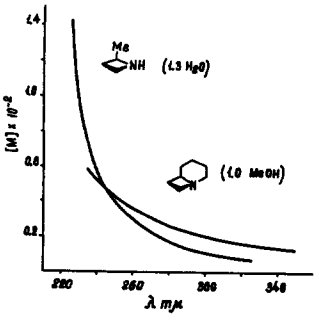


Fig.4

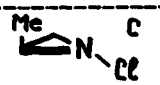
TABLE 1

Compounds[a]	Yield,%	B.p.°C	n_D^{20}	$[\alpha]_D^{20}$	$[M]_{300}$	Conc.	Solvent
	58.5[b]	74–76	1.4208	+3.05	+26.5	3.7	$n\text{-}C_9H_{20}$
					+11.9	1.3	H_2O
	28.5	32-3/48	1.4410	+21.5	+172	3.0	MeOH
	44.7[b]	140–2	1.4670	+3.14	+20.9	1.0	MeOH

a) 2-methylazetidine and conidine were prepared as described in [13] and [14] respectively and resolved by means of dibenzoyl-d(-)-tartaric acid; 1-chloro-2-methylazetidine was obtained according to [15]; the structure of the products was confirmed with the NMR[11] and mass-spectrometry [15], the mass spectra of conidine at 30 eV m/e (%): M(74), 110(20), 83(96), 82(40), 56(31), 55(100), 54(24.6), 42(71.4), 41(42.8), 28(28.6).

b) Per enantiomer.

TABLE 2

Compounds				
$[\theta]$	+160	+56	+187	-257	-269
$\lambda_{m\mu}$	257.5 max	232 min	225 max	242 min	280 min
Conc.(MeOH)		1.0	0.7	0.85	1.3

a) $[M]^{max}_{264}$ + 313; $[M]^{min}_{255}$ + 210 (3.0 MeOH)

b) No Cotton effect is observed in the ORD spectrum.

c) Cf. ref. [3] for the data on ORD.

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11. The dihedral angle of the puckered ring of 1-chloro-2-methylazetidine is 160°; the location of the Cl- and Me-groups being pseudo-equatorial. (A.A.Fomichov, R.G.Kostyanovsky, I.A.Zon, I.M.Gella, K.S.Zakharov, V.I.Markov, Dokl.Akad.Nauk SSSR, in press (1972)).

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