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Synthesis and Molecular Structure of 1,5-Dimethyl-3,7-di-*tert*-butyl-3,7-diazabicyclo[3.3.1]nonan-9-one

Konstantin A. Potekhin,[a] Olga I. Levina,[a] Yurii T. Struchkov,[b] Anna M. Svetlanova,[a] Roza S. Idrisova,[a] Vladimir A. Palyulin[a] and Nicolai S. Zefirov[a]

[a] *Department of Chemistry, Moscow State University, 119899 Moscow, USSR*
[b] *Institute of Organoelement Compounds, Academy of Sciences of the USSR, 117813 Moscow, USSR*

X-Ray analysis of 1,5-dimethyl-3,7-di-*tert*-butyl-3,7-diazabicyclo[3.3.1]nonan-9-one **5** has established that its molecules adopt a chair–boat conformation; compound **5** has been synthesized in one step using a Mannich condensation.

The conformational behaviour of bicyclo[3.3.1]nonanes and their hetero analogues has been extensively studied during the last two decades.[1] These studies are important from a theoretical point of view because they allow the influence of various kinds of intramolecular interactions on the conformational behaviour to be revealed. Furthermore the bicyclo[3.3.1]nonane moiety is incorporated in a great number of natural compounds. However, in many cases, the correct prediction of the conformational behaviour of substituted heterobicyclo[3.3.1]nonanes is still a challenge.

Bicyclo[3.3.1]nonane itself and most of its hetero analogues ordinarily adopt a chair–chair conformation in the absence of significant steric factors.[1] However, for the series of 3,7-dialkyl-3,7-diazabicyclo[3.3.1]nonan-9-ones **1**–**3**[2–5] (see Scheme 1) a preference for a chair–boat conformation was found (explained by repulsion between the lone electron pairs of the nitrogen

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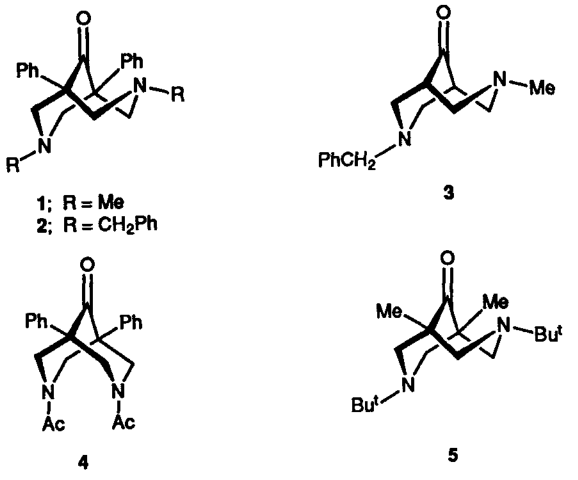

1; R = Me
2; R = CH_2Ph

3

4

5

Scheme 1

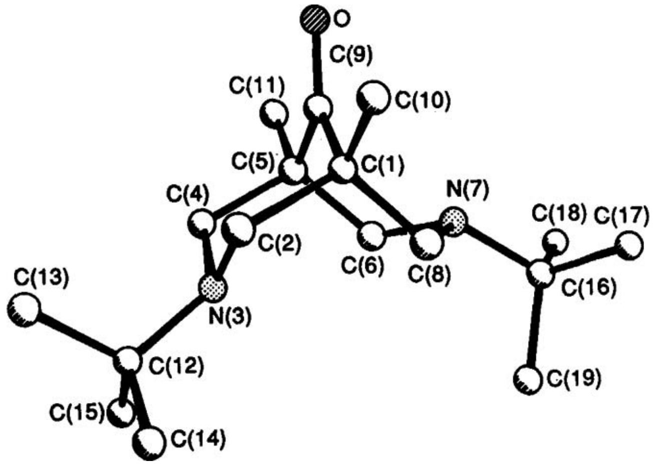

Fig. 1 PLUTO picture showing the molecular structure of **5**

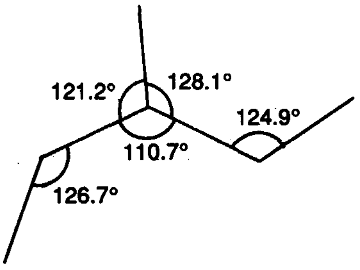

Fig. 2 Dihedral angles in compound **5**

atoms) while in the case of **4**, having acyl substituents in the 3,7-positions, a chair–chair conformation was predominant.[5,6] However, the role of the substituents at 1,5-positions and of bulky substituents at the 3,7-positions was not clear. In order to shed additional light on the factors responsible for the conformational behaviour of bicyclo[3.3.1]nonane systems we synthesized and studied 1,5-dimethyl-3,7-di-*tert*-butyl-3,7-diazabicyclo[3.3.1]nonan-9-one **5** *i.e.*, a derivative with small methyl substituents at the 1,5-positions and bulky 3,7-*tert*-butyl groups.

Compound **5** was obtained in one step by a Mannich condensation. Acetic acid (10.8 g) was added to a solution of diethylketone (7.6 g), paraformaldehyde (14 g) and *tert*-butylamine (13.14 g) in ethanol (100 ml). The mixture was refluxed for 18 h, treated with excess of aqueous NaOH solution, extracted with $CHCl_3$, washed with water and dried over $MgSO_4$. After removal of the chloroform and recrystallization from diethyl ether–hexane **5** [6.8 g (30%)] was obtained, m.p. 128–130 °C.†

The molecular structure of **5** is shown in Fig. 1. In crystalline state the molecules adopt a chair–boat conformation. The puckering parameters[7] are as follows: for the ring C(9)—C(1)—C(2)—N(3)—C(4)—C(5) (A) $S = 1.23$, $\theta = 0.9°$, $\psi_2 = 20.2°$; and for the ring C(9)—C(5)—C(6)—N(7)—C(8)—C(1) (B) $S = 0.98$, $\theta = 93.3°$, $\psi_2 = 0.3°$. Hence the conformation of ring A is nearly an ideal chair, while the ring B exists in a boat conformation with greater puckering of the C(6)—N(7)—C(8) apex as compared with the C(1)—C(9)—C(5) one. Fig. 2 shows the dihedral angles in the molecule. The data discussed show that the conformation of molecule **5** having methyl groups at the 1,5-positions and bulky *tert*-butyl groups at the 3,7-positions and the distortions of its rings are very similar to those in molecules **1** and **2** which have phenyl groups at the 1,5-positions and methyl or benzyl groups at the 3,7-positions.

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† *Crystal data* for **5**: $C_{17}H_{32}N_2O$, monoclinic, space group $P2_1/c$, $a = 9.8471(6)$, $b = 9.7065(9)$, $c = 18.579(3)$ Å; $\beta = 100.556(8)°$; $Z = 4$, Mo-Kα radiation, $\bar{\lambda} = 0.71073$ Å. Intensities of 2288 independent reflections were measured with an automated Hilger–Watts Y-290 diffractometer, 2137 of these with $I > 2.5\,\sigma(I)$ were used in the refinement. The structure was solved by direct methods. All H-atoms were located by a difference Fourier synthesis of the electron density. The structure was refined to $R = 0.049$ and $R_w = 0.055$ by full-matrix least-squares with anisotropic thermal parameters for the non-hydrogen atoms, while the positional and thermal parameters of the hydrogen atoms were fixed. Atomic coordinates, bond lengths and angles, and thermal parameters have been deposited at the Cambridge Crystallographic Data Centre. See Notice to Authors. Issue No. 1, *J. Chem. Soc., Chem. Commun.*