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STUDIES RELATING TO THE THERMAL RESPONSE OF AZABICYCLONONATRIENES[1,2]

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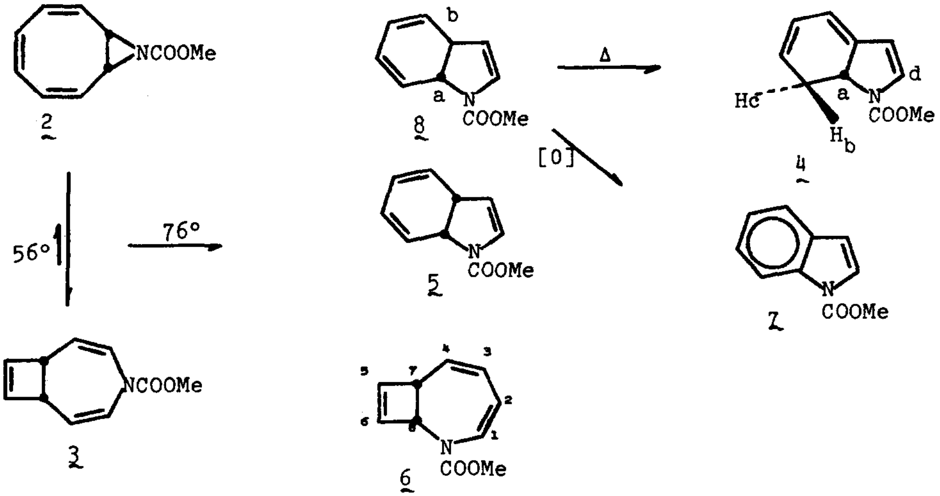
RECENTLY we described the preparation of parent 9-azabicyclo[6.1.0]nona-2,4,6-triene(1)[4] a potentially ideal progenitor to a host of N-substituted variants of the series. Presently we detail information relating to the thermolytic response of one such derivative, 2 [mp. 55.5-56.5°; ν_{CO} (KBr) 1725 cm.$^{-1}$, λ_{max} (95% EtOH) 240 nm (ε 3600); nmr (60 MHz; C_6D_6) τ 3.82-4.32 (6H, m), 6.53 (3H, s), 7.08 (2H, s)]. Thermolysis of 2 in benzene solution at 56° occurs with a half-life ($t_{\frac{1}{2}}$) of *ca*. 73 min., and supplies 3[5] [ν_{CO} (neat) 1710 cm.$^{-1}$, λ_{max} (C_6H_{14}) 228 nm (ε 15,500); nmr (60 MHz; C_6D_6) τ 3.03 (2H, d, J = 9.5 Hz), 4.00 (2H, s), 5.10 (2H, d, J = 9.5 Hz), 6.42 (2H, nm), 6.60 (3H, s)] in essentially quantitative yield[6]. When exposed to the same temperature, *pure* 3 rapidly generates a two-component equilibrium mixture of $>$95% 3 and $<$5% 2 (nmr) which on heating to 76° undergoes slow ($t_{\frac{1}{2}}\sim$ 17 hr.) but irreversible isomerization to yield, after *ca*. 40 hr., a thermolysate consisting of[7] 54% 4 [ν_{CO} (neat) 1720 cm.$^{-1}$, λ_{max} (95% EtOH) 226 nm (ε 11,000), 337 (5500); nmr (60 MHz; C_6D_6; 75°) τ 3.00 (1H, d, J= 4.0 Hz, H_d), 3.7-4.1 (1H, m), 4.2 4.6 (3H, m), 5.71 (1H, dd, J = 20.0, 8.5 Hz, H_a), 6.52 (3H, s), 6.7-7.3 (1H, m, J = 17.0, 8.5, 6.0 Hz, H_b), 7.95 (1H, dd, J = 20.0, 17.0 Hz, H_c)][8], 27% 5 [spectrally (nmr, uv, ir) analogous to the N-carbethoxyl counterpart][9], 11% 6 [ν_{CO} (neat) 1720 cm.$^{-1}$, λ_{max} (C_6H_{12}) 279 nm (ε 5700); nmr (100 MHz; C_6D_6) τ 3.43 (1H, d, J = 8.5 Hz, H_1), 3.86 (1H, dd, J = 2.7, 1.0, H_5 or H_6), 4.3-4.5 (4H, m), 4.8-5.0 (1H, m, J = 8.5, 5.5 Hz, H_2), 6.52 (1H, t, J = 5.5 Hz, H_7), 6.60 (3H, s)] and 8% 7 [ν_{CO} (neat) 1745 cm.$^{-1}$, λ_{max} (C_6H_{12}) 225 nm (ε 22,500), 253 (11,000), 260 (10,500); nmr (60 MHz; C_6D_6) τ 1.55 (1H, m), 2.5-2.9 (4H, m), 3.67 (1H, d, J = 4.0 Hz), 6.60 (3H, s)]. Moreover, compounds 5 and 6 were shown (uv monitor) *not* to rearrange to 4 on heating at 76° for as long as 60 hr.

By contrast, workup[7] of a thermolysate generated from only partial thermal consumption of 3, in benzene, at 76° (*ca.* 8 hr., <50% reaction) yielded[7] 8 [ν_{CO} (neat) 1715 cm.$^{-1}$; nmr (60 MHz; C_6D_6) τ 3.30 (1H, dd, J = 4.5, 3.0 Hz), 3.7-4.5 (4H, m), 5.06 (1H, dd, J = 4.5, 2.0 Hz), 6.08 (1H, d, J_{ab} = 23.5 Hz), 6.60 (3H, s), 6.80 (1H, d, J_{ab} = 23.5 Hz)] as the major (> 50%) product. Not unexpectedly, 8 was found to readily yield 7 (nmr) on exposure to air and 4 (nmr, uv) on heating at 76° ($t_{\frac{1}{2}}$ ~ 3.5 hr.)[10] The present results thus *effectively establish 8 as a major product in the thermolysis of 3 at 76°.*



From a mechanistic viewpoint, the information recorded herein is best interpretable when contrasted to the thermal response of the N-acetyl analog of 3.[1] Thus, bearing in mind that the acetamide is substantially more heat sensitive [$t_{\frac{1}{2}}$ (76°) ~ 80 min.] than 3 and that its thermolysis at 76° leads exclusively to the N-acetyl counterparts of 5 and 6 we find it tempting to ascribe the formation of 8 in the present instance chiefly to "leakage" from 2 triggered as an effective mechanistic competitor by the relatively sluggish ($t_{\frac{1}{2}}$ ~ 17 hr.) response of 3 at 76°. Adhering to this line of reasoning we might further suggest that isomers **5** and **6** are largely derived from **3**.

Finally, we stress that in light of the present information one might well question the accuracy of a recent claim by Masamune and Darby[11] to the effect that the carbethoxyl analog of **3** thermolyzes to a *cis*-fused 8,9-dihydroindole. In fact, preliminary work within our laboratories appears to confirm our suspicions in this connection insofar as the urethane counterpart of **4** is readily detectable (nmr) as a major component of a mixture generated on heating the carbethoxyl analog of **3** at 76°.

We are actively pursuing work with this intriguing family of bicyclics.

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REFERENCES AND REMARKS

(1) Preceeding paper in the series: A. G. Anastassiou and R. L. Elliott, *Chem. Commun.*, in press[2]

(2) Presented at the "Fourth Northeast Regional Meeting" Hartford, Conn., October 17, 1972

(3) NDEA Graduate Fellow 1971-74

(4) A. G. Anastassiou, S. W. Eachus, R. L. Elliott and E. Yakali, *Chem. Commun.*, 531 (1972)

(5) An analogous thermal conversion was reported earlier for the carbethoxyl counterparts: S. Masamune and N. T. Castellucci, *Angew. Chem.*, **76**, 569 (1964)

(6) While **3** is by far the major thermolysis product of **2**, purification of the thermolysate by column chromatography at *ca.* -15, invariably leads to the isolation of minor quantities (*ca.* 10%) of N-carbomethoxy-*trans*-8,9-dihydroindole (**8**) (see text for characterization)

(7) The mixture was separated into its individual components by chromatography on alumina at *ca.* -15°. The percentages given were calculated from the weights of the various fractions and are thus necessarily approximate.

(8) Two particularly revealing spectral features of **4** are (i) the magnitude of J_{ac} (20 Hz) and (ii) the presence of a relatively low energy uv band (337 nm) both of which are accomodated by the Dreiding model of **4** which requires that H_a and H_c possess a *trans* coplanar disposition and that the "π" frame of the molecule be essentially flat.

(9) A. G. Anastassiou and J. H. Gebrian, *Tetrahedron Letters*, 5239 (1969)

(10) For similar transformations among hydrocarbons see: S. W. Staley and T. J. Henry, *J. Amer. Chem. Soc.*, **91**, 1239, 7737 (1969); A. G. Anastassiou and R. C. Griffith, *Chem. Commun.*, 399 (1972)

(11) S. Masamune and N. Darby, *Accts. Chem. Res*; **5** 272 (1972)