Tetrahedron. Vol. 26, pp. 5789 to 5791 Pergamon Press 1970. Printed in Great Britain

NEW HETEROCYCLIC SYSTEMS—II

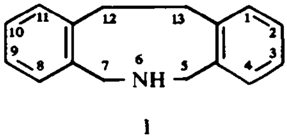
5,7,12,13-TETRAHYDRO-6*H*-DIBENZ[*c*,*g*]AZONINE

G. Pala, E. Crescenzi and G. Bietti
Research Laboratories of Istituto De Angeli, 20139 Milan, Italy

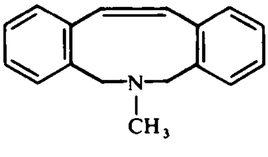
(*Received in the UK* 22 *June* 1970; *Accepted for publication* 29 *July* 1970)

Abstract—5,7,12,13-Tetrahydro-6*H*-dibenz[*c*,*g*]azonine (I), a novel tricyclic system, was synthesized by three different routes. Besides the threefold mode of formation, the structure of I was determined on the basis of analytical and spectral evidence.

Recently we have reported on the synthesis of 5,6-dihydro-7*H*,12*H*-dibenz[*c*,*f*]azocine.[1] We describe here the preparation of the homologous 5,7,12,13-tetrahydro-6*H*-dibenz[*c*,*g*]azonine (I), a tricyclic system which had not been previously reported except for 5,7-dihydro-6-methyldibenz[*c*,*g*]azonine (II), obtained in 1951 by Wittig *et al.*[2]



I



II

I was synthesized by three different routes, which were very similar to those used for the preparation of the previous 5,6-dihydro-7*H*,12*H*-dibenz[*c*,*f*]azocine.[1] The closure of 2,2′-bis-aminomethyldiphenylethane III afforded I in scarcely 35% yield. Decyanation of 5,7,12,13-tetrahydro-6-cyanodibenz[*c*,*g*]azonine VII by dil H_2SO_4 gave I in about 50% yield. Compound I was successfully obtained in nearly quantitative yield by catalytic debenzylation of 5,7,12,13-tetrahydro-6-benzyldibenz[*c*,*g*]azonine VIII hydrochloride.

PMR showed that I, contrary to the homologous 5,6-dihydro-7*H*,12*H*-dibenz[*c*,*f*] azocine,[1] is a freely rotating ring system at room temperature (Experimental).

EXPERIMENTAL

M.ps were taken on a Büchi capillary m.p. apparatus and are corrected. The UV spectrum of I was determined in abs EtOH using a Beckman DB spectrophotometer. IR spectra were recorded as nujol mulls using a Perkin–Elmer 337 grating spectrometer. PMR spectra were run in $CDCl_3$ soln (unless otherwise stated) on a Varian A-60 A spectrometer, operating at 60·00 Mc/s in a radio-frequency range of 0·03–0·04 milligaus; the reference zero was internal TMS and the chemical shifts were expressed in ppm down-field from this point (δ-scale). Microanalyses were carried out by Dr. G. Sekules.

2,2′-*Bis-aminomethyldiphenylethane* (III)

(a) *From 2,2′-bis-cyanodiphenylethane* (IV). A soln of 10·7 g (0·046 mole) of IV[3] in abs EtOH (300 ml) was saturated with NH_3 and hydrogenated over Raney Ni at 120° and 120 atm initial H press. The catalyst was then filtered off and the soln was evaporated to dryness to give 10·9 g (98 %) crude III, m.p. 58–63°. Recrystallization from light petroleum (b.p. 40–70°) furnished an analytical sample as colourless crystals, m.p. 65–67°. (Found: C, 80·01; H, 8·45; N, 11·60. $C_{16}H_{20}N_2$ requires: C, 79·95; H, 8·39; N, 11·66 %); IR: 3364, 3264 and 3171 cm^{-1} (NH_2), 753 and 739 cm^{-1} (*ortho* substituted benzenes); PMR (2·5:1 mixture of DMSO-d_6 and $CDCl_3$): 2·02 δ (NH_2, s, 4 H), 2·92 δ ($CH_2—CH_2$, s, 4 H), 3·82 δ ($CH_2—N$, s, 4 H), 7·1–7·6 δ (aromatics, complex, 8 H).

By adding excess conc HCl to a soln of the free base III (3·5 g, 0·0145 mole) in boiling EtOH (80 ml), 4·4 g (97 %) of the *dihydrochloride* separated on standing as colourless shining flakes, m.p. 360–361°. (Found: C, 61·50; H, 7·11; N, 8·87; Cl, 22·60. $C_{16}H_{22}N_2Cl_2$ requires: C, 61·34; H, 7·08; N, 8·94; Cl, 22·64 %).

(b) *From 2,2'-bis-bromomethyldiphenylethane* (V). 36·8 g (0·1 mole) of V[4] and 41 g (0·22 mole) K phthalimide were warmed 3 hr at 160° in DMF (100 ml). The mixture was then poured into H_2O (1·5 l) and extracted with $CHCl_3$. Evaporation of the solvent gave 26·4 g (53 %) of the *diphthalimido derivative* VI, m.p. 200–205°. (Found: C, 76·30; H, 4·98; N, 5·41. $C_{32}H_{24}N_2O_4$ requires: C, 76·78; H, 4·83; N, 5·60 %).

Compound IV (11·5 g; 0·023 mole) and 85 % N_2H_4. H_2O (4·1 g; 0·07 mole) were refluxed 5 hr in 95 % EtOH (200 ml). The reaction mixture was cooled to room temp, made acid with conc HCl and then filtered. The solid was suspended in H_2O, made alkaline with 10 % NaOH aq and extracted with $CHCl_3$. After evaporation of the solvent, the residue was taken up in abs EtOH (100 ml) filtering off the undissolved material. Evaporation of EtOH gave 3·7 g (67 %) of III, m.p. and m.m.p. 64–66°.

5,7,12,13-*Tetrahydro-6-cyanodibenz*[c,g]*azonine* (VII)

Compound V[4] (25 g; 0·068 mole) and practical $CaCN_2$ (50 g) was refluxed 12 hr with stirring in 70 % EtOH (125 ml). The mixture was then filtered and the soln was evaporated to dryness. The residue was taken up in C_6H_6 and the soln was evaporated to give a residue which was in turn taken up in ether. Removal of ether furnished a pasty residue which was triturated with i-PrOH. Crystallization from the same solvent afforded 2·45 g (14·5 %) of VII as colourless crystals, m.p. 128–129°. (Found: C, 82·15; H, 6·56; N, 11·21; mol. wt. 247 by cryoscopy. $C_{17}H_{16}N_2$ requires: C, 82·22; H, 6·50; N, 11·28 %; mol. wt. 248); IR: 2208 cm^{-1} (CN), 763 cm^{-1} (*ortho* substituted benzenes); PMR: 2·93 δ ($CH_2—CH_2$, s, 4 H), 3·83 δ ($CH_2—N$, s, 4 H), 7·1–7·7 δ (aromatics, complex, 8 H).

5,7,12,13-*Tetrahydro-6-benzyldibenz*[c,g]*azonine* (VIII)

A soln of benzylamine (9·35 g; 0·087 mole) in MeCN (20 ml) was added dropwise with stirring into a soln of V[4] (10 g; 0·027 mole) in boiling MeCN (250 ml). After refluxing 2 hr, the solvent was distilled off and the residue was poured into H_2O. The white solid which separated was recrystallized from abs EtOH (50 ml) to give 6·55 g (77 %) of VIII as colourless crystals, m.p. 109·5–110°. (Found: C, 88·20; H, 7·35; N, 4·48; mol. wt. 311 by cryoscopy. $C_{23}H_{23}N$ requires: C, 88·13; H, 7·40; N, 4·47 %; mol. wt. 313); IR: 765 cm^{-1} (*ortho* substituted benzenes), 740 and 702 cm^{-1} (mono-substituted benzene); PMR: 2·91 δ ($CH_2—CH_2$, s, 4 H), 3·33 δ ($CH_2—N$, s, 4 H), 3·75 δ ($CH_2—N$, s, 2 H), 6·9–7·6 δ (aromatics, complex, 13 H).

By bubbling HCl into a soln of the free base VIII (4 g; 0·0128 mole) in ether (100 ml), 4·5 g (98 %) of the *hydrochloride* separated as a white solid. Recrystallization from abs EtOH afforded an analytical sample as colourless crystals, m.p. 246–247°. (Found: C, 79·12; H, 7·01; N, 3·98; Cl, 10·00. $C_{23}H_{24}NCl$ requires: C, 78·95; H, 6·91; N, 4·00; Cl, 10·13 %).

5,7,12,13-*Tetrahydro*-6H-*dibenz*[c,g]*azonine* (I)

(a) *By closure of the diamine* III. Compound III (2 g; 0·0083 mole) and its dihydrochloride (2·6 g; 0·0083 mole) was warmed 8 hr at 300° in a sealed tube in H_2O (100 ml). The mixture was taken up in dil HCl and the soln, after filtering, was made alkaline with 10 % NaOH aq. The ppt which formed was filtered off and crystallized from abs EtOH to give 1·3 g (35 %) of I as colourless and tasteless needles, m.p. 152·5°. (Found: C, 86·04; H, 7·71; N, 6·20; mol. wt. 223 by cryoscopy. $C_{16}H_{17}N$ requires: C, 86·05; H, 7·67; N, 6·27 %; mol. wt. 223). It sublimes at 140° at 750 mm and at 100° at 0·05 mm; insoluble in H_2O, freely sol in acids and in the common organic solvents; quite stable in air, in sunlight and on heating; UV (ε): 223 mμ (2,434), 263 mμ (491); IR: 3271 cm^{-1} (NH), 757 cm^{-1} (*ortho* substituted benzenes); PMR: 1·98 δ (NH, s, 1 H), 2·92 δ ($CH_2—CH_2$, s, 4 H), 3·42 δ ($CH_2—N$, s, 4 H), 7·1–7·6 δ (aromatics, complex, 8 H).

The *hydrochloride* was prepared by adding ethanolic HCl to a soln of the free base in boiling abs EtOH, m.p. 268–268·5°. (Found: C, 74·13; H, 6·94; N, 5·40; Cl, 13·51. $C_{16}H_{18}NCl$ requires: C, 73·97; H, 6·98; N, 5·39; Cl, 13·65 %).

The *picrate* was prepared by adding a saturated ethanolic soln of picric acid to a soln of the free base in boiling abs EtOH, m.p. 185–186°. (Found: C, 58·35; H, 4·40; N, 12·57. $C_{22}H_{20}N_4O_7$ requires: C, 58·40; H, 4·46; N, 12·39%).

The *tosyl derivative* was prepared by refluxing 30 min a soln of I and *p*-toluenesulphonyl chloride in dry pyridine. Recrystallized from abs EtOH, it melted at 260–261°. (Found: C, 72·90; H, 5·98; N, 3·65; S, 8·41. $C_{23}H_{23}NO_2S$ requires: C, 73·17; H, 6·14; N, 3·71; S, 8·49%).

(b) *By decyanation of* VII. A mixture of VII (2 g, 0·008 mole), conc H_2SO_4 (21 ml) and H_2O (90 ml) was refluxed 6 hr. The reaction mixture was then poured into H_2O (500 ml) and filtered, and the aq soln was made alkaline with 10% NaOH aq and extracted with ether. After evaporation of the solvent, the residue was crystallized from abs EtOH to give 0·9 g (50%) of I, m.p. and m.m.p. 152·5°.

(c) *By catalytic debenzylation of* VIII. A soln of 11 g (0·0315 mole) of VIII hydrochloride in abs EtOH (700 ml) was hydrogenated over 1 g of 5% Pd/C at about 25° and 3 atm press. The catalyst was then filtered off, and the soln was diluted with H_2O (1·4 l) and made alkaline with 10% NaOH aq; I separated as a white solid and weighed 6·9 g (98%), m.p. and m.m.p. 152°.

REFERENCES

[1] G. Pala, A. Mantegani and E. Zugna, *Tetrahedron* **26**, 1275 (1970)
[2] G. Wittig, H. Tenhaeff, W. Schoch and G. Koenig, *Liebigs Ann.* **572**, 1 (1951)
[3] R. C. Fuson, *J. Am. Chem. Soc.* **48**, 830 (1926)
[4] E. D. Bergmann and Z. Pelchowicz, *Ibid.* **75**, 4281 (1953)