peri-Naphthylenediamines
37.* Synthesis of *N,N´*-diisopropyl-*N,N´*-dimethyl-1,8-diaminonaphthalene

V. A. Ozeryanskii and A. F. Pozharskii*

Rostov State University,
7 ul. Zorge, 344090 Rostov-on-Don, Russian Federation.
Fax: +7 (863 2) 22 3958. E-mail: vv_ozer2@chimfak.rsu.ru

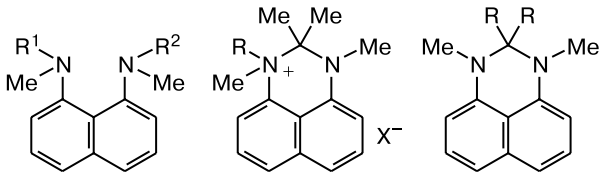
Alkylation of *N,N´*-dimethyl-1,8-diaminonaphthalene with 2-iodopropane in a KOH—DMSO system afforded a new "proton sponge," *viz.*, *N,N´*-diisopropyl-*N,N´*-dimethyl-1,8-diaminonaphthalene; the rotation barrier of the Pr^i groups about the N—C bond is 68.4±0.4 kJ mol^{-1} (DMSO).

Key words: 1,8-diaminonaphthalenes, 2,3-dihydroperimidines, *N*-alkylation, "proton sponges".

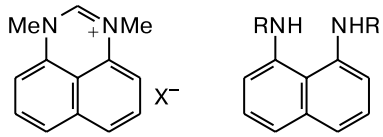
It is known that *peri* interactions of the substituents in 1,8-bis(dialkylamino)naphthalenes ("proton sponges") not only lead to abnormally high basicity of these compounds but are also accompanied by interesting conformational effects (rotation of the functional groups, inversion of the bonds at the nitrogen atoms, *etc.*) (see the review[2]). Thus, the nonequivalence of the methyl groups of the NMe_2 fragments is manifested in the NMR spectra of solutions of 1,8-bis(dimethylamino)naphthalene (**1**) only at −120 °C, whereas this effect in the NMR spectra of its monobenzyl (**2**) and monoisopropyl (**3**) analogs is observed already at −38 °C [3] and +40 °C, respectively.[4] Chiral *N,N´*-dibenzyl derivative **4** can occur both in the *dl* and *meso* forms whose interconversions were found by English chemists.[5]

In the present study, we synthesized chiral diamine **5**, which is the first "proton sponge" containing secondary alkyl groups at different N atoms.

Earlier,[4] we have prepared monoisopropyl derivative **3** in high yield by reduction of 2,3-dihydroperimidinium salt **6**. However, we failed to introduce the second isopropyl group according to this procedure because salt **7** required for this purpose was not generated upon heating of base **8** with 2-halopropanes in a wide range of reaction conditions. 1,3-Dimethyl-2,3-dihydroperimidine (**9**) also did not react with an excess of 2-bromopropane at 60 °C. At 100 °C, compound **9** was slowly dehydrogenated to form salt **10** (X = Br) (68% after 150 h). The reaction of 2-iodopropane with compound **9** proceeded more readily to give iodide **10** in 90% yield at 90 °C after 24 h (93% at 35 °C after 70 days). The $Pr^iOH—BF_3 \cdot Et_2O$ system also generated the perimidinium cation (20 °C, 5 days, 35%). Therefore, secondary alkylating agents act as acceptors of the hydride ions and induce aromatization of the 2,3-dihydroperimidine ring.



1—5 **6:** R = Me; **7:** R = Pr^i **8:** R = Me; **9:** R = H



10 **11:** R = H; **12:** R = Me

	1	2	3	4	5
R^1	Me	Me	Me	CH_2Ph	Pr^i
R^2	Me	CH_2Ph	Pr^i	CH_2Ph	Pr^i

1,8-Diaminonaphthalenes **11** and **12** were not alkylated with 2-haloalkanes as well. Upon heating with Pr^iI, these compounds gave hydroiodides in quantitative yields. Nevertheless, target compound **5** was prepared in 22% yield by alkylation of dimethyl derivative **12** in the $Pr^iI—KOH—DMSO$ system.

"Proton sponge" **5**, like its dibenzyl analog **4**, contains two stereogenic centers and, as was demonstrated by preliminary studies, can undergo dynamic transformations. In particular, the ^1H NMR spectrum of compound **5** in DMSO-d_6 (or $CDCl_3$) at 20 °C has two doublets, which are located at a distance of ~0.8 ppm from each other and belong to the methyl groups of the isopropyl substituents.

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Upon heating of a solution in DMSO-d_6, the doublets lost their shape (40 °C), coalesced (70 °C), and degenerated into one doublet (120 °C) whose shape remained unchanged on further heating (to 160 °C). These data correspond to the rotation barrier of the isopropyl group about the N—C bond $\Delta G^{\#} = 68.4 \pm 0.4$ kJ mol^{-1}. At the same time, the shape and position of the signal for the protons of the N—Me groups in the above-mentioned temperature range remain virtually unchanged (only slight broadening of the peak is observed at 150—160 °C), which is, apparently, indicates that the substituents at the nitrogen atoms do not undergo inversion. Presumably, we deal only with one of stereoisomers of compound **5** in which the $CHMe_2$ groups are in *trans* positions with respect to the plane of the naphthalene system. The constant pK_a^1 for diamine **5**, which was measured by trans-protonation, is 7.9 and pK_a^1 for compound **1** is 7.5 (DMSO, 22 °C).

Presently, we are carrying out a more detailed study of the nature and energy of the conformational transitions and are investigating the structure of compound **5** in the solid state.

Experimental

The NMR spectra were recorded on Bruker DPX-250 (250 MHz, ^{1}H) and Unity-300 (75 MHz, ^{13}C) instruments with $SiMe_4$ as the internal standard. The melting points were measured in sealed glass tubes on a PTP instrument and were not corrected.

1,3-Dimethylperimidinium iodide (10, X = I). A solution of dihydroperimidine **9** [4] (0.1 g, 0.5 mmol) in 2-iodopropane (5 mL) was refluxed for 24 h. The solvent was removed, the residue was washed with ether, and twice recrystallized from EtOH. Salt **10** was obtained as greenish-yellow needle-like crystals in a yield of 0.146 g (90%), m.p. 272—273 °C (*cf.* lit. data[6]: 275 °C). ^{1}H NMR (CD_3CN), δ: 3.56 (s, 6 H, NMe); 6.94 (d, 2 H, H(4), H(9)); 7.51 (t, 2 H, H(5), H(8)); 7.62 (dd, 2 H, H(6), H(7)); $J_{4,5}$ = 7.6 Hz, $J_{5,6}$ = 8.5 Hz, $J_{4,6}$ = 0.7 Hz.

***N,N′*-Diisopropyl-*N,N′*-dimethyl-1,8-diaminonaphthalene (5).** Finely dispersed KOH (1.01 g, 18 mmol) was added to a solution of diamine **12** [4] (0.56 g, 3 mmol) in DMSO (15 mL) under argon. The reaction mixture was stirred for 10 min and Pr^iI (3 mL, 30 mmol) was added. The reaction mixture was stirred at 100 °C for 3 h and cooled. Then a 20% aqueous solution of KOH (5 mL) was added. The mixture was extracted with *n*-hexane (2×15 mL), diluted with water (50 mL), and additionally extracted with benzene (3×15 mL). The extracts were combined and the solvents were removed. The residue was evacuated and eluted with benzene through a layer of Al_2O_3 (Brockmann activity III). Brownish crystals were obtained in a yield of 0.178 g (22%), m.p. 67—68 °C (from MeOH). Found (%): C, 80.04; H, 10.13. $C_{18}H_{26}N_2$. Calculated (%): C, 79.95; H, 9.69. ^{1}H NMR, δ: (1) $CDCl_3$, 20 °C: 0.48 and 1.26 (both d, 6 H each, $CH\underline{Me}_2$); 2.74 (s, 6 H, NMe); 3.44 (m, 2 H, $C\underline{H}Me_2$); 6.96 (br.d, 2 H, H(2), H(7)); 7.23—7.37 (m, 4 H, H(3), H(4), H(5), H(6)); $J_{CH,Me}$ = 6.4 Hz, $J_{2,3}$ = 7.2 Hz; (2) DMSO-d_6, 20 °C: 0.42 and 1.24 (both d, 6 H each, $CH\underline{Me}_2$); 2.69 (s, 6 H, NMe); 3.34 (m, 2 H, $C\underline{H}Me_2$); 6.96 (br.d, 2 H, H(2), H(7)); 7.26 (t, 2 H, H(3), H(6)); 7.35 (d, 2 H, H(4), H(5)); $J_{CH,Me}$ = 6.5 Hz, $J_{2,3}$ = 7.2 Hz, $J_{3,4}$ = 7.9 Hz; (3) DMSO-d_6, 120 °C: 0.95 (d, 12 H, $CH\underline{Me}_2$); 2.75 (s, 6 H, NMe); 3.50 (m, 2 H, $C\underline{H}Me_2$); 7.02 (br.d, 2 H, H(2), H(7)); 7.27 (t, 2 H, H(3), H(6)); 7.36 (br.d, 2 H, H(4), H(5)); $J_{CH,Me}$ = 6.0 Hz, $J_{2,3}$ = 7.2 Hz, $J_{3,4}$ = 7.7 Hz; (4) DMSO-d_6, 20 °C, with an addition of 1 equiv. of $HClO_4$: 0.99 and 1.33 (both d, 6 H each, $CH\underline{Me}_2$); 3.18 (d, 6 H, NMe); 3.63 (m, 2 H, $C\underline{H}Me_2$); 7.75 (t, 2 H, H(3), H(6)); 7.98 (br.d, 2 H, H(2), H(7)); 8.13 (br.d, 2 H, H(4), H(5)); 17.25 (br.s, 1 H, NH); $J_{CH,Me}$ = 6.5 Hz, $J_{NH,NMe}$ = 2.5 Hz, $J_{2,3}$ = 7.8 Hz, $J_{3,4}$ = 8.2 Hz. ^{13}C NMR, δ: ($CDCl_3$, 20 °C) 14.9 (124.8, C—$\underline{C}H_3$); 20.2 (124.9, C—$\underline{C}H_3$); 30.8 (134.7, N—$\underline{C}H_3$); 54.8 (138.4, $\underline{C}$—CH_3); 115.1 (156.2, C(2)); 118.5 (C(8a)); 122.1 (160.2, C(4)); 124.9 (158.0, C(3)); 137.8 (C(4a)); 150.4 (C(1)).

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