Fused-*s*-Triazino Heterocycles. XII. 13*H*-4,6,7,8,13a, 13c-Hexaazabenzo-[*de*]naphthacene, A New Ring System

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The synthesis of the titled compound is described using 5-(2-carboxyanilino)-2-methyl-1,3-4,6,9b-pentaazaphenalene as starting material.

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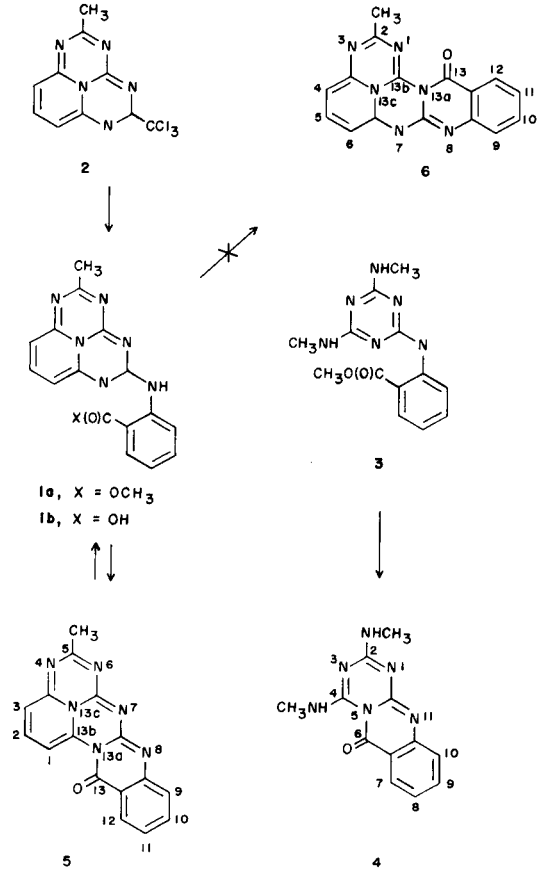
We recently had occasion to prepare 5-(2-methoxycarbonyl)anilino-2-methyl-1,3,4,6,9b-pentaazaphenalene (**1a**) for a screening program. The synthesis involved reacting a *N,N*-dimethylformamide (DMF) solution of 2-trichloromethyl-5-methyl-1,3,4,6,9b-pentaazaphenalene (**2**) with methyl anthranilate for 43 hours at ~75° in the presence of 4-dimethylaminopyridine (DMAP), the latter serving to catalyze the nucleophilic reaction. This utilization of the trichloromethyl function as a leaving group in nucleophilic displacement reactions of 1,3,4,6,9b-pentaazaphenalene derivatives has been subject of two recent papers [2a,b]. The structure of **1a**, in part, resembled 2,4-bis(methylamino)-6-(2-methoxycarbonyl) anilino-*s*-triazine (**3**), a compound we had previously been able to cyclize to 2,4-bis-(methylamino)-*s*-triazino[2,1-*b*]quinazolin-6(6*H*)-one (**4**) using sodium hydride as base catalyst [3]. Attempts to carry out a similar reaction with **1a** using sodium hydride as catalyst were unsuccessful.

Figure 1



Hoping that ring closure of 5-(2-carboxyanilino)-2-methyl-1,3-4,6,9b-pentaazaphenalene (**1b**) with phosphorus oxychloride or acetic anhydride would be more promising, we converted **2** to **1b** in 77% yield by reacting **2** for 22 hours at ~65° with anthranilic acid in the presence of DMAP and triethylamine (DMF as solvent). The reaction of **1b** with phosphorus oxychloride gave intractible products. However, refluxing **1b** with acetic anhydride for 20 hours gave 5-methyl-13*H*-4,6,7,8,13a,13c-hexaazabenzo[*de*]-naphthacen-13-one (**5**), a member of a new ring system, in 76% yield. Thin layer chromatography of the reaction mixture showed the presence of only one new product.

Although an alternative ring closure of **1b** could yield 2-methyl-13*H*-1,3,7,8,13a,13c-hexaazabenzo[*de*]naphthacen-13-one (**6**) pmr data supports **5** as the correct structure. A survey [4a-d] of the many derivatives of the 1,3,4,6,9b-pentaazaphenalene ring system shows H_7 and H_9 (unlike H_8) with δ values consistently in the range of 6.15 ± 0.15. Upon ring closure the value of H_7 or H_9 in **1b** shifted from δ 6.07 or 6.18 to δ 7.19 or 7.40 (positions 1 or 3 in **5**). This rather large downfield shift (especially when the protons of the anthranilate moiety before and after ring closure are substantively unchanged) suggests the closer proximity of the electron withdrawing carbonyl group to H_1 and H_3 as in **5** rather than more distant attachment as in **6**. Satisfactory elemental analysis for **5** was

obtained (**6** has the same theoretical values). The ir spectra for **5** or **6** would be expected to be rather similar; the ir spectrum obtained for the new ring system did show a tertiary amide type carbonyl band at 5.90 and no absorption bands in the NH-OH region.

The newly formed amide bond in **5** was easily broken. Thus addition of a small amount of 12% sodium methoxide to **5** in methanol at room temperature gave within ~one half hour at 96% yield of **1a**.

EXPERIMENTAL

Melting points were determined in open capillaries on a Thomas-Hoover melting point bath and are uncorrected. Infrared spectra were recorded using a Perkin-Elmer 735B spectrometer. The pmr spectra were determined on a Varian XL-200 spectrometer using TMS as an internal reference. Some of the pmr assignments were made using spin decoupling techniques. Analyses were performed by Micro-Analyses Inc., Wilmington, Delaware. All evaporations were carried out on a rotary evaporator at reduced pressure.

N,N-dimethylformamide (DMF) was dried using standard methods and stored over molecular sieves. Woelm silica gel (70-230 mesh) for column chromatography was obtained from ICN Pharmaceutical Inc. Methyl anthranilic acid, and 4-dimethylaminopyridine (DMAP) were obtained from Aldrich Chemical Company.

5-(2-Methoxycarbonyl)anilino-2-methyl-1,3,4,6,9b-pentaazaphenlene (**1a**).

A. From **2** and Methyl anthranilate.

A stirred solution of 6.35 g (0.02 mole) of **2** [2a], 31.7 g (0.21 mole) of methyl anthranilate, 2.56 g (0.02 mole) of DMAP and 21 ml of dry DMF was heated at ~75° for 43 hours and then evaporated to a thin syrup. Column chromatography (silica gel, 60 g using chloroform-methanol (90/10) as eluent) of the solid resulting from addition of 50 ml of methanol to the evaporation residue gave 2.81 g (40%) of crude **1a**, mp 229-231°. Recrystallization from toluene gave orange crystals, mp 236-238°; ir λ (Nujol): μ 2.92 (NH), 5.88 (C=O); pmr (deuteriochloroform): δ 2.03 (s, 3H, CH_3), 3.79 (s, 3H, OCH_3), 6.06 [d (J = 8 Hz), 1H, H_7 or H_9], 6.15 [d, (J = 8 Hz), 1H, H_7 or H_9], 7.42-7.65 (m, 3H, H_8 and benzene H_3, H_4), 7.80 [d (J = 8 Hz), 1H, benzene H_2], 8.45 [d (J = 8 Hz), 1H, benzene H_5].

Anal. Cacld. for $C_{17}H_{14}N_6O_2$: C, 61.07; H, 4.22; N, 25.14. Found: C, 60.92; H, 4.51; N, 24.93.

B. From **5** and Sodium Methoxide.

A stirred slurry of 1 g (0.0033 mole) of **5** in 100 ml of dry methanol was treated dropwise at 25° with 12% sodium methoxide until a *p*H (Hydrion paper) of 9 was given (14 drops). The reaction mixture was stirred for an additional half hour, filtered, washed with a small amount of methanol and oven dried (100°), 1.06 g, (96%) mp 229-232°. Recrystallization from toluene gave orange crystals, mp 236-238°, identical in all respects (ir, pmr, tlc) to the material prepared in A.

5-(2-Carboxyanilino)-2-methyl-1,3,4,6,9b-pentaazaphenalene (**1b**).

A thin slurry of 12.1 g (0.04 mole) of **2**, 27.4 g (0.20 mole) of anthranilic acid, 9.6 g (0.08 mole) of 4-dimethylaminopyridine, 12.1 g (0.12 mole) of triethylamine and 90 ml of dry DMF was heated with stirring at ~65° for 22 hours. The cooled reaction mixture was filtered, washed with ether till the washings were almost colorless, dried and then stirred with 175 ml 1*N* hydrochloric acid for one half hour. The insoluble material was filtered, washed with a small amount of water and oven dried (100°), 9.9 g (77%), mp 295-297° dec. Recrystallization from DMF gave light brick-red crystals, mp 309-310° dec; ir λ (Nujol): μ 3.10-4.25 broad (OH), 5.95 (C=O); pmr (DMSO-d_6): δ 1.97 (s, 3H, CH_3), 6.07 [d (J = 8 Hz), 1H, H_7 or H_9], 6.18 [d (J = 8 Hz), 1H, H_7 or H_9], 7.54-7.79 (m, 3H, H_8 and benzene H_3, H_4), 7.97 [d (J = 8 Hz), 1H, benzene H_2], 8.55 [d, (J = 8 Hz), 1H, benzene H_5], 11.5 (s, 1H, CO_2H).

Anal. Cacld. for $C_{16}H_{12}N_6O_2$: C, 59.99; H, 3.78; N, 26.24. Found: C, 59.90; H, 4.03; N, 26.12.

5-Methyl-13*H*-4,6,7,8,13a,13c-hexaazabenzo[*de*]naphthacen-13-one (**5**).

A stirred mixture of 0.5 g (0.0016 mole) of **1b** and 5 ml of acetic anhydride was refluxed for 20 hours. The cooled reaction mixture was filtered, washed well with ether and oven dried (100°), 0.37 g (76%) mp 310-315° dec. Recrystallization from *o*-dichlorobenzene gave yellow fluffy crystals mp 315-316° dec; ir λ (Nujol): μ 5.90 (C=O); pmr (DMSO-d_6): λ 2.05 (s, 3H, CH_3), 7.19 [d (J = 8 Hz), 1H, H_1 or H_3] 7.30 [d, (J = 8 Hz), 1H, H_1 or H_3] 7.40 [d (J = 8 Hz), 1H, H_9], 7.55-7.83 (m, 4H, H_2, H_9, H_{10} and H_{11}), 8.39 [d (J = 8 Hz), 1H, H_{12}].

Anal. Calcd. for $C_{16}H_{10}N_6O$: C, 63.57; H, 3.33; N, 27.80. Found: C, 63.78; H, 3.24; N, 27.64.

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