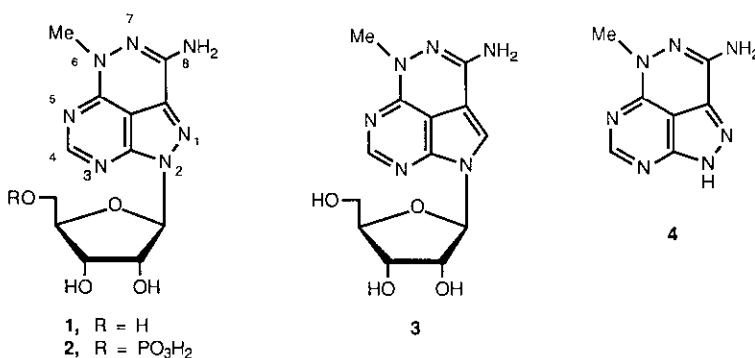# THE SYNTHESIS OF 8-AMINO-6-N-METHYL-1,2,3,5,6,7-HEXAAZAACENAPHTHYLENE

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Abstract- The protected tricyclic heterocycle 8-amino-6-N-methyl-2-(tetrahydropyran-2-yl)-1,2,3,5,6,7-hexaazaacenaphthylene (11) was prepared from 3-cyano-4,6-bis-methylthiopyrazolo-[3,4-d]pyrimidine (5) in a six-step reaction sequence. Treatment of 11 with hydrogen chloride gas under anhydrous conditions has afforded 8-amino-6-N-methyl-1,2,3,5,6,7-hexaazaacenaphthylene (4) in a moderate yield.

We have synthesized the aza analog, 8-amino-6-N-methyl-2-(β-D-ribofuranosyl)-1,2,3,5,6,7-hexaazaacenaphthylene[1] (1), of the potent antitumor agent 6-amino-4-N-methyl-8-(β-D-ribofuranosyl)-1,3,4,5,8-pentaazaacenaphthylene (TCN, 3). Nucleoside 1 has been evaluated against the leukemia L1210 cell line but exhibited no significant biological activity. To ensure that a deamination of 1 by adenosine deaminase was not the cause for this biological inactivity, compound 1 was administered with deoxycoformycin[2] which is a potent inhibitor of adenosine deaminase. In this experiment, compound 1 was still found to be inactive against the L1210 cell line.[1] Another possible explanation for the biological inactivity of 1 could be that 1 is not a substrate for adenosine kinase, i.e., the 5'-phosphate derivative 2, of nucleoside 1, is not formed intracellularly. It has been shown that the formation of TCN-P, the 5'-monophosphate derivative of TCN, is necessary for the biological activity of TCN.[3,4] If nucleoside 1 is not a substrate for adenosine kinase, the formation of 2 might be achieved via another biochemical pathway which involves adenine phosphoribosyl-1-pyrophosphate[5] (APRTase). The enzyme APRTase catalyzes the formation of the 5'-monophosphate of adenosine from adenine and

1, R = H
2, R = PO₃H₂

3

4

5-phosphoribosyl-1-pyrophosphate.[5] If the aglycone 8-amino-6-N-methyl-1,2,3,5,6,7-hexaazaacenaphthylene (4) of nucleoside 1 is recognized as a substrate by APRTase, this biological pathway might effect the intracellular formation of the monophosphate derivative 2. Since the heterocyclic compound (4) required for these biological studies was unknown, this prompted us to initiate a study to investigate possible routes for the synthesis of the heterocyclic aglycone 4.

RESULTS AND DISCUSSION

Our initial approach for the synthesis of **4** was by the treatment of 3-cyano-4,6-bis(methylthio)pyrazolo[3,4-d]pyrimidine (**5**) with methylhydrazine. The desired 3-cyano-4-N-(1-methylhydrazino)-6-methylthiopyrazolo[3,4-d]pyrimidine (**6**) was not obtained since no reaction occurred when several equivalents of methylhydrazine were used. The use of excess reagent only resulted in intractable mixtures. It has been proposed that compound **5** is deactivated towards nucleophilic reactions by strong bases due to a deprotonation of the heterocycle. Thus, we elected to protect the heterocycle as the tetrahydropyranyl derivative[7] 3-cyano-4,6-bis(methylthio)-1-(tetrahydropyran-2-yl)pyrazolo[3,4-d]pyrimidine (**7**). The site of alkylation of **7** was assigned on the basis of the uv spectrum at pH 7, 1, and 11. It has been established that alkylation at the N-1 position of substituted pyrazolo[3,4-d]pyrimidines results in little change of the uv spectrum relative to that of the unalkylated heterocycle, whereas, N-2 alkylation results in a uv spectrum which shows a bathochromic shift of about 20 nm relative to that of the unalkylated heterocycle. The reaction of **7** with methylhydrazine effected a facile and
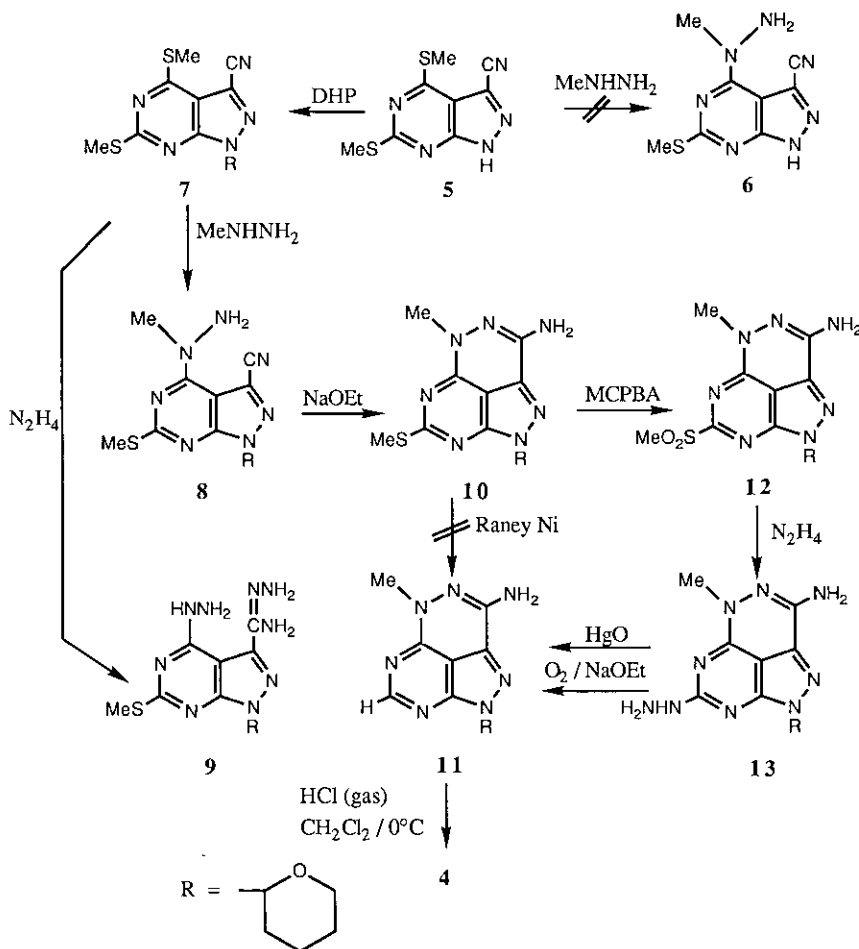
selective displacement of the 4-methythio group to afford 3-cyano-4-N-(1-methylhydrazino)-6-methylthio-1-(tetrahydropyran-2-yl)pyrazolo[3,4-d]pyrimidine (**8**) in a high yield. The ir spectrum of **8** showed the presence of a band at 2235 cm^{-1} which indicated the presence of a cyano group. In the ^{1}H nmr spectrum of **8**, a singlet at δ 3.46 was observed and assigned to the N-methyl function. If a displacement of the 4-methylthio group has occurred *via* the unsubstituted nitrogen of the methylhydrazine, the ^{1}H nmr spectrum of the product would have exhibited a doublet for the N-methyl signal due to the N-H coupling. In direct contrast, treatment of **7** with hydrazine resulted in a nonselective

N-methyl signal due to the N-H coupling. In direct contrast, treatment of 7 with hydrazine resulted in a nonselective displacement of the methylthio group, concomitant with an addition to the cyano function, to afford 3-carboxamidrazone-4-hydrazino-6-methylthio-1-(tetrahydropyran-2-yl)pyrazolo[3,4-d]pyrimidine (9).

The treatment of 8 with sodium ethoxide effected a ring closure of 8 to afford 8-amino-6-N-methyl-4-methylthio-2-(tetrahydropyran-2-yl)-1,2,3,5,6,7-hexaazaacenaphthylene (10) in a high yield. In support of the cyclization of 8, the ir spectrum of 10 showed the absence of a cyano band, and in the ^{1}H nmr spectrum of 10, there was a downfield shift of δ 0.21 for the N-methyl group. Also, the uv spectrum of 10 showed a bathochromic shift of 7 nm relative to that of 8 which indicated the occurrence of a transformation of the ring system of 8. The most straightforward method to obtain 8-amino-6-N-methyl-1,2,3,5,6,7 hexaazaacenaphthylene (11) would have been by a conventional dethiation of 10 using Raney nickel. However, as in case of the analogous nucleoside,[1] treatment of 10 with Raney nickel resulted in undesired products. Four products were isolated on a small scale, and the uv spectra of all these products showed a hypsochromic shift of about 20 nm relative to that observed for 10. Based on a similar reaction involving the analogous nucleoside in which the products were characterized,[1] the uv spectra implied that the treatment of 10 with Raney nickel had caused a reductive cleavage of the pyridazine ring of 10. Previously, we had observed an unusual lability of the hexaazaacenaphthylene ring system, as a nucleoside, toward mild reductive conditions.[1]

Thus, it was decided that nonreductive methodology must be used for the reactions involving 10 and derivatives. The methylthio group of 10 was oxidized with m-chloroperoxybenzoic acid[8] to give 8-amino-4-methylsulfonyl-6-N-methyl-2-(tetrahydropyran-2-yl)-1,2,3,5,6,7-hexaazaacenaphthylene (12) in a 95% yield. The methylsulfonyl function of 12 was displaced with hydrazine to afford 8-amino-4-hydrazino-6-N-methyl-2-(tetrahydropyran-2-yl)-1,2,3,5,6,7-hexaazaacenaphthylene (13) in high yield. In an attempt to oxidatively replace the hydrazino group of 13 with hydrogen, 13 was treated with mercuric oxide.[9,10] However, the desired product 11 was not obtained from this reaction. An alternate procedure for a replacement of a hydrazino function with hydrogen is via the use of oxygen in the presence of base.[9] The reaction of 13 with oxygen in the presence of sodium ethoxide did afford the desired product 11 in a moderate yield. The ^{1}H nmr spectrum of 11 exhibited a singlet at δ 8.46 which was attributed to the aromatic proton. A removal of the tetrahydropyranyl group of 11, using dilute hydrochloric acid in ethanol,[11] or an acetic acid/tetrahydrofuran/water mixture,[12] or pyridinium p-toluenesulfonate,[13] resulted in the formation of a product. However, the ^{1}H nmr spectrum of this product showed the absence of an aromatic signal in the δ 8.5-7.5 region. The loss of the aromatic proton from the product resulting from these conditions, vide supra, could be explained by the occurrence of an acid catalyzed hydrolytic ring-opening of the pyrimidine ring at the 4-position of 11 followed by a loss of formic acid. We subsequently found that when strictly anhydrous conditions, using gaseous hydrogen chloride in methylene chloride at 0°C, were applied in the treatment of 11, we could obtain the desired product 4 in a 66% yield. The ^{1}H nmr spectrum of 4 shows a non-exchangeable singlet at δ 8.22 which was attributed to the aromatic proton, and the elemental analysis (C, H, N) of 4 corroborated the structure assignment. This constitites a successful synthesis of the heterocyclic moiety of the nucleoside 1 and the biological evaluation of compound 4 will be described elsewhere.

EXPERIMENTAL

General Methods. Melting points were determined on a Thomas-Hoover Unimelt apparatus and are uncorrected. Rotary evaporations were conducted with a Buchler flash evaporator at less that 50°C, unless otherwise specified, using a water aspirator (15 mmHg) or a vacuum pump (1 mmHg). Low-pressure chromatography was performed on Instrumentation Specialties Company model 226 absorbance monitor with optical unit (254 nm), model 614 chart recorder, and model 328 fraction collector. A Michel-Miller (Ace Glass) column (4 x 30 cm) which was packed with normal phase silica, EM Reagent Kieselgel 60 (230-400 mesh ASTM), was used as the column unless otherwise specified. Typical flow rates for low-pressure chromatography were 5ml/min and 20ml/fraction were collected. Flash chromatography was performed using normal phase silica, EM Reagent Kieselgel 60 (230-400 mesh ASTM), and open-

bed chromatography was performed using normal phase silica, EM Reagent Kieselgel 60 (70-230 mesh ASTM). All eluant systems are stated as volume to volume ratios. Thin-layer chromatography (tlc) was accomplished using SilicAR 7GF (250 micrometer layer) on prescored glass plates (2.5 x 8 cm) purchased from Analtech, Inc., Newark, Delaware. Proton nuclear magnetic resonance (^{1}H nmr) spectra were obtained using Bruker WM 360 (360 MHz) or Bruker WP 270 SY (270 MHz) spectrometers. Nmr spectra were recorded using either deuteriochloroform as solvent and tetramethyl-silane as internal standard or dimethyl sulfoxide-d_6 and tetramethylsilane as internal standard. The following abbrevations are used to designate the multiplicity of individual signals: s = singlet, d = doublet, t = triplet, q = quartet, m = multiplet, dd = doublet of doublets, br s = broad singlet. Uv spectra were recorded on a Hewlet-Packard 8450 spectrophotometer. The symbol ε is defined as the molar extinction coefficient, and values reported as absorbances indicate relative absorbances at the specified wavelengths λ. Mass spectral data were obtained on a Finnigan Model 4023 GC/MS using electron ionization or chemical ionization. Analytical samples were dried *in vacuo* (vacuum pump) at 78°C in the presence of phosphorus pentoxide for at least 12 h unless otherwise specified. Elemental analyses were obtained from M-H-W Laboratories, P.O. Box 15149, Phoenix, Arizona 85018. Technical grade *m*-chloroperoxybenzoic acid was purified according to the procedure reported by Schwartz.[14]

8-Amino-6-N-methyl-1,2,3,5,6,7-hexaazaacenaphthylene (4). Compound **11** (219 mg, 0.80 mmol) was suspended in dichloromethane (20 ml) and this reaction mixture was cooled to 0°C. Hydrogen chloride gas (tech. grade) was bubbled through concentrated sulfuric acid, then through the cold reaction mixture for 5 min. After stirring the reaction mixture at 0°C for 25 min, cold (0°C) methanolic ammonia (3 ml), which was saturated at 0°C, was added to the cold reaction mixture dropwise to a pH of 10. The reaction mixture was allowed to warm to room temperature and stirred for 30 min. Filtration of the suspension gave a white solid which was washed with dichloromethane (3 x 5 ml) and then with water (3 x 5 ml). The product was triturated with methanol (3 x 10 ml) at room temperature followed by decantation of the solvent. This wet solid was collected by filtration and washed with methanol (2 x 3 ml) to give **4** as a white solid (101 mg, 66%): mp >350°C; ^{1}H nmr (270 MHz, Me$_2$SO-d_6): δ 13.52 (br s, 1, NH, D$_2$O exchangeable), 8.22 (s, 1, C-4H), 6.61 (br s, 2, NH$_2$, D$_2$O exchangeable), 3.55 (s, 3, NMe); uv λ $_{max}$ nm (ε x 10^{-3}): (pH 7) 285 (2.72), 308 (3.51); (pH 1) 314 (2.51); (pH 11) 234 (3.65), 309 (3.46). Anal. Calcd for C$_7$H$_7$N$_7$: C, 44.43; H, 3.74; N, 51.83. Found: C, 44.61; H, 3.84; N, 51.83.

3-Cyano-4,6-bis(methylthio)-1-(tetrahydropyran-2-yl)pyrazolo[3,4-d]pyrimidine (7). Compound **5**[6] (3.00 g, 12.6 mmol) was suspended in ethyl acetate (30 ml) and this mixture was heated at 75°C. Concentrated sulfuric acid (20 drops) was added to the hot reaction mixture to effect a pH of 2. This was followed by a dropwise addition of 3,4-dihydro-2H-pyran (3.0 ml, 31.9 mmol) as an ethyl acetate (20 ml) solution. After a complete addition of the reagent, ethyl acetate (30 ml) was added to the hot reaction mixture and the mixture was filtered. The resulting solution was extracted with saturated aqueous sodium carbonate (40 ml) and the organic phase was separated. After standing for 30 min at room temperature, the organic phase afforded white crystals which were collected by filtration and recrystallized from ethyl acetate at reflux to give **7** as white crystals (3.12 g, 77%): mp 181-182°C; R$_f$ 0.8, chloroform/methanol (97.5/2.5); ^{1}H nmr (CDCl$_3$): δ 5.97 (dd, 1, H-1'), 4.08 (dd, 1), 3.74 (m, 1), 2.68 (s, 3, SMe), 2.61 (s, 3 SMe), 2.45 (m, 1), 2.13 (m, 1), 1.80 (m, 4); ir (KBr):2238 cm^{-1}; uv λ$_{max}$ nm (ε x 10^{-3}): (pH 7) 252 nm (18.9), 295 (10.4), 323 (8.5); (pH 1) 252 (19.7), 295 (10.8), 323 (8.6); (pH 11) 252 (18.2), 295 (10.4), 323 (8.6). Anal. Calcd for C$_{13}$H$_{15}$N$_5$OS$_2$: C, 48.58; H, 4.70; N, 21.79. Found: C, 48.60; H, 4.59; N, 21.74.

3-Cyano-4-(1-methylhydrazino)-6-methylthio-1-(tetrahydropyran-2-yl)pyrazolo[3,4-d]pyrimidine (8) Compound **7** (1.00 g, 3.11 mmol) was dissolved in a 10% solution of methylhydrazine in chloroform (20 ml), and this solution was stirred at room temperature for 4 h. The reaction mixture was filtered, ethanol (5 ml) was added to the filtrate, and the solvent was evaporated *in vacuo* (water aspirator) to a volume of about 5 ml to give a white precipitate. This solid was collected by filtration and recrystallized from acetonitrile to give **8** as white crystals: mp 205-207°C (dec); R$_f$ 0.45, chloroform/methanol (97.5/2.5); ^{1}H nmr (CDCl$_3$): δ 5.95 (dd, 1, H-1'), 4.27 (br s, 2, NH$_2$, D$_2$O

exchangeable), 4.09 (dd, 1), 3.74 (m, 1), 3.46 (s, 3, NMe), 2.54 (s, 3, SMe), 2.47 (m, 1), 2.11 (m, 1), 1.70 (m, 4); uv λ_{max} nm (ε x 10^{-3}): (pH 7) 244 nm (18.7), 260 (13.3), 305 (10.2); (pH 1) 244 (19.0), 260 (13.3), 304 (10.3); (pH 11) 245 (18.6), 283 (10.9), 296 (10.7); ir (KBr): 3320, 2235 cm^{-1}. Anal. Calcd for $C_{13}H_{17}N_7OS$: C, 48.88; H, 5.37; N, 30.70. Found: C, 48.86; H, 5.14; N, 30.59.

3-Carboxamidrazone-4-hydrazino-6-methylthio-1-(tetrahydropyran-2-yl)pyrazolo[3,4-d]pyrimidine (9). Compound 7 (2.24 g, 6.7 mmol) was dissolved in tetrahydrofuran (160 ml), and 95% hydrazine (1.2 ml, 38 mmol) was added to the reaction mixture. After stirring the reaction mixture for 2 days at room temperature, the solvent was evaporated *in vacuo* (water aspirator) to give a residue. This residue was dissolved in chloroform/methanol (99/1) (10 ml), and the solution was subjected to flash chromatography (4 x 55 cm column). The product was eluted with chloroform/methanol (99/1) (500 ml) followed by chloroform/methanol (95/5). Fractions 50-65 (16 x 25 ml) and 71-91 (21 x 25 ml) were combined and evaporated *in vacuo* (water aspirator) to give a solid. This solid was subjected to flash chromatography as before, and fractions 25-45 (21 x 50 ml) were combined and evaporated *in vacuo* (water aspirator) to give a solid. Recrystallization of this solid from acetonitrile gave 9 as a beige solid (0.90 g, 40%): mp 201°C; R_f 0.2, chloroform/methanol (95/5), ^{1}H nmr (270 MHz, Me$_2$SO-d_6): δ 11.26 (br s, 1, NH, D$_2$O exchangeable), 5.83 (br s, 2, NH, D$_2$O exchangeable), 5.75 (dd, 1, H-1'), 5.13 (br s, 4.0, NH, D$_2$O exchangeable), 3.95 (m, 1), 3.65 (m, 1), 2.53 (s, 3, SMe), 2.05-1.55 (m, 6); ir (KBr): absence of a band in the 2200-2300 cm^{-1} region; EI-mass spectrum: *m/z*: 337 (M$^+$).

8-Amino-6-N-methyl-4-methylthio-2-(tetrahydropyran-2-yl)-1,2,3,5,6,7-hexaazaacenaphthylene (10). Compound 8 (0.500 g, 1.57 mmol) was dissolved in 0.09 M sodium ethoxide in ethanol (15 ml) at reflux temperature. After heating the reaction mixture for 15 min, the solution was cooled in an ice bath for 1 h to give a white precipitate. This precipitate was filtered, washed with ethanol (3 x 0.5 ml) at room temperature, and dried *in vacuo* (water aspirator) at 50°C to give a white solid (0.477 g, 95%). An analytical sample of 10 was obtained by recrystallization of the solid from chloroform/ethanol (50/50) with water as a cosolvent: mp 255-257°C (dec); $R_f = 0.35$, chloroform/methanol (97.5/2.5); ^{1}H nmr (CDCl$_3$): δ 5.77 (dd, 1, H-1'), 4.73 (br s, 2, NH$_2$, D$_2$O exchangeable), 4.14 (m, 1), 3.75 (m, 1), 3.67 (s, 3, NMe), 2.61 (m, s, 4), 2.10-1.60 (m, 5); uv λ_{max} nm (ε x 10^{-3}): (ethanol) 263 (27.3), 312 (11.9); (pH 1) 270 (22.5), 306 (10.4); (pH 11) 263 (28.6), 311 (12.6); ir (KBr): absence of a band within the region of 2200-2300 cm^{-1}. Anal. Calcd for $C_{13}H_{17}N_7OS \cdot 0.25 H_2O$: C, 48.20; H, 5.46; N, 30.27. Found: C, 48.23; H, 5.29 N, 30.20.

8-Amino-6-N-methyl-2-(tetrahydropyran-2-yl)-1,2,3,5,6,7-hexaazaacenaphthylene (11). Sodium metal (2.5 g, 109 mmol) was dissolved in absolute ethanol (500 ml). Compound 13 (3.36 g, 11.1 mmol) was added to this solution and oxygen gas (carbon dioxide-free) was bubbled through the reaction mixture for 6 h while the reaction mixture was heated at 40°C. The bubbling of oxygen was stopped and the reaction mixture was stirred an additional 12 h at 40°C. After the solvent was evaporated *in vacuo* (water aspirator), there was a residue which was triturated with water (200 ml) at room temperature. The solid was filtered and recrystallized from ethanol to give a light-purple solid (1.86 g, 61%). An analytical sample was prepared by subjecting the product to low-pressure chromatography using chloroform/methanol (98/2) as eluant. Fractions 25-35 (11 x 10 ml) were evaporated *in vacuo* (water aspirator) to give a white solid which was recrystallized from ethanol to afford 11 as white crystals: mp 222-223°C, $R_f = 0.45$, chloroform/methanol (93/7); ^{1}H nmr (CDCl$_3$): δ 8.46 (s, 1, C-4), 5.82 (dd, 1, H-1'), 4.81 (br s, 2, NH$_2$, D$_2$O exchangeable), 4.16 (m, 1), 3.81 (m, 1), 3.71 (s, 3, NMe), 2.60 (m, 1), 2.65-1.61 (m, 5); uv λ_{max} nm (ε x 10^{-3}): (ethanol) 244 (18.7), 260 (13.3), 305 (10.2); (pH 1) 245 (18.6), 283 (10.9), 296 (10.7); (pH 11) 244 (19.0), 260 (13.3), 304 (10.3). Anal. Calcd for $C_{12}H_{15}N_7O$: C, 52.74; H, 5.53; N, 35.88. Found: C, 52.62; H, 5.45; N, 35.85.

8-Amino-4-methylsulfonyl-6-N-methyl-2-(tetrahydropyran-2-yl)-1,2,3,5,6,7-hexaazaacenaphthylene (12). Compound 10 (10.00 g, 31.31 mmol) was dissolved in chloroform (300 ml) at room temperature and 1M sodium

phosphate buffer (300 ml) at pH 7.5 was added to the reaction mixture. m-Chloroperoxybenzoic acid (15.46 g, 89.59 mmol) as a chloroform (225 ml) solution, was added to the biphasic mixture dropwise at room temperature. After the addition was complete, the organic phase was separated and washed with a 10% aqueous sodium sulfite solution (2 x 200 ml) followed by washing with a saturated aqueous sodium chloride solution (2 x 200 ml). The organic phase was then dried with magnesium sulfate, treated with carbon, and the solvents were evaporated *in vacuo* (water aspirator) at room temperature to afford **12** as a pale yellow solid (10.44 g, 95%), mp 197°C. An analytical sample was obtained by subjecting the product to dry-column chromatography using Woelum alumina treated with an inorganic fluorescent indicator. The column (2 x 21 in.) was prepared in a Nylon tube, and the sample was absorbed onto alumina and applied onto the top of the column. Acetonitrile was used as the eluant and a uv lamp was used to detect a band which eluted to a region 1-5 inches from the origin. This band was cut from the column, the alumina was washed with 300 ml of chloroform/methanol (50/50), and solvent was evaporated *in vacuo* (water aspirator) to give a pale yellow solid. The analytical sample was prepared by recrystallization from acetonitrile to give **12** as white crystals: mp 203-204°C (dec); R_f = 0.4, chloroform/methanol (95/5); ^{1}H nmr (CDCl$_3$): δ 5.86 (dd, 1, H-1'), 5.00 (br s, 2, NH$_2$, D$_2$O exchangeable), 4.10 (m, 1), 3.78 (m, 1), 3.71 (s, 3, NMe), 3.33 (s, 3, SO$_2$Me), 2.49 (m, 1), 2.10-1.50 (m, 5); uv λ_{max} nm: (ethanol) 281, 316; (pH 1) 281, 316; (pH 11) 281, 316; ir (KBr): 1287, 1118 cm^{-1}. Anal. Calcd for C$_{13}$H$_{17}$N$_7$O$_3$S: C, 44.44; H, 4.88; N, 27.90. Found: C, 44.71; H, 4.97; N, 28.07.

8-Amino-4-hydrazino-6-N-methyl-2-(tetrahydropyran-2-yl)-1,2,3,5,6,7-hexaazaacenaphthylene (**13**). Compound **12** (1.21 g, 3.44 mmol) was dissolved in methylene chloride (75 ml) at room temperature and anhydrous hydrazine (0.51 ml, 16 mmol) was added to the reaction mixture. After stirring the reaction mixture at room temperature for 48 h, the precipitate was collected by filtration and washed with tetrahydrofuran (10 ml). The solid was then washed with methanol (10 ml) at room temperature to give **13** as a solid (1.00 g, 96%). The analytical sample was obtained by recrystallization from dimethylformamide at 95°C to give **13** as white crystals: mp 269-271°C (dec); R_f = 0.2-0.3, chloroform/methanol (95/5); ^{1}H nmr (Me$_2$SO-d_6): δ 8.06 (br s, 1, NH, D$_2$O exchangeable), 6.39 (br s, 2, NH$_2$, D$_2$O exchangeable), 5.53 (dd, 1, H-1'), 3.94 (m, 1), 3.63 (m, 1), 3.47 (s, 3, NMe), 2.49 (m), 2.10-1.40 (m, 5); uv λ_{max} nm (absorbance) (ε x 10^{-3}): (methanol) 236 (9.1), 296 (4.0); (pH 1) 228 (5.7), 296 (2.7); (pH 11) 236 (5.4), 296 (2.2); ir (KBr): 3380-3290, 3160 cm^{-1}. Anal. Calcd for C$_{12}$H$_{17}$N$_9$O: C, 47.52; H, 5.65; N, 41.56. Found: C, 47.63; H, 5.72; N, 41.63.

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