SUPPORTING INFORMATION

Synthesis of β - and γ -Carbolines by the Palladium/Copper-Catalyzed Coupling and Cyclization of Terminal Acetylenes

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2-Ethynylbenzofuran. *tert*-Butyl lithium (6.5 mL, 1.7 M in pentane, 11 mmol) was added to a solution of benzofuran (1.18 g, 10 mmol) in dry ether (20 mL) at $-78\text{ }^{\circ}\text{C}$. The mixture was stirred for 30 min and a solution of I_2 (2.85 g, 11 mmol) in dry ether (30 mL) was added. The mixture was stirred for another 30 min, allowed to warm to room temperature, diluted with satd aq NH_4Cl , and extracted with ether. The organic solution was washed with $\text{Na}_2\text{S}_2\text{O}_3$ and water, dried over Na_2SO_4 and the solvent evaporated under reduced pressure, affording 2.32 g (95%) of crude 2-iodobenzofuran as a yellow oil in $> 90\%$ purity, which was confirmed by ^1H NMR spectroscopy.

To 2.32 g of crude 2-iodobenzofuran was added CuI (19 mg, 1 mol %), $\text{PdCl}_2(\text{PPh}_3)_2$ (133 mg, 2 mol %), Et_3N (20 mL) and trimethylsilylacetylene (1.12 g, 11 mmol, 1.2 equiv). The mixture was flushed with Ar and heated at $60\text{ }^{\circ}\text{C}$ for 3 h. The precipitate and solvent were filtered and evaporated, affording 2.24 g (100%) of crude 2-(trimethylsilylethynyl)benzofuran as a yellow oil, which was then dissolved in CH_3OH (20 mL) containing KOH (0.533 g, 9.5 mmol, 1 equiv). The mixture was stirred at room temperature for 30 min. The solvent was evaporated by vacuum and the residue was purified by column chromatography using hexanes, affording 0.86 g (64% based on benzofuran) of 2-ethynylbenzofuran as a pale yellow oil: ^1H NMR (CDCl_3) δ 3.49 (s, 1H), 7.00 (d, $J = 0.4\text{ Hz}$, 1H), 7.24 (dt, $J = 8.0, 1.2\text{ Hz}$, 1H), 7.35 (dt, $J = 8.0, 1.2\text{ Hz}$, 1H), 7.46

(dd, J = 8.0, 0.8 Hz, 1H), 7.56 (dd, J = 8.0, 0.8 Hz, 1H); ^{13}C NMR (CDCl_3) δ 74.2, 83.5, 111.4, 112.7, 121.4, 123.5, 126.0, 127.2, 137.7, 154.8.

1-Benzyl-3-iodoindole-2-carboxaldehyde (4c). This aldehyde was prepared as a white solid in 100% yield by the method used to prepare 3-iodo-1-(methoxymethyl)indole-2-carboxaldehyde¹ only employing 3-iodo-1H-indole-2-carboxaldehyde and benzyl iodide: mp 114-115 °C; ^1H NMR (CDCl_3) δ 5.84 (s, 2H), 7.08 (d, J = 6.8 Hz, 2H), 7.20-7.27 (m, 4H), 7.35 (d, J = 8.4 Hz, 1H), 7.43 (dt, J = 8.0, 0.4 Hz, 1H), 7.61 (d, J = 8.4 Hz, 1H), 10.00 (s, 1H); ^{13}C NMR (CDCl_3) δ 48.0, 111.4, 122.1, 123.9, 126.6, 127.6, 128.5, 128.7, 130.0, 131.1, 137.4, 140.4, 184.5.

1-Benzyl-2-bromoindole-3-carboxaldehyde (5c). This aldehyde was prepared as a pale yellow solid in 97% yield by the method used to prepare 3-iodo-1-(methoxymethyl)indole-2-carboxaldehyde¹ only employing 2-bromo-1H-indole-3-carboxaldehyde and benzyl iodide: mp 124-126 °C (lit.² mp 125 °C); the ^1H NMR spectral data are consistent with those previously reported;² ^{13}C NMR (CDCl_3) δ 48.9, 110.6, 121.5, 123.7, 124.5, 125.7, 126.3, 126.6, 126.7, 128.3, 129.3, 135.4, 137.3, 185.8.

Alkynylindoles Prepared

3-(1-Cyclohexenylethynyl)-1-methylindole-2-carboxaldehyde (3b).

The reaction mixture was chromatographed using 20:1 hexanes/EtOAc to afford 129 mg (98%) of the indicated compound as a yellow solid: mp 71-73 °C; ^1H NMR (CDCl_3) δ 1.61-1.69 (m, 2H), 1.69-1.97 (m, 2H), 2.18-2.21 (m, 2H), 2.29-2.32 (m, 2H), 4.08 (s, 1H), 6.31 (m, 1H), 7.22 (m, 1H), 7.37 (d, J = 8.4 Hz, 1H), 7.45 (m, 1H), 7.82 (d, J = 8.4 Hz, 1H), 10.19 (s, 1H); ^{13}C NMR (CDCl_3) δ 20.5, 21.3, 24.8, 28.3, 30.7, 76.5, 98.0, 109.4, 111.7, 119.7, 120.4, 121.2, 126.6, 126.7, 134.1, 134.8, 138.5, 181.4; IR (neat, cm^{-1}) 2935, 2178, 1668; HRMS calcd for $\text{C}_{18}\text{H}_{17}\text{NO}$: 263.1310. Found: 263.1314.

3-(1-Decynyl)-1-methylindole-2-carboxaldehyde (3c). The reaction mixture was chromatographed using 20:1 hexanes/EtOAc to afford 130 mg

(88%) of the indicated compound as a yellow oil: ^1H NMR (CDCl_3) δ 0.89 (t, J = 6.8 Hz, 3H), 1.22-1.40 (m, 8H), 1.45-1.55 (m, 2H), 1.64-1.71 (m, 2H), 2.54 (t, J = 8.0 Hz, 2H), 4.07 (s, 3H), 7.21 (t, J = 7.2 Hz, 1H), 7.36 (d, J = 8.0 Hz, 1H), 7.44 (m, 1H), 7.81 (d, J = 8.0 Hz, 1H), 10.17 (s, 1H); ^{13}C NMR (CDCl_3) δ 13.1, 18.9, 21.7, 27.8, 27.9, 28.1, 28.2, 30.7, 30.8, 70.2, 97.4, 109.3, 112.2, 120.2, 121.2, 126.6, 126.9, 134.4, 138.5, 181.5; IR (neat, cm^{-1}) 2926, 2232, 1654; HRMS calcd for $\text{C}_{20}\text{H}_{25}\text{NO}$: 295.1936. Found: 295.1939.

3-(Cyclohexylethynyl)-1-methylindole-2-carboxaldehyde (3d). The reaction mixture was chromatographed using hexanes/EtOAc 15:1 to afford 128 mg (96%) of the indicated compound as a yellow oil: ^1H NMR (CDCl_3) δ 1.35-1.50 (m, 3H), 1.50-1.70 (m, 3H), 1.70-1.87 (m, 2H), 1.87-1.98 (m, 2H), 2.75 (m, 1H), 4.04 (s, 3H), 7.20 (m, 1H), 7.33 (m, 1H), 7.42 (m, 1H), 7.80 (dt, J = 8.4, 0.9 Hz, 1H), 10.25 (s, 1H); ^{13}C NMR (CDCl_3) δ 23.4, 24.6, 28.7, 30.3, 31.3, 69.8, 101.1, 108.9, 111.9, 119.8, 120.8, 126.2, 126.4, 133.9, 138.1, 181.1; IR (neat, cm^{-1}) 2929, 2219, 1669; HRMS calcd for $\text{C}_{18}\text{H}_{19}\text{NO}$: 265.1467. Found: 265.1472.

3-(4-Hydroxy-1-butynyl)-1-methylindole-2-carboxaldehyde (3e). The reaction mixture was chromatographed using 1.5:1 hexanes/EtOAc to afford 99 mg (87%) of the indicated compound as a yellow solid: mp 109-110 $^{\circ}\text{C}$; ^1H NMR (CDCl_3) δ 1.93 (s, 1H), 2.84 (t, J = 6.4 Hz, 2H), 3.90 (t, J = 6.4 Hz, 2H), 4.07 (s, 1H), 7.23 (m, 1H), 7.37 (d, J = 7.8 Hz, 1H), 7.45 (m, 1H), 7.81 (d, J = 7.8 Hz, 1H), 10.18 (s, 1H); ^{13}C NMR (CDCl_3) δ 23.3, 30.7, 60.2, 72.1, 93.2, 109.4, 111.0, 120.5, 121.0, 126.7, 126.8, 134.6, 138.4, 181.3; IR (neat, cm^{-1}) 3420, 2941, 2233, 1667; HRMS calcd for $\text{C}_{14}\text{H}_{13}\text{NO}_2$: 227.0946. Found: 227.0950.

3-(10-Methoxycarbonyl-1-decynyl)-1-methylindole-2-carboxaldehyde (3f). The reaction mixture was chromatographed using 8:1 hexanes/EtOAc to afford 173 mg (98%) of the indicated compound as a yellow solid: mp 53-55 $^{\circ}\text{C}$; ^1H NMR (CDCl_3) δ 1.30-1.45 (m, 6H), 1.45-1.57 (m, 2H), 1.57-1.75 (m, 4H), 2.31 (t, J = 7.2 Hz, 2H), 2.52 (t, J = 7.2 Hz, 2H), 3.66 (s, 3H), 4.07 (s, 3H), 7.23 (m, 1H), 7.36 (d, J = 8.4 Hz, 1H), 7.43 (m, 1H), 7.81 (m, 1H), 10.16 (s, 1H); ^{13}C NMR (CDCl_3) δ 19.9, 25.0, 28.8, 28.9, 29.0, 29.1, 29.2, 31.7, 34.1, 51.5, 71.3, 98.4,

110.4, 113.2, 121.3, 122.2, 127.7, 127.9, 135.5, 139.5, 174.4, 182.5; IR (neat, cm^{-1}) 3019, 2929, 2232, 1732, 1664; HRMS calcd for $\text{C}_{22}\text{H}_{27}\text{NO}_3$: 353.1991. Found: 353.1998.

3-(5-Cyano-1-pentynyl)-1-methylindole-2-carboxaldehyde (3g). The reaction mixture was chromatographed using 3:1 hexanes/EtOAc to afford 103 mg (82%) of the indicated compound as a yellow oil: ^1H NMR (CDCl_3) δ 2.05 (quintet, J = 7.2 Hz, 2H), 2.62 (t, J = 7.2 Hz, 2H), 2.77 (t, J = 6.8 Hz, 2H), 4.08 (s, 3H), 7.24 (t, J = 6.8 Hz, 1H), 7.38 (d, J = 8.8 Hz, 1H), 7.46 (t, J = 6.8 Hz, 1H), 7.78 (d, J = 8.4 Hz, 1H), 10.16 (s, 1H); ^{13}C NMR (CDCl_3) δ 16.4, 19.1, 24.7, 31.8, 73.3, 94.7, 110.6, 111.8, 119.1, 121.6, 122.0, 127.81, 127.82, 135.6, 139.5, 182.2; IR (neat, cm^{-1}) 2940, 2246, 1668; HRMS calcd for $\text{C}_{16}\text{H}_{14}\text{N}_2\text{O}$: 250.1106. Found: 250.1110.

1-Methyl-3-(triethylsilylethynyl)indole-2-carboxaldehyde (3h). The reaction mixture was chromatographed using 20:1 hexanes/EtOAc to afford 149 mg (100%) of the indicated compound as a pale yellow solid: mp 55-56 $^{\circ}\text{C}$; ^1H NMR (CDCl_3) δ 0.75 (m, 6H), 1.10 (m, 9H), 4.08 (s, 3H), 7.24 (m, 1H), 7.37 (d, J = 8.4 Hz, 1H), 7.45 (m, 1H), 7.82 (dd, J = 8.0, 0.8 Hz, 1H), 10.22 (s, 1H); ^{13}C NMR (CDCl_3) δ 4.5, 7.7, 31.8, 96.6, 100.4, 110.5, 112.1, 121.7, 122.2, 127.8, 128.0, 136.1, 139.4, 182.4; IR (neat, cm^{-1}) 2953, 2144, 1674; HRMS calcd for $\text{C}_{18}\text{H}_{23}\text{NOSi}$: 297.1549. Found: 297.1154.

3-(1-Hydroxycyclohexylethynyl)-1-methylindole-2-carboxaldehyde (3i). The reaction mixture was chromatographed using 3:1 hexanes/EtOAc to afford 141 mg (100%) of the indicated compound as a yellow solid: mp 147-148 $^{\circ}\text{C}$; ^1H NMR (CDCl_3) δ 1.30 (m, 1H), 1.50-1.90 (m, 7H), 2.10 (m, 2H), 2.55 (s, 1H), 4.03 (s, 1H), 7.22 (t, J = 7.6 Hz, 1H), 7.33 (d, J = 8.4 Hz, 1H), 7.43 (t, J = 7.6 Hz, 1H), 7.78 (d, J = 8.0 Hz, 1H), 10.16 (s, 1H); ^{13}C NMR (CDCl_3) δ 23.6, 25.2, 31.8, 40.2, 69.6, 75.2, 100.7, 110.5, 111.5, 121.6, 122.1, 127.7, 127.8, 135.5, 139.4, 182.3; IR (neat, cm^{-1}) 3407, 2933, 1655; HRMS calcd for $\text{C}_{18}\text{H}_{19}\text{NO}_2$: 281.1416. Found: 281.1421.

1-Methoxymethyl-3-(phenylethynyl)indole-2-carboxaldehyde (3j). The reaction mixture was chromatographed using 10:1 hexanes/EtOAc to afford 138 mg (95%) of the indicated compound as a yellow solid: mp 81-83 °C; ^1H NMR (CDCl_3) δ 3.32 (s, 3H), 6.01 (s, 2H), 7.33 (m, 1H), 7.38-7.45 (m, 3H), 7.51 (m, 1H), 7.57-7.65 (m, 3H), 7.94 (m, 1H), 10.33 (s, 1H); ^{13}C NMR (CDCl_3) δ 56.3, 75.1, 80.1, 98.0, 111.9, 114.4, 122.5, 122.7, 123.0, 128.3, 128.7, 128.8, 129.1, 131.9, 135.7, 139.8, 182.3; IR (neat, cm^{-1}) 2212, 1654; HRMS calcd for $\text{C}_{19}\text{H}_{15}\text{NO}_2$: 289.1103. Found: 289.1108.

1-Benzyl-3-(phenylethynyl)indole-2-carboxaldehyde (3k). The reaction mixture was chromatographed using 12:1 hexanes/EtOAc to afford 149 mg (89%) of the indicated compound as a yellow solid: mp 134-135 °C; ^1H NMR (CDCl_3) δ 5.85 (s, 2H), 7.11 (d, J = 6.8 Hz, 2H), 7.20-7.30 (m, 4H), 7.38-7.45 (m, 5H), 7.60 (m, 2H), 7.94 (d, J = 8.0 Hz, 1H), 10.32 (s, 1H); ^{13}C NMR (CDCl_3) δ 48.2, 80.2, 97.4, 111.3, 112.8, 122.0, 122.4, 123.0, 126.7, 127.6, 128.0, 128.1, 128.6, 128.7, 131.6, 135.1, 137.3, 139.4, 182.1; IR (neat, cm^{-1}) 3061, 2205, 1667; HRMS calcd for $\text{C}_{24}\text{H}_{17}\text{NO}$: 335.1310. Found: 335.1315.

3-(Phenylethynyl)-1*H*-indole-2-carboxaldehyde (3l). The reaction mixture was chromatographed using 4:1 hexanes/EtOAc to afford 122 mg (100%) of the indicated compound as a yellow solid: mp 200 °C (decomp); ^1H NMR (CDCl_3) δ 7.27 (m, 1H), 7.37-7.44 (m, 3H), 7.44-7.50 (m, 2H), 7.62 (m, 2H), 7.93 (d, J = 8.0 Hz, 1H), 9.42 (s, 1H), 10.17 (s, 1H); ^{13}C NMR (CDCl_3) δ 80.0, 96.7, 110.1, 112.7, 122.0, 122.3, 122.9, 128.2, 128.6, 128.7, 128.8, 131.7, 136.2, 137.0, 181.1; IR (neat, cm^{-1}) 3278, 1652; HRMS calcd for $\text{C}_{17}\text{H}_{11}\text{NO}$: 245.0841. Found: 245.0845.

1-Methyl-2-(phenylethynyl)indole-3-carboxaldehyde (6a). The reaction mixture was chromatographed using 4:1 hexanes/EtOAc to afford 121 mg (93%) of the indicated compound as a yellow solid: mp 118-119 °C (lit.³ mp 120-121 °C); ^{13}C NMR (CDCl_3) δ 31.3, 77.5, 101.3, 109.8, 119.9, 121.3, 122.3, 123.6, 124.5, 125.1, 128.8, 129.9, 131.9, 132.1, 137.6, 185.2. All other spectral properties are consistent with those reported previously.³

2-(1-Decynyl)-1-methylindole-3-carboxaldehyde (6c). The reaction mixture was chromatographed using 7:1 hexanes/EtOAc to afford 122 mg (82%) of the indicated compound as a yellow oil: ^1H NMR (CDCl_3) δ 0.90 (t, J = 3.2 Hz, 3H), 1.25-1.40 (m, 8H), 1.50 (m, 2H), 1.70 (m, 2H), 2.59 (t, J = 7.2 Hz, 2H), 3.83 (s, 3H), 7.28-7.36 (m, 3H), 8.30 (d, J = 8.4 Hz, 1H), 10.14 (s, 1H); ^{13}C NMR (CDCl_3) δ 14.2, 19.9, 22.7, 28.3, 29.0, 29.1, 31.1, 31.9, 69.3, 103.8, 109.6, 119.5, 122.1, 123.4, 124.4, 124.7, 137.1, 185.4 (one sp^2 carbon missing due to overlap); IR (neat, cm^{-1}) 2922, 2232, 1644; HRMS calcd for $\text{C}_{20}\text{H}_{25}\text{NO}$: 295.1936. Found: 295.1939.

2-(Cyclohexylethynyl)-1-methylindole-3-carboxaldehyde (6d). The reaction mixture was chromatographed using 5:1 hexanes/EtOAc to afford 119 mg (89%) of the indicated compound as a yellow solid: mp 63-65 $^\circ\text{C}$; ^1H NMR (CDCl_3) δ 1.40-1.52 (m, 3H), 1.52-1.71 (m, 3H), 1.71-1.85 (m, 2H), 1.90-2.00 (m, 2H), 2.80 (m, 1H), 3.82 (s, 1H), 7.26-7.36 (m, 3H), 8.29 (m, 1H), 10.15 (s, 1H); ^{13}C NMR (CDCl_3) δ 24.9, 26.0, 30.2, 31.2, 32.4, 69.5, 107.7, 109.8, 119.6, 122.3, 123.5, 124.6, 124.8, 133.6, 137.4, 185.6; IR (neat, cm^{-1}) 2931, 2227, 1654; HRMS calcd for $\text{C}_{18}\text{H}_{19}\text{NO}$: 265.1467. Found: 265.1472.

2-(11-Hydroxy-1-undecynyl)-1-methylindole-3-carboxaldehyde (6e). The reaction mixture was chromatographed using 1:1 hexanes/EtOAc to afford 99 mg (61%) of the indicated compound as a yellow solid: mp 63-65 $^\circ\text{C}$; ^1H NMR (CDCl_3) δ 1.30-1.65 (m, 14H), 1.70 (m, 2H), 2.60 (t, J = 7.2 Hz, 2H), 3.65 (t, J = 6.8 Hz, 2H), 3.83 (s, 3H), 7.28-7.37 (m, 3H), 8.30 (d, J = 8.4 Hz, 1H), 10.14 (s, 1H); ^{13}C NMR (CDCl_3) δ 19.9, 25.7, 28.3, 28.9, 29.3, 29.4, 31.1, 32.8, 63.1, 69.4, 103.7, 109.6, 119.5, 122.1, 123.4, 124.4, 124.7, 133.3, 137.1, 185.4; IR (neat, cm^{-1}) 3347, 2930, 2233, 1644; HRMS calcd for $\text{C}_{21}\text{H}_{27}\text{NO}_2$: 325.2042. Found: 325.2046.

2-(10-Methoxycarbonyl-1-decynyl)-1-methylindole-3-carboxaldehyde (6f). The reaction mixture was chromatographed using 3:1 hexanes/EtOAc to afford 153 mg (86%) of the indicated compound as a yellow solid: mp 42-44 $^\circ\text{C}$; ^1H NMR (CDCl_3) δ 1.30-1.40 (m, 6H), 1.42-1.57 (m, 2H), 1.57-1.78 (m, 4H), 2.31

(t, J = 7.5 Hz, 2H), 2.59 (t, J = 7.2 Hz, 2H), 3.66 (s, 3H), 3.83 (s, 3H), 7.27-7.38 (m, 3H), 8.29 (dd, J = 8.4, 1.2 Hz, 1H), 10.14 (s, 1H); ^{13}C NMR (CDCl_3) δ 20.0, 25.1, 28.5, 29.1, 29.30, 29.34, 31.2, 34.3, 51.7, 69.6, 103.8, 109.8, 119.7, 122.3, 123.6, 124.6, 124.9, 133.4, 137.3, 174.5, 185.6 (one sp^3 carbon missing due to overlap); IR (neat, cm^{-1}) 2932, 2231, 1736, 1644; HRMS calcd for $\text{C}_{22}\text{H}_{27}\text{NO}_3$: 353.1991. Found: 353.1998.

1-Methyl-2-(triethylsilylethynyl)indole-3-carboxaldehyde (6g). The reaction mixture was chromatographed using 10:1 hexanes/EtOAc to afford 140 mg (94%) of the indicated compound as a pale yellow solid: mp 67-69 °C; ^1H NMR (CDCl_3) δ 0.78 (m, 6H), 1.09 (m, 9H), 3.86 (s, 3H), 7.29-7.40 (m, 3H), 8.30 (dd, J = 8.4, 1.2 Hz, 1H), 10.19 (s, 1H); ^{13}C NMR (CDCl_3) δ 4.2, 7.6, 31.1, 93.4, 106.6, 109.8, 120.4, 122.4, 123.6, 124.2, 125.2, 132.0, 137.3, 185.3; IR (neat, cm^{-1}) 2955, 2157, 1661; HRMS calcd for $\text{C}_{18}\text{H}_{23}\text{NOSi}$: 297.1549. Found: 297.1154.

2-(1-Hydroxycyclohexylethynyl)-1-methylindole-3-carboxaldehyde (6h). The reaction mixture was chromatographed using 1.5:1 hexanes/EtOAc to afford 122 mg (87%) of the indicated compound as a yellow solid: mp 155-156 °C; ^1H NMR (CDCl_3) δ 1.25-1.40 (m, 1H), 1.51-1.65 (m, 3H), 1.72-1.88 (m, 4H), 2.08-2.15 (m, 2H), 3.30 (br s, 1H), 3.53 (s, 3H), 7.14 (d, J = 7.6 Hz, 1H), 7.26-7.34 (m, 2H), 8.26 (dd, J = 6.8, 1.6 Hz, 1H), 10.08 (s, 1H); ^{13}C NMR (CDCl_3) δ 23.4, 25.1, 30.8, 39.7, 69.2, 72.3, 106.2, 109.7, 119.5, 122.1, 123.6, 124.2, 124.9, 132.2, 137.1, 185.5; IR (neat, cm^{-1}) 3390, 2934, 1642; HRMS calcd for $\text{C}_{18}\text{H}_{19}\text{NO}_2$: 281.1416. Found: 281.1421.

2-(2-Benzofurylethynyl)-1-methylindole-3-carboxaldehyde (6i). The reaction mixture was chromatographed using hexanes/EtOAc 4:1 to afford 79 mg (78%) of the indicated compound as a yellow solid: mp 147-148 °C; ^1H NMR (CDCl_3) δ 3.93 (s, 3H), 7.21 (s, 1H), 7.28-7.37 (m, 3H), 7.37-7.43 (m, 2H), 7.52 (d, J = 8.4 Hz, 1H), 7.63 (d, J = 8.0 Hz, 1H), 8.34 (m, 1H), 10.28 (s, 1H); ^{13}C NMR (CDCl_3) δ 31.5, 83.4, 91.0, 109.8, 111.5, 114.3, 120.8, 121.7, 122.4, 123.8,

124.5, 125.6, 126.7, 127.3, 130.1, 137.0, 137.8, 155.4, 184.9; IR (neat, cm^{-1}) 3062, 2206, 1652; HRMS calcd for $\text{C}_{20}\text{H}_{13}\text{NO}_2$: 299.0946. Found: 299.0950.

1-Methoxymethyl-2-(phenylethynyl)indole-3-carboxaldehyde (6j). The reaction mixture was chromatographed using 4:1 hexanes/EtOAc to afford 140 mg (97%) of the indicated compound as a yellow oil: ^1H NMR (CDCl_3) δ 3.38 (s, 3H), 5.72 (s, 2H), 7.35-7.50 (m, 5H), 7.53 (d, J = 8.0 Hz, 1H), 7.63 (m, 2H), 8.35 (d, J = 7.8 Hz, 1H), 10.34 (s, 1H); ^{13}C NMR (CDCl_3) δ 56.6, 75.6, 77.2, 101.5, 110.7, 120.9, 121.1, 122.3, 124.1, 124.8, 125.7, 128.8, 130.1, 131.8, 131.9, 137.1, 185.7; IR (neat, cm^{-1}) 2210, 1657; HRMS calcd for $\text{C}_{19}\text{H}_{15}\text{NO}_2$: 289.1103. Found: 289.1108.

1-Benzyl-2-(phenylethynyl)indole-3-carboxaldehyde (6k). The reaction mixture was chromatographed using 4.5:1 hexanes/EtOAc to afford 122 mg (73%) of the indicated compound as a yellow solid: mp 119-120 $^\circ\text{C}$; ^1H NMR (CDCl_3) δ 5.56 (s, 2H), 7.22-7.35 (m, 8H), 7.35-7.45 (m, 3H), 7.56 (m, 2H), 8.36 (m, 1H), 10.34 (s, 1H); ^{13}C NMR (CDCl_3) δ 48.7, 77.6, 101.4, 110.4, 120.2, 121.2, 122.3, 123.6, 124.8, 125.2, 126.9, 128.0, 128.7, 129.0, 129.9, 131.9, 136.0, 137.1, 185.4; IR (neat, cm^{-1}) 3060, 2211, 1655; HRMS calcd for $\text{C}_{24}\text{H}_{17}\text{NO}$: 335.1310. Found: 335.1315.

2-(Phenylethynyl)-1*H*-indole-3-carboxaldehyde (6l). The reaction mixture was chromatographed using 2.5:1 hexanes/EtOAc to afford 79 mg (64%) of the indicated compound as a yellow solid: mp 171-172 $^\circ\text{C}$; ^1H NMR (CDCl_3) δ 7.30-7.45 (m, 6H), 7.57 (dd, J = 7.2, 1.2 Hz, 2H), 8.35 (d, J = 7.6 Hz, 1H), 9.08 (s, 1H), 10.33 (s, 1H); ^{13}C NMR (CDCl_3) δ 78.2, 98.4, 111.1, 120.8, 121.2, 122.1, 123.6, 124.5, 125.5, 128.7, 129.4, 129.8, 131.9, 135.9, 185.7; IR (neat, cm^{-1}) 3198, 1637; HRMS calcd for $\text{C}_{17}\text{H}_{11}\text{NO}$: 245.0841. Found: 245.0845.

Carbolines Prepared

3-(1-Cyclohexenyl)-9-methyl-9*H*-pyrido[3,4-*b*]indole (2b). The reaction mixture was chromatographed using 2:1 hexanes/EtOAc to afford a 93% yield of the indicated compound as a yellow solid: mp 110-111 $^\circ\text{C}$; ^1H NMR (acetone- d_6)

δ 1.65-1.75 (m, 2H), 1.75-1.85 (m, 2H), 2.27 (m, 2H), 2.65 (m, 2H), 3.96 (s, 3H), 6.77 (m, 1H), 7.25 (m, 1H), 7.55-7.62 (m, 2H), 8.15 (s, 1H), 8.23 (d, J = 7.8 Hz, 1H), 8.89 (s, 1H); ^{13}C NMR (acetone- d_6) δ 22.5, 23.2, 25.8, 26.5, 109.8, 119.5, 121.5, 121.8, 124.9, 128.3, 128.8, 131.1, 137.4, 142.4, 149.2 (one sp^3 carbon missing due to overlap); IR (neat, cm^{-1}) 3026, 2927; HRMS calcd for $\text{C}_{18}\text{H}_{18}\text{N}_2$: 262.1470. Found: 262.1475.

9-Methyl-3-*n*-octyl-9H-pyrido[3,4-*b*]indole (2c). The reaction mixture was chromatographed using 1:1 hexanes/EtOAc to afford a 93% yield of the indicated compound as a yellow oil: ^1H NMR (acetone- d_6) δ 0.87 (m, 3H), 1.25-1.40 (m, 10H), 1.82 (m, 2H), 2.94 (t, J = 7.8 Hz, 2H), 3.97 (s, 3H), 7.23 (m, 1H), 7.59 (dd, J = 4.5, 0.9 Hz, 2H), 7.91 (d, J = 0.9 Hz, 1H), 8.20 (dt, J = 8.1, 0.9 Hz, 1H), 8.87 (d, J = 0.9 Hz, 1H); ^{13}C NMR (acetone- d_6) δ 13.7, 28.4, 28.9, 29.4, 29.5, 29.6, 30.7, 32.0, 38.1, 109.7, 112.6, 119.3, 121.2, 121.8, 128.2, 128.8, 131.5, 135.9, 142.4, 151.4; IR (neat, cm^{-1}) 3055, 2924; HRMS calcd for $\text{C}_{20}\text{H}_{26}\text{N}_2$: 294.2096. Found: 294.2101.

3-Cyclohexyl-9-Methyl-9H-pyrido[3,4-*b*]indole (2d). The reaction mixture was chromatographed using 20:1 $\text{CHCl}_3/\text{CH}_3\text{OH}$ to afford an 87% yield of the indicated compound as a yellow solid: mp 129-130 $^\circ\text{C}$; ^1H NMR (CDCl_3) δ 1.36 (tt, J = 12.0, 3.2 Hz, 1H), 1.48 (qt, J = 12.8, 2.4 Hz, 2H), 1.65 (qd, J = 12.4, 2.8 Hz, 2H), 1.79 (d, J = 12.8 Hz, 1H), 1.91 (d, J = 13.2 Hz, 2H), 2.08 (d, J = 11.6 Hz, 2H), 2.91 (tt, J = 12.0, 3.2 Hz, 1H); ^{13}C NMR (CDCl_3) δ 26.3, 26.9, 29.4, 33.9, 46.5, 109.1, 111.1, 119.3, 121.2, 121.8, 128.2, 129.3, 130.8, 135.8, 142.2, 156.0; IR (neat, cm^{-1}) 2925, 2851; HRMS calcd for $\text{C}_{18}\text{H}_{20}\text{N}_2$: 264.1627. Found: 264.1632.

3-(2-Hydroxyethyl)-9-methyl-9H-pyrido[3,4-*b*]indole (2e). The reaction mixture was chromatographed using acetone to afford a 95% yield of the indicated compound as a white solid: mp 135-136 $^\circ\text{C}$; ^1H NMR (acetone- d_6) δ 3.13 (t, J = 6.4 Hz, 2H), 3.96 (t, J = 6.4 Hz, 2H), 3.99 (s, 3H), 7.27 (m, 1H), 7.61 (d, J = 4.0 Hz, 2H), 7.96 (s, 1H), 8.22 (d, J = 8.0 Hz, 1H), 8.88 (s, 1H); ^{13}C NMR (acetone- d_6) δ 29.6, 41.2, 63.1, 110.4, 114.2, 120.1, 121.7, 122.5, 129.1, 129.6,

132.1, 136.8, 143.1, 150.0; IR (neat, cm^{-1}) 3212, 2920; HRMS calcd for $\text{C}_{14}\text{H}_{14}\text{N}_2\text{O}$: 226.1106. Found: 226.1111.

3-(8-Methoxycarbonyl-1-octyl)-9-methyl-9H-pyrido[3,4-*b*]indole (2f).

The reaction mixture was chromatographed using 20:1 $\text{CHCl}_3/\text{CH}_3\text{OH}$ to afford a 95% yield of the indicated compound as a yellow oil, which crystallized upon standing at 0 °C overnight: mp 67-68 °C; ^1H NMR (CDCl_3) δ 1.25-1.40 (m, 8H), 1.60 (m, 2H), 1.80 (m, 2H), 2.29 (t, J = 7.5 Hz, 2H), 2.97 (t, J = 7.5 Hz, 2H), 3.65 (s, 3H), 3.90 (s, 3H), 7.26 (m, 1H), 7.42 (d, J = 7.8 Hz, 1H), 7.59 (dt, J = 7.8, 0.9 Hz, 1H), 7.80 (br s, 1H), 8.11 (d, J = 7.6 Hz, 1H), 8.79 (br s, 1H); ^{13}C NMR (CDCl_3) δ 25.2, 29.37, 29.43, 29.6, 31.0, 34.3, 51.7, 109.3, 119.5, 121.2, 122.0, 128.4, 129.4, 142.4, 174.6 (two sp^3 carbons are missing due to overlap; two unusual broad peaks are observed at 113.0 and 131.0 ppm, and two sp^2 carbons somehow are missing, even when the noise was very low. Using the 300 and 400 MHz NMR spectrometers or changing the relaxation time of the spectrometers gave similar incomplete spectra); IR (neat, cm^{-1}) 2926, 1735; Anal. calcd. for $\text{C}_{22}\text{H}_{28}\text{N}_2\text{O}_2$: C, 74.97; H, 8.01, N, 7.95. Found: C, 74.45; H, 8.13; N, 7.67; HRMS calcd for $\text{C}_{22}\text{H}_{28}\text{N}_2\text{O}_2$: 352.2151. Found: 352.2157.

3-(3-Cyanopropyl)-9-methyl-9H-pyrido[3,4-*b*]indole (2g). The reaction mixture was chromatographed using 20:1 $\text{CHCl}_3/\text{CH}_3\text{OH}$ to afford an 88% yield of the indicated compound as an off-white solid: mp 187-188 °C; ^1H NMR (CDCl_3) δ 2.20 (quintet, J = 7.2 Hz, 2H), 2.38 (t, J = 7.2 Hz, 2H), 3.10 (t, J = 7.2 Hz, 2H), 3.86 (s, 3H), 7.26 (dt, J = 8.4, 0.6 Hz, 1H), 7.41 (d, J = 8.4 Hz, 1H), 7.59 (m, 1H), 7.79 (s, 1H), 8.09 (d, J = 7.8 Hz, 1H), 8.77 (s, 1H); ^{13}C NMR (CDCl_3) δ 16.6, 26.0, 29.4, 36.5, 109.3, 113.6, 119.6, 119.9, 120.8, 121.9, 128.5, 129.3, 131.3, 142.2, 148.3; IR (neat, cm^{-1}) 3052, 2930, 2243; HRMS calcd for $\text{C}_{16}\text{H}_{15}\text{N}_3$: 249.1266. Found: 249.1270.

9-Methyl-9H-pyrido[3,4-*b*]indole (2h). The reaction mixture was chromatographed using 10:1 $\text{CHCl}_3/\text{CH}_3\text{OH}$ to afford a 41% yield of the indicated compound as a yellow solid: mp 104-106 °C (lit.⁴ mp 106-107 °C); ^1H NMR (CDCl_3) δ 3.84 (s, 3H), 7.26 (t, J = 7.6 Hz, 1H), 7.40 (d, J = 8.4 Hz, 1H), 7.58 (t, J

= 8.0 Hz, 1H), 7.90 (br s, 1H), 8.09 (d, J = 7.6 Hz, 1H), 8.46 (br s, 1H), 8.86 (br s, 1H); ^{13}C NMR (CDCl_3) δ 29.3, 109.2, 119.6, 121.0, 121.8, 128.2, 128.4, 131.8, 138.8, 141.7 (one unusual broad peak is observed at 114.5 ppm and one sp^2 carbon is missing due to overlap); IR (neat, cm^{-1}) 3050, 2926; HRMS calcd for $\text{C}_{12}\text{H}_{10}\text{N}_2$: 182.0844. Found: 182.0846.

9-Methoxymethyl-3-phenyl-9H-pyrido[3,4-*b*]indole (2i). The reaction mixture was chromatographed using 3:1 hexanes/EtOAc to afford a 100% yield of the indicated compound as a white solid: mp 114-115 °C; ^1H NMR (acetone- d_6) δ 3.30 (s, 3H), 5.90 (s, 2H), 7.34 (q, J = 7.6 Hz, 2H), 7.47 (t, J = 7.6 Hz, 2H), 7.62 (t, J = 7.6 Hz, 1H), 7.76 (d, J = 7.6 Hz, 1H), 8.22 (d, J = 8.0 Hz, 2H), 8.34 (d, J = 8.0 Hz, 1H), 8.68 (s, 1H), 9.14 (s, 1H); ^{13}C NMR (acetone- d_6) δ 55.5, 74.1, 110.6, 110.8, 120.6, 121.9, 126.5, 127.7, 128.6, 128.7, 130.0, 132.5, 136.2, 140.4, 142.0, 147.8; IR (neat, cm^{-1}) 3062, 1461; HRMS calcd for $\text{C}_{19}\text{H}_{16}\text{N}_2\text{O}$: 288.1263. Found: 288.1267.

9-Benzyl-3-phenyl-9H-pyrido[3,4-*b*]indole (2j). The reaction mixture was chromatographed using 4.5:1 hexanes/EtOAc to afford a 99% yield of the indicated compound as a white solid: mp 145-146 °C; ^1H NMR (CDCl_3) δ 5.53 (s, 2H), 7.17-7.20 (m, 2H), 7.20-7.30 (m, 3H), 7.30-7.58 (m, 6H), 8.09 (dd, J = 7.2, 1.5 Hz, 2H), 8.19 (d, J = 7.8 Hz, 1H), 8.38 (d, J = 0.6 Hz, 1H), 8.87 (d, J = 0.6 Hz, 1H); ^{13}C NMR (CDCl_3) δ 47.3, 110.1, 111.6, 120.2, 121.9, 122.2, 126.8, 127.0, 128.0, 128.1, 128.9, 129.0, 129.2, 130.0, 132.0, 136.2, 136.7, 140.7, 142.1, 148.1; IR (neat, cm^{-1}) 3059, 3030, 2936; HRMS calcd for $\text{C}_{24}\text{H}_{18}\text{N}_2$: 334.1470. Found: 334.1476.

5-Methyl-3-phenyl-5H-pyrido[4,3-*b*]indole (7a). The reaction mixture was chromatographed using 3:1 hexanes/EtOAc to afford a 92% yield of the indicated compound as a yellow solid: mp 106-107 °C (lit.³ mp 106-107 °C); ^1H NMR (CDCl_3) δ 3.89 (s, 3H), 7.34 (t, J = 7.6 Hz, 1H), 7.40-7.46 (m, 2H), 7.49-7.56 (m, 3H), 7.69 (s, 1H), 8.11 (d, J = 8.0 Hz, 2H), 8.17 (d, J = 8.0 Hz, 1H), 9.36 (s, 1H); ^{13}C NMR (CDCl_3) δ 29.1, 100.6, 108.9, 118.7, 120.6, 120.7, 121.3, 126.7,

127.3, 128.5, 128.8, 140.6, 141.5, 142.3, 146.1, 153.6; IR (neat, cm^{-1}) 3054, 1594; HRMS calcd for $\text{C}_{18}\text{H}_{14}\text{N}_2$: 258.1157. Found: 258.1161.

5-Methyl-3-*n*-octyl-5H-pyrido[4,3-*b*]indole (7c). The reaction mixture was chromatographed using 20:1 $\text{CHCl}_3/\text{CH}_3\text{OH}$ to afford an 87% yield of the indicated compound as a yellow oil: ^1H NMR (CDCl_3) δ 0.87 (t, J = 6.8 Hz, 3H), 1.20-1.45 (m, 10H), 1.82 (m, 2H), 2.95 (t, J = 8.0 Hz, 2H), 3.79 (s, 3H), 7.11 (s, 1H), 7.29 (m, 1H), 7.39 (d, J = 8.0 Hz, 1H), 7.49 (m, 1H), 8.10 (d, J = 8.0 Hz, 1H), 9.19 (s, 1H); ^{13}C NMR (acetone- d_6) δ 14.2, 22.7, 29.1, 29.3, 29.6, 30.7, 31.9, 39.2, 102.2, 108.8, 117.8, 120.4, 121.6, 126.3, 141.2, 141.9, 146.1, 158.3; IR (neat, cm^{-1}) 3052, 2924; HRMS calcd for $\text{C}_{20}\text{H}_{26}\text{N}_2$: 294.2096. Found: 294.2101.

3-Cyclohexyl-5-methyl-5H-pyrido[4,3-*b*]indole (7d). The reaction mixture was chromatographed using 20:1 $\text{CHCl}_3/\text{CH}_3\text{OH}$ to afford an 83% yield of the indicated compound as a yellow solid: mp 134-135 $^\circ\text{C}$; ^1H NMR (CDCl_3) δ 1.36 (tt, J = 12.0, 3.2 Hz, 1H), 1.48 (qt, J = 12.8, 2.4 Hz, 2H), 1.65 (qd, J = 12.4, 3.2 Hz, 2H), 1.79 (d, J = 12.4 Hz, 1H), 1.91 (dt, J = 13.2, 2.8 Hz, 2H), 2.07 (dd, J = 11.2, 1.6 Hz, 2H), 2.89 (tt, J = 12.0, 3.2 Hz, 1H); ^{13}C NMR (CDCl_3) δ 26.3, 26.8, 29.1, 33.6, 47.2, 100.4, 108.8, 117.9, 120.4, 120.5, 121.6, 126.3, 141.2, 141.8, 146.2, 162.7; IR (neat, cm^{-1}) 2924, 2851; HRMS calcd for $\text{C}_{18}\text{H}_{20}\text{N}_2$: 264.1627. Found: 264.1632.

3-(9-Hydroxy-1-nonyl)-5-methyl-5H-pyrido[4,3-*b*]indole (7e). The reaction mixture was chromatographed using 10:1 $\text{CHCl}_3/\text{CH}_3\text{OH}$ to afford a 72% yield of the indicated compound as a white solid: mp 120-121 $^\circ\text{C}$; ^1H NMR (CDCl_3) δ 1.28-1.45 (m, 10H), 1.55 (m, 2H), 1.81 (m, 2H), 1.92 (br s, 1H), 2.95 (t, J = 8.0 Hz, 2H), 3.63 (t, J = 6.8 Hz, 2H), 3.81 (s, 3H), 7.12 (s, 1H), 7.30 (t, J = 7.8 Hz, 1H), 7.40 (d, J = 8.0 Hz, 1H), 7.50 (dt, J = 8.0, 0.8 Hz, 1H), 8.11 (d, J = 8.0 Hz, 1H), 9.19 (s, 1H); ^{13}C NMR (CDCl_3) δ 25.8, 29.1, 29.4, 29.50, 29.53, 29.55, 30.6, 32.9, 39.1, 62.9, 102.2, 108.8, 117.8, 120.4, 120.5, 121.5, 126.3, 141.2, 141.8, 146.1, 158.3; IR (neat, cm^{-1}) 3199, 2917; HRMS calcd for $\text{C}_{21}\text{H}_{28}\text{N}_2\text{O}$: 324.2202. Found: 324.2206.

3-(8-Methoxycarbonyl-1-octyl)-5-methyl-5H-pyrido[4,3-b]indole (7f).

The reaction mixture was chromatographed using 20:1 CHCl₃/CH₃OH to afford an 88% yield of the indicated compound as a yellow oil: ¹H NMR (CDCl₃) δ 1.25-1.45 (m, 8H), 1.61 (m, 2H), 1.82 (m, 2H), 2.29 (t, *J* = 7.5 Hz, 2H), 2.94 (t, *J* = 7.8 Hz, 2H), 3.65 (s, 3H), 3.80 (s, 3H), 7.11 (s, 1H), 7.29 (d, *J* = 7.8 Hz, 1H), 7.39 (d, *J* = 7.5 Hz, 1H), 7.49 (t, *J* = 7.5 Hz, 1H), 8.10 (d, *J* = 7.5 Hz, 1H), 9.19 (s, 1H); ¹³C NMR (CDCl₃) δ 25.2, 29.2, 29.3, 29.4, 29.6, 29.7, 30.8, 34.3, 39.3, 51.7, 102.3, 109.0, 118.0, 120.5, 120.6, 121.7, 126.5, 141.3, 142.1, 146.3, 158.5, 174.6; IR (neat, cm⁻¹) 2927, 1734; HRMS calcd for C₂₂H₂₈N₂O₂: 352.2151. Found: 352.2157.

5-Methyl-5H-pyrido[4,3-b]indole (7g). The reaction mixture was chromatographed using 10:1 CHCl₃/CH₃OH to afford a 43% yield of the indicated compound as a yellow oil: ¹H NMR (CDCl₃) δ 3.80 (s, 3H), 7.28 (br s, 1H), 7.32 (dt, *J* = 7.8, 0.9 Hz, 1H), 7.42 (d, *J* = 8.1 Hz, 1H), 7.53 (dt, *J* = 8.1, 0.9 Hz, 1H), 8.13 (d, *J* = 7.8 Hz, 1H), 8.60 (br s, 1H), 9.30 (br s, 1H); ¹³C NMR (CDCl₃) δ 29.3, 109.2, 120.8, 120.9, 121.6, 127.1, 141.1, 142.7, 144.9, 145.2, 145.3 (one sp² carbon missing due to overlap); IR (neat, cm⁻¹) 3045, 2930; HRMS calcd for C₁₂H₁₀N₂: 182.0844. Found: 182.0846.

3-(2-Benzofuranyl)-5-methyl-5H-pyrido[4,3-b]indole (7h). The reaction mixture was chromatographed using 3:1 hexanes/EtOAc to afford a 95% yield of the indicated compound as a yellow solid: mp 167-168 °C; ¹H NMR (CDCl₃) δ 3.83 (s, 1H), 7.25 (t, *J* = 7.2 Hz, 1H), 7.31 (t, *J* = 7.2 Hz, 2H), 7.38 (d, *J* = 8.0 Hz, 1H), 7.45 (s, 1H), 7.50 (t, *J* = 8.0 Hz, 1H), 7.56 (d, *J* = 8.0 Hz, 1H), 7.64 (d, *J* = 7.8 Hz, 1H), 7.83 (s, 1H), 8.11 (d, *J* = 7.8 Hz, 1H), 9.27 (s, 1H); ¹³C NMR (CDCl₃) δ 29.2, 100.1, 104.1, 109.1, 111.3, 119.0, 120.7, 120.8, 121.4, 121.6, 123.1, 124.8, 126.9, 129.3, 141.6, 142.7, 144.9, 145.5, 155.2, 156.4; IR (neat, cm⁻¹) 3058, 2935; HRMS calcd for C₂₀H₁₄N₂: 298.1106. Found: 298.1111.

5-Methoxymethyl-3-phenyl-5H-pyrido[4,3-b]indole (7i). The reaction mixture was chromatographed using 3:1 hexanes/EtOAc to afford an 80% yield of the indicated compound as a white solid: mp 101-102 °C; ¹H NMR (CDCl₃) δ

3.31 (s, 3H), 5.68 (s, 2H), 7.35 (m, 1H), 7.41 (m, 1H), 7.48-7.58 (m, 4H), 7.81 (d, $J = 0.4$ Hz, 1H), 8.09 (m, 2H), 8.14 (d, $J = 8.0$ Hz, 1H), 9.35 (s, 1H); ^{13}C NMR (CDCl_3) δ 56.4, 74.2, 101.3, 109.8, 119.3, 120.8, 121.6, 121.9, 127.1, 127.3, 128.6, 128.8, 140.4, 141.1, 142.6, 146.2, 154.2; IR (neat, cm^{-1}) 3057, 1596; HRMS calcd for $\text{C}_{19}\text{H}_{16}\text{N}_2\text{O}$: 288.1263. Found: 288.1267.

5-Benzyl-3-phenyl-5H-pyrido[4,3-b]indole (7j). The reaction mixture was chromatographed using 4:1 hexanes/EtOAc to afford a 90% yield of the indicated compound as a white solid: mp 154-155 °C; ^1H NMR (CDCl_3) δ 5.52 (s, 2H), 7.15 (m, 2H), 7.23-7.30 (m, 3H), 7.32-7.41 (m, 3H), 7.42-7.50 (m, 3H), 7.65 (s, 1H), 8.04 (dd, $J = 7.2, 1.5$ Hz, 2H), 8.18 (d, $J = 7.5$ Hz, 1H), 9.39 (s, 1H); ^{13}C NMR (CDCl_3) δ 46.8, 101.2, 109.7, 119.1, 121.0, 121.2, 121.8, 126.6, 127.1, 127.5, 128.1, 128.7, 129.0, 129.2, 136.4, 140.7, 141.4, 142.8, 146.3, 154.1; IR (neat, cm^{-1}) 3059, 3030, 2928; HRMS calcd for $\text{C}_{24}\text{H}_{18}\text{N}_2$: 334.1470. Found: 334.1476.

3-Phenyl-5H-pyrido[4,3-b]indole (7k). The reaction mixture was chromatographed using 2:1 hexanes/EtOAc to afford a 49% yield of the indicated compound as a yellow solid: mp 272-273 °C; ^1H NMR ($\text{DMSO}-d_6$) δ 7.27 (t, $J = 7.6$ Hz, 1H), 7.41 (t, $J = 8.0$ Hz, 1H), 7.44-7.55 (m, 3H), 7.58 (d, $J = 8.0$ Hz, 1H), 7.96 (s, 1H), 8.18 (d, $J = 7.2$ Hz, 2H), 8.24 (d, $J = 8.0$ Hz, 1H), 9.41 (s, 1H), 11.78 (s, 1H); ^{13}C NMR ($\text{DMSO}-d_6$) δ 102.3, 111.5, 112.3, 118.7, 120.1, 120.7, 126.6, 126.7, 128.3, 128.7, 139.9, 140.2, 142.4, 144.9, 151.7; IR (neat, cm^{-1}) 3415, 3021; HRMS calcd for $\text{C}_{17}\text{H}_{12}\text{N}_2$: 244.1001. Found: 244.1004.

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