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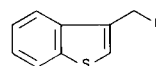
Received May 10, 1979

The reductive alkylation of 3-aminomethylbenzo[*b*]thiophene by the Eschweiler-Clarke (formaldehyde-formic acid) method and of 3- $\beta$ -aminoethylbenzo[*b*]thiophene by the Borch (formaldehyde-cyanoborohydride) method proceeded in good yields. However, the Eschweiler-Clarke reaction with 3- $\beta$ -aminoethylbenzo[*b*]thiophene gave the Pictet-Spengler cyclized product, *N*-methyl-1,2,3,4-tetrahydrobenzo[*b*]thieno[2,3*c*]pyridine. Mechanistic aspects of the latter reaction were investigated.

*J. Heterocyclic Chem.*, **16**, 1321 (1979).

In 1968 (2) we reported that treatment of the sulfur isostere of tryptamine (**1e**) with formaldehyde-formic acid under Eschweiler-Clarke (3) conditions afforded the expected *N,N*-dimethylated derivative **1g**. We were surprised to note that this compound exhibited a biphasic response to pentobarbital sedation in rabbits, in contrast to the linear response obtained with 3- $\beta$ -aminoethylindoles and 3- $\beta$ -aminoethylbenzo[*b*]thiophenes (2). We have since reinvestigated this reaction and found that the product **1g** was incorrectly characterized, and it has now been identified as the benzo[*b*]thiophene analog of *N*-methyl-tetrahydro- $\beta$ -carboline **2b**. Apparently the Pictet-Spengler (4) cyclization *via* the intermediate imminium ion occurred more rapidly than reduction of the ion with formic acid under the conditions of the reaction. By comparison, Lewis, *et al.* (5), have reported that the Eschweiler-Clarke reaction of 3-aminomethylbenzo[*b*]thiophene (**1i**) afforded the expected *N,N*-dimethylated derivative **1j**. This prompted us to investigate the scope and limitations of the condensation and reductive alkylation of 3-aminoalkylbenzo[*b*]thiophenes with formaldehyde. The products that were obtained were of interest to us as a continuation of our pharmacological studies with biologically active benzo[*b*]thiophenes (6).

A convenient source of the 3-substituted benzo[*b*]thiophene **1a** was by polyphosphoric acid dehydrative cyclization of ethyl 4-(phenylthio)acetoacetate. Treatment of **1a** with ammonia or methylamine in ethylene glycol at room temperature afforded the corresponding amides **1c-d** which were reduced with diborane in tetrahydrofuran to the corresponding amines **1e-f**. The dimethylamino derivative **1g** was prepared from **1b** by reduction of the dimethylamide with lithium aluminum hydride (8). 3-Aminomethylbenzo[*b*]thiophene **1i** was prepared from 3-chloromethylbenzo[*b*]thiophene **1h** by the Gabriel synthesis (5), whilst displacement of the chloro group in **1h** by dimethylamine in methanol afforded **1j** in 61% yield.

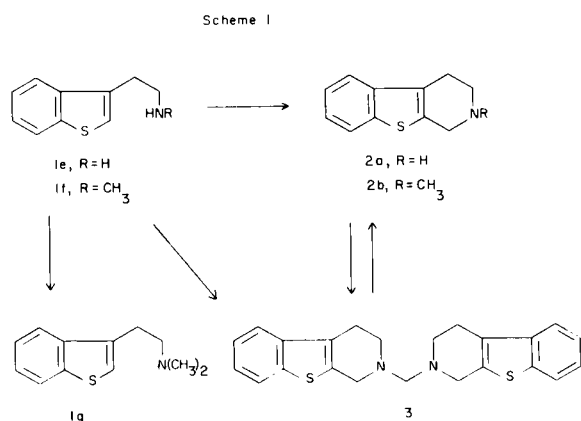


- 1a) R = CO<sub>2</sub>Et
- b) R = CO<sub>2</sub>H
- c) R = CONH<sub>2</sub>
- d) R = CONHCH<sub>3</sub>
- e) R = CH<sub>2</sub>NH<sub>2</sub>
- f) R = CH<sub>2</sub>NHCH<sub>3</sub>
- g) R = CH<sub>2</sub>N(CH<sub>3</sub>)<sub>2</sub>
- h) R = Cl
- i) R = NH<sub>2</sub>
- j) R = N(CH<sub>3</sub>)<sub>2</sub>

The condensations and reductive alkylation of benzo[*b*]thiophenes **1e** and **1f** with formaldehyde are summarized in Scheme 1. Treatment of **1e** with formaldehyde/formic acid under Eschweiler-Clarke conditions afforded the Pictet-Spengler cyclized product **2b** in 91% yield. No trace of the *N,N*-dimethyl derivative **1g** was detected. Presumably this reaction proceeded *via* the intermediate diamine **3**, since **3** was formed in 97% yield upon reaction of **1e** with formaldehyde in aqueous acetic acid. The reaction of this stable diamine **3** with formic acid yielded a mixture of **2a** and the *N*-methylated product **2b**. This product (**2b**) was isolated in 95% yield after heating a mixture of **3** in aqueous formic acid containing formaldehyde. The diamine **3** was converted into the amine **2a** (81%) by distilling a 1*M* hydrochloric acid solution of **3** to half its original volume. The amine **2a** was readily reconverted into the diamine **3** by addition of **2a** to acidic formaldehyde.

Not surprisingly, treatment of the monomethyl amine **1f** with formaldehyde in aqueous formic acid or acetic acid afforded the Pictet-Spengler cyclized benzo[*b*]thiophene derivative **2b** in high yield.

For comparison with our work, we repeated the study by Lewis, *et al.* (5), and confirmed that the Eschweiler-Clarke reaction of the amine **1i** yielded the *N,N*-dimethyl derivative **1j** (94%) and no trace of a possible 5-membered



ring cyclized product.

An alternative to the Eschweiler-Clarke method for the synthesis of tertiary methylated amines is the formaldehyde-cyanoborohydride procedure which was first described by Borch (9). The latter method requires milder conditions and we found its application to **1e** and **1f** afforded the *N,N*-dimethylated derivative **1g** in good yield and with no trace of cyclized material. These reactions are summarized in Table I.

It is apparent from these reactions that one equivalent of formaldehyde condenses readily, on heating under acidic conditions, with 3-β-aminoethylbenzo[b]thiophene to produce the cyclized β-carboline analog, and this in turn is converted with excess formaldehyde to the methylenediamine **3**. Acid treatment causes **3** to dissociate to **2a** and an iminium ion, which is reduced by formic acid to the *N*-methyl derivative **2b**. Additional formaldehyde in the presence of formic acid also converts **2a** to **2b**, so that **3**, in the presence of formaldehyde and formic acid, is converted quantitatively to **2b**. The ready conversion of 3-β-methylaminoethylbenzo[b]thiophene (**1f**) to **2b** by warming with formaldehyde in dilute acid confirms this interpretation.

## EXPERIMENTAL

Melting points were determined on a "uni-melt" Thomas Hoover capillary melting point apparatus and are uncorrected. Infrared spectra were obtained with a Varian T60A spectrometer using tetramethylsilane as an internal standard. In aqueous solution, TMS was used as an internal standard. Mass spectral analyses were performed on a Varian MAT CH7 at 70 eV ionization potential. Eastman chromatogram sheets (13181 Silica gel with fluorescent indicator No. 6060) were used for thin layer chromatography. Elemental analyses were performed by Midwest Microlab, Indianapolis.

### Ethyl 4-(Phenylthio)acetoacetate.

Ethyl 4-chloroacetoacetate (164.6 g., 1 mole) (Aldrich) was added dropwise to a stirred solution of benzenethiol (110.4 g., 1 mole) in pyridine (120 ml.). The mixture was stirred for one hour followed by addition of ether (400 ml.) and water (300 ml.). The ethereal layer was washed with 1*M* hydrochloric acid (4 × 200 ml.) and dried (magnesium sulfate). Evaporation of the solvent afforded a light yellow oil (225 g., 95%) whose nmr and ir spectra were identical to those of a commercial sample (Parish) of ethyl 4-(phenylthio)acetoacetate; ir (liquid film):  $\nu$  1725 (broad, C=O)  $\text{cm}^{-1}$ ; nmr (deuteriochloroform):  $\delta$  1.23 (t, 3H, ester  $\text{CH}_3$ ), 3.58 (s, 2H,  $\text{CH}_2\text{CO}_2\text{Et}$ ), 3.78 (s, 2H,  $\text{SCH}_2$ ), 4.13 (q, 2H, ester  $\text{CH}_2$ ), 7.23 (m, 5H, ArH) ppm

### Ethyl 3-Benzo[b]thienylacetate (**1a**).

This compound was prepared by modification of the procedure used by Dann and Kokorudz (7). A 3-necked 2 liter round bottom flask, fitted with a mechanical stirrer and a condenser and containing polyphosphoric acid (800 g.), was immersed in an oil bath maintained at 115°. Ethyl 4-(phenylthio)acetoacetate (160 g., 0.67 mole) in xylene (300 ml.) was added to the vigorously stirred polyphosphoric acid. After 2.5 hours the mixture was added to ice and extracted twice with xylene. The combined xylene extracts were dried (magnesium sulfate) and evaporated under pressure. The remaining dark brown oil was distilled and afforded the desired product (**1a**) as a pale yellow oil (88 g., 60%), b.p. 123-124°/0.3 mm (lit. (7) b.p. 130-145°/0.4 mm). A portion was redistilled, b.p. 150-151°/3 mm; ir (liquid film):  $\nu$  1740 (C=O)  $\text{cm}^{-1}$ ; nmr (deuteriochloroform):  $\delta$  1.20 (t, 3H, ester  $\text{CH}_3$ ), 3.82 (s, 2H, Ar $\text{CH}_2$ ), 4.15 (q, 2H, ester  $\text{CH}_2$ ), 7.1-8.0 (m, 5H, ArH) ppm; ms: *m/e* 220 ( $M^+$ ). 3-Benzo[b]thienylacetamide (**1c**).

A solution (220 ml.) of ethylene glycol saturated with ammonia was added to a solution of ethyl 3-benzo[b]thienylacetate (11.0 g., 50 mmoles) in methanol (55 ml.). After 58 hours at room temperature, the mixture was diluted with water (600 ml.), affording the amide **1c** (8.9 g., 93%) as colorless flakes, m.p. 172-173° (lit. (2) m.p. 173-174°) (from aqueous

Table I  
Reaction of 3-β-Aminoethylbenzo[b]thiophenes with Formaldehyde under Acidic and Reducing Conditions

Starting Material	Reagents	Product	% Yield
<b>1e</b>	Formaldehyde-Formic Acid	<b>2b</b>	91
<b>1e</b>	Formaldehyde-Acetic Acid	<b>3</b>	97
<b>1e</b>	Formaldehyde-Sodium Cyanoborohydride	<b>1g</b>	87
<b>3</b>	Formic Acid	<b>2a + 2b</b>	
<b>3</b>	Formaldehyde-Formic Acid	<b>2b</b>	95
<b>3</b>	Hydrochloric Acid	<b>2a</b>	81
<b>2a</b>	Formaldehyde-Acetic Acid	<b>3</b>	90
<b>1f</b>	Formaldehyde-Formic Acid	<b>2b</b>	94
<b>1f</b>	Formaldehyde-Acetic Acid	<b>2b</b>	93
<b>1f</b>	Formaldehyde-Sodium Cyanoborohydride	<b>1g</b>	84

ethanol): ir (potassium bromide):  $\nu$  1645, 1630 (C=O), 3300, 3110 (NH<sub>2</sub>) cm<sup>-1</sup>; nmr (hexadeuteriodimethylsulfoxide):  $\delta$  3.65 (s, 2H, CH<sub>2</sub>), 6.92 (s, 1H, NH), 8.0-7.1 (m, 6H, NH and ArH) ppm.

#### *N*-Methyl-3-benzo[*b*]thienylacetamide (**1d**).

The previous procedure was repeated, but methylamine was used in place of ammonia. The reaction afforded the amide **1d** (86%) as colorless needles, m.p. 126-127° (lit. (2) m.p. 110-111°) (from aqueous ethanol); ir (potassium bromide):  $\nu$  1635, 1550 (C=O) 3250 (NH) cm<sup>-1</sup>; nmr (deuteriochloroform):  $\delta$  2.67 (d, 3H, CH<sub>3</sub>), 3.77 (s, 2H, CH<sub>2</sub>), 5.87 (s, 1H, NH), 7.2-8.0 (m, 5H, ArH).

*Anal.* Calcd. C<sub>11</sub>H<sub>11</sub>NOS: C, 64.36; H, 5.40; N, 6.82; M.W. 205. Found: C, 64.31; H, 5.65; N, 6.81; *m/e* 205 (M<sup>+</sup>), 147 (base, M<sup>+</sup> - CONHMe).

#### 3- $\beta$ -Aminoethylbenzo[*b*]thiophene (**1e**).

Under a nitrogen atmosphere, 1*M* borane in tetrahydrofuran (50 ml., 50 mmoles) was combined with **1c** (3.82 g., 20 mmoles) in dry tetrahydrofuran (100 ml.). The solution was stirred and heated under reflux for 4 hours and then quenched by dropwise addition of 6*N* hydrochloric acid (25 ml.). Tetrahydrofuran was evaporated from the mixture *in vacuo*. The residual mixture was basified with 1*M* sodium hydroxide (200 ml.) and extracted thrice with ether. The combined ethereal extracts were dried (sodium sulfate) and added to ethereal hydrogen chloride, yielding the desired amine **1e** as a hydrochloride salt (3.70 g., 87%), colorless spikes, m.p. 224-225° (lit. (2) m.p. 220-221°) (from acetonitrile-ethanol): ir (potassium bromide):  $\nu$  2930 (broad), 1575 (R<sub>2</sub>NH) cm<sup>-1</sup>; nmr (hexadeuteriodimethylsulfoxide):  $\delta$  3.23 (m, 4H, CH<sub>2</sub>-CH<sub>2</sub>), 7.2-8.2 (m, 5H, ArH), 8.47 (s (broad), 3H, R<sub>2</sub>NH) ppm.

*Anal.* Calcd. for C<sub>10</sub>H<sub>12</sub>ClNS: C, 56.19; H, 5.66; N, 6.55. Found: C, 55.94; H, 5.75; N, 6.32.

#### 3- $\beta$ -Methylaminoethylbenzo[*b*]thiophene (**1f**).

By the previous method, **1d** (5.50 g., 27 mmoles) was treated with 1*M* borane (65 mmoles). The reaction mixture was worked up after 6 hours, affording the desired amine **1f** hydrochloride (5.20 g., 85%) as colorless needles, m.p. 168-169° (lit. (8) m.p. 163-164°) (from acetonitrile); ir (potassium bromide):  $\nu$  2420, 1570 (H<sub>2</sub>N<sup>+</sup>) cm<sup>-1</sup>; nmr (deuterium oxide):  $\delta$  2.93 (s, 3H, CH<sub>3</sub>), 3.40 (s, 4H, CH<sub>2</sub>-CH<sub>2</sub>), 7.3-8.1 (m, 5 H, ArH) ppm.

*Anal.* Calcd. for C<sub>11</sub>H<sub>14</sub>ClNS: C, 58.01; H, 6.20; N, 6.15. Found: C, 58.22; H, 6.25; N, 6.05.

#### 3- $\beta$ -Dimethylaminoethylbenzo[*b*]thiophene (**1g**).

Compound **1g** was prepared from 3-benzo[*b*]thienylacetic acid by the method of Champan, *et al.* (8). The hydrochloride salt of **1g** was recrystallized from isopropanol, affording colorless crystals, m.p. 189° (lit. (8) m.p. 184-185°); ir (potassium bromide):  $\nu$  2500 (broad, R<sub>2</sub>NH) cm<sup>-1</sup>; nmr (deuterium oxide): 3.10 (s, 6H, CH<sub>3</sub>), 3.50 (m, 4H, CH<sub>2</sub>-CH<sub>2</sub>), 7.3-8.2 (m, 5H, ArH). Free base: nmr (deuteriochloroform):  $\delta$  2.32 (s, 6H, CH<sub>3</sub>), 2.4-3.2 (m, 4H, CH<sub>2</sub>-CH<sub>2</sub>), 6.9-8.0 (m, 5H, ArH) ppm; tlc (acetonitrile tetrahydrofuran 3:1): R<sub>f</sub> 0.25.

*Anal.* Calcd. for C<sub>12</sub>H<sub>16</sub>ClNS: C, 59.61; H, 6.67; N, 5.79; M.W. 241. Found: C, 59.49; H, 6.47; N, 5.53; *m/e* 205 (M<sup>+</sup>-HCl), 58 (base, CH<sub>2</sub>NMe<sub>2</sub>).

Using the method of Borch and Hassid (9), to a stirred solution of **1e** hydrochloride (508 mg., 2.38 mmoles) and 37% aqueous formaldehyde (2 ml.) in acetonitrile (15 ml.) was added sodium cyanoborohydride (0.5 g.). The reaction was stirred for 15 minutes and then glacial acetic acid (1.5 ml.) was added dropwise over a period of 75 minutes. The solvent was evaporated at reduced pressure and 1*M* sodium hydroxide (40 ml.) was added to residue. The resulting mixture was extracted thrice with ether. The combined ethereal extracts were washed with 1*M* sodium hydroxide and then extracted with 1*M* hydrochloric acid (3  $\times$  15 ml.). The acid extracts were combined and basified with 5*N* sodium hydroxide and then extracted thrice with ether. The combined ether extracts were dried (sodium sulfate) and the solvent was evaporated, affording a colorless oil (499 mg., 87%) whose physical and spectral characteristics were identical to those of **1g**.

c)

By the same method, **1f** hydrochloride was converted to **1g** in 84% yield.

#### *N,N'*-Methylenebis(1,2,3,4-tetrahydrobenzo[*b*]thieno[2,3-*c*]pyridine) (**3**).

a)

A mixture of **1e** hydrochloride (502 mg., 2.35 mmoles), water (2 ml.), acetic acid (2 ml.) and 37% aqueous formaldehyde (2 ml.) was heated at 100° for one hour. The solution was cooled and added to 1*M* sodium hydroxide (50 ml.), affording colorless crystals (446 mg., 97%), m.p. 167-170° dec (from acetonitrile); nmr (deuteriochloroform):  $\delta$  2.63-3.23 (m, 8H, CH<sub>2</sub>-CH<sub>2</sub>), 3.42 (s, 2H, N-CH<sub>2</sub>-N), 3.90 (m, 4H, Ar-CH<sub>2</sub>-N), 7.0-7.9 (m, 8H, ArH) ppm; tlc (acetonitrile/tetrahydrofuran 3:1): R<sub>f</sub> 0.57.

*Anal.* Calcd. for C<sub>28</sub>H<sub>22</sub>N<sub>2</sub>S<sub>2</sub>: C, 70.73; H, 5.68; N, 7.17; M.W. 390. Found: C, 70.81; H, 5.81; N, 7.26; *m/e* 390 (M<sup>+</sup>), 202 (base peak).

b)

A mixture of **2a** hydrochloride (200 mg., 0.886 mmole), water (10 drops), acetic acid (10 drops) and 37% aqueous formaldehyde (10 drops) was heated on a steam bath for 2 minutes and added to 1*M* sodium hydroxide (20 ml.), affording colorless crystals (155 mg., 90%) whose physical and spectral characteristics were identical to those of **3**.

#### *N*-Methyl-1,2,3,4-tetrahydrobenzo[*b*]thieno[2,3-*c*]pyridine (**2b**).

a)

A mixture of **1f** hydrochloride (504 mg., 2.21 mmoles), water (2 ml.), acetic acid (2 ml.), and 37% aqueous formaldehyde (2 ml.) was heated at 100° for one hour. The solution was added to chilled 1*M* sodium hydroxide (50 ml.), affording colorless cubes (420 mg., 93%), m.p. 67-68° (sublimed); nmr (deuteriochloroform):  $\delta$  2.50 (s, 3H, CH<sub>3</sub>), 2.83 (m, 4H, CH<sub>2</sub>-CH<sub>2</sub>), 3.68 (m, 2H, ArCH<sub>2</sub>N), 7.1-7.9 (m, 4H, ArH); tlc (acetonitrile/tetrahydrofuran 3:1): R<sub>f</sub> 0.41.

*Anal.* Calcd. for C<sub>12</sub>H<sub>13</sub>NS: C, 70.89; H, 6.44; N, 6.89; M.W. 203. Found: C, 70.97; H, 6.62; N, 6.89; *m/e* 203 (M<sup>+</sup>), 160 (base, M<sup>+</sup> - CH<sub>2</sub>NCH<sub>3</sub>).

A solution of **2b** in concentrated hydrochloric acid was evaporated *in vacuo*. The residue was triturated over acetone and recrystallized from isopropanol, affording **2b** hydrochloride as colorless crystals, m.p. 259°; ir (potassium bromide):  $\nu$  2450 (R<sub>2</sub>NH) cm<sup>-1</sup>; nmr (deuterium oxide): 2.9-3.9 (m, 4H, ArCH<sub>2</sub>CH<sub>2</sub>N), 3.20 (s, 3H, NCH<sub>3</sub>), 3.44 (m, 2H, ArCH<sub>2</sub>N), 7.4-8.2 (m, 4H, ArH).

*Anal.* Calcd. for C<sub>12</sub>H<sub>14</sub>ClNS: C, 60.11; H, 5.88; N, 5.84. Found: C, 59.87; H, 5.77; N, 5.80.

b)

A mixture of **1f** hydrochloride (507 mg., 2.23 mmoles), water (2 ml.), formic acid (2 ml.), and 37% aqueous formaldehyde (2 ml.) was heated at 100° under reflux for one hour. The solution was added to 1*M* sodium hydroxide (70 ml.) affording colorless crystals (424 mg., 94%) whose physical and spectral characteristics were identical to those of **2b**.

c)

A mixture of **3** (515 mg., 1.32 mmoles), water (2 ml.), formic acid (2 ml.) and 37% aqueous formaldehyde (2 ml.) was heated at 100° under reflux for 3 hours. The solution was added to 1*M* sodium hydroxide (60 ml.) affording colorless cubes (507 mg., 95%) whose physical and spectral characteristics were identical to those of **2b**.

d)

A mixture of **1e** hydrochloride (250 mg., 1.177 mmole), water (1 ml.), formic acid (1 ml.) and 37% aqueous formaldehyde (1 ml.) was heated at 100° for 3 hours. The solution was added to 1*M* sodium hydroxide (30 ml.) affording colorless cubes (217 mg., 91%) whose physical and spectral characteristics were identical to those of **2b**.

#### 1,2,3,4-Tetrahydrobenzo[*b*]thieno[2,3-*c*]pyridine (**2a**).

a)

A solution of **3** (525 mg., 1.34 mmole) in 1*M* hydrochloric acid (100 ml.)

was distilled to half volume. The remaining solution was basified with 5M sodium hydroxide (25 ml.) and extracted thrice with ether. The combined ethereal extracts were dried (sodium sulfate) and added to ethereal hydrogen chloride, affording colorless crystals (490 mg., 81%) of **2a** hydrochloride, m.p. 257-258° (lit. (10) m.p. 255-259°, from isopropanol).

*Anal.* Calcd. for C<sub>11</sub>H<sub>12</sub>ClNS: C, 58.52; H, 5.36; N, 6.21. Found: C, 58.77; H, 5.31; N, 6.11.

Treatment of **2a** hydrochloride with 1M sodium hydroxide liberated the free base; ir (liquid film):  $\nu$  3250 (NH) cm<sup>-1</sup>; nmr (deuteriochloroform):  $\delta$  1.72 (s, 1H, NH), 2.52-3.45 (m, 4H, CH<sub>2</sub>-CH<sub>2</sub>), 4.05 (m, 2H, ArCH<sub>2</sub>N), 7.05-7.98 (m, 4H, ArH); ms: m/e 189 (M<sup>+</sup>), 160 (base, M<sup>+</sup> - HNCH<sub>2</sub>).

b)

A solution of **3** (150 mg.) in formic acid (1 ml.) was heated under reflux at 100° for 3 hours. The solution was added to 1M sodium hydroxide (30 ml.) and extracted thrice with ether. The combined ethereal extracts were dried (sodium sulfate). Tlc showed that the solution contained 2 compounds with R<sub>f</sub> values corresponding to those of **2a** and **2b**. The ether solution was evaporated at reduced pressure and the nmr (deuteriochloroform) of the residue showed that the peaks for ArCH<sub>2</sub>N of **2b** ( $\delta$  3.68 ppm) and **2a** ( $\delta$  4.05 ppm) were in approximately equal ratio.

3-Aminomethylbenzo[*b*]thiophene (**1i**).

Compound **1i** was prepared from 3-chloromethylbenzo[*b*]thiophene (11) by the Gabriel synthesis (5). The hydrochloride salt of **1i** was recrystallized from isopropanol, affording colorless crystals, m. 253° (lit. (5) m.p. 259-260°); ir (potassium bromide):  $\nu$  2870 (broad), 1585, 1480, (NH) cm<sup>-1</sup>; nmr (deuterium oxide):  $\delta$  4.63 (s, 2H, CH<sub>2</sub>), 7.3-8.2 (m, 5H, ArH) ppm.

*Anal.* Calcd. for C<sub>8</sub>H<sub>10</sub>ClNS: C, 54.13; H, 5.05; N, 7.01. Found: C, 54.40; H, 4.97; N, 6.87.

3-Dimethylaminomethylbenzo[*b*]thiophene (**1j**).

a)

A solution of 3-chloromethylbenzo[*b*]thiophene (11) (6 g., 33 mmoles) in methanol (100 ml.) saturated with dimethylamine was stirred overnight and evaporated. The residue was treated with 1M sodium hydroxide (100 ml.) and extracted thrice with ether. The combined ethereal extracts were evaporated and the residue was taken up in ether, dried (sodium sulfate) and added to ethereal hydrogen chloride. The resultant white precipitate was recrystallized from acetonitrile, giving the desired amine **1j**

hydrochloride (4.6 g., 61%) as colorless plates, m.p. 215-216° (lit. (5) m.p. 218-222°); ir (potassium bromide): 2600 (broad, NH) cm<sup>-1</sup>; nmr (deuterium oxide):  $\delta$  2.98 (s, 6H, CH<sub>3</sub>), 4.57 (s, 2 H, CH<sub>2</sub>), 7.3-8.1 (m, 5H, ArH).

*Anal.* Calcd. for C<sub>11</sub>H<sub>14</sub>ClNS: C, 58.01; H, 6.20; N, 6.15. Found: C, 58.25; H, 6.34; N, 6.36.

b)

A mixture of 3-aminomethylbenzo[*b*]thiophene hydrochloride (**5**) (258 mg., 1.29 mmoles), water (1 ml.), formic acid (1 ml.) and 37% aqueous formaldehyde (1 ml.) was heated under reflux for 100° for 3 hours. The solution was added to 1M sodium hydroxide (30 ml.) and extracted with ether. The ether extracts were combined and dried (sodium sulfate). Addition of the solution to ethereal hydrogen chloride afforded an oil which, upon drying, crystallized to colorless plates (275 mg., 94%) whose physical and spectral characteristics were identical to those of **1j** hydrochloride.

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