A Novel Heterocyclic Ring System

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The synthesis of a novel 2',3'-dihydrospiro(benzofuran-2(3*H*),4'(1'*H*)isoquinoline] ring system (**IV**) by a nucleophilic aromatic fluoride displacement-cyclization is described. Preparation of various derivatives of **IV** as well as the precursor 4-(2-fluorobenzyl)-1,2,3,4-tetrahydro-4-isoquinolinols is also described.

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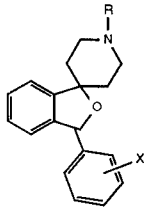
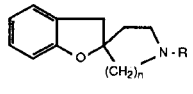
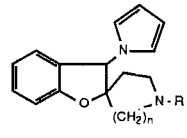
The 3-aryl-1,3-dihydrospiro[isobenzofuran-1(3H),4'-piperidine]s **I** have demonstrated marked activity in pharmacological tests indicative of antidepressant [1], neuroleptic [2], diuretic [3] and antihypertensive [4] utility. This diverse biological activity prompted us to synthesize related spiro[benzofuranpiperidine]s **II** [5] and **III** [6], utilizing a nucleophilic displacement of aromatic fluorine.



I

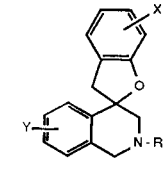


II, n = 1, 2



III, n = 1, 2

We have recently reported an additional example of the application of this reaction as a method of synthesis of pyrrolo[2,1-*c*][1,4]benzoxazepines [7]. We now report the synthesis of another novel heterocyclic system, 2',3'-dihydrospiro[benzofuranisoquinoline]s **IV**, utilizing nucleophilic displacement of aromatic fluorine. The intermediate *N*-benzyl or *N*-methyl-2,3-dihydro-4(1*H*)-isoquinolones **2** were synthesized by modified literature procedures. The *N*-methylisoquinolone **2b** was obtained by base hydrolysis and subsequent acidic decarboxylation of the β-keto ester **1b**, which was obtained by Dieckmann cyclization of the diester precursor, obtained from condensation of sarcosine ethyl ester and methyl α-bromo toluate [10].



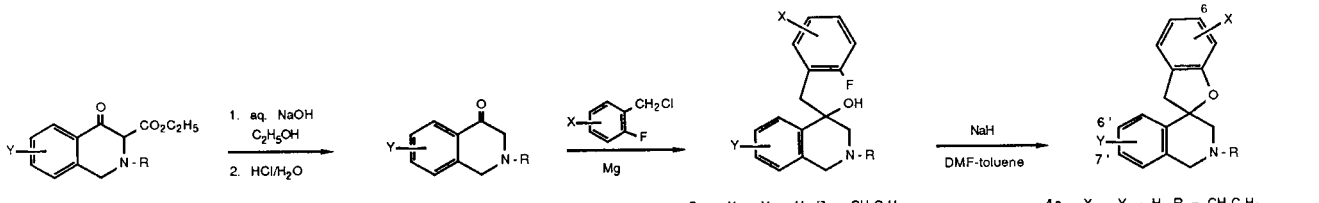
IV

The free base of the *N*-benzylisoquinolone **2a**, previously reported as an oil [8], and characterized as a hydrochloride salt [9], was obtained here as a low melting solid, the hydrochloride of which was consistent with reported values [9].

The 6,7-dimethoxy-*N*-methylisoquinolone **2c** was also prepared using a Dieckmann cyclization similar to a previously described procedure for *N*-benzyl-6,7-dimethoxyisoquinolone [11].

Grignard addition of an *o*-fluorobenzyl chloride to ketone **2a-c** gave the tertiary isoquinolinols **3** which were cyclized with sodium hydride-dimethylformamide [6] to give the 2',3'-dihydrospiro[benzofuran-2(3*H*),4'(1'*H*)isoquinolines] (Scheme I). Secondary amines **4h-j** were obtained by conversion of *N*-methyl **4b-d** to either the phenyl or ethyl carbamates **4e-g** using phenyl or ethyl chloroformate, followed by base hydrolysis. A number of *N*-alkyl derivatives were prepared either by direct alkylation, or by acylation to give the amide and subsequent reduction. Amidines (*eg.* **4q**) were prepared *via* the thio

Scheme I



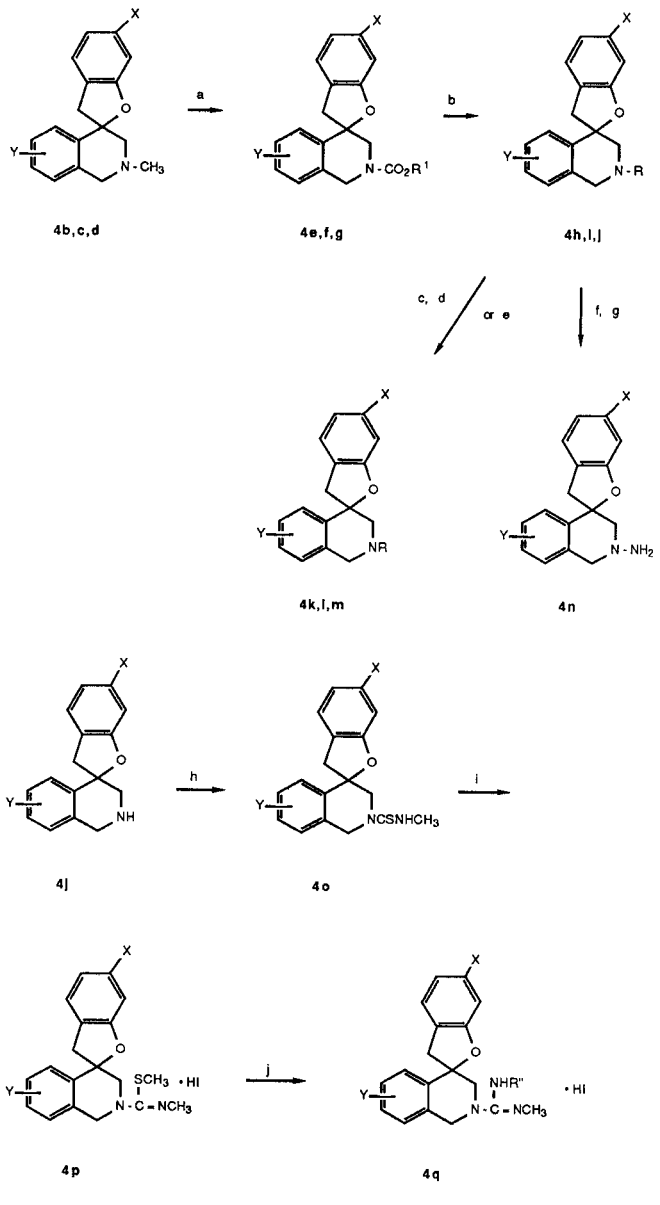
1a, Y = H, R = $CH_2C_6H_5$
1b, Y = H, R = CH_3
1c, Y = 6',7'-$(OCH_3)_2$, R = CH_3

2a, Y = H, R = $CH_2C_6H_5$
2b, Y = H, R = CH_3
2c, Y = 6',7'-$(OCH_3)_2$, R = CH_3

3a, X = Y = H, R = $CH_2C_6H_5$
3b, X = Y = H, R = CH_3
3c, X = H, Y = 6',7'-$(OCH_3)_2$, R = CH_3
3d, X = 4-Cl, Y = H, R = CH_3

4a, X = Y = H, R = $CH_2C_6H_5$
4b, X = Y = H, R = CH_3
4c, X = H, Y = 6',7'-$(OCH_3)_2$, R = CH_3
4d, X = 6-Cl, Y = H, R = CH_3

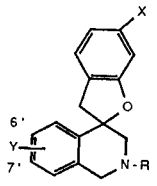
Scheme II



ureas and isothiouronium salts. The *N*-amino **4n** was prepared by reduction of the intermediate *N*-nitroso (Scheme II, Table I).

Biological activity for these compounds [12] included anticonvulsant (*e.g.* **4l**, supramaximal electroshock [13], ED_{50} = 17 mg/kg ip) and antinociceptive (**4k**, antiphenylquinone writhing [14], ED_{50} = 12.6 mg/kg sc).

Table I



Compound	R	X	Y
4a	$CH_2C_6H_5$	H	H
4b	CH_3	H	H
4c	CH_3	H	6′,7′-$(OCH_3)_2$
4d	CH_3	Cl	H
4e	$CO_2C_6H_5$	H	H
4f	$CO_2C_2H_5$	H	6′,7′-$(OCH_3)_2$
4g	$CO_2C_6H_5$	Cl	H
4h	H	H	H
4i	H	H	6′,7′-$(OCH_3)_2$
4j	H	Cl	H
4k	C_3H_7	H	H
4l	$(CH_2)_2N(C_2H_5)_2$	H	H
4m	$(CH_2)_2N(C_2H_5)_2$	H	6′,7′-$(OCH_3)_2$
4n	NH_2	H	H
4o	$CSNHCH_3$	Cl	H
4p	$C(SCH_3)=NCH_3$	Cl	H
4q	$C(=NCH_3)NH(CH_2)_3N(CH_3)_2$	Cl	H

EXPERIMENTAL

Melting points were determined on a Thomas-Hoover capillary melting point apparatus and are uncorrected. Infrared spectra were recorded on a Perkin-Elmer 457 grating spectrophotometer. Nuclear magnetic resonance spectra were taken on a Varian 200XL or Jeol C-60HL (where indicated) instrument. Chemical shifts are reported as δ units with tetramethylsilane as an internal standard. The mass spectra were obtained from a Finnigan Model 4000 spectrophotometer with an INCOS data system at 70 eV by direct insertion. Elemental analyses were performed by Micro-Tech Laboratories, Skokie, Illinois.

Methyl-3,4-dimethoxy-6-methylbenzoate.

A mixture of 3,4-dimethoxy-6-methylbenzoic acid [11] (347 g, 1.77 moles), methanol (300 ml), and concentrated sulfuric acid (130 ml) in dichloromethane (2 l) was refluxed overnight, concentrated, and washed successively with water, saturated sodium carbonate solution, water, and saturated sodium chloride solution. The organic layer was dried over magnesium sulfate, the magnesium sulfate filtered off, and the solvent evaporated to give an oil which upon trituration with petroleum ether afforded a white solid, 267.8 g (72%), mp 58-60.5°; ir (chloroform): 1705 cm^{-1} (C=O); nmr (deuteriochloroform): (60 MHz) δ 2.62 (s, 3H, ArCH_3), 3.95, 4.0 (2s, 9H, OCH_3), 6.85 (s, 1H, ArH), 7.66 (s, 1H, ArH).

Methyl-6-bromomethyl-3,4-dimethoxybenzoate.

A solution of methyl-3,4-dimethoxy-6-methylbenzoate (180 g, 0.856 mole) in carbon tetrachloride (1 *l*) was added slowly to a refluxing mixture of *N*-bromosuccinimide (142 g, 0.8 mole) and benzoyl peroxide (1 g) in carbon tetrachloride (500 ml). After the addition was completed, the mixture was refluxed an additional three hours. The reaction mixture was filtered and the filtrate washed successively with 2*N* sodium hydroxide, water, and saturated sodium chloride solution, then dried over magnesium sulfate. The magnesium sulfate was removed by filtration, and the solvent evaporated to give 241 g of off-white solid (97%). Trituration with petroleum ether afforded a white solid, 198.4 g (80%), mp

122-124°; ir (chloroform): 1718 cm^{-1} (C=O); nmr (deuteriochloroform): (60 MHz) δ 3.95 (s, 9H, OCH_3), 5.0 (s, 2H, CH_2), 6.95 (s, 1H, ArH), 7.55 (s, 1H, ArH).

N-(2-Carboethoxy-4,5-dimethoxybenzyl)sarcosine Methyl Ester.

A mixture of methyl-6-bromomethyl-3,4-dimethoxybenzoate (260 g, 0.9 mole), sarcosine ethyl ester (117 g, 1.0 mole) and sodium carbonate (127 g, 1.2 mole) in toluene (1500 ml) was heated at 85° for 3.5 hours. Additional sarcosine ethyl ester (25 g, 0.21 mole) and sodium carbonate (50 g, 0.47 mole) was added, and the mixture refluxed for another 3 hours. The reaction mixture was filtered and concentrated to a yellow oil which was dissolved in ether, then washed with 3*N* hydrochloric acid. The acidic aqueous phase was washed with ether, then basified with sodium carbonate and extracted with ether. The ether extract was washed with water, then saturated sodium chloride solution, and dried over magnesium sulfate. The magnesium sulfate was filtered off and the solvent removed to give 255.1 g (87%) of yellow oil; ir (chloroform): 1715 cm^{-1}, 1745 cm^{-1} (shoulder) (C=O); nmr (deuteriochloroform): δ 2.28 (t, 3H, CH_3), 2.45 (s, 3H, NCH_3), 3.3 (s, 2H, CH_2), 3.9, 3.95, 4.0 (3s, 9H, $3OCH_3$), 4.05 (s, 2H, CH_2), 4.22 (q, 2H, CH_2), 7.35 (s, 1H, ArH), 7.5 (s, 1H, ArH).

2-Benzyl-2,3-dihydro-4(1*H*)-isoquinolone (**2a**).

A mixture of 2-benzyl-3-carboethoxy-2,3-dihydro-4(1*H*)-isoquinolone **1a** [8] (66.7 g, unpurified) in ethanol (750 ml) and 2*N* sodium hydroxide (600 ml) was refluxed for 3 hours, then cooled by ice bath and acidified with 6*N* hydrochloric acid. This acidic mixture was refluxed an additional 3 hours, cooled again, basified with 6*N* sodium hydroxide, and extracted with benzene. The organic extract was washed with saturated sodium chloride solution and dried over magnesium sulfate. The magnesium sulfate was filtered off and the solvent removed to give 37.7 g (0.159 mole, 74%) of isoquinolone. A portion was distilled by short path distillation under vacuum (185°/0.75 mm) to give a golden viscous oil which solidified to a yellow solid, mp 48-49.5° (hydrochloride, mp 197-201°, lit [9] 199-200°).

2-Methyl-2,3-dihydro-4(1*H*)-isoquinolone (**2b**).

Sodium (spheres) (16.3 g, 0.71 mole) was added to absolute ethanol (150 ml), and after reaction was complete excess ethanol was azeotropically distilled off with benzene. A solution of *N*-(2-carbomethoxybenzyl)-sarcosine ethyl ester (150.0 g, 0.57 mole) in benzene (200 ml) was added, and slow azeotropic distillation continued until a constant 80° distillation temperature. The solvent was then removed, the resultant yellow solid **1b** was dissolved in ethanol (200 ml) and 2*N* sodium hydroxide (600 ml), and refluxed for 2 hours. The mixture was cooled slowly to room temperature, then acidified with 6*N* hydrochloric acid, and refluxed for 3 hours. The reaction mixture was again cooled, basified with 6*N* sodium hydroxide, and extracted with chloroform. The chloroform extract was washed with water, then saturated sodium chloride solution, dried (magnesium sulfate), and evaporated to give 84.6 g (92%) of oil. Distillation of 20.0 g afforded 16.3 g of pale yellow oil (118-121°/1.5 mm); ir (chloroform): 1690 cm^{-1} (C=O); nmr (deuteriochloroform): δ 2.55 (s, 3H, CH_3), 3.36 (s, 2H, CH_2), 3.8 (s, 2H, CH_2), 7.2-7.8 (m, 3H, ArH), 8.08-8.3 (m, 1H, ArH).

6,7-Dimethoxy-2-methyl-2,3-dihydro-4(1*H*)-isoquinolone (**2c**).

Fresh sodium ethoxide was prepared by warming sodium spheres (15.5 g, 0.67 mole) in absolute ethanol (150 ml). Benzene was added and ethanol azeotropically distilled until 80°. A solution of *N*-(2-carbethoxy-4,5-dimethoxybenzyl)sarcosine methyl ester (182.6 g, 0.56 mole) in benzene (250 ml) was added dropwise. A slow azeotropic distillation was continued until 80°. The solvent was then removed to give a yellow solid which was dissolved in ethanol (250 ml) and 2*N* sodium hydroxide. The mixture was refluxed for three hours, cooled slowly to room temperature, acidified with 6*N* hydrochloric acid, and refluxed again for 2.5 hours. The mixture was cooled, basified with 6*N* sodium hydroxide, and extracted with chloroform. The chloroform extract was washed with water, saturated sodium chloride solution, then dried (magnesium sulfate) and evaporated to yield 99.1 g of solid product. Trituration with petroleum ether afforded 99 g (80%), mp 125-133°, used without further purification; ir (chloroform): 1680 cm^{-1} (C=O); nmr (deuteriochloroform): δ 2.5 (s, 3H, NCH_3), 3.3 (s, 2H, CH_2), 3.7 (s, 2H, CH_2), 3.95, 3.98 (2S, 6H, $2OCH_3$), 6.72 (s, 1H, ArH), 7.55 (s, 1H, ArH).

4-(2-Fluorobenzyl)-2-methyl-1,2,3,4-tetrahydro-4-isoquinolinol Hydrochloride (**3b**).

Several milliliters of o-fluorobenzyl chloride (27.18 g, 0.188 mole) was added to a suspension of magnesium shavings (3.96 g, 0.165 mole) and a crystal of iodine in anhydrous ether (50 ml). After initiation of the reaction with heat, the remainder of the o-fluorobenzyl chloride was added dropwise as a solution in ether (50 ml). After the addition was complete, the reaction mixture was refluxed for 2 hours. A solution of 2-methyl-2,3-dihydro-4(1*H*)-isoquinolone (24.17 g, 0.150 mole) in ether (100 ml) was added dropwise at room temperature. The granular precipitate which formed was stirred at room temperature for one hour, filtered and washed with ether. The solid was hydrolyzed by stirring at room temperature for one hour with ammonium chloride solution, followed by ether extraction. The ether extract was washed with saturated sodium chloride solution and dried over magnesium sulfate. Removal of the ether yielded a brown oil (28.62 g, 70%). A portion (5 g) of the oil was dissolved in ether and converted to the hydrochloride salt (5.5 g, 97%) dec at 105°; nmr (deuteriochloroform): δ 2.84 (s, 3H, CH_3), 3.0-3.52 (m, 4H, $2CH_2$), 3.92 (d, 1H, CH_2), 4.44 (d, 1H, CH_2), 5.8 (bs, 1H, OH), 6.92-7.12 (m, 3H, ArH), 7.16-7.52 (m, 4H, ArH), 7.84 (d, 1H, ArH), 12.3 (bs, 1H, NH^+); ms: m/e 271 (M^+).

Anal. Calcd. for $C_{17}H_{18}FNO \cdot HCl$: C, 66.34; H, 6.22; N, 4.55. Found: C, 66.23; H, 6.32; N, 4.51.

2-Benzyl-4-(2-fluorobenzyl)-1,2,3,4-tetrahydro-4-isoquinolinol Hydrochloride (**3a**).

To a suspension of magnesium shavings (2.7 g) and a crystal of iodine in anhydrous ether (25 ml) was added several milliliters of 2-fluorobenzyl chloride (14.5 g, 0.1 mole). After initiation of the reaction with heat, the remainder of the 2-fluorobenzyl chloride was added dropwise as a solution in ether (75 ml). After the addition was completed, the reaction mixture was refluxed for 15 minutes. A solution of 2-benzyl-2,3-dihydro-4(1*H*)-isoquinolone (23.7 g, 0.1 mole) in ether (100 ml) was added dropwise at room temperature. The granular precipitate which formed was stirred at room temperature, filtered and washed with ether. The solid was hydrolyzed by stirring at room temperature with ammonium chloride solution for one hour, followed by ether extraction. After washing the ether solution with saturated sodium chloride solution and drying over magnesium sulfate, the ether was removed to give a brown oil (30 g, 86%). The oil was dissolved in anhydrous ether and converted to the hydrochloride salt, which was recrystallized first from acetone then again from 2-propanol to provide 13.9 g (36%) of white crystals, mp 192-194°; nmr (deuteriochloroform): δ 3.0-3.6 (m, 4H, CH_2), 3.65-3.9 (m, 1H, CH_2), 4.0-4.6 (m, 3H, CH_2), 6.08 (s, 1H, OH), 6.9-7.12 (m, 3H, ArH), 7.15-7.7 (m, 9H, ArH), 7.82 (d, 1H, ArH), 12.8 (bs, 1H, NH^+); ms: m/e 347 (M^+).

Anal. Calcd. for $C_{23}H_{22}FNO \cdot HCl$: C, 71.95; H, 6.05; N, 3.65. Found: C, 71.68; H, 6.14; N, 3.66.

4-(2-Fluorobenzyl)-6,7-dimethoxy-2-methyl-1,2,3,4-tetrahydro-4-isoquinolinol (**3c**).

A solution of 2-fluorobenzyl chloride (8.7 g, 0.06 mole) in anhydrous ether (20 ml) was added dropwise to a suspension of magnesium shavings (1.5 g, 0.06 mole) and a few crystals of iodine in anhydrous ether (50 ml). After the addition was completed, the reaction mixture was refluxed for thirty minutes. A soution of 6,7-dimethoxy-2-methyl-2,3-dihydro-4(1*H*)-isoquinolone (8.8 g, 0.04 mole) in tetrahydrofuran (100 ml) was added dropwise. After the addition was completed, the reaction mixture was refluxed for three hours, cooled, then quenched by stirring with saturated ammonium chloride solution (500 ml). The mixture was ex-

tracted with ether and the ether extract washed with water, then saturated sodium chloride solution, then dried over anhydrous magnesium sulfate. After filtering, the solvent was removed to yield a solid, which upon trituration with ether yielded 9.8 g (74%) of yellow solid. A portion was recrystallized twice from ether to give a pale yellow analytical sample, mp 117-118°; nmr (deuteriochloroform): δ 2.36 (s, 3H, NCH_3), 2.48 (q, 2H, CH_2), 2.94 (bs, 1H, OH), 3.26 (q, 2H, CH_2), 3.44 (s, 2H, CH_2), 3.82 (s, 3H, OCH_3), 3.85 (s, 3H, OCH_3), 6.5 (s, 1H, ArH), 6.96 (s, 1H, ArH), 7.0-7.4 (m, 4H, ArH); ms: m/e 331 (M^+).

Anal. Calcd. for $C_{19}H_{22}FNO_3$: C, 68.86; H, 6.69; N, 4.23. Found: C, 68.63; H, 6.55; N, 4.42.

4-(4-Chloro-2-fluorobenzyl)-2-methyl-1,2,3,4-tetrahydro-4-isoquinolinol (**3d**).

A solution of 4-chloro-2-fluorobenzylbromide (146.0 g, 0.65 mole) in anhydrous ether (200 ml) was slowly added to a suspension of magnesium shavings (15.7 g, 0.65 mole) and a few crystals of iodine in anhydrous ether (200 ml) at such a rate so as to maintain ether reflux. After the addition was completed, the reaction mixture was refluxed for two hours. A solution of 2-methyl-2,3-dihydro-4(1*H*)-isoquinolone (70.2 g, 0.44 mole) in anhydrous ether (200 ml) was slowly added dropwise. After the addition was completed the reaction mixture was refluxed for three hours.

The reaction mixture, after cooling, was stirred in saturated ammonium chloride solution (1.5 *l*), then extracted with ether. The combined ether extracts were washed with water (2x) then saturated sodium chloride solution, and dried over magnesium sulfate. After filtering, the solvent was removed to yield a pale yellow solid, which upon trituration with pertroleum ether, yielded a near white solid (109.5 g, 82%), mp 113-116°. An analytical sample was recrystallized from anhydrous ether to yield white needles, mp 116-117°; nmr (deuteriochloroform): δ 2.36 (s, 3H, CH_3), 2.46 (q, 2H, CH_2), 3.16 (s, 1H, OH), 3.24 (q, 2H, CH_2), 3.48 (q, 2H, CH_2), 7.0-7.16 (m, 3H, ArH), 7.18-7.4 (m, 3H, ArH), 7.5-7.64 (d, unresolved, 1H, ArH); ms: m/e 305 (M^+).

Anal. Calcd. for $C_{17}H_{17}ClFNO$: C, 66.77; H, 5.60; N, 4.58. Found: C, 66.81; H, 5.55; N, 4.56.

2'-Benzyl-2',3'-dihydrospiro[benzofuran-2(3*H*),4'(1'*H*)-isoquinoline]hydrochloride (**4a**).

A solution of 2-benzyl-4-(2-fluorobenzyl)-1,2,3,4-tetrahydro-4-isoquinolinol (3.4 g, 9.8 mmoles) in benzene (30 ml) was added dropwise at room temperature to a suspension of sodium hydride (0.52 g, 0.01 mole, (98%) 50% oil dispersion washed with hexane) in dimethylformamide (10 ml) and benzene (20 ml). The reaction mixture was stirred at reflux overnight. Unreacted starting material remained (thin layer chromatography), so an additional 0.01 mole of 99% sodium hydride (0.25 g) was added and the mixture refluxed again overnight to achieve complete conversion. The mixture was cooled, poured into water and extracted with benzene. The benzene extract was washed with saturated sodium chloride solution, dried over magnesium sulfate, filtered and the solvent evaporated to afford 3.2 g (9.8 mmole, 100%) of brown oil which was converted to the hydrochloride salt. Recrystallization from 2-propanol-methanol gave 1.9 g (5.2 mmoles, 53%) of off-white solid, mp 214-216°; nmr (deuteriochloroform): δ 3.5-3.9 (m, 4H, $2CH_2$), 4.2 (d, 1H, $ArCH_2N$), 4.56 (s, 2H, $N\text{-}CH_2C_6H_5$), 4.68 (d, 1H, $ArCH_2N$), 6.82 (d, 1H, Ar-H), 7.0 (t, 1H, Ar-H), 7.08-7.80 (m, 11H, Ar-H), 13.3 (bs, 1H, NH^+); ms: m/e 327 (M^+).

Anal. Calcd. for $C_{23}H_{21}NO{\cdot}HCl$: C, 75.91; H, 6.11; N, 3.85. Found: C, 75.97; H, 6.13; N, 3.82.

2'-Methyl-2',3'-dihydrospiro[benzofuran-2(3*H*),4'(1'H)-isoquinoline]-Hydrochloride (**4b**).

Sodium hydride (2.98 g, 0.061 mole) (98%, 50% oil dispersion) was placed in a previously flamed 500 ml 3 neck round bottom flask and washed with hexane under nitrogen atmosphere. Benzene (100 ml) was added, followed by the dropwise addition of 4-(2-fluorobenzyl)-2-methyl-1,2,3,4-tetrahydro-4-isoquinolinol (15 g, 0.055 mole) in benzene (100 ml). After addition of dry dimethylformamide (30 ml), the mixture was refluxed and monitored by thin layer chromatography. After twenty-four hours, some starting material still remained. An additional 1.5 g of 99% sodium hydride (0.061 mole), 30 ml of dimethylformamide and 100 ml of benzene were added, and reflux was continued until all starting material was consumed. The reaction mixture was cooled, poured into water and extracted with ether. The ether extract was washed with saturated sodium chloride solution and dried over magnesium sulfate. Removal of the ether yielded a dark oil (9 g), which was converted to the hydrochloride salt. Recrystallization from 2-propanol-ether gave 6.2 g of a white solid, mp 214-215° (40%); nmr (DMSO-d_6): δ 2.96 (s, 3H, CH_3), 3.2-4.1 (m, 4H, $2CH_2$), 4.5 (s, 2H, $ArCH_2N$), 6.7-7.5 (m, 8H, Ar-H), 10.9, 12.4 (2bs, 1H, NH^+); ms: m/e 252 (MH^+).

Anal. Calcd. for $C_{17}H_{17}NO{\cdot}HCl$: C, 70.95; H, 6.30; N, 4.87. Found: C, 70.65; H, 6.46; N, 4.76.

6',7'-Dimethoxy-2'-methyl-2',3'-dihydrospiro[benzofuran-2(3*H*),4'(1'-*H*)-isoquinoline]Hydrochloride (**4c**).

A solution of 4-(2-fluorobenzyl)-6,7-dimethoxy-2-methyl-1,2,3,4-tetrahydro-4-isoquinolinol (17.4 g, 0.053 mole) in toluene (50 ml) and dimethylformamide (25 ml) was added dropwise to a suspension of sodium hydride 50% (98%) (5.1 g, 0.11 mole), previously washed with hexanes, in toluene (180 ml) and dimethylformamide (40 ml). The reaction mixture was refluxed for 1.5 hours at which time thin layer chromatography showed complete conversion.

The reaction mixture, after cooling, was stirred in water (1 *l*), then extracted with chloroform. The combined organic extracts were washed first with water then saturated sodium chloride solution, and dried over anhydrous magnesium sulfate. After filtering, removal of solvent yielded 14.2 g (86%) of dark oil which was dissolved in ether and converted to the hydrochloride salt (12.2 g, 66%), from which an analytical sample was obtained by twice recrystallizing from ethyl acetate-methanol to yield a white solid dec at 184-185°; nmr (deuteriochloroform): δ 3.06 (d, 3H, NCH_3), 3.5-3.8 (m, 4H, $2CH_2$), 3.76 (s, 3H, OCH_3), 3.92 (s, 3H, OCH_3), 4.12 (bd, 1H, $ArCH_2N$), 4.66 (bd, 1H, $ArCH_2N$), 6.64 (s, 1H, Ar-H), 6.82 (d, 1H, Ar-H), 6.88 (s, 1H, Ar-H), 7.0 (t, 1H, Ar-H), 7.16-7.35 (m, 2H, Ar-H), 13.3 (bs, 1H, NH^+); ms: m/e 311 (M^+).

Anal. Calcd. for $C_{19}H_{21}NO_3{\cdot}HCl$: C, 65.60; H, 6.38; N, 4.03. Found: C, 65.51; H, 6.61; N, 3.96.

6-Chloro-2'-methyl-2',3'-dihydrospiro[benzofuran-2(3*H*),4'(1'*H*)-isoquinoline]Hydrochloride (**4d**).

A solution of 4-(4-chloro-2-fluorobenzyl)-2-methyl-1,2,3,4-tetrahydro-4-isoquinolinol (10.0 g, 0.033 mole) in toluene (65 ml) and dimethylformamide (10 ml) was added dropwise to a suspension of sodium hydride 50% (98%) (3.2 g, 0.065 mole), previously washed with hexanes, in toluene, (65 ml). After the addition was completed the mixture was brought to reflux, and additional dimethylformamide (35 ml) was slowly added dropwise. The reaction mixture was then refluxed for four hours. Removal of solvents yielded a dark oil which was stirred in water (500 ml), then extracted with chloroform. The combined organic extracts were washed with water then saturated sodium chloride solution, and dried over magnesium sulfate. After filtering, removal of solvent yielded a dark oil which was dissolved in ether, then converted to the hydrochloride salt (9.0 g, 80%, mp 105-116). This material was recrystallized from ethyl acetate-methanol to yield a white solid (6.8 g, mp 196-199°). An analytical sample was twice recrystallized to yield a white solid mp 203-205°; nmr (deuteriochloroform): δ 3.05 (s, 3H, CH_3), 3.5-3.96 (m, 4H, $2CH_2$), 4.16 (d, 1H, CH_2), 4.7 (d, 1H, CH_2), 6.8 (d, 1H, ArH), 6.96 (dd, 1H, ArH), 7.1-7.56 (m, 5H, ArH), 13.5 (bs, 1H, NH^+); ms: m/e 285 (M^+).

Anal. Calcd. for $C_{17}H_{16}ClNO{\cdot}HCl$: C, 63.36; H, 5.32; N, 4.35. Found: C, 63.20; H, 5.39; N, 4.30.

N-Phenoxycarbonyl-2',3'-dihydrospiro[benzofuran-2(3*H*),4'(1'*H*)-isoquinoline] (**4e**).

A solution of phenyl chloroformate (22.2 g, 0.142 mole) in dichloromethane (20 ml) was added dropwise to a solution of 2'-methyl-2',3'-dihydrospiro[benzofuran-2(3*H*),4'(1'*H*)-isoquinoline] (32.5 g, 0.129 mole) in di-

chloromethane (700 ml), and the resulting mixture stirred at room temperature overnight. Removal of the solvent yielded 49.5 g (100%) of off-white solid. Recrystallization of 4.0 g from ethyl acetate gave 2.6 g white solid, mp 128°; nmr (deuteriochloroform): δ 3.2-3.9 (m, 3H, CH_2), 4.2-5.2 (m, 3H, CH_2), 6.8-7.0 (m, 2H, ArH), 7.04-7.7 (m, 11H, ArH); ms: m/e 357 (M^+).

Anal. Calcd. for $C_{23}H_{19}NO_3$: C, 77.29; H, 5.36; N, 3.92. Found: C, 77.12; H, 5.45; N, 3.78.

6′,7′-Dimethoxy-2′-ethoxycarbonyl-2′,3′-dihydrospiro[benzofuran-2(3*H*),4′(1′*H*)-isoquinoline] (**4f**).

A mixture of 6′,7′-dimethoxy-2′-methyl-2′,3′-dihydrospiro[benzofuran-2(3*H*),4′(1′*H*)-isoquinoline] (20.6 g, 0.07 mole), ethyl chloroformate (10.9 g, 0.1 mole) and potassium carbonate (20 g) in dry benzene (400 ml) was refluxed overnight.

The reaction mixture was cooled, then stirred with water (200 ml) for 15 minutes. The organic phase was then washed successively with dilute hydrochloric acid, water, and saturated sodium chloride solution, then dried over anhydrous magnesium sulfate. The magnesium sulfate was removed by filtration and the solvent evaporated to yield 14.9 g (58%) of an oil. This was used as such for hydrolysis to the secondary amine. An analytical sample was obtained by silica gel dry column chromatography of 2.0 g of the above oil, with ethyl acetate as eluent, to give 1.8 g of pale yellow solid, mp 72-76°; nmr (deuteriochloroform): δ 1.28 (bs, (unresolved), 3H, CH_3), 3.2-3.5 (m, 3H, $2CH_2$), 3.8 (s, 3H, OCH_3), 3.88 (s, 3H, OCH_3), 4.2 (m, 3H, OCH_2, CH_2), 4.65 (gem q, 2H, $ArCH_2N$), 6.6 (s, 1H, ArH), 6.8-7.04 (m, 3H, ArH), 7.15-7.32 (m, 2H, ArH); ms: m/e 369 (M^+).

Anal. Calcd. for $C_{21}H_{23}NO_5$: C, 68.27; H, 6.28; N, 3.79. Found: C, 68.03; H, 6.31; N, 3.73.

6-Chloro-2′-phenoxycarbonyl-2′,3′-dihydrospiro[benzofuran-2(3*H*),4′-(1′*H*)-isoquinoline] (**4g**).

A solution of phenyl chloroformate (3.7 g, 0.024 mole) in dichloromethane (20 ml) was added dropwise to an ice cooled solution of 6-chloro-2′-methyl-2′,3′-dihydrospiro[benzofuran-2(3*H*),4′(1′*H*)-isoquinoline] (5.0 g, 0.017 mole) in dichloromethane. The resulting mixture was stirred at ambient temperature overnight. Removal of solvent *in vacuo* yielded an orange oil which solidified upon trituration with hexanes (6.6 g light tan solid, 99%). An analytical sample was twice recrystallized from hexanes to yield a white solid mp 138-140°; nmr (deuteriochloroform): δ 3.2-3.9 (m, 3H, ring $CH_{2's}$), 4.32 (bt, 1H, ring CH_2) 4.6-5.3 (m, 2H, ring CH_2), 6.8-7.04 (m, 2H, ArH), 7.08 -7.6 (m, 10H, ArH); ms: m/e 391 (M^+).

Anal. Calcd. for $C_{23}H_{18}ClNO_3$: C, 70.50; H, 4.63; N, 3.58. Found: C, 70.56; H, 4.72; N, 3.35.

2′,3′-Dihydrospiro[benzofuran-2(3*H*),4′(1′*H*)-isoquinoline]Hydrochloride (**4h**).

A solution of *N*-phenoxycarbonyl-2′,3′-dihydrospiro[benzofuran-2(3*H*),4′(1′*H*)-isoquinoline] (13.7 g, 0.04 mole) in 1-propanol (250 ml) and water (6 ml) with potassium hydroxide (20 g) was refluxed for 24 hours. Evaporation of solvent yielded 40 g of dark oil. Water (300 ml) was added to the oil, and the oil which separated was extracted with chloroform. The organic layer was collected, washed first with water, then saturated sodium chloride solution, and dried over magnesium sulfate. The solution was filtered and the solvent removed to give a light brown solid, which was converted to the hydrochloride salt. Recrystallization from 2-propanol-methanol yielded 5.5 g (52%) of the desired compound, mp 229-230°; nmr (deuteriochloroform): δ 3.4-3.9 (m, 4H, $2CH_2$), 4.5 (s, 2H, $ArCH_2N$), 6.86 (d, 1H, Ar-H), 6.96 (t, 1H, Ar-H), 7.1-7.6 (m, 6H, Ar-H), 10.2 (bs, 1H, NH_2^+), 10.7 (bs, 1H, NH_2^+); ms: m/e 237 (M^+).

Anal. Calcd. for $C_{16}H_{15}NO{\cdot}HCl$: C, 70.20; H, 5.89; N, 5.12. Found: C, 69.93; H, 5.90; N, 5.04.

6′,7′-Dimethoxy-2′,3′-dihydrospiro[benzofuran-2(3*H*),4′(1′*H*)-isoquinoline]Maleate (**4i**).

A mixture of 6′,7′-dimethoxy-2′-ethoxycarbonyl-2′,3′-dihydrospiro-[benzofuran-2(3*H*),4′(1′*H*)-isoquinoline] (4.2 g, 0.011 mole), potassium hydroxide (7.0 g) and water (7.0 ml) in 1-propanol (150 ml) was refluxed for four hours. Removal of solvent under reduced pressure yielded a dark oil which was stirred in water (300 ml) then extracted with chloroform. The combined organic phases were washed with water, then saturated sodium chloride solution, and dried over magnesium sulfate. After filtering, the solvent was removed to yield 3.1 g (81%) of an oil which was dissolved in ether and converted to the maleate salt (1.9 g, mp 165-167°). This material was twice recrystallized from ethyl acetate-methanol to yield a white solid (1.4 g, dec at 180-181°); nmr (deuteriochloroform): δ 3.34-3.8 (m, 4H, $2CH_2$), 3.8 (s, 3H, OCH_3), 3.9 (s, 3H, OCH_3), 4.34 (q, 2H, CH_2), 6.26 (s, 2H, maleate), 6.66 (s, 1H, ArH), 6.8 (d, 1H, ArH), 6.9 (s, 1H, ArH), 7.0 (t, 1H, ArH), 7.16-7.36 (m, 2H, ArH); ms: m/e 297 (M^+).

Anal. Calcd. for $C_{18}H_{19}NO_3{\cdot}C_4H_4O_4$: C, 63.91; H, 5.61; N, 3.39. Found: C, 63.94; H, 5.66; N, 3.30.

6-Chloro-2′,3′-dihydrospiro[benzofuran-2(3*H*),4′(1′*H*)-isoquinoline]-Hydrochloride (**4j**).

A mixture of 6-chloro-2′-phenoxycarbonyl-2′,3′-dihydrospiro[benzofuran-2(3*H*),4′(1′*H*)-isoquinoline] (25.0 g, 0.064 mole), potassium hydroxide (25 g) and water (25 ml) in 1-propanol (250 ml) was refluxed for four hours. Removal of solvent under reduced pressure yielded an orange solid which was stirred with water (500 ml) then extracted with ether. The basic material was extracted from ether with 3*N* hydrochloric acid then rebasified with sodium carbonate. The product which separated was extracted with ether, and the ether solution washed with saturated sodium chloride solution then dried over magnesium sulfate. After filtering, the solvent was removed to yield a near white solid (13.5 g, 78%, mp 93-98°). A portion (4.0 g) was dissolved in ether and converted to the hydrochloride salt (4.3 g, 96%), which was recrystallized from ethyl acetate-methanol to yield a white solid (3.8 g, dec at 240-243°). An analytical sample was recrystallized twice more from ethyl acetate-methanol to yield a white solid 238-239°; nmr (DMSO-d_6): δ 3.6 (s, 2H, ring CH_2), 3.66 (s, 2H, ring CH_2), 4.32 (s, 2H, $ArCH_2N$); 6.9 (d, 1H, ArH), 7.02 (dd, 1H, ArH), 7.2-7.6 (m, 5H, ArH), 10.1 (bs, 2H, NH_2^+); ms: m/e 271 (M^+).

Anal. Calcd. for $C_{16}H_{14}ClNO{\cdot}HCl$: C, 62.35; H, 4.91; N, 4.55. Found: C, 62.33; H, 4.93; N, 4.47.

2′-Propyl-2′,3′-dihydrospiro[benzofuran-2(3*H*),4′(1′*H*)-isoquinoline]-Hydrochloride (**4k**).

A solution of propionyl chloride (2.8 g, 0.03 mole) in dichloromethane (20 ml) was added dropwise to a cooled solution of 2′,3′-dihydrospiro[benzofuran-2(3*H*),4′(1′*H*)-isoquinoline] (6.0 g, 0.025 mole) and triethylamine (3.1 g, 0.03 mole) in dichloromethane (35 ml). The reaction mixture was stirred at room temperature for 24 hours, then washed successively with water and saturated sodium chloride solution. The organic layer was dried over anhydrous magnesium sulfate, filtered and evaporated to dryness to yield 6.8 g (91%) of a dark oil. Trituration of 2.0 g with hexane yielded 1.3 g of a light tan solid which was recrystallized from hexane to give 1.0 g, mp 97-98°.

A solution of 2′-propionyl-2′,3′-dihydrospiro[benzofuran-2(3*H*),4′(1′*H*)-isoquinoline] (4.8 g, 0.016 mole) in dry tetrahydrofuran (35 ml) was added dropwise to a stirred refluxing suspension of lithium aluminum hydride (1.2 g, 0.032 mole) in dry tetrahydrofuran (100 ml). The reaction mixture was refluxed for 24 hours, then cooled, and saturated ammonium chloride solution (100 ml) added dropwise. The mixture was filtered, diluted with ether, and washed with water followed by saturated sodium chloride solution. The organic layer was dried over anhydrous magnesium sulfate, filtered and evaporated to give an oil (4.0 g, 88%) which was converted to the hydrochloride salt. Recrystallization from ethyl acetate-methanol yielded 2.9 g (57%) white solid, mp 234-235°; nmr (deuteriochloroform): δ 1.0 (t, 3H, CH_3), 2.0 (sextet, 2H, $CH_2CH_2CH_3$), 3.1-3.5 (br.m, 2H, CH_2), 3.5-3.8 (m, 4H, $2CH_2$), 4.2 (d, 1H, $ArCH_2N$), 4.7 (d, 1H, $ArCH_2N$), 6.7-7.6 (m, 8H, Ar-H), 13.2 (bs, 1H, NH^+); ms: m/e 279 (M^+).

Anal. Calcd. for $C_{19}H_{21}NO{\cdot}HCl$: C, 72.25; H, 7.02; N, 4.44. Found: C, 72.03; H, 6.98; N, 4.57.

2′-(2-*N*,*N*-Diethylaminoethyl)-2′,3′-dihydrospiro[benzofuran-2(3*H*),4′-(1′*H*)-isoquinoline]Dihydrochloride (**4l**).

A solution of 2',3'-dihydrospiro[benzofuran-2(3*H*),4'(1'*H*)-isoquinoline] (7.0 g, 0.030 mole), diethylaminoethyl chloride (4.8 g, 0.035 mole), potassium carbonate (20 g) and a few crystals of potassium iodide in 1-butanol (100 ml) was refluxed overnight. The reaction mixture was filtered and the solvent was removed to yield a dark oil which was poured into water (600 ml) and extracted with ether. The ether layer was washed first with water then saturated sodium chloride solution, then dried over magnesium sulfate. The ether solution was filtered and evaporated to give a dark oil that was converted to the dihydrochloride salt, and recrystallized twice from ethyl acetate-methanol to yield 4.4 g (36%) of white solid, dec. 161°; nmr (DMSO-d_6): δ 1.3 (t, 6H, $2CH_3$), 3.2 (m, 4H, $2CH_2$), 3.4-4.1 (m, 8H, $4CH_2$), 4.6 (bs, 2H, $ArCH_2N$), 6.8-7.5 (m, 8H, Ar-H), 11.5 (bs, 2H, $2NH^+$); ms: m/e 337 (MH^+).

Anal. Calcd. for $C_{22}H_{28}N_2O \cdot 2HCl$: C, 64.54; H, 7.39; N, 6.84. Found: C, 64.44; H, 7.45; N, 6.77.

2'-(2-*N*,*N*-Diethylaminoethyl)-6',7'-dimethoxy-2',3'-dihydrospiro[benzofuran-2(3*H*),4'(1'*H*)-isoquinoline]Dioxalate (**4m**).

A mixture of 6',7'-dimethoxy-2',3'-dihydrospiro[benzofuran-2(3*H*),4'-(1'*H*)-isoquinoline] (4.6 g, 0.015 mole), 2-diethylaminoethyl chloride (4.2 g, 0.031 mole), potassium carbonate (8.0 g) and a few crystals of potassium iodide in 1-butanol was refluxed for four hours. Removal of solvent yielded an orange oil which was stirred in water, then extracted with ether. The combined organic phases were washed with water, then saturated sodium chloride solution and dried over magnesium sulfate. After filtering, the solvent was removed to yield an orange oil which was dissolved in ether, then converted to the dioxalate salt (6.7 g, 78%), and recrystallized twice from ethyl acetate-methanol to yield 3.5 g (40%) of white solid, mp 175-177°; nmr (DMS-d_6): δ 1.2 (t, 6H, $2CH_3$), 2.88 (q (unresolved), 4H, $2CH_2$), 3.2 (bd, (unresolved), 6H, $3CH_2$), 3.4 (s, 2H, CH_2), 3.6 (bd, 1H, $ArCH_2N$), 3.62 (s, 3H, OCH_3), 3.76 (s, 3H, OCH_3), 3.8 (bd, 1H, $ArCH_2N$), 6.6-7.0 (m, 4H, Ar-H), 7.1-7.3 (m, 2H, Ar-H), 8.0-9.5 (bs, 4H, $2NH^+$, $2CO_2H$); ms: m/e 397 (MH^+).

Anal. Calcd. for $C_{24}H_{32}N_2O_3 \cdot 2(CO_2H)_2$: C, 58.32; H, 6.29; N, 4.86. Found: C, 57.87; H, 6.30; N, 4.78.

2'-Amino-2',3'-dihydrospiro[benzofuran-2(3*H*),4'(1'*H*)-isoquinoline]Hydrochloride (**4n**).

A solution of sodium nitrite (4.1 g, 0.06 mole) in water (18 ml) was added dropwise to a stirred solution of 2',3'-dihydrospiro[benzofuran-2(3*H*),4'(1'*H*)-isoquinoline] (7.0 g, 0.03 mole) in glacial acetic acid (30 ml) and water (12 ml) at 0-5° under a nitrogen atmosphere. The mixture was stirred at room temperature for one hour following completion of the addition. Water (60 ml) was then added, and the liquid decanted to leave a viscous residue which was dissolved in dichloromethane. The organic solution was washed with water, then saturated sodium chloride solution, and dried over anhydrous magnesium sulfate. The solution was filtered and the solvent evaporated to give a light brown oil (7.1 g, 92% of the nitroso intermediate). This oil was dissolved in glacial acetic acid (80 ml) then slowly added dropwise to a stirred suspension of zinc dust (7.8 g, 0.12 mole) in 100 ml of 1:1 acetic acid-water, under nitrogen, maintaining the temperature at 15-20°. After the addition was complete, the mixture was allowed to stir at room temperature for one-half hour. The mixture was then filtered and the zinc and inorganic salts were washed with 1*N* hydrochloric acid. The filtrate was basified with 6*N* sodium hydroxide and extracted with ether. The ether extract was washed with water, then saturated sodium chloride solution, and dried over anhydrous magnesium sulfate. The solution was filtered and the solvent evaporated to afford a light brown oil (6.3 g, 95%) which was converted to the hydrochloride salt (6.1 g, 80%). This was recrystallized four times from ethyl acetate-methanol to give 4.0 g white needles, mp 198-199°; nmr (DMSO-d_6): δ 3.2-3.6 (m, 4H, $2CH_2$), 4.42 (s, 2H, $ArCH_2N$), 6.76-7.0 (m, 2H, Ar-H), 7.1-7.4 (m, 6H, Ar-H), 10.0 (bs, 3H, NH_3^+); ms: m/e 252 (M^+).

Anal. Calcd. for $C_{16}H_{16}N_2O \cdot HCl$: C, 66.54; H, 5.93; N, 9.70. Found: C, 66.25; H, 5.91; N, 9.75.

6-Chloro-2'-(*N*-methylthiocarbamyl)-2',3'-dihydrospiro[benzofuran-2(3*H*),4'(1'*H*)-isoquinoline] (**4o**).

A solution of methyl isothiocyanate (5.6 g, 0.077 mole) in benzene (25 ml) was added dropwise to a stirred solution of 6-chloro-2',3'-dihydrospiro[benzofuran-2(3H),4'(1'*H*)-isoquinoline] (10.4 g, 0.038 mole) in benzene (50 ml). The reaction mixture was stirred at room temperature for twelve hours, then diluted with hexane (60 ml), cooled, then filtered to give 12.6 g white solid (96%), mp 195-198°. An analytical sample was recrystallized from benzene to give a white solid, mp 195-196°; nmr (deuteriochloroform): δ 3.2 (d, 3H, CH_3), 3.24 (d, 1H, ring CH_2, geminal), 3.54 (d, 1H, ring CH_2, geminal), 3.7 (d, 1H, ring CH_2, geminal), 4.76 (d, 1H, ring CH_2, geminal), 4.96 (q, 2H, $ArCH_2N$), 5.9 (bs, 1H, NH), 6.8-7.0 (m, 2H, ArH), 7.04-7.52 (m, 5H, Ar-H); ms: m/e 344 (M^+).

Anal. Calcd. for $C_{18}H_{17}ClN_2OS$: C, 62.69; H, 4.97; N, 8.12. Found: C, 63.05; H, 4.88; N, 8.09.

6-Chloro-2'-(*N*,*S*-dimethylthiocarbamyl)-2',3'-dihydrospiro[benzofuran-2(3*H*),4'(1'*H*)-isoquinoline]Hydroiodide (**4p**).

A solution of 6-chloro-2'-(*N*-methylthiocarbamyl)-2',3'-dihydrospiro-[benzofuran-2(3*H*),4'(1*H*)-isoquinoline] (12.0 g, 0.035 mole) and iodomethane (7.4 g, 0.052 mole) in methanol (150 ml) and ethanol (100 ml) was refluxed for four hours. Removal of solvents *in vacuo* yielded a pale yellow solid which, upon trituration with ether, yielded a white solid (16.4 g, 99%, dec at 187-193°). An analytical sample was recrystallized from ethyl acetate-methanol to yield a white solid dec at 181-182°; nmr (DMSO-d_6): δ 2.6 (s, 3H, SCH_3), 3.2 (s, 3H, NCH_3), 3.56 (gem q, 2H, CH_2), 4.34 (gem q, 2H, CH_2), 5.1 (gem q, 2H, $ArCH_2N$), 6.9 (d, 1H, ArH), 7.04 (dd, 1H, ArH), 7.3-7.6 (m, 5H, ArH), 9.68 (bs, 1H, NH^+); ms: m/e 358 (M^+).

Anal. Calcd. for $C_{19}H_{19}ClN_2OS \cdot HI$: C, 46.88; H, 4.14; N, 5.76. Found: C, 46.76; H, 4.01; N, 5.57.

6-Chloro-2'-[*N*'-methyl-*N*-(3-dimethylaminopropyl)]amidino-2',3'-dihydrospiro[benzofuran-(3*H*),4'(1'*H*)-isoquinoline]Hydroiodide (**4q**).

To a stirring suspension of 6-chloro-2'-(*N*,*S*-dimethylthiocarbamyl)-2',3'-dihydrospiro[benzofuran-2(3*H*),4'(1'*H*)-isoquinoline] (8.0 g, 0.016 mole) in absolute ethanol (100 ml) was slowly dropped 3-dimethylaminopropylamine (1.9 g, 0.018 mole) in ethanol (20 ml). The reaction mixture was refluxed for two hours, cooled, and concentrated *in vacuo* to yield a gummy white solid which was immediately recrystallized from ethyl acetate-methanol to yield a white solid (6.9 g, 78%). This material was recrystallized again from ethyl acetate-methanol to yield white needles (6.4 g, 74%, dec at 190-191°); nmr (DMSO-d_6): δ 1.7 (bt, unresolved, 2H, CH_2), 2.12 (s, 6H, $N(CH_3)_2$), 2.28 (t, 2H, CH_2), 2.9 (s, 3H, NCH_3), 3.34 (m, unresolved, 2H, CH_2), 3.5 (q, geminal, 2H, ring CH_2), 3.85 (q, geminal, 2H, ring CH_2), 4.72 (s, 2H, Ar-CH_2N), 6.83-7.1 (m, 2H, Ar-H), 7.24-7.5 (m, 5H, Ar-H), 8.12 (bs, 2H, NH_2^+); ms: m/e 413 (MH^+).

Anal. Calcd. $C_{23}H_{29}ClN_4O \cdot HI$: C, 51.07; H, 5.59; N, 10.36. Found: C, 50.88; H, 5.56; N, 10.23.

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