analysis to give ethyl (*E*)-1-iodo-1-octene-6-carboxylate (14). Anal. $C_{11}H_{19}O_2I$) C, H, I, O.

Evaporation of fractions 25–35 (single compact spot on TLC, solvent 5% acetone in $CHCl_3$, v/v) under vacuum provided a residue, which was crystallized from a solution of 5% $CHCl_3$ in CCl_4 to yield 110 mg (31%) of **12** as a white crystalline product: mp 158–159 °C; ^1H NMR ($CDCl_3$) δ 9.1 (br s, 2, NH and NH), 5.9–6.7 (m, 2, I CH=), 1.1–2.3 (m and m, 6 and 2, pentenyl methylenes and CH_2 of ethyl), 0.9 (t, 3, CH_3 of ethyl). Anal. ($C_{11}H_{15}N_2O_3I$) C, H, N, I.

(*E*)-5-Ethyl-5-(1-[^{125}I]iodo-1-penten-5-yl)barbituric Acid ([^{125}I]12) and (*E*)-6-(Ethoxycarbonyl)-1-[^{125}I]iodo-1-octene-6-carboxylic Acid ([^{125}I]13). Radioiodinated compounds [^{125}I]**12** and [^{125}I]**13** were prepared via **11** (method A) as described for the corresponding nonradioactive analogues **12** and **13**. A solution of **8** (30 mg, 0.1 mmol) in THF (0.5 mL) was cooled in an ice bath and shielded from light. Sodium [^{125}I]iodide (15.5 mCi, 15 mg, 0.1 mmol) in H_2O (0.5 mL) was added, followed by the addition of a solution of chloramine-T (45 mg, 0.2 mmol) in 50% aqueous THF (1 mL). After 0.5 h of stirring in the dark, the solution was diluted with H_2O (10 mL) and extracted with petroleum ether (2 × 15 mL). The petroleum ether portion was washed with aqueous sodium metabisulfite solution (5%, 20 mL), followed by H_2O (2 × 20 mL), and dried (Na_2SO_4). The petroleum ether was coevaporated with argon at 35–40 °C. The residue was passed through a column (1.2 × 30 cm) packed with a silica gel slurry (75 mL) in petroleum ether. The column was eluted with a 50% (v/v) solution of petroleum ether in $CHCl_3$ to provide [^{125}I]**11** (9.28 mCi, 61.4%), which was identical on silica gel TLC ($CHCl_3$; petroleum ether; 1:1, v/v) with an authentic cold sample of **11**. [^{125}I]**11** was dried under vacuum at 35 °C (1 h), dissolved in absolute ethanol (0.5 mL), and added to a solution of NaH (60% oil dispersion, 8 mg, 0.2 mmol) and urea (30 mg, 0.5 mmol) in ethanol (0.5 mL). The mixture was gently refluxed (oil-bath temperature 82–85 °C) with exclusion of moisture for 36 h. The solvent was coevaporated with argon at ~50 °C. Compounds [^{125}I]**12** (1.39 mC, 15%) and [^{125}I]**13** (3.7 mCi, 40%) were isolated from the residue by ethyl ether extraction, followed by chromatographic purification as described for the corresponding unlabeled analogues. The radioiodinated compounds cochromatographed with the unlabeled standard upon TLC analysis.

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Registry No. **2**, 18995-13-6; **3**, 84928-66-5; **4**, 84928-67-6; **5**, 84928-68-7; **6**, 2523-73-1; **8**, 84928-69-8; **9**, 84928-70-1; **10**, 84928-71-2; **11**, 84928-72-3; [^{125}I]**11**, 84928-73-4; **12**, 84928-74-5; [^{125}I]**12**, 84928-75-6; **13**, 84944-04-7; [^{125}I]**13**, 84944-05-8; **14**, 84928-76-7; 5-chloro-1-pentyne, 14267-92-6; catecholborane, 274-07-7; propargyl bromide, 106-96-7; urea, 57-13-6.

Sulfur Analogues of Psychotomimetic Agents. 2. Analogues of (2,5-Dimethoxy-4-methylphenyl)- and (2,5-Dimethoxy-4-ethylphenyl)isopropylamine

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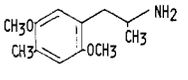
The two thio analogues of each of the well-known psychotomimetic drugs DOM [(2,5-dimethoxy-4-methylphenyl)isopropylamine] and DOET [(2,5-dimethoxy-4-ethylphenyl)isopropylamine] have been synthesized and pharmacologically evaluated in man. The 5-thio isomers are more potent as psychotomimetic agents than the 2-thio isomers but still represent a drop of an order of magnitude in potency from the sulfur-free counterparts. The dithio analogue of DOM was synthesized and found to be without central activity at a dosage of ~50 times the mean effective dose of DOM.

Of the large number of alkoxy-substituted phenethylamines that are known to be psychotomimetic in man,[1] only a few analogues with a sulfur atom replacing an oxygen atom have been prepared and evaluated pharmacologically.

Mescaline, the principal centrally active component from the cactus *Anhalonium lewinii*, contains three oxygen atoms, and the two possible thio analogues of it [3-(methylthio)-4,5-dimethoxyphenethylamine and 4-(methylthio)-3,5-dimethoxyphenethylamine] have been shown to be more potent as psychotomimetic agents.[2] The potent psychotomimetic agent (2,4,5-trimethoxyphenyl)isopropylamine (TMA-2) also contains three oxygen atoms. All three possible thio analogues of it have also been prepared,[3,4] but it is only the 4-thio analogue that exceeds the parent drug in central activity.[5] The centrally inactive positional isomer of mescaline, 2,3,4-trimethoxyphenethylamine (isomescaline) has three possible sulfur analogues, not one of which is active.[2] From these limited data, no generalities can be made concerning the pharmacological consequences of sulfur for oxygen substitution.

(2,5-Dimethoxy-4-methylphenyl)isopropylamine (DOM, **1**) and its 4-ethyl homologue (DOET, **2**) are among the



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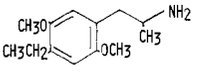

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more potent phenethylamine psychotomimetics known.[6] Each can give rise to two possible thio analogues, with 2- or 5-sulfur substitution. It was felt that their preparation

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(1) Shulgin, A. T. *Handb. Psychopharmacol.* **1978**, *11*, 243 (and references cited therein).
(2) Jacob III, P.; Shulgin, A. T. *J. Med. Chem.* **1981**, *24*, 1348; to be considered paper 1 of this series.
(3) Nichols, D. E.; Shulgin, A. T. *J. Pharm. Sci.* **1976**, *65*, 1554.
(4) Jacob III, P.; Anderson III, G.; Meshul, C. K.; Shulgin, A. T.; Castagnoli, Jr., N. *J. Med. Chem.* **1977**, *20*, 1235.
(5) Shulgin, A. T.; Nichols, D. E. In "The Psychopharmacology of Hallucinogens"; Stillman, R. C.; Willette, R. E., Eds.; Pergamon Press: New York, 1978; p 74.
(6) Shulgin, A. T. *Handb. Exp. Pharmacol.* **1981**, *55* (III), 3.

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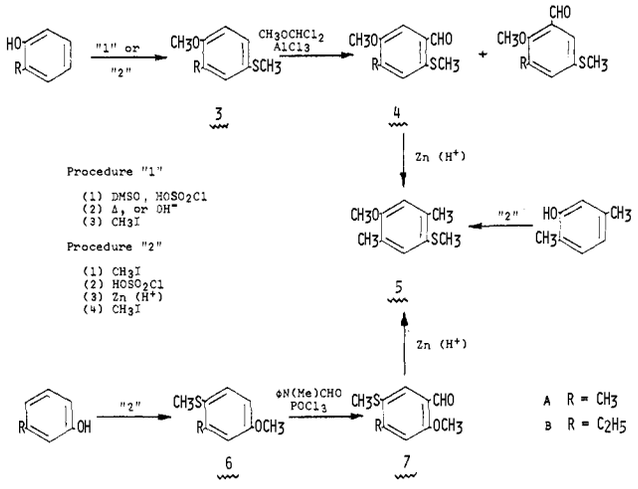
Scheme I



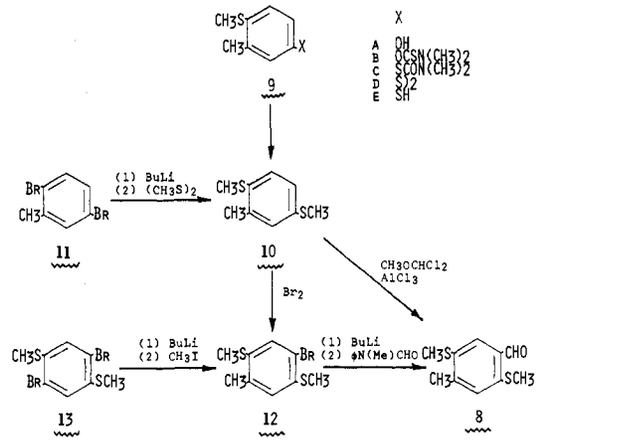
and pharmacological evaluation might allow determination of the relative importance of these two positions. This report describes the preparation and psychopharmacological assay of these compounds (**15a–d**), as well as the dithio analogue of (2,5-dimethoxy-4-methylphenyl)isopropylamine (**15e**). The 2-carbon side-chain (phenethylamine) analogues of these compounds were also synthesized but were not evaluated pharmacologically.

Chemistry. All target compounds were prepared through the intermediacy of the corresponding trisubstituted benzaldehyde. The 2-thio analogue of DOM was synthesized from 2-methyl-4-(methylthio)anisole (**3a**) (see Scheme I). This compound could be prepared either from *o*-cresol and Me_2SO by the procedure of Goethals and de Radzitzky[7] with the intermediate sulfonium salt being pyrolyzed to the (methylthio)-*o*-cresol, followed by methylation to the anisole, or by the chlorosulfonation of *o*-methoxytoluene, followed by reduction and methylation to **3a**. The conversion of **3a** to **4a** was achieved by Friedel–Crafts alkylation with dichloromethyl methyl ether. The usual Vilsmeier–Haack reaction with *N*-methylformanilide and $POCl_3$ was ineffective. Since the position of alkylation of **3a** was potentially ambiguous and since a second aldehyde [presumably 2-methoxy-3-methyl-5-(methylthio)benzaldehyde] was evident by TLC, the major product **4a** was structurally verified by its reduction to 2-methoxy-5-(methylthio)-*p*-xylene (**5**), independently synthesized from 2,5-xylenol (see Scheme I). Attempted synthesis of the homologous ether 2-ethyl-4-(methylthio)anisole (**3b**) via the sulfonium salt was unsuccessful; consequently, it was prepared from *o*-ethylanisole by the chlorosulfonation route.

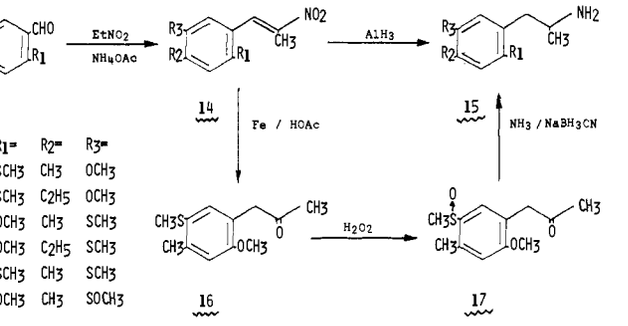
The 5-thio analogues were prepared from the intermediate ethers **6a** and **6b**, which on conventional Vilsmeier–Haack condensation with *N*-methylformanilide yielded the corresponding aldehydes **7a** and **7b**. The structure of **7a** was confirmed by reduction to the *p*-xylene derivative **5**.

The key intermediate for the synthesis of the dithio analogue of DOM, 2,5-bis(methylthio)-4-methylbenzaldehyde (**8**), was prepared by two independent routes. Commercially available 4-(methylthio)-*m*-cresol (**9a**) was converted to 4-(methylthio)-*m*-thiocresol (**9e**) via thermal O → S rearrangement of the corresponding *N*,*N*-dimethylthiocarbamate (**9b**), followed by hydrolysis (Scheme II). Methylation to the thioether (**10**) and reaction with

Scheme II



Scheme III



dichloromethyl methyl ether and $AlCl_3$ provided aldehyde **8**. An alternate and more efficient route utilized 2,5-dibromotoluene (**11**) as the starting material, which was converted to 2,5-dilithiotoluene with butyllithium and then reacted with dimethyl disulfide to give bis(thio ether) **10**. Bromination of **10** provided 4-bromo-2,5-bis(methylthio)toluene (**12**, also synthesized from *p*-dibromobenzene derivative **13**, Scheme II), which upon metal–halogen exchange with butyllithium and reaction with *N*-methylformanilide yielded aldehyde **8**.

The aldehydes **4a,b**, **7a,b**, and **8** were condensed with nitroethane to give the corresponding nitrostyrenes, which were reduced with AlH_3 to provide the desired amines (**15a–e**), isolated as their hydrochloride salts (Scheme III). The sulfoxide analogue of **15c** (**15f**) was prepared in three steps from the nitrostyrene **14c**. Reduction with iron in acetic acid produced the corresponding phenylacetone (**16**), which was sequentially oxidized with hydrogen peroxide to the sulfoxide (**17**), and then reductively aminated with ammonia and $NaBH_3CN$ to **15f**.

Pharmacology. The phenylisopropylamines described in this study were evaluated in normal human subjects. The results are summarized in Table I, with a direct comparison to the literature values of the sulfur-free counterparts. Quantitatively, two generalities are immediately evident. The inclusion of a single sulfur atom in the parent structure of either DOM or DOET (**1** or **2**) reduces the human potency by an order of magnitude (two sulfur atoms reduce the activity yet further), and of the two possible thio analogues, the 2-methylthio compounds are about half the potency of the 5-methylthio derivatives. This ranking is consistent with the reported studies that compared an *o*- and a *m*-sulfur substituted psychotomimetic with the sulfur-free counterpart, by use of rabbit hyperthermia measurements. Here, the compound with sulfur in the ortho position ([2-(methylthio)-4,5-dimethoxyphenyl]isopropylamine) had two-thirds the potency of the 5-thio analogue ([5-(methylthio)-2,4-dimethoxy-

(7) Goethals, E.; de Radzitzky, P. *Bull. Soc. Chim. Belg.* **1964**, *73*, 546.

Table I. Properties of the Nitrostyrenes (14) and of the Corresponding Amines (15)

no.	mp, °C	crystn solvent	C[a]	% Y	emp formula	anal.	no.	mp, °C	% Y	emp formula	anal.	human potency, MU[d]	N[b]	T[c]
							1					80[e]		
							2					100[e]		
14a	83–84	MeOH	YO	24	$C_{12}H_{15}NO_3S$	C, H	**15a**	195–196	50	$C_{12}H_{20}ClNOS$	C, H	4	2	9
14b	83–83.5	MeOH	Y	58	$C_{13}H_{17}NO_3S$	C, H	**15b**	164–167	42	$C_{13}H_{22}ClNOS$	C, H	4	2	11
14c	102–102.5	IPA	Y	87	$C_{12}H_{15}NO_3S$	C, H	**15c**	156–157	65	$C_{12}H_{20}ClNOS$	C, H	8	9	19
14d	59–60	MeOH	O	85	$C_{13}H_{17}NO_3S$	C, H	**15d**	146–147	53	$C_{13}H_{22}ClNOS$	C, H	16	8	19
14e	90–91	EtOH	P	87	$C_{12}H_{15}NO_2S_2$	C, H	**15e**	228–229	39	$C_{12}H_{20}ClNS_2$	C, H	<2	2	10
							15f[f]	227–229	78	$C_{12}H_{20}ClNO_2S$	C, H	<2	2	11

[a] Color: Y = yellow; O = orange; R = red; and P = pumpkin. [b] Number of subjects. [c] Number of individual trials. [d] All compounds were administered orally, as aqueous solution of the hydrochloride salts; activity is expressed as mescaline units; see ref 17. [e] Values from ref 6. [f] Prepared by reductive amination of the corresponding 1-aryl-2-propanone (see Experimental Section).

phenyl]isopropylamine, **4**) and only one-sixth the potency of the sulfur-free analogue [(2,4,5-trimethoxyphenyl)isopropylamine].[8] In the present study, the 5-thio analogue **15c** and **15d** were the most potent and appeared to be the most interesting psychopharmacologically.

A direct comparison of **15c** with **15d** has revealed some significant differences. The effects of **15c**, administered orally in the range of 30–50 mg, were first noted at about 0.5 h, and maximum development was generally present early in the 3rd h. The plateau lasted until the 5th h and then subsided rather slowly, being dissipated at 12–16 h following the initial ingestion. Central effects were described as mainly sensory enhancement and distortion, some visual distortion accompanied by some persistent physical malaise. There was considerable gastric disturbance and evidence of neurological discoordination. In contrast, **15d** is twice as potent and much longer lived in action. Following oral administration of **15d** in the 16–25 mg range, the onset of action was noted at about 0.5 h, but the full development of effects was not realized until the 4th h and persisted for an additional 4–6 h. A complete recovery of base-line state was achieved at 18–24 h. Although there was a generalized restlessness, the physical disturbance was much less with **15d** than with **15c**, and there was generally a brighter affect, with easy humor and much visual elaboration in some subjects. With both compounds there was some sleep disturbance and compensatory lethargy in the day following exposure. There was noted an occasional hypersensitivity (one of nine subjects with **15c**; two of eight subjects with **15d**), with a full intoxication syndrome being expressed at about one-half the normal mean dosage. The fact that one experimental subject showed this idiosyncratic response to both compounds suggests some metabolic peculiarity. One metabolic locus common to both **15c** and **15d** is the sulfur atom at the aromatic 5-position. This justified the synthesis and evaluation of the corresponding sulfoxide analogue **15f**, which, however, proved to be of lower potency than **15c**. The metabolic fate of these several compounds and model aromatic thioethers is presently under investigation.

Experimental Section

Melting points were taken on a Laboratory Devices Mel-temp apparatus and are uncorrected. Infrared spectra were obtained with a Beckman Acculab spectrometer, and the NMR spectrum was obtained with a Varian FT-80 instrument. Distillations were carried out bulb to bulb in an Aldrich Kugelrohr oven. Microanalyses were performed by Galbraith Laboratories, Knoxville, TN. Unless otherwise noted, TLC was performed with silica gel G plates (Brinckmann) developed with methylene chloride and visualized by quenching of 254 nm fluorescence.

2-Methyl-4-(methylthio)anisole (3a). Procedure 1. A solution of 64.8 g of o-cresol (600 mmol) and 56 g of Me_2SO (720 mmol) in ether (300 mL) was cooled in an ice bath and treated with 40 mL of $ClSO_2OH$ (70.8 g, 610 mmol), which was added dropwise with vigorous stirring. After the addition was complete, the two-phase reaction mixture was brought to room temperature and allowed to stand for 12 h. The upper phase was discarded, the viscous, red residue was dispersed with 300 mL of 2-propanol and filtered, and the solids were washed with an additional 150 mL of 2-propanol and air-dried to provide 31.6 g (26%) of pale pink dimethyl(4-hydroxy-3-methylphenyl)sulfonium chloride. An analytical sample was prepared by dissolving 0.4 g in 1 mL of water and diluting quickly with 40 mL of acetone, which yielded 0.3 g of white crystals, mp 155–156 °C with effervescence. Anal. ($C_9H_{13}ClOS$) C, H, S. Reference 7 describes this salt as the bisulfate, without analytical data or physical properties.

(8) Anderson III, G. M.; Castagnoli, Jr., N.; Kollman, P. A. *NIDA Res. Monogr.* **1978**, *no. 22*, 199.

Direct heating of 31.0 g of dimethyl(4-hydroxy-3-methylphenyl)sulfonium chloride in an Erlenmeyer flask with an open flame resulted in melting with vigorous effervescence. Heating was maintained until effervescence ceased. After cooling, the product was diluted with 200 mL of CH_2Cl_2 and extracted with 3 × 100 mL of 5% NaOH. The basic extracts were pooled, acidified with concentrated HCl, and reextracted with 3 × 75 mL of CH_2Cl_2. The solvent was removed in vacuo, and the residue (24.5 g) was distilled [100–110 °C (0.5 mm)] to provide a product that spontaneously crystallized. The yield of 2-methyl-4-(methylthio)phenol was 22.0 g (94%), mp 36–37 °C. A small sample from methylcyclohexane gave mp 35–36 °C (lit.[7] mp 35–36 °C).

A solution of 25.5 g (166 mmol) of the above phenol in 100 mL of warm MeOH was mixed with 12 g of 85% KOH in 60 mL of warm MeOH and 12.4 mL of methyl iodide and held at reflux for 16 h. The solvent was removed in vacuo, the residue was quenched in 400 mL of H_2O, made basic with 5% NaOH, and extracted with 3 × 100 mL of CH_2Cl_2. Removal of the solvent from the combined extracts provided a light amber oil (28.3 g), which was distilled at 72–80 °C (0.5 mm). The title compound was obtained as a pale yellow oil: IR (OCH_3) 2835, 1033 cm^{-1}; IR (fingerprint) 752, 806, 882, 969, (1033), 1100, 1139, and 1181 cm^{-1}. Anal. ($C_9H_{12}OS$) C, H.

Procedure 2. Compound **3a** was also obtained from o-methylanisole by chlorosulfonation, followed by reduction and methylation, analogous to the preparation of 3,4-dimethoxythioanisole described in ref 4. The sulfonyl chloride was obtained in 65% yield; mp of a small sample recrystallized from cyclohexane was 51–52 °C; sulfonamide mp 135–136 °C, from ethyl acetate (lit.[9] mp 137 °C). Reduction with zinc and acid gave a 91% yield of crude thiol, mp 39–43 °C; a small sample recrystallized from methanol gave lustrous white places, mp 45–46 °C. Anal. ($C_8H_{10}OS$) C, H. Methylation with methyl iodide and KOH in methanol provided a 62% yield of **3a** that was identical in all respects with the product obtained by procedure 1.

5-Methoxy-4-methyl-2-(methylthio)benzaldehyde (4a). To a well-stirred solution of 22.1 g of 2-methyl-4-(methylthio)anisole (130 mmol) in 600 mL of CH_2Cl_2 there was added 17.5 g of dichloromethyl methyl ether, followed by 24.5 g of anhydrous $AlCl_3$, portionwise, over 1 min. The color progressed from a fading yellow-orange to red and then finally to a deep burgundy. Stirring at ambient temperature was continued for an additional 20 min, after which 500 mL of H_2O was added cautiously. Yellow solids separated, which, with an additional 0.5 h of stirring, produced two separate clear phases. These were separated, and the aqueous phase was extracted with 100-mL portions of CH_2Cl_2. The extracts were pooled and washed with 5% NaOH, and the solvent was removed in vacuo. Distillation of the residue at 0.5 mmHg gave a forerun (85–95 °C) that proved to be largely starting ether, and a major fraction (8.4 g, bp 95–120 °C) that contained product by TLC analysis. This distillate was dissolved in warm cyclohexane (30 mL) and cooled to about 8 °C until the aldehyde had crystallized. Filtering, washing with cold cyclohexane, and air-drying yielded 2.9 g (11%) of a pale yellow crystalline solid (mp 69–70 °C). Anal. ($C_{10}H_{12}O_2S$) C, H. Since the mother liquor from this crystallization contained, in addition to much starting ether (higher R_f by TLC), a major second component of lower R_f [a similarly fluorescent component, presumably the isomeric aldehyde 2-methoxy-3-methyl-5-(methylthio)benzaldehyde], the positional substitution pattern of **4a** was verified by reduction to the substituted *p*-xylene (**5**); see below.

3-Methyl-4-(methylthio)anisole (6a). 4-(Methylthio)-*m*-cresol (Crown-Zellerbach; 35.8 g, 232 mmol) was methylated according to procedure 1, which yielded 33.6 g (86%) of a colorless oil; bp 80–90 °C (0.25 mmHg), lit.[10] bp 272 °C.

2-Methoxy-4-methyl-5-(methylthio)benzaldehyde (7a). A solution of 72 g of *N*-methylformanilide and 82 g of $POCl_3$ was heated on the steam bath for 10 min. To this there was added **6a** (33.6 g, 200 mmol), and the mixture was heated on the steam bath for 2 h. The reaction mixture was then poured into 1.2 L of water and stirred for 12 h, yielding a granular sticky solid. This was removed by filtration and washed with water. The resulting brown solid (33.6 g wet weight) was ground under 60 mL of methanol and filtered, and the solids were washed sparingly with methanol, yielding a nearly white solid (17.8 g), which upon recrystallization from 50 mL of boiling methanol afforded pale yellow crystals (13.4 g), mp 98–99 °C. An additional 1.9 g was obtained from the mother liquors, for a total yield of 39%, lit.[10] mp 100 °C.

2-Methoxy-5-(methylthio)-*p*-xylene (5). 2,5-Dimethylanisole was converted via the benzenesulfonyl chloride to the thiophenol analogously to the preparation of **3a** by procedure 2. The product, 2,5-dimethyl-4-methoxythiophenol, was obtained as pale yellow crystals (mp 37–39 °C), which upon recrystallization from methanol yielded a white solid, mp 38 °C sharp. Anal. ($C_9H_{12}OS$) C, H. Reference 11 describes this product as an oil, bp 252–254. Methylation (with CH_3I, KOH, and methanol, analogous to *procedure 2* for **3a**) provided **5**, which on recrystallization from methanol (6 mL/g) yielded white solids, mp 67–68 °C (lit.[11] mp 65–66 °C). Anal. ($C_{10}H_{14}OS$) C, H.

Reduction of 4a. To 7.0 g of 20–30 mesh Zn metal there was added 30 mg of $HgCl_2$ in 1 mL of hot water, and the combination was allowed to stand with occasional swirling for 2 h. The water was decanted, and there was added 1 mL of concentrated HCl, followed by a solution of 0.30 g of **4a** in 3 mL of ethanol containing 0.2 mL of concentrated HCl. Following the exothermic reaction, the mixture was heated on a steam bath, and after 10 min, an additional 4 mL of HCl was added. After 12 h of heating at 100 °C, the liquid phase was decanted from the unreacted Zn, which was washed with water and CH_2Cl_2. The organic fraction was separated and washed with water and 1% NaOH, and the solvent was removed in vacuo. The resulting oil spontaneously crystallized (0.18 g), and the solids were recrystallized from methanol to yield 0.13 g of **5**, mp 67–68 °C, as white crystals: mmp with the above sample, 67–68 °C.

Reduction of 7a. In the same manner as above, **7a** was reduced to **5**, as off-white crystals, mp 63–64 °C (mmp with the authentic sample above, 63–64 °C).

2-Ethyl-4-(methylthio)anisole (3b). o-Ethylphenol was methylated with methyl iodide (50% excess) and KOH in methanol (reflux, 12 h) to give an 81% yield of o-ethylanisole, bp 55–65 °C (0.4 mmHg), lit.[12] bp 70–71 °C (11 mmHg). The resulting ether was converted to the sulfonyl chloride in 75% yield, mp 43–45 °C. A sample recrystallized from hexane had mp 44–46 °C. The corresponding sulfonamide, prepared on a small scale and recrystallized from water, had mp 98 °C sharp. Anal. ($C_9H_{13}NO_3S$) C, H.

The sulfonyl chloride was reduced in 63% yield to the thiophenol, a water-white mobile oil: bp 72–84 °C (0.3 mmHg); IR (smear on NaCl) showed the SH group (2562 cm^{-1}), the OCH_3 group (2837, 1061 cm^{-1}), and the fingerprint 806, 880, 1052 (1061), 1142, 1179 cm^{-1}. Anal. ($C_9H_{12}OS$) C, H. The thiophenol was methylated to give a 91% yield of **3b** as a colorless oil, bp 78–85 °C (0.2 mmHg); mp ~0 °C; IR (smear on NaCl) showed no SH group, the OCH_3 group (2832, 1031 cm^{-1}), and the fingerprint 808, 970, (1031), 1051, 1144, 1179 cm^{-1}. Anal. ($C_{10}H_{14}OS$) C, H.

An attempt to employ procedure 1, with o-ethylphenol, yielded no solid sulfonium salt, and attempts to pyrolyze the oily intermediate led to extensive decomposition.

4-Ethyl-5-methoxy-2-(methylthio)benzaldehyde (4b). The procedure used to prepare **4a** was employed. From 11.2 g of **3b** (62 mmol) was obtained a crude aldehyde product that distilled into broad fractions 87–100 °C (0.3 mmHg) (2.9 g of a yellow oil), containing considerable starting ether by TLC, and 100–130 °C (0.2 mmHg) (4.8 g of a viscous deep yellow oil), containing no starting ether by TLC but a slower moving, white fluorescent spot, presumably the positional isomer, analogous to that mentioned under **4a**. Both fractions were dissolved in equal volumes of methanol and cooled to 0 °C, yielding yellow solids, mp 62–63 °C. From the mother liquors, an additional crop was obtained for a total yield of 5.3 g (41% yield). Recrystallization from methanol gave light yellow crystals of the same melting point. Anal. ($C_{11}H_{14}O_2S$) C, H.

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3-Ethyl-4-(methylthio)anisole (6b). Analogous to procedure 1 for **3a** above, 25.0 g (205 mmol) of *m*-ethylphenol was converted to 20.0 g of white sulfonium salt (mp 168–170 °C without effervescence, yield 45%), which was used without further characterization. A solution of this salt in 500 mL of methanol and 200 mL of water was treated with 30 g of NaOH, and the resulting solution was heated on the steam bath for 36 h. The bulk of the methanol was removed on the rotary evaporator, and the resulting basic solution was extracted with 2 × 75 mL of CH_2Cl_2. The remaining aqueous solution was acidified with HCl and reextracted with 3 × 100 mL of CH_2Cl_2. The latter extracts were pooled, the solvent was removed in vacuo, and the resulting oil (12.6 g) was distilled at 95–105 °C (0.3 mmHg) to provide a fraction that spontaneously crystallized to give 10.0 g (29% based on the starting phenol) of 3-ethyl-4-(methylthio)phenol, mp 47–49 °C. A small sample from cyclohexane had mp 47–48 °C, lit.[13] bp 135–137 °C (4 mmHg). 3-Ethyl-4-(methylthio)anisole (**6b**) was obtained in 75% yield from 9.7 g (58 mmol) of the above phenol (employing the methylation step of procedure 1) as a colorless oil, bp 78–88 °C (0.3 mmHg). Anal. ($C_{10}H_{14}OS$) C, H.

4-Ethyl-2-methoxy-5-(methylthio)benzaldehyde (7b). In a manner analogous to that describing **7a**, 7.7 g (42 mmol) of **6b** was treated with 6.9 g of *N*-methylformanilide and 7.8 g of $POCl_3$ for 2 h. When the reaction was quenched in water (400 mL) and stirred for 12 h, there resulted a light amber oil, with no indication of crystallization. The mixture was extracted with CH_2Cl_2 (3 × 75 mL), the extracts were pooled, the solvent was removed, and the residual oil (9.2 g) was suspended in 25 mL of hexane. The clear solution was decanted from some insoluble material (after standing 1 h), and upon concentration under vacuum yielded 7.7 g of a clear amber oil that was quite complex by TLC but consisted largely of starting ether and product aldehyde. Distillation at 0.25 mmHg yielded a first cut (5.3 g) boiling between 75 and 115 °C, consisting largely of **6b**. A second cut (120–140 °C, 1.6 g) crystallized in the receiver as an orange solid: yield 18%; mp 55–57 °C. A small portion that recrystallized from an equal weight of cyclohexane gave white crystals, mp 57–58 °C. Anal. ($C_{11}H_{14}O_2S$) C, H. Recycling the distillation cut no. 1 (largely ether, some aldehyde) with *N*-methylformanilide and $POCl_3$ (12 h at 100 °C) eventually yielded another 0.3 g of **7b**.

2,5-Bis(methylthio)toluene (10). Preparation from 2,5-Dibromotoluene. To a solution of 9.0 g of 2,5-dibromotoluene (11; 36 mmol) in 50 mL of petroleum ether under He atmosphere there was added 50 mL of a 1.6 M hexane solution of butyllithium (80 mmol). The exothermic reaction produced a granular precipitate, and this suspension was stirred for 12 h.[14] There was then added 7.5 g of CH_3SSCH_3 (80 mmol), with ice cooling, which produced a heavy precipitate that lightened toward the end of the addition. Stirring was continued for 20 min, and then the reaction mixture was poured into acidified water. The phases were separated, the aqueous phase was extracted with ether (50 mL), and the combined organic phases were washed with dilute NaOH and then with water and finally dried over anhydrous K_2CO_3. After removal of the solvent, the residue (10 g) was distilled in vacuo. The product had a bp 75–85 °C (0.3 mmHg) (5.3 g, 80% yield), which was, by TLC, 80–90% pure **10**. The R_f's of the two major impurities were consistent with the two possible monomethylthio derivatives.

Preparation from 4-(Methylthio)-*m*-cresol (9a). To a solution of 7.65 g (50 mmol) of 4-(methylthio)-*m*-cresol (Crown-Zellerbach) in 50 mL of dry THF, under an atmosphere of He, there was added 3.5 g of NaH (57% in mineral oil). After the exothermic reaction quieted, there was added 6.8 g of *N,N*-dimethylthiocarbamoyl chloride (55 mmol) in 30 mL of dry THF. After 4 h at reflux, the reaction was poured into 1 L of acidified water and extracted with 3 × 100 mL of CH_2Cl_2, the pooled extracts were washed with 5% NaOH (100 mL) and then water, and the solvent was removed in vacuo. The viscous residue (13.4 g) was suspended in hot hexane (2 × 50 mL), and the solution was removed by decantation after the insolubles had settled. Removal of the solvent and distillation [150–160 °C (0.5 mmHg)] yielded 3.4 g of 3-methyl-4-(methylthio)phenyl *N,N*-dimethylthiocarbamate (**9b**), a viscous lemon-yellow oil that was used without further purification in the following step: yield 28%, of a product that by TLC (CH_2Cl_2 or $CHCl_3$/MeOH, 9:1; silica gel) contained no starting phenol but three polar impurities (minor) and an unknown amount of mineral oil; IR (smear on NaCl) showed no carbamate carbonyl but the fingerprint 685, 712, 754, 812, 870, 915, 963, 1003, 1061, 1137, 1173 cm^{-1}, with the three last peaks as the major bands.

The above thionocarbamate (3.1 g, 13 mmol) was heated with an open flame to 280–300 °C for 3 min, and the dark but fluid product distilled [150–160 °C (0.3 mmHg)], yielding 2.5 g of a pale yellow distillate, which crystallized to a waxy yellow solid (mp 56–63 °C): yield 81%. Trituration under methanol gave 3-methyl-4-(methylthio)phenyl *N,N*-dimethylthiocarbamate (**9c**) as a white solid: mp 63–68 °C. IR (smear on NaCl) showed the carbamate carbonyl (1664 cm^{-1}) and the fingerprint 686, 809, 908, 1059, 1093 cm^{-1}. Anal. ($C_{11}H_{15}NOS_2$) C, H.

A solution of 2.2 g (9 mmol) of the above thiolocarbamate in 100 mL of MeOH was treated with 32 mL of 5% NaOH, held at reflux for 12 h, and allowed to stand at room temperature for 24 h. The white solids that formed were removed by filtration and extracted with 2 × 10 mL of boiling hexane, and the combined extracts upon cooling yielded 0.4 g of white crystals of the bis-(3-methyl-4-methylthiophenyl) disulfide (**9d**), mp 79–80 °C. Recrystallization from boiling MeOH (100 mL/g) yielded flocculant white crystals (0.35 g), mp 78–79 °C. Anal. ($C_{16}H_{18}S_4$) C, H. The IR spectrum was free of OH, SH, and carbonyl absorptions and had the following fingerprint: 804, 814, 866, 880, 1053, 1111 cm^{-1}. The basic aqueous mother liquors, upon extraction with CH_2Cl_2, yielded a neutral fraction, which upon trituration under methanol provided an additional 0.1 g of the disulfide (mp 78–79 °C). The aqueous phase, after acidification, was extracted with CH_2Cl_2 (2 × 75 mL), the extracts were pooled, the solvent was removed in vacuo, and the residue (1.7 g of a fluid oil) was distilled to provide a fraction [bp 80–110 °C (0.2 mmHg)] that proved to be (by TLC and IR) a mixture of the phenol **9a** and the thiophenol **9e**. This fraction (0.6 g) was dissolved in 6 mL of MeOH and treated with 0.35 mL of 35% H_2O_2 at about 35 °C, which converted the yellow oil into a waxy solid. This was removed and recrystallized from methanol to provide an additional 0.15 g of the disulfide: mp 76–78 °C; total yield 0.6 g (39% of theory).

A solution of 0.6 g of the above disulfide (1.8 mmol) in 10 mL of hot HOAc was treated with 1.5 g of Zn dust, followed by 0.5 mL of concentrated HCl. The mixture was heated on the steam bath for 1 h and decanted into 100 mL of water, producing waxy solids. These were extracted with 3 × 100 mL of CH_2Cl_2, the extracts were pooled, the solvent was removed in vacuo, and the residue was distilled [85–95 °C (0.3 mmHg)] providing 0.55 g (92%) of 3-methyl-4-(methylthio)thiophenol (**9e**) as a water-white liquid, which was free of phenol by both IR and TLC. Anal. ($C_8H_{10}S_2$) C, H.

The IR spectrum showed an SH band at 2560 cm^{-1}, but no OH nor carbonyl absorption, and the following fingerprint: 804, 873, 1055, 1119, 1200 cm^{-1}. A solution of 0.50 g of the above thiophenol (3 mmol) in 5 mL of MeOH was treated with 0.4 mL of CH_3I, followed by 0.25 g of KOH in 5 mL of warm MeOH. The solution was held at reflux for 1 h, the solvent was removed in vacuo, and the residue was suspended in 200 mL of H_2O, made strongly basic with 5% NaOH, and extracted with CH_2Cl_2 (2 × 50 mL). The pale amber oil that remained after solvent removal was distilled, yielding 0.50 g of **10**, a colorless fluid: bp 88–96 °C (0.3 mmHg); yield 91%. The IR spectrum had no functionality, had a fingerprint 803, 874, 968, 1053, 1114, 1200 cm^{-1}, and was virtually identical (by IR and TLC) with 2,5-bis(methylthio)toluene obtained from 2,5-dibromotoluene, described above. Anal. ($C_9H_{12}S_2$) C, H.

2,5-Bis(methylthio)-4-bromotoluene (12). Preparation from 10. To a solution of 3.9 g of **10** (21 mmol) in 20 mL of HOAc containing a crystal of I_2 there was added 3.5 g of Br_2 (22 mmol). The solution was heated for 1 h on the steam bath and cooled to 10 °C, and the resulting yellow solid was removed by filtration: yield 1.9 g (34%); mp 129–132 °C. Recrystallization from 2-propanol gave white crystals, mp 133–134 °C. Anal. ($C_9H_{11}BrS_2$) C, H.

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Preparation from *p*-Dibromobenzene. To 150 mL of hexamethylphosphoramide there was added 50 g of *p*-dibromobenzene (195 mmol) and 50 g of $NaSCH_3$ (715 mmol), and the suspension was heated on the steam bath for 4 h. A TLC analysis at this point (hexane/CH_2Cl_2, 4:1) indicated the absence of starting dibromobenzene but the presence of methylthio and dimethylthio products in the ratio of about 2:1. An additional 25 g of $NaSCH_3$ (360 mmol) was added, and heating continued for an additional 16 h. The reaction mixture was quenched in 1 L of H_2O, and the white solids formed were removed by filtration and washed well with water. The 36 g of damp crude white solid obtained was recrystallized from 120 mL of boiling 2-propanol to give 25 g of white crystalline product that was about 80% pure (yield ~55%). Recrystallization alternately from 2-propanol and hexane yielded white platelets, mp 83.5–84.5 °C, but with a considerable loss of yield, lit.[15] mp 85 °C.

The above *p*-bis(methylthio)benzene (10.1 g, 60 mmol, ~80% pure material) and 21.3 g of Br_2 (134 mmol) were added to 50 mL of HOAc containing a crystal of iodine. There was the immediate formation (exothermically) of a brown precipitate. The mixture was heated on a steam bath for 1.5 h and cooled, and the orange solid product formed was separated by filtration. After drying, this crude product was recrystallized from 120 mL of toluene to provide 11.0 g (56%) of off-white crystals, mp 195–199 °C, lit.[15] mp 198 °C.

A suspension of the above 2,5-dibromo-1,4-bis(methylthio)-benzene (1.32 g, 4 mmol) in 50 mL of anhydrous ether, under He, was treated with 3.1 mL of 1.6 M BuLi in hexane (5 mmol). Stirring was continued for 1.5 h, during which time the reaction mixture developed a turbid, milky character. Methyl iodide (2 mL) was added in equal portions spaced 15 min apart. After an additional 10 min, the reaction mixture was added to 100 mL of H_2O, the organic layer was separated, the aqueous phase was extracted with ether (50 mL), the organic extracts were combined, and the solvent (after drying with anhydrous K_2CO_3) was removed in vacuo. Distillation [130–140 °C (0.3 mmHg)] provided a 0.3-g fraction that largely crystallized. Trituration with methanol yielded an off-white solid, mp 118–136 °C, that was identical (by TLC and IR) with **12** as described above.

4-Methyl-2,5-bis(methylthio)benzaldehyde (8). To a solution of 2.4 g of **12** (9 mmol) in 100 mL of anhydrous ether (under He) there was added 10 mL (16 mmol) of 1.6 M butyllithium in hexane, and the mixture was stirred for 10 min. The addition of 2.5 mL of *N*-methylformanilide (16 mmol) led to an exothermic reaction. After stirring for 10 min, the reaction mixture was added to 100 mL of dilute HCl, the phases were separated, and the aqueous layer was extracted with ether. The organic extracts were combined and dried with anhydrous K_2CO_3, and the solvent was removed in vacuo. The resulting solids were recrystallized from 15 mL of boiling 2-propanol to yield 1.1 g (57%) of a yellow-brown solid, mp 107–109 °C. An analytical sample from MeOH had mp 110–111 °C; NMR ($CDCl_3$, Me_4Si) δ 2.39 (3 H), 2.50 (6 H) [$ArCH_3$, $(SCH_3)_2$], 7.15 (1 H), 7.60 (1 H) (ArH), 10.31 (1 H) CHO; IR (carbonyl function) 1680 cm^{-1}; IR (fingerprint) 797, 870, 968, 1108, 1189 cm^{-1}. Anal. ($C_{10}H_{12}OS_2$) C, H.

The benzaldehyde **8** was alternately synthesized directly from **10** in an inferior yield. To a solution of 0.4 g of **10** (2.2 mmol) in 12 mL of CH_2Cl_2 there was added 0.4 g of Cl_2CHOCH_3 and 0.4 g of anhydrous $AlCl_3$, and the mixture was stirred for 20 min. H_2O (12 mL) was added, the phases were separated, the aqueous phase was extracted with CH_2Cl_2 (2 × 25 mL), and the organic fractions were combined. After removal of the solvent in vacuo, the residue was distilled [120–130 °C (0.3 mmHg)] to give 0.05 g (11% yield) of a yellow oil that spontaneously crystallized, mp 103–107 °C. Its spectral and chromatographic properties were identical with the analytical sample described above.

β,4-Dimethyl-2-methoxy-5-(methylthio)-β-nitrostyrene (14c). A solution of 13.4 g of **7a** (68 mmol) in 100 mL of nitroethane was treated with 1.0 g of ammonium acetate and held at steam-bath temperature, with periodic assays of the aldehyde/nitrostyrene ratio being made by TLC. The nitrostyrene had a higher R_f and fluoresced deep purple under long-wave length UV light, whereas the aldehyde had a pale yellow fluorescence. After 5 h of heating, the solvent was removed in vacuo, and the resulting yellow solid was recrystallized from 120 mL of boiling 2-propanol, yielding 14.4 g of **14c**, mp 101–102 °C. A second recrystallization raised the mp to 102–102.5 °C. Evaporation of the mother liquors yielded a second crop, mp 100–101 °C, for a total yield of 87%. Anal. ($C_{12}H_{15}NO_3S$) C, H. All of the remaining nitrostyrenes were made in a similar manner, with the appropriate use of either nitromethane or nitroethane. In each case, continuous titration of the composition of the reaction mixture was necessary so that the reaction could be stopped when the starting aldehyde was substantially consumed, before the generation of undesired polar byproducts became significant. The times required ranged from 40 min to 6 h. The nitromethane condensations were generally faster and more prone to the generation of side-products.

α,4-Dimethyl-2-methoxy-5-(methylthio)benzeneethanamine (15c). To a suspension of 2.0 g of $LiAlH_4$ in 100 mL of anhydrous THF at 0 °C there was added slowly, under He atmosphere, 1.28 mL of 100% H_2SO_4 (prepared from concentrated H_2SO_4 and 120% fuming sulfuric acid). A solution of 1.35 g of **14c** in 50 mL of THF was added over a period of 5 min at room temperature, and the reaction mixture was warmed on the steam bath to a gentle boil. After cooling, the excess hydride was destroyed with 2-propanol, which was followed by the addition of 15% NaOH until the initial heavy gray precipitate was transformed into a loose suspension of white solids. The reaction mixture was filtered, the remaining solids were washed with 2-propanol, and the resulting combined mother liquors and washings were stripped of solvent in vacuo. The residue was taken up in dilute H_2SO_4 and extracted with CH_2Cl_2 (3 × 50 mL, discarded), and the aqueous layer was made basic with NaOH and reextracted with 2 × 50 mL of CH_2Cl_2. The combined extracts were stripped of solvent, and the resulting oil was distilled [115–125 °C (0.3 mmHg)] to give 0.9 g of a colorless oil. This was dissolved in 4 mL of 2-propanol, acidified with concentrated HCl (employing external, damp universal pH paper, about 11 drops required), and finally diluted, with good stirring, with 20 mL of anhydrous ether. After about 10 s, a white crystalline solid appeared, which was allowed to stand for several hours. After filtration, the product was washed with IPA/ether (1:5) and then with ether and air-dried: yield 0.9 g (65%); mp 156–157 °C. Anal. ($C_{12}H_{20}ClNOS$) C, H. The amine hydrochlorides **15a–e** and their phenethylamine counterparts **19a–e** were prepared in a similar manner.

1-[2-Methoxy-4-methyl-5-(methylthio)phenyl]-2-propanone (16). A suspension of 12.7 g of **14c** (50 mmol) in 50 mL of warm acetic acid was added, in small portions with good swirling, to a warmed (60 °C) suspension of elemental iron (22.5 g, electrolytic grade) in 100 mL of acetic acid. The reaction mixture was heated cautiously on a steam bath until an exothermic reaction set in. The solvent refluxed gently as the internal color of the reaction proceeded from yellow to deep brown to eventually colorless. After standing for an hour (on cooling the reaction became quite gummy), the mixture was poured into 1 L of water, the inorganic residues were removed by filtration, and the filtrate was extracted with 3 × 100 mL of CH_2Cl_2. The pooled extracts were washed with 5% NaOH (removing most of the color), and upon evaporation, yielded 11.6 g of a pale amber oil that spontaneously crystallized. Distillation [110–120 °C (0.4 mmHg)] gave 9.9 g of white solids, mp 41–42 °C, which was not improved by recrystallization from hexane: yield 88%. Anal. ($C_{12}H_{16}O_2S$) C, H.

1-[2-Methoxy-4-methyl-5-(methylsulfinyl)phenyl]-2-propanone (17). A solution of 7.3 g of the above sulfide (16; 33 mmol) in 35 mL of MeOH was treated with 7.3 mL of 35% H_2O_2 and kept at 60 °C for 40 min. After the removal of all volatiles, there was added 250 mL of water, followed by extraction with 3 × 50 mL of CH_2Cl_2. The pooled extracts were evaporated, yielding an oily solid (8.6 g crude) that on crystallization from 10 mL of toluene yielded white crystals (5.4 g, 69%), mp 89–89.5 °C. Anal. ($C_{12}H_{16}O_3S$) C, H.

α,4-Dimethyl-2-methoxy-5-(methylsulfinyl)benzeneethanamine (15f). To a solution of 5.2 g of the above sulfoxide **17** (22 mmol) in 70 mL of MeOH there was added, with vigorous stirring, 17 g of NH_4OAc (220 mmol), followed by 1.0 g of $NaBH_3CN$. Concentrated HCl was added dropwise as needed to

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maintain the pH at about 6 (as determined by external, dampened universal pH paper). After 3 days, the generation of base had ceased, and the reaction was quenched with 500 mL of water, made strongly acidic with HCl, and washed with 2 × 100 mL of CH_2Cl_2. The aqueous fraction was made basic with 25% NaOH and extracted with 3 × 100 mL of CH_2Cl_2. Removal of the solvent from these pooled extracts yielded 7.1 g of a pale amber oil, which distilled as a viscous colorless oil (4.4 g), bp 150–160 °C (0.3 mmHg). This was dissolved in 13 mL of 2-propanol and acidified with concentrated HCl (about 30 drops needed), and the solution was heated to about 35 °C, and finally diluted with 20 mL of boiling ether. White crystals formed almost immediately, which, after cooling and standing for several hours, were removed by filtration, washed with an ether/IPA mixture and then with ether, and air-dried. A white crystalline solid (presumably a mixture of diasteriomers, 4.4 g, 78%) was obtained, mp 227–229 °C. Anal. (vacuum drying for 24 h at 100 °C) ($C_{12}H_{20}ClNO_2S$) C, H.

Psychopharmacological Assays. Preliminary screening was carried out with spaced trials (about 1-week separation) of small increments of chemical (1.6:1), starting with 0.5 mg of the hydrochloride administered orally as an aqueous solution. Following establishment of threshold levels, the effective dosages and qualitative effects were determined in normal adult subjects (age range 32–65 years, all experienced with a broad spectrum of psychotropic drugs) for compounds **15c** (9 subjects, 19 trials, dosage range 20–50 mg) and **15d** (8 subjects, 19 trials, dosage range 10–30 mg). The same protocol was used with **15a,b,e,f** (9, 11, 10, and 11 trials, respectively) at dosage maxima of 100, 100, 160, and 150 mg, respectively. No central disturbance was observed with either **15e** or **15f**.

The protocol utilized the "double conscious" technique described by Alles[16] and Shulgin.[17] Prior to the experiments, subjects were told the effective dosage range based on preliminary data and were free to choose their own dosage within this range. The setting was informal, and subjects were allowed to interact with one another or to remain alone as desired. At the conclusion of each experimental session, subjects were asked to provide a written report describing the time course of action and qualitative nature of their experience.

Potencies are expressed in mescaline units[17] using the mean of the effective dosage range and taking the effective dose of mescaline as 400 mg.

Registry No. **3a**, 50390-78-8; **3b**, 84910-71-4; **4a**, 84910-72-5; **4b**, 84910-73-6; **5**, 84910-74-7; **6a**, 22583-04-6; **6b**, 84910-75-8; **7a**, 22583-05-7; **7b**, 84910-76-9; **8**, 84910-77-0; **9a**, 3120-74-9; **9b**, 84910-78-1; **9c**, 84910-79-2; **9d**, 84910-80-5; **9e**, 84910-81-6; **10**, 84910-82-7; **11**, 615-59-8; **12**, 84910-83-8; **13**, 84910-84-9; **14a**, 84910-85-0; **14b**, 84910-86-1; **14c**, 84910-87-2; **14d**, 84910-88-3; **14e**, 84910-89-4; **15a**, 84910-90-7; **15b**, 84910-91-8; **15c**, 84910-92-9; **15d**, 84910-93-0; **15e**, 84910-94-1; **15f**, 84910-95-2; **16**, 84910-96-3; **17**, 84910-97-4; o-cresol, 95-48-7; dimethyl(4-hydroxy-3-methylphenyl)sulfonium chloride, 7379-36-4; 2-methyl-4-(methylthio)phenol, 3795-76-4; o-methylanisole, 578-58-5; 4-methoxy-3-methylbenzenesulfonyl chloride, 84910-98-5; 4-methoxy-3-methylbenzenesulfonamide, 84910-99-6; 4-methoxy-3-methylbenzenethiol, 698-32-8; dichloromethyl methyl ether, 4885-02-3; *N*-methylformanilide, 93-61-8; 2,5-dimethylanisole, 1706-11-2; 2,5-dimethyl-4-methoxythiophenol, 84911-00-2; o-ethylphenol, 90-00-6; o-ethylanisole, 14804-32-1; 3-ethyl-4-methoxybenzenesulfonyl chloride, 84911-01-3; 3-ethyl-4-methoxybenzenesulfonamide, 84911-02-4; 3-ethyl-4-methoxybenzenethiol, 84911-03-5; *m*-ethylphenol, 620-17-7; 3-ethyl-4-(methylthio)phenol, 14143-36-3; dimethyl disulfide, 624-92-0; *N,N*-dimethylthiocarbamoyl chloride, 16420-13-6; *p*-dibromobenzene, 106-37-6; nitroethane, 79-24-3.

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