Synthesis of Possible Metabolites of Chlorpromazine. III. 7,8-Disubstituted Chlorpromazine Derivatives (1)

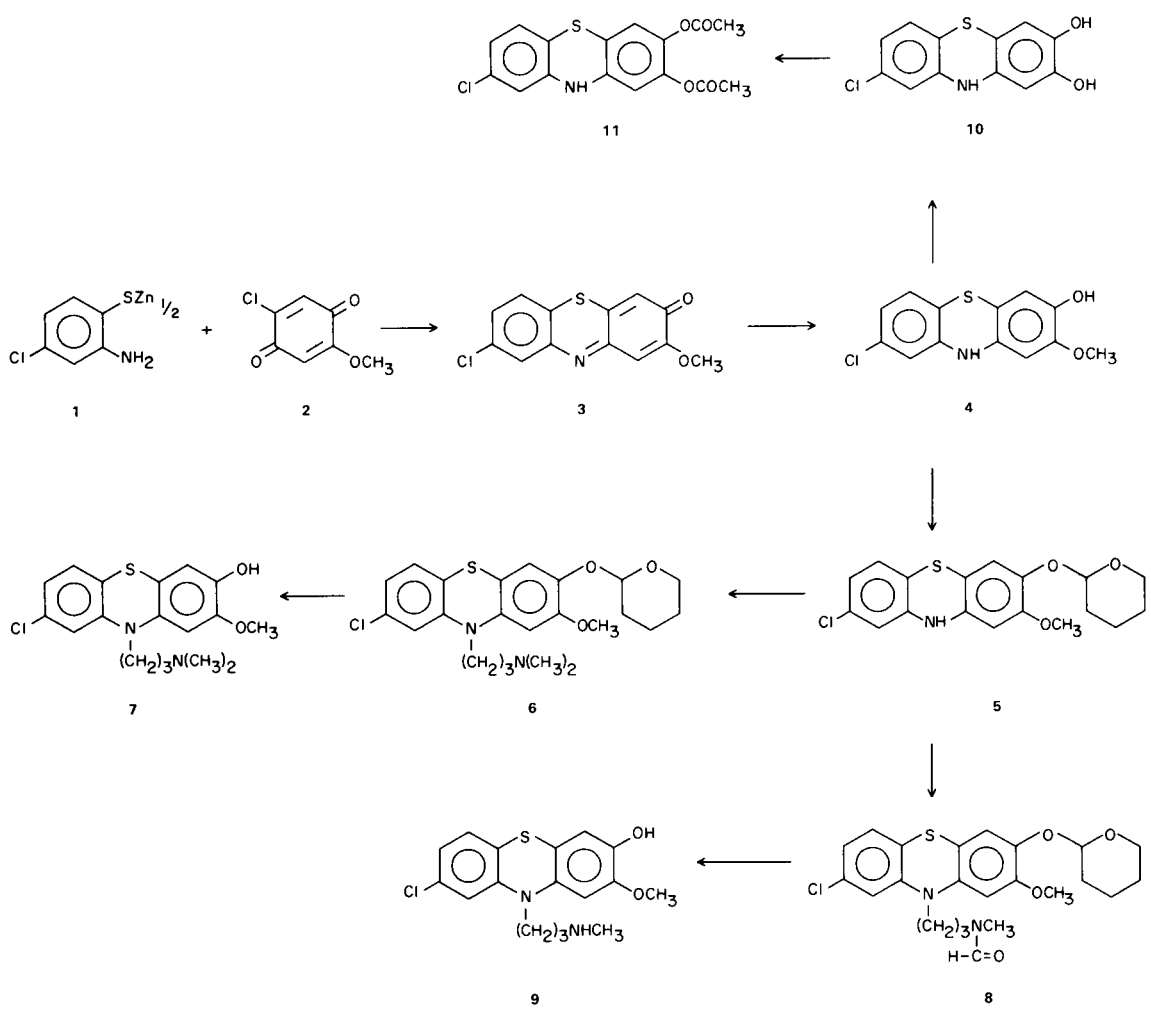
Edward A. Nodiff, Keiichi Tanabe, Franz Schnierle, Shiro Morosawa, Thomas W. Hoffman, Katsuhiko Takeda and Albert A. Manian (2)

The Research Institute of Temple University

Earlier articles in this series (3) have detailed the preparation of 3-, 7-, 8- and 9-hydroxychlorpromazine (23). Grotta *et al.* reported the 1- and 6- isomers (4). The present paper describes the synthesis of several 7,8-disubstituted chlorpromazine derivatives, which have been postulated or reported as present in various biological media (5-11).

The preparation of 7-hydroxy-8-methoxychlorpromazine (**7**) and its nor_1 (**9**) and nor_2 (**13**) derivatives (23) is outlined in Schemes 1 and 2. Construction of this family of compounds was begun with the synthesis of the phenothiazone (**3**) *via* the Mine reaction (12) between the zinc salt of 2-amino-4-chlorobenzenethiol (**1**) (13) and 2-chloro-5-methoxybenzoquinone (**2**) (14). Sequential reduction of **3** to **4** (sodium dithionite) tetrahydropyranylation to **5** (3,4-dihydropyran, *p*-toluenesulfonic acid), alkylation to **6** (3-dimethylaminopropyl chloride, dimethyl sulfoxide, sodium hydride) and acidic depyranylation of the latter (without isolation) produced 7-hydroxy-8-methoxychlorpromazine (**7**).

SCHEME I



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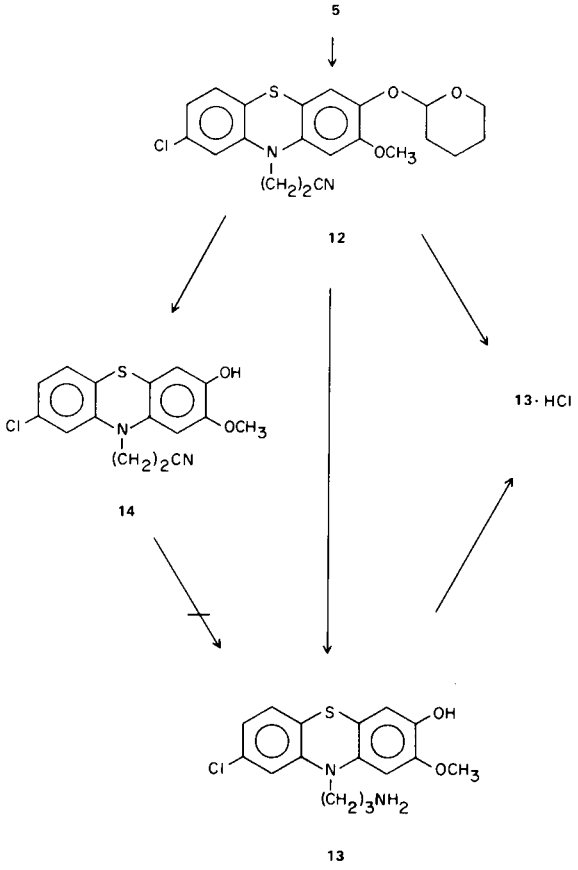

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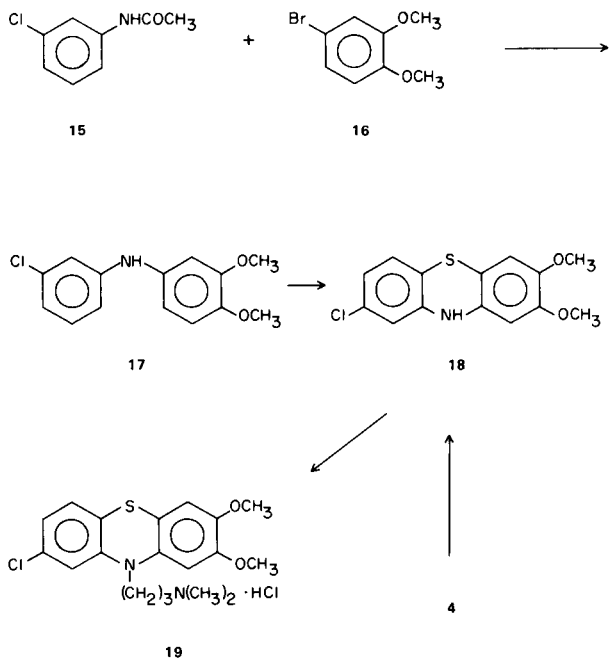
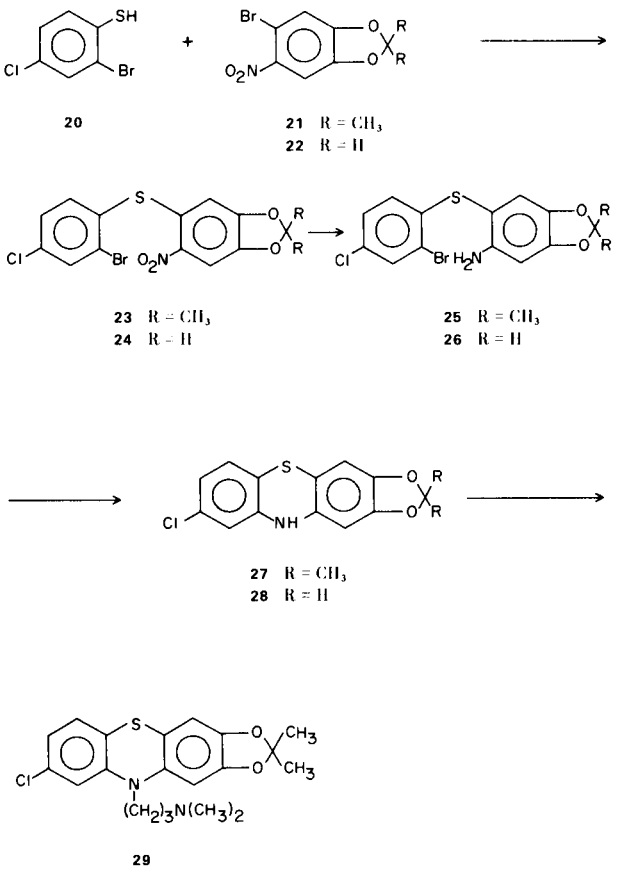


SCHEME 4



The nor$_1$ derivative (**9**) was obtained by alkylation of **5** with *N*-(3-chloropropyl)-*N*-methylformamide (3a) and subsequent alkaline removal, from the resultant **8**, of its *N*-formyl group.

Cyanoethylation of **5** (Scheme 2) and catalytic hydrogenation of the cyanoethyl compound (**12**) produced the nor$_2$ derivative (**13**). A single attempt to obtain **13** by reduction of **14** was unsuccessful.

The Goldberg reaction (15) between 3-chloroacetanilide (**15**) and 4-bromoveratrole (**16**) initiated the synthesis of 7,8-dimethoxychlorpromazine hydrochloride (**19**) (Scheme 3). Bernthsen thionation (15) of the resulting diphenylamine (**17**) provided two isomeric chlorodimethoxyphenothiazines. Identification of the predominant isomer as the desired 2-chloro-7,8-dimethoxyphenothiazine (**18**) was accomplished by IR, TLC and mixture-melting point comparison with authentic material. The latter was prepared by *O*-methylation of 2-chloro-7-hydroxy-8-methoxyphenothiazine (**4**). The congener of **18** remained unidentified (16).

The general reaction sequence which moves from 2-nitrohalobenzenes to phenothiazines, *via* the diphenylsulfides, was described in our earlier publications (3). We have now used this route (Scheme 4) to prepare 2-chloro-7,8-methylenedioxyphenothiazine (**28**) and 2-chloro-7,8-dimethylmethylenedioxyphenothiazine (**27**). Alkylation of the latter with 3-dimethylaminopropyl chloride produced the corresponding chlorpromazine (**29**).

An attempt to convert **28** to the dihydroxy derivative (**10**) by cleavage with phosphorus pentachloride was unproductive. It was found more expedient to prepare **10** by demethylation of **4** as indicated in Scheme 1.

EXPERIMENTAL

Melting points were determined in sealed, evacuated capillary tubes, in an electrically heated Thiele-Dennis apparatus, and are uncorrected.

All reactions were mechanically stirred under dry nitrogen and in the absence of strong, direct light.

Elemental analyses were performed by Schwarzkopf Microanalytical Laboratory, Woodside, N.Y., and Microanalysis, Inc., Wilmington, Delaware.

Infrared spectra were taken as liquid films or Nujol mulls on a Perkin-Elmer Model 137B Infracord Spectrophotometer.

Organic solutions were dried with anhydrous magnesium sulfate and decolorized with Darco G-60. Concentration and complete solvent removal were carried out under reduced pressure.

2-Chloro-8-methoxyphenothiazin-7-one (**3**).

A mixture of 50 g. (0.29 mole) of 2-chloro-5-methoxybenzoquinone (**2**) (14), 55.5 g. (0.15 mole) of the zinc salt of 2-amino-4-chlorobenzenethiol (**1**) (13) and 2.5 l. of ethanol was heated under reflux for 1.5 hours, allowed to cool and filtered. The orange solid was extracted with 3 l. of boiling chloroform and the extract was concentrated to give a quantitative yield of **3**, m.p. 260° (sintering at 230°). Recrystallization from ethanol provided an analytical sample as orange-red needles with the same melting point.

Anal. Calcd. for $C_{13}H_8ClNO_2S$: C, 56.20; H, 2.88; N, 5.04. Found: C, 55.86; H, 2.71; N, 5.30.

2-Chloro-7-hydroxy-8-methoxyphenothiazine (**4**).

A mixture of 10 g. of **3**, 10 g. of sodium dithionite, 50 ml. of water and 600 ml. of acetone was heated under reflux for 80 minutes. The mixture, which had turned from red-brown to colorless, was allowed to cool and poured into a solution of 35 g. of sodium dithionite in 2 l. of water. The resulting white solid was washed with water, dried *in vacuo* at 100° and crystallized from toluene to give 9.1 g. (90%) of **4**, m.p. 245-246°. Additional crystallization from toluene provided the analytical sample as white needles, m.p. 246.5°.

Anal. Calcd. for $C_{13}H_{10}ClNO_2S$: C, 55.80; H, 3.58; N, 5.01. Cl, 12.61. Found: C, 56.01; H, 3.85; N, 5.13; Cl, 12.98.

The *O*-benzyl derivative of **4** was obtained in 27% yield by treatment with benzyl bromide (acetone, potassium carbonate, reflux overnight), m.p. 202.5-203° (toluene).

Anal. Calcd. for $C_{20}H_{16}ClNO_2S$: C, 64.94; H, 4.36; N, 3.80. Found: C, 65.11; H, 4.28; N, 3.89.

2-Chloro-8-methoxy-7-tetrahydropyranyloxyphenothiazine (**5**).

A mixture of 20 g. (0.072 mole) of **4**, 1 l. of 3,4-dihydropyran and 0.1 g. of *p*-toluenesulfonic acid monohydrate was stirred for 5 hours at room temperature. After standing overnight, the mixture was filtered to remove a small amount of insoluble material (**3**) and diluted with an equal volume of ether. The solution was washed with 10% sodium hydroxide and water, dried, treated with carbon and concentrated. The residual dark-red oil was pumped for 4 hours at 100°, dissolved in 300 ml. of ethanol, treated with carbon and allowed to evaporate slowly (15-20 hours), at room temperature, in an open beaker. The resulting pink solid was washed with methanol to give 6.2 g. (24%) of **5** as off-white needles with an indefinite melting point at about 170°. Initial melting was followed by solidification and remelting at 249° (17). Recrystallization from methanol provided an analytical sample with the same melting characteristics.

Anal. Calcd. for $C_{18}H_{18}ClNO_3S$: C, 59.45; H, 4.96; N, 3.85. Found: C, 59.59; H, 4.97; N, 3.61.

7-Hydroxy-8-methoxychlorpromazine (**7**).

To a suspension of 0.62 g. (0.013 mole) of sodium hydride (50% dispersion in mineral oil) in 50 ml. of dimethylsulfoxide was added a solution of 4.6 g. (0.015 mole) of **5** in 200 ml. of dimethylsulfoxide. The mixture was stirred for 2 hours at room temperature and a solution of 1.6 g. (0.013 mole) of 3-dimethylaminopropyl chloride in 20 ml. of dimethylsulfoxide was added dropwise. The temperature was raised to 80° and maintained at 80-90° for 5 hours. After standing overnight at room temperature, the mixture was poured into 500 ml. of water containing 1 g. of ammonium chloride. Extraction with ether was followed by extraction of the ether solution with 5% hydrochloric acid. The dark-blue acid extract was adjusted to *p*H 8 with 28% ammonium hydroxide and the resulting pink solid was extracted with ethyl acetate. Drying, decolorization and concentration of the extract gave 2.9 g. (63%) of **7**, m.p. 164-166°. Recrystallization from ethanol-ligroine (b.p. 60-90°) provided an analytical sample as white needles, m.p. 166-167.5°.

Anal. Calcd. for $C_{18}H_{21}ClN_2O_2S$: C, 59.23; H, 5.82; N, 7.67. Cl, 9.73. Found: C, 59.70; H, 5.77; N, 7.88; Cl, 9.67.

2-Chloro-8-methoxy-10-[3-(*N*-methylformamido)propyl]-7-tetrahydropyranyloxyphenothiazine (**8**).

Alkylation of **5** with *N*-(3-chloropropyl)-*N*-methylformamide was effected in the manner described earlier (3a) for the synthesis of 2-chloro-7-isopropoxy-10-[3-(*N*-methylformamido)propyl]-phenothiazine. The resultant crude **8**, isolated as a brown oil (86% yield), was used without further purification.

2-Chloro-7-hydroxy-8-methoxy-10-(3-methylaminopropyl)phenothiazine (**9**).

A mixture of 10 g. (0.022 mole) of **8**, 360 ml. of ethanol and 50 ml. of 20% sodium hydroxide was heated under reflux for 3 hours, concentrated to half its volume, and poured into 1 l. of water. The aqueous layer was extracted with ether (3 x 200 ml.) and the combined extracts were extracted with 4% hydrochloric acid (3 x 200 ml.). Basification (*p*H 8) of the blue acid solution gave 8 g. of crude **9** as a pink solid. Crystallization from xylene provided 5.6 g. (68%) of off-white solid, m.p. 170-172°. The analytical sample was obtained from ethanol (carbon) as white crystals, m.p. 174-175°.

Anal. Calcd. for $C_{17}H_{19}ClN_2O_2S$: C, 58.19; H, 5.46; N, 7.98; Cl, 10.10. Found: C, 58.29; H, 5.44; N, 7.95; Cl, 10.24.

2-Chloro-10-(2-cyanoethyl)-8-methoxy-7-tetrahydropyranyloxyphenothiazine (**12**).

To a mixture of 12 g. (0.033 mole) of **5**, 120 ml. of benzene

and 10 ml. of acrylonitrile was added 20 drops of Triton B (40% benzyltrimethylammonium hydroxide in methanol). The dark red solution was stirred at 60° for 1 hour, diluted with 120 ml. of methanol, heated to boiling, treated with carbon and filtered. After 2 days, 12 g. (88%) of **12** separated from the filtrate, m.p. 142-145°. Crystallization from ethanol provided the analytical sample as off-white crystals, m.p. 147-148°.

Anal. Calcd. for $C_{21}H_{21}ClN_2O_3S$: C, 60.49; H, 5.08; N, 6.72. Found: C, 60.68; H, 4.96; N, 6.72.

10-(3-Aminopropyl)-2-chloro-7-hydroxy-8-methoxyphenothiazine (**13**).

A mixture of 5 g. (0.012 mole) of **12**, 300 ml. of ethanol, 3 g. of platinum oxide and 7 ml. of ethanol saturated with hydrogen chloride gas was shaken under hydrogen (60 psig.) for 3 hours at 50° and for 2 additional hours at room temperature. The mixture was allowed to stand overnight, filtered, concentrated to 50 ml., poured into 500 ml. of water and extracted with ether. [Concentration of the ether returned 1 g. of the dealkylated compound, 2-chloro-7-hydroxy-8-methoxyphenothiazine (**4**)]. The aqueous phase was adjusted to *p*H 8 with solid potassium carbonate and the resulting oil was extracted with ethyl acetate. The extract was dried and concentrated to 10 ml. to give 1.5 g. (37%) of **13**, m.p. 178-180°. Several crystallizations from toluene (toluene solution decolorized by stirring with a mixture of carbon and activated alumina) afforded the analytical sample, m.p. 183.5-184.5°.

Anal. Calcd. for $C_{16}H_{17}ClN_2O_2S$: C, 57.04; H, 5.08; N, 8.31; Cl, 10.52. Found: C, 57.80; H, 5.08; N, 7.94; Cl, 10.49.

Hydrochloride.

Reduction of **12** was carried out as described above. Removal of the catalyst and concentration of the filtrate produced the hydrochloride of **13**, m.p. 279° (methanol-ether).

Anal. Calcd. for $C_{16}H_{18}Cl_2N_2O_2S$: C, 51.48; H, 4.86; N, 7.50. Cl, 18.99. Found: C, 51.31; H, 4.89; N, 7.88; Cl, 18.90.

This hydrochloride was also prepared by treating **13** with concentrated hydrochloric acid.

2-Chloro-10-(2-cyanoethyl)-7-hydroxy-8-methoxyphenothiazine (**14**).

A mixture of 12 g. (0.029 mole) of **12**, 300 ml. of ethanol and 100 ml. of 10% hydrochloric acid was heated under reflux for 20 minutes, allowed to stand overnight and diluted with water to give 8 g. (83%) of **14**, m.p. 143-145°. An analytical sample was obtained from ethanol as white needles, m.p. 151-151.5°.

Anal. Calcd. for $C_{16}H_{13}ClN_2O_2S$: C, 57.74; H, 3.94; N, 8.42. Found: C, 58.13; H, 3.88; N, 8.58.

3'-Chloro-3,4-dimethoxydiphenylamine (**17**).

A mixture of 50 g. (0.23 mole) of commercial 4-bromoveratrole (**16**), 46.9 g. (0.28 mole) of 3-chloroacetanilide (**15**) (18), 22.3 g. (0.16 mole) of anhydrous potassium carbonate and 0.79 g. of copper-bronze catalyst was heated to 220° (external) during 2 hours and stirred at this temperature, under reflux, for 20 additional hours. The dark brown, viscous reaction mixture was extracted with 400 ml. of acetone and the acetone was stripped. The dark-brown, viscous residue was heated overnight, under reflux, with a mixture of 90 ml. of concentrated hydrochloric acid and 250 ml. of ethanol. The mixture was poured into 1.25 l. of cold water, made just alkaline with 20% sodium hydroxide and extracted with ether. The extract was dried and concentrated. On cooling, the dark-brown oily residue crystallized. Recrystallization from ethanol gave 24.9 g. (32%) of **17** as white solid, m.p. 100-101°. Three crystallizations from ethanol and a final crystallization from benzene gave the analytical sample as glistening white crystals, m.p. 101.5-102°.

Anal. Calcd. for $C_{14}H_{14}ClNO_2$: C, 63.76; H, 5.31; N, 5.31. Found: C, 63.74; H, 5.40; N, 5.58.

2-Chloro-7,8-dimethoxyphenothiazine (**18**).

A mixture of 20 g. (0.08 mole) of **17**, 4.3 g. (0.13 mole) of sulfur and 0.31 g. (0.0012 mole) of iodine was stirred under nitrogen at 150-160° for 1.5 hours (19). The red-brown, oily, viscous reaction mixture was dissolved in 150 ml. of boiling benzene, treated with a mixture of Darco G-60 and chromatographic alumina (Merck, acid washed) and concentrated to give 8.7 g. of crude **18** as tan crystals, m.p. 185-193°. A single crystallization from benzene and two crystallizations from carbon tetrachloride provided 4.1 g., (18%) of pure **18**, m.p. 208-209.5°. Two additional crystallizations from benzene did not change the melting point.

Anal. Calcd. for $C_{14}H_{12}ClNO_2S$: C, 57.24; H, 4.09; N, 4.77. Found: C, 57.22; H, 4.10; N, 4.89.

Identification of this compound as 2-chloro-7,8-dimethoxyphenothiazine (**18**) was effected by IR, TLC and mmp comparison with authentic material. The latter was prepared by methylation of 2-chloro-7-hydroxy-8-methoxyphenothiazine (**4**) with dimethylsulfate in a solution of aqueous potassium hydroxide, acetone and sodium dithionite (1.5 hours at 60°), yield 47%.

Concentration of the original benzene filtrate of the crude **18** gave 1 g. of an unidentified isomer of **18**, m.p. 208-209° (one crystallization from benzene and another from acetone).

Anal. Calcd. for $C_{14}H_{12}ClNO_2S$: C, 57.24; H, 4.09; N, 4.77. Found: C, 57.47; H, 4.05; N, 5.02.

Mixture melting point comparison of **18** and its isomer revealed a depression of 17°. IR and TLC provided additional evidence that these compounds were different despite identical melting points.

Further concentration of the benzene filtrate gave 8.7 g. of crude starting material (**17**), m.p. 92-94°.

7,8-Dimethoxychlorpromazine Hydrochloride (**19**).

To a suspension of 1.45 g. (0.035 mole) of sodium hydride (59% dispersion in mineral oil; Metal Hydrides, Inc., Beverly, Mass.) in 30 ml. of dimethylsulfoxide was added a solution of 5 g. (0.017 mole) of **18** in 60 ml. of dimethylsulfoxide. The resulting red-brown mixture was stirred at room temperature for 2 hours and then treated with a solution of 5.16 g. (0.043 mole) of 3-dimethylaminopropyl chloride in 20 ml. of dimethylsulfoxide. After 5 hours at 60-70°, the mixture was poured into water-ice and the resulting pale yellow suspension was extracted with 4 x 250 ml. of ether. The ether was extracted with 4 x 150 ml. of 10% hydrochloric acid and the combined acid extracts were extracted with ether (discarded). The acid solution (blue) was basified with 20% sodium hydroxide solution and the pale yellow basic solution was extracted with ether (4 x 250 ml.). The ether solution was dried, decolorized and concentrated to give 4.7 g. of yellow oil. The oil was redissolved in ether and treated with hydrogen chloride gas to give 4.88 g. of the crude hydrochloride **19**. Five crystallizations from ethanol-ether gave 3.6 g. (51%) of white needles, m.p. 198.5-199°.

Anal. Calcd. for $C_{19}H_{24}Cl_2N_2O_2S$: C, 54.93; H, 5.78; N, 6.75. Found: C, 55.42; H, 5.70; N, 6.54.

2'-Bromo-4'-chloro-4,5-methylenedioxy-2-nitrodiphenylsulfide (**24**).

To a stirred solution of 123 g. of **22** (22) in 600 ml. of hot ethanol was slowly added a solution of 112 g. of **20** (21), 300 ml. of ethanol, 20 g. of sodium hydroxide and 20 ml. of water. The

mixture (bright yellow precipitate in red solution) was heated under reflux for 3 additional hours and cooled to 0°. The yellow solid was washed with cold ethanol to give 171 g. (88%) of **24**, m.p. 155-157°. Crystallization from ethanol provided an analytical sample, m.p. 161.5-162°.

Anal. Calcd. for $C_{13}H_7BrClNO_4S$: C, 40.18; H, 1.82; N, 3.60. Found: C, 40.54; H, 1.74; N, 3.83.

2′-Bromo-4′-chloro-4,5-dimethylmethylenedioxy-2-nitrodiphenylsulfide (**23**).

Preparation of this compound from **21** (20), in a manner identical with that described for **24**, gave 88% of crude material (m.p. 169-172°) which was used without purification.

2-Amino-2′-bromo-4′-chloro-4,5-dimethylmethylenedioxydiphenylsulfide (**25**).

Reduction of **23** (10 g.) was effected in benzene (250 ml.) with hydrogen (initial pressure, 66 psig.) in the presence of platinum oxide (3.8 g.) at room temperature. After reduction was complete (1 hour) the mixture was filtered and concentrated. The brown crystalline residue was recrystallized from ligroine to give 8 g. (86%) of **25**, m.p. 116-118°. Additional crystallization from ligroine provided an analytical sample as white needles, m.p. 118-120°.

Anal. Calcd. for $C_{15}H_{13}BrClNO_2S$: C, 46.59; H, 3.39; N, 3.62. Found: C, 46.85; H, 3.56; N, 3.74.

2-Amino-2′-bromo-4′-chloro-4,5-methylenedioxydiphenylsulfide (**26**).

The nitro compound (**24**) was reduced in ethanol with a mixture of stannous chloride dihydrate and hydrochloric acid using Method A in Paper II (3b), 60% yield, m.p. 157.5-158° (1-butanol).

Anal. Calcd. for $C_{13}H_9BrClNO_2S$: C, 43.53; H, 2.53; N, 3.90. Found: C, 43.79; H, 2.73; N, 3.73.

2-Chloro-7,8-dimethylmethylenedioxyphenothiazine (**27**) and 2-Chloro-7,8-methylenedioxyphenothiazine (**28**).

Cyclization of **25** and **26** was carried out in the usual manner (3).

Compound **27**.

The reflux time was 15 hours, 63% yield, m.p. 213-216° (ligroin).

Anal. Calcd. for $C_{15}H_{12}ClNO_2S$: C, 58.91; H, 3.95; N, 4.58. Found: C, 58.99; H, 4.22; N, 4.84.

Compound **28**.

The reflux time was 6 hours, 66% yield, m.p. 250-250.5° (vacuum sublimation followed by several crystallizations from benzene).

Anal. Calcd. for $C_{13}H_8ClNO_2S$: C, 56.22; H, 2.90; N, 5.05. Found: C, 56.29; H, 2.83; N, 4.83.

7,8-Dimethylmethylenedioxychlorpromazine (**29**).

Alkylation of **27**, in essentially the same manner described above for the synthesis of **19** gave 60% of **29** as pale yellow crystals, m.p. 89-90.5° (petroleum ether).

Anal. Calcd. for $C_{20}H_{23}ClN_2O_2S$: C, 61.44; H, 5.92; N, 7.16. Found: C, 61.31; H, 5.93; N, 6.97.

2-Chloro-7,8-dihydroxyphenothiazine (**10**).

A mixture of 31.7 g. of **4** and 41 g. of pyridine hydrochloride was heated at 200-205° for 8 hours, cooled and diluted with 400 ml. of water. The resulting crude, green **10** was dried *in vacuo* at 100°, and then stirred at room temperature for 10 hours with a mixture of 800 ml. of pyridine, 22.2 ml. of acetic anhydride and 28 g. of sodium dithionite. The mixture was concentrated to 100 ml. and poured into 1.5 l. of water containing 3 g. of sodium dithionite. A dark green gum separated which was dissolved in 1.5 l. of benzene and dried over a mixture of magnesium sulfate and sodium dithionite. Removal of the solvent and repeated crystallization of the residue from benzene-cyclohexane (1:1) gave 10.6 g. of 2-chloro-7,8-diacetoxyphenothiazine (**11**) as off-white crystals, m.p. 182-183°.

Anal. Calcd. for $C_{16}H_{12}ClNO_4S$: C, 54.94; H, 3.46; N, 4.00. Found: C, 55.16; H, 3.49; N, 4.12.

A mixture of 1 g. of **11**, 30 ml. of ethanol, 4.8 ml. of 5% ethanolic sodium hydroxide and 0.3 g. of sodium dithionite was stirred at room temperature for 4.5 hours, allowed to stand overnight and poured into 500 ml. of water containing 0.5 g. of sodium dithionite. The solution was adjusted to *p*H 7 and extracted with ether. The extract was washed with aqueous sodium dithionite, dried over a mixture of magnesium sulfate and sodium dithionite and concentrated to give 0.7 g. of **10** as gray-green powder, m.p. 280° dec. A small amount of an unidentified, colored impurity was removed by pumping at 120-130°. At 180° and 0.03 mm., pure **10** sublimed as off-white solid, m.p. 283° dec.

Anal. Calcd. for $C_{12}H_8ClNO_2S$: C, 54.24; H, 3.03; N, 5.27. Found: C, 54.26; H, 3.00; N, 5.22.

Acknowledgment.

The authors gratefully acknowledge the assistance of Tetsuya Kohno, James P. Smith, Masami Mori and Ronald W. Berninger.

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(1) These compounds were proposed by and iniated at the request of Dr. Albert A. Manian and prepared under contract No. SA-43-ph-3758 with the Psychopharmacology Research Branch, National Institute of Mental Health.

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(14) Preparation of **2** from commercial vanillin was effected using the methods of L. C. Raiford and J. G. Lichty, *J. Am. Chem. Soc.*, **52**, 4576 (1930) and I. S. Ioffe and A. F. Sukhina, *Zh. Obshch. Khim.*, **23**, 295 (1953); *Chem. Abstr.*, **48**, 2640 (1954).

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(16) The unidentified isomer has a strong peak in the infrared at 13.0 μ (3 adjacent free H atoms) and is therefore most probably 4-chloro-6,7-dimethoxyphenothiazine or 4-chloro-7,8-dimethoxyphenothiazine.

(17) Infrared analysis indicated that **5** lost its protective group at the melting point and reverted to **4**.

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(19) The reaction mixture fused at 110-130°. The liquid turned successively tan, dark green, and finally red-brown.

(20) Commercial catechol was converted to **21** using the procedure of G. Sloof, *Rec. Trav. Chim.*, **54**, 995 (1935) and G. R. Pettit and D. M. Piatak, *J. Org. Chem.*, **25**, 724 (1960).

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(22) T. G. H. Jones and R. Robinson, *J. Chem. Soc.*, 903 (1917).

(23) Chlorpromazine is the generic name for 2-chloro-10-(3-dimethylaminopropyl)phenothiazine. Nor_1- and nor_2-chloropromazine are derivatives of chlorpromazine in which the 10- side chain has lost, respectively, one or both of its methyl groups.

Received September 6, 1969 Philadelphia, Pa. 19144