lute sodium carbonate and water. The ether was dried over sodium sulfate and evaporated to a sirup which was stirred on a steam-bath with 200 ml. of ethanol whereby a voluminous white, crystalline precipitate formed; weight 7.7 g. or 68% of theory; m.p. 176–177°. Recrystallization from 2:1 ethanol–acetone gave 7.0 g. (62%) melting at 179–180°; $[\alpha]^{25}D$ −75° (*c* 2.00, acetone).

Anal. Calcd. for $C_{46}H_{32}O_{10}$: C, 74.2; H, 4.33. Found: C, 74.4; H, 4.41.

β-Norconidendrin (III). A. From Conidendrin.[7]—A mixture of 10 g. of conidendrin and 9 g. of pyridine hydrochloride was heated in a 200-ml. round-bottomed flask with an air condenser to 155° until a yellow solution resulted. The temperature was then raised to 180° and kept there for one hour. The clear melt was dissolved in 250 ml. of hot water and then held at 50° for three hours during which crystallization rapidly took place. After standing 16 hours at room temperature, the mixture was filtered giving 7.6 g. (82% theory) of nearly white β-norconidendrin melting at 251–252°; $[\alpha]^{25}D$ +15° (*c* 5.00, acetone).

Anal. Calcd. for $C_{18}H_{16}O_6$: C, 65.9; H, 4.91; OCH_3, 0.0. Found: C, 66.0; H, 5.01; OCH_3, 0.08.

The product was soluble in hot water, cold aqueous alkali or carbonate, and in most of the common organic solvents It reduced hot Fehling solution and gave an immediate black precipitate of silver with Tollens reagent. An aqueous solution of β-norconidendrin gave a light green color with ferric chloride which turned to deep red with sodium carbonate. β-Norconidendrin dissolved quickly in aqueous sodium hydroxide to give a yellow solution which on heating turned successively green, blue, black, brown and red. A solution of the substance in aqueous sodium carbonate was yellow turning to orange on heating.

B. From β-Conidendrin.—A mixture of 5 g. of β-conidendrin (ammonia method), 25 ml. of 57% hydriodic acid and 25 ml. of glacial acetic acid was refluxed for 30 minutes. The excess acids were removed on the steam-bath under pressure from an aspirator. The resulting sirup was dissolved in 125 ml. of hot water which deposited 2.8 g. (61% yield) of a mixture of white and brown crystals after standing four hours at 40° and 16 hours at room temperature. Recrystallization from 40 ml. of hot water containing 0.5 g. of sodium bisulfite gave 1.9 g. (41% yield) of white crystals melting at 245–247°. A mixture with the product from conidendrin and pyridine hydrochloride melted at the same temperature. A mixture with conidendrin melted below 225°.

C. From α-Norconidendrin and Ammonia.—A solution of 10 g. of α-norconidendrin in 100 ml. of ethanol and 6 ml. of concentrated ammonium hydroxide was sealed in a glass-lined bomb in which the air had been displaced by nitrogen. The bomb was heated in a constant-temperature bath at 145° for one hour. The contents of the bomb were then diluted with 700 ml. of hot water containing 7 ml. of concentrated hydrochloric acid. The solution was boiled to remove alcohol, then cooled at 0° for 18 hours. The clear supernatant liquid was decanted from the tar which had settled out and left at room temperature for 24 hours during which time 1.7 g. (17% yield) white crystals came out, melting at 249–250°. A mixed melting point with β-norconidendrin made from conidendrin and pyridine hydrochloride showed no depression.

β-Tetramethylnorconidendrin (II).—β-Norconidendrin (from conidendrin and pyridine hydrochloride) (1.0 g.) and dimethyl sulfate (3 ml.) gave, after recrystallization from ethanol, 0.3 g. (26% yield) of colorless crystals melting at 153–154°. A mixture of this product and β-dimethylconidendrin[5] melted at 154–155°.

β-Norconidendrin Tetraacetate (VI).—A suspension of 4 g. of β-norconidendrin (from conidendrin and pyridine hydrochloride) in 20 ml. of acetic anhydride treated with one drop of concentrated sulfuric acid gave 5.1 g. (84% yield) of colorless crystals melting at 175–178°. Recrystallization from hot ethanol gave 4.9 g. (81%) melting at 179–180°; $[\alpha]^{25}D$ +14° (*c* 4.00, acetone).

Anal. Calcd. for $C_{26}H_{24}O_{10}$: C, 62.9; H, 4.87. Found: C, 62.8; H, 4.94.

CAMAS, WASHINGTON RECEIVED FEBRUARY 26, 1951

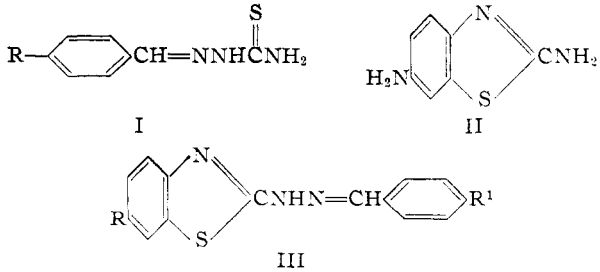
[CONTRIBUTION FROM THE SCHENLEY LABORATORIES, INC.]

Antituberculous Compounds. II. 2-Benzalhydrazinobenzothiazoles[1a]

BY LEON KATZ

A series of benzothiazole derivatives have been prepared for evaluation against *Mycobacterium tuberculosis*. These compounds were synthesized by replacement of the 2-chloro group in a benzothiazole (IV, VI, VIII and IX) by a hydrazino radical and subsequent condensation of the 2-hydrazinobenzothiazoles with aromatic aldehydes. Compounds 3 and 5 (Table I) were the most active.

Considerable interest has been aroused by the publication of Behnisch, Domagk, Mietzsch and Schmidt[1b] concerning the use of *p*-substituted benzaldehyde thiosemicarbazones, I,[2] in the treatment of tuberculosis. A good review of the work done by these investigators in correlating structure with activity appeared recently.[3] The important correlations were these: (1) *p*-substituted benzaldehydes gave rise to the most effective compounds, (2) S- or N-alkylation decreased the activity, and (3) reduction of the C=N bond did not result in loss of activity. These results have been confirmed in two independent laboratories.[4] A study was begun in this Laboratory with the aim of preparing effective compounds by modifying the structure of I.



I II

III

Freedlander and French[5] reported that 2,6-diaminobenzothiazole (II) which contains a cyclic thioureido group, was highly active *in vivo* against tuberculosis. If the 2-amino group were replaced

(1) (a) After this article had been submitted for publication a report by J. Bernstein, H. L. Yale, K. Losee, M. Holsing, J. Martins and W. A. Lott, THIS JOURNAL, **73**, 906 (1951), appeared, describing compounds 2, 4 and 5 (Table I). (b) G. Domagk, *et al.*, *Naturwissenschaften*, **33**, 315 (1946).

(2) R = CH_3CONH, Schenley "Tibione," Brand of Amithiozone.

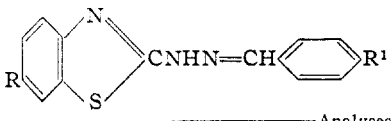
(3) R. Behnisch, F. Mietzsch and H. Schmidt, *Am. Rev. Tuberc.*, **61**, 1 (1950). This article is a translation of an article published in *Angew. Chem.*, **60**, 113 (1948).

(4) E. Hoggarth, A. R. Martin, N. E. Storey and E. H. P. Young, *Brit. J. Pharmacol.*, **4**, 248 (1949); R. Donovick, F. Pansy, G. Stryker and J. Bernstein, *J. Bact.*, **59**, 667 (1950).

(5) B. L. Freedlander and F. A. French, *Proc. Soc. Expil. Biol. Med.*, **66**, 362 (1947).

TABLE I

2-BENZALHYDRAZINOBENZOTHIAZOLES



No.	R	R¹	Yield, %	Melting point, °C.[a]	Empirical formula	Analyses, % Carbon	Calcd. Hydrogen	Calcd. Nitrogen	Found Carbon	Found Hydrogen	Found Nitrogen
1	H	OH	80	253–254.5[b]	$C_{14}H_{11}ON_3S$	62.45	4.09	15.95	62.26	4.18	15.70
2	H	OCH_3	70	194–195[c]	$C_{15}H_{13}ON_3S$	63.60	4.59	14.84	63.63	4.69	14.54
3	H	OCH_2CO_2H	81	254–257[d]	$C_{16}H_{13}O_3N_3S$	58.71	3.96	12.84	58.13	3.91	12.64
4	H	$NHCOCH_3$	89	294–296[e]	$C_{16}H_{14}ON_4S$	61.94	4.51	18.06	62.33	4.55	18.06
5	H	$N(CH_3)_2$	77	243–244.5[c]	$C_{16}H_{16}N_4S$	64.86	5.42	18.92	65.05	5.19	18.68
6	H	$NHCOCH_2CH_2CO_2H$	91	255–257[b]	$C_{18}H_{16}O_3N_4S$	58.69	4.35	15.20	58.77	4.48	15.31
7	H	CO_2H	86	319–320[e]	$C_{15}H_{11}O_2N_3S$	60.60	3.71	14.14	59.82	3.55	14.01
8	NO_2	OH	73	318–319[e]	$C_{14}H_{10}O_3N_4S$	53.50	3.18	17.83	53.65	3.36	17.56
9	NO_2	OCH_3	72	299–300[b]	$C_{15}H_{12}O_3N_4S$	54.88	3.66	17.10	55.10	3.71	17.10
10	NO_2	OCH_2CO_2H	68	280–281.5[g]	$C_{16}H_{12}O_5N_4S$	51.61	3.23	15.05	51.83	3.01	14.81
11	NO_2	$NHCOCH_3$	70	312–313[f]	$C_{16}H_{13}O_3N_5S$	54.08	3.66	19.70	53.98	3.63	19.45
12	NO_2	$N(CH_3)_2$	77	263–265[b]	$C_{16}H_{15}O_2N_5S$	56.30	4.40	20.53	56.35	4.57	20.22
13	NO_2	$NHCOCH_2CH_2CO_2H$	81	326–328[e]	$C_{18}H_{15}O_5N_5S$	52.30	3.63	16.91	52.18	3.74	16.33
14	NO_2	CO_2H	69	331–332[g]	$C_{15}H_{10}O_4N_4S$	52.34	2.93	16.38	52.67	3.01	16.42
15	$NHCOCH_3$	OH	77	279–281[h]	$C_{16}H_{14}O_2N_4S$	58.89	4.29	17.15	58.75	4.53	17.08
16	$NHCOCH_2$	OCH_3	93	262–263[e]	$C_{17}H_{16}O_2N_4S$	60.00	4.70	16.45	60.44	4.90	16.52
17	$NHCOCH_3$	OCH_2CO_2H	84	296–297[e]	$C_{18}H_{16}O_4N_4S$	56.25	4.17	14.57	56.14	4.36	14.62
18	$NHCOCH_3$	$NHCOCH_3$	89	292–293[g]	$C_{18}H_{17}O_2N_5S$	58.85	4.63	19.08	58.67	4.73	19.16
19	$NHCOCH_3$	$N(CH_3)_2$	91	286–287[e]	$C_{18}H_{19}ON_5S$	61.18	5.38	19.80	61.22	5.11	19.75
20	$NHCOCH_3$	CO_2H	86	326–327[b]	$C_{17}H_{14}O_3N_4S$	57.62	3.95	15.81	56.44	4.10	15.54

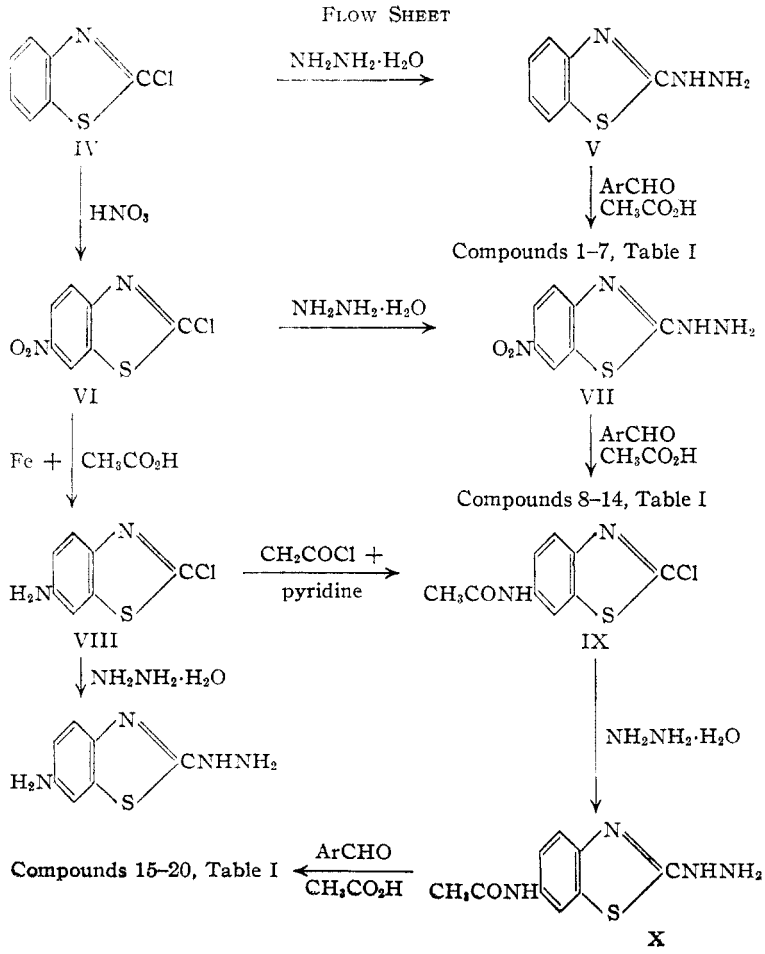
[a] All m.p.'s are uncorrected. [b] Recrystallized from acetic acid. [c] Recrystallized from isopropyl alcohol. [d] Recrystallized from dioxane. [e] Recrystallized from formamide. [f] Recrystallized from dimethylformamide. [g] Recrystallized from 60% acetic acid–40% formamide. [h] Recrystallized from 50% aqueous formamide.

by a hydrazino group the resulting compound would condense with aromatic aldehydes to form compounds, III, closely related to I and II. The high *in vivo* activity of II was the basis for expecting antitubercular activity in this class of compounds. After this work was well underway a report[6] appeared which did not corroborate the findings of Freedlander and French.

The 2-hydrazinobenzothiazole[7] and 2-hydrazino-6-nitrobenzothiazole[8] have been prepared previously and Colonna treated both of these compounds with benzaldehyde and acetophenone to form the corresponding hydrazone derivatives. The compounds described in Table I were prepared as indicated in the flow sheet.

2-Chlorobenzothiazole (IV) reacted smoothly with hydrazine hydrate to produce 2-hydrazinobenzothiazole. V condensed readily with aldehydes. Nitration of IV afforded 2-chloro-6-nitrobenzothiazole (VI) in 95% yield. Boiling 85% hydrazine hydrate converted VI to VII which was again

FLOW SHEET



(6) B. Croshaw and L. Dickinson, *Brit. J. Pharmacol.*, **5**, 178 (1950).

(7) O. Bayer, E. Herdiekhoff and H. Schindhelm (to I. G. Farbenind. A.-G.) U. S. Patent 2,073,600, March 16, 1937.

(8) M. Colonna, *Bull. sci. facultà chim. ind. univ. Bologna*, **6**, 24 (1948).

condensed with aromatic aldehydes. Iron reduction of VI resulted in 75–80% yields of VIII which was converted to the acetyl derivative, IX, in excellent yield. IX reacted with hydrazine hydrate to give X which condensed readily with the aromatic aldehydes.

Acknowledgment.—The author is indebted to Drs. K. Ladenburg and B. Puetzer for their continued interest during this investigation and to Mr. R. Weber for the microbiological results.

Experimental[9]

p-Hydroxybenzaldehyde, *p*-methoxybenzaldehyde, *p*-dimethylaminobenzaldehyde and 2-chlorobenzothiazole were obtained from the Eastman Kodak Company and were used without further purification. *p*-Acetylaminobenzaldehyde was obtained from the General Aniline and Film Company. *p*-Carboxybenzaldehyde was kindly supplied by the Bayer Company, Elberfeld, Germany. *p*-Formylphenoxyacetic acid was prepared by methods described in the literature.[10]

2-Hydrazinobenzothiazole (V).—Into a 1-l. three-necked flask equipped with an efficient stirrer, reflux condenser, Glas-col and thermometer was charged 300 g. (85% real, 5.1 moles) of hydrazine hydrate. The liquid was heated to gentle reflux and 170 g. (1.0 mole) of 2-chlorobenzothiazole added so that the gentle refluxing was not disturbed. The time of addition was one hour. After one-half of the chloro compound had been added a heavy crystalline precipitate began to appear. The mass was stirred vigorously in order to avoid bumping. The slurry was held at reflux for one-quarter hour after the final addition, cooled and filtered cold. The filtrate containing the excess hydrazine hydrate and some hydrazine hydrochloride was saved for rectification. The cake was washed with 1 l. of 50% aqueous methanol and dried *in vacuo* at 60°. The weight of white solid was 150.6 g. (89%), m.p. 197–199° (lit.,[11] m.p. 195–205°). This material was used without further purification.

***p*-Succinoylaminobenzaldehyde.**—Into a 300-ml. three-necked flask fitted with a sealed stirrer, thermometer and Glas-col were charged 30.0 g. (30% real, 0.075 mole) of *p*-aminobenzaldehyde and 30 g. of glacial acetic acid. The mixture was stirred and heated to 100°. After adding 45 g. (0.45 mole) of succinic anhydride to the smooth slurry, the mixture was held at 95–100° for 3.5 hours. The reaction mixture was diluted with 150 ml. of glacial acetic acid and allowed to cool overnight. The dark reddish-brown precipitate was collected and washed with 500 ml. of water. The cake was dried *in vacuo* at 50°. The dry solid was pulverized and suspended in 300 ml. of water containing 50 ml. of concd. aqueous ammonia. After stirring the slurry for one hour, 20 g. of Supercel was added and the resulting suspension was filtered through a glass sintered funnel. The filtrate was acidified to strong congo red test with 6 *N* hydrochloric acid. The yellow solid was collected by filtration, the cake washed with 500 ml. of water, and dried *in vacuo* at 50°. The weight of solid, m.p. 222–225°, was 12.5 g. (80%). A sample recrystallized from formamide separated as pale yellow cubes, m.p. 231–232.5°.

Anal. Calcd. for $C_{11}H_{11}O_4N$: C, 59.72; H, 4.99; N, 6.35. Found: C, 59.22; H, 5.17; N, 6.52.

Condensation of V with Aromatic Aldehydes.—Because this condensation was similar in all cases, the reaction of V with *p*-acetylaminobenzaldehyde is cited as an example. Into a 600-ml. beaker on a hot-plate were charged 150 ml. of glacial acetic acid and 16.9 g. (0.1 mole) V. When the mixture was heated to boiling a clear solution was obtained. To this solution was added 13.5 g. (0.083 mole) *p*-acetylaminobenzaldehyde. A heavy white precipitate formed almost immediately. The slurry was stirred manually for ten minutes, cooled, filtered, and the cake washed with 300 ml. of methanol. The weight of white solid, m.p. 287–288°, was 19.5 g. From the filtrates an additional 3.4 g., m.p. 283–287°, was obtained. The total yield was 89%. A sample was recrystallized twice from glacial acetic acid, m.p. 291–293°.

Anal. Calcd. for $C_{16}H_{14}ON_4S$: C, 61.94; H, 4.51; N, 18.06. Found: C, 62.23; H, 4.55; N, 18.06.

2-Chloro-6-nitrobenzothiazole (VI).—This compound was prepared using a modification of a method described by Hofmann.[12] Into a 2-l. three-necked flask equipped with a sealed stirrer, thermometer, dropping funnel and ice-bath was charged 800 g. of concentrated sulfuric acid. From the dropping funnel 101 g. (0.60 mole) of 2-chlorobenzothiazole was added to the acid at 10–17° in the course of one-half hour. A slightly milky solution was obtained. This solution was cooled to 12° and 66 g. (0.66 mole) finely pulverized potassium nitrate added portion-wise in the course of one hour so that the temperature did not exceed 18°. The brownish solution was stirred an additional one-quarter hour at 15–18° and warmed to 25° in one-half hour. The temperature then rose spontaneously to 40° after which it began to fall. At this point the clear amber solution was poured into 4 l. of ice and water. The slurry was diluted to 6 l., the solid collected on a Buchner funnel, washed with water until the wash water was acid free to congo red, and dried *in vacuo* at 60° overnight. The weight of lemon-colored solid, m.p. 172–180°, was 122 g. (95%). By recrystallization from hot ethanol an 80% recovery of material, m.p. 190–191°, was obtained (lit.,[12] m.p. 192°). The yields were unaffected when the reaction was carried out using five- to tenfold quantities.

6-Nitro-2-hydrazinobenzothiazole (VII).—Into a 3-l. three-necked flask equipped with a sealed stirrer, reflux condenser and Glas-col were charged 2000 ml. of 95% ethanol and 57.0 g. (0.267 mole) of 6-nitro-2-chlorobenzothiazole. This slurry was heated to reflux and then 300 g. (85% real, 5.1 moles) of hydrazine hydrate, previously heated to 80°, added. The slurry was stirred vigorously, and almost immediately an extremely flocculent yellow precipitate appeared. The yellow slurry was stirred an additional one-quarter hour at reflux and filtered hot. The yellow cake was washed with 500 ml. of 95% ethanol and dried *in vacuo* at 60°. The yield of material, m.p. 255–257°, was 48 g. From the cold filtrate an additional 3.2 g., m.p. 247–252°, was obtained. The total yield was 91%. A sample recrystallized three times from a small amount of dimethylformamide melted at 264–266° with decomposition (lit.,[8] m.p. 244°).

Anal. Calcd. for $C_7H_6O_2N_4S$: C, 40.00; H, 2.85; N, 26.66. Found: C, 40.09; H, 2.94; N, 26.66.

Condensation of VII with Aromatic Aldehydes. A. With *p*-hydroxybenzaldehyde.—Into a 2-l. beaker on a hot-plate were charged 500 ml. of glacial acetic acid, 150 ml. of dioxane and 21.0 g. (0.1 mole) of VII. The mixture was heated to boiling, 15.0 g. (0.122 mole) of *p*-hydroxybenzaldehyde added to the clear yellow solution and held for one-quarter hour at 105–107°. The solution was cooled to room temperature overnight, the solid collected by filtration, and the cake washed with 250 ml. of methanol. The weight of dry material was 18.1 g., m.p. 316–318°. The filtrate was diluted with water to 1.33 l. and a second fraction, 4.9 g., m.p. 298–302°, isolated. The total yield was 23.0 g. (73%). A sample recrystallized twice from formamide melted at 318–319°.

B. With *p*-Succinoylaminobenzaldehyde.—Into a 600-ml. beaker on a hot-plate were charged 350 ml. of glacial acetic acid and 11.0 g. (0.0525 mole) of VII. The mixture was heated to boiling and 10 ml. of formamide added in order to obtain a clear solution. Meanwhile a solution of 8.8 g. (0.042 mole) of *p*-succinoylaminobenzaldehyde in 50 ml. of water and 3 ml. concd. aqueous ammonia was prepared. This solution was heated to boiling and added to the boiling acetic acid solution. The mixture began to cloud rapidly and then set to a solid cake. After cooling to room temperature the yellow slurry was diluted with 300 ml. of methanol, the solid collected by filtration, and the cake washed with 300 ml. of 50% aqueous methanol. The weight of dry yellow solid was 14.1 g. (81%), m.p. 319–321°.

6-Amino-2-chlorobenzothiazole (VIII).—This compound was prepared using a modification of a method reported by

(9) All m.p.'s are uncorrected.

(10) T. Elkan, *Ber.*, **19**, 3042 (1886); C. F. Koelsch, THIS JOURNAL, **53**, 304 (1931).

(11) See ref. 7; M. Colonna, *Pubb. ist. chim. univ. Bologna*, **2**, 3–10 (1943), or *C. A.*, **41**, 754 (1947); W. Boggust and W. Cocker, *J. Chem. Soc.*, 355 (1949). The latter investigators prepared this compound from 2-mercaptobenzothiazole and hydrazine hydrate by refluxing in an alcohol solution for three hours, m.p. 199.5°.

(12) A. Hofmann, *Ber.*, **13**, 8 (1880).

Drozdov and Stavrovskaya.[13] Into a 1-l. three-necked flask equipped with a stirrer, condenser, Glascol and thermometer were charged 150 ml. of 95% ethanol, 10 g. (0.166 mole) of glacial acetic acid, 250 g. of water and 50 g. (0.89 mole) of 100 mesh iron powder. This slurry was stirred and heated to 80–85° in one-half hour and then 21.0 g. (0.1 mole) of 2-chloro-6-nitrobenzothiazole added in small portions in the course of one hour. The dark slurry was held at 80° an additional hour and 200 ml. of 95% ethanol and 10 g. of Darco G-60 added. This mixture was refluxed an additional one-quarter hour and filtered hot through a heated funnel into 250 ml. of water. The filtrate was chilled in an ice-box and the solid filtered off and dried *in vacuo* at 50°. The weight of material, m.p. 155–157° (lit.,[13] m.p. 162°), was 13.8 g. (75%). This material was pure enough to be used without further purification.

6-Acetylamino-2-chlorobenzothiazole (IX).—Into a 300-ml. three-necked flask equipped with a sealed stirrer, dropping funnel and ice-bath were charged 18.4 g. (0.1 mole) of 6-amino-2-chlorobenzothiazole and 70 ml. of pyridine. The solution was stirred and at 10° 10.8 g. (0.16 mole) of acetyl chloride was added dropwise in the course of 20 minutes. The reaction mixture was stirred at 0–10° an additional one-half hour and poured into 800 ml. of ice and water. The heavy white slurry was stirred to dissolve the ice and the white solid collected on a Buchner funnel. The cake was washed with 500 ml. of water and dried *in vacuo* at 50°. The weight of material, m.p. 118–121°, was 21.6 g. (95%). A sample was recrystallized twice by dissolving in a minimum amount of 95% ethanol, filtering, and adding the filtrate to 40 volumes of hot water. Fine white needles separated, melting at 131–132°.

Anal. Calcd. for $C_9H_8ON_2SCl$: C, 47.47; H, 3.51; N, 12.20. Found: C, 47.56; H, 3.18; N, 12.57.

6-Acetylamino-2-hydrazinobenzothiazole (X).—Into a 600-ml. beaker on a hot-plate was placed 150 g. (85% real, 2.55 moles) of hydrazine hydrate. The liquid was stirred and heated to boiling and 42.5 g. (0.186 mole) of 6-acetylamino-2-chlorobenzothiazole added quickly. A heavy slurry was formed. The slurry was diluted with a 125 ml. of hot water, held at the boil for an additional five minutes, cooled by adding 150 g. of ice, and filtered. The cake was washed with water and dried *in vacuo* at 50°. The weight of material, m.p. 215–219°, was 38.3 g. (93%). A sample was recrystallized from aqueous methanol, m.p. 233–235°.

Anal. Calcd. for $C_9H_{10}ON_4S$: C, 48.64; H, 4.50; N, 25.22. Found: C, 48.90; H, 4.39; N, 24.49.

Condensation of 6-Acetylamino-2-hydrazinobenzothiazole with Aromatic Aldehydes.—Into a 250-ml. beaker on a hot-plate were charged 3.0 g. (0.0135 mole) of 6-acetylamino-2-hydrazinobenzothiazole and 100 ml. of 25% acetic acid. The slurry was heated to boiling and a solution was obtained. To the yellow solution at the boil was added 3.0 g. (0.024 mole) of *p*-hydroxybenzaldehyde. A thick slurry was obtained almost immediately. This was stirred manually for 10 minutes, cooled, filtered, and the cake washed with water. The yield of material, m.p. 274–277°, was 3.4 g. (77%).

6-Amino-2-hydrazinobenzothiazole (XI).—Into a 100-ml. beaker were charged 10 g. (0.054 mole) of 6-amino-2-chlorobenzothiazole and 50 g. (85% real, 0.85 mole) of hydrazine hydrate. The slurry was heated to boiling and stirred manually. A straw-colored solution was formed which was boiled five minutes longer and cooled to 20°. The bulky precipitate was collected on a Buchner funnel, washed with 200 ml. of water, and dried *in vacuo* at 55°. The weight of pale yellow crystals was 8.6 g. (88%), m.p. 208–210°. A sample recrystallized twice from isopropyl alcohol melted at 209.5–211°.

Anal. Calcd. for $C_7H_8N_4S$: C, 46.66; H, 4.45; N, 31.03. Found: C, 47.12; H, 4.24; N, 30.84.

2-Chloro-6-phenylsulfonamidobenzothiazole.—In a 50-ml. beaker on a hot-plate were mixed 20 ml. of pyridine, 1.3 g. (0.007 mole) of 6-amino-2-chlorobenzothiazole, and 2.0 g. (0.0114 mole) benzenesulfonyl chloride. The mixture was heated to boiling and the cherry-red fluorescent solution obtained was cooled and poured into 150 ml. of water. The light red solid was collected on a Buchner funnel and recrystallized from aqueous ethanol. The weight of material melting point 175–177° was 2.1 g. or 95% of theory. A sample was recrystallized once again from aqueous ethanol, m.p. 176–177.5°.

Anal. Calcd. for $C_{13}H_9O_2N_2S_2Cl$: C, 48.07; H, 2.76; N, 8.63. Found: C, 48.71; H, 3.02; N, 8.55.

2-Hydrazino-6-phenylsulfonamidobenzothiazole.—In a 50-ml. beaker on a hot-plate were mixed 2.1 g. (0.0065 mole) of 2-chloro-6-phenylsulfonamidobenzothiazole and 20 g. (85% real, 0.34 mole) of hydrazine hydrate. When this mixture was heated to boiling a pale yellow solution was obtained. This solution was boiled an additional five minutes, cooled, and neutralized to litmus paper with 6 *N* sulfuric acid. Fifty milliliters of water was added and the solid was collected on a Buchner funnel. The cake was washed with water and air dried. The weight of material, m.p. 212–216°, was 1.7 g. (82%). A sample was recrystallized twice from toluene–alcohol. Pale yellow crystals were obtained melting at 214–216°.

Anal. Calcd. for $C_{13}H_{12}O_2N_4S_2$: C, 48.75; H, 3.75; N, 17.50. Found: C, 49.33; H, 3.75; N, 17.60.

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(13) N. S. Drozdov and V. I. Stavrovskaya, *J. Gen. Chem. (U. S. S. R.)*, **9**, 409 (1949), or *C. A.*, **34**, 103 (1940).

NOTES

Preparation of 1,3-Dichlorohexafluoropropane

BY B. L. BAKER AND A. M. WHALEY[1]

It became necessary during the course of a program concerning stability studies on various fluorochlorides to prepare highly fluorinated materials. One of the compounds synthesized was 1,3-dichlorohexafluoropropane, $CF_2Cl–CF_2–CF_2Cl$, and the procedure reported represents a practical three-step method from commercially available 1,2-dichloro-2-propene. The low boiling point and the indicated stability coupled with the below reported method of preparation of the fluoride would seem to make it worthy of further study as a possible refrigerant.

There has been considerable confusion in the literature regarding the structure of the 1,2- and 1,3-dichlorohexafluoropropanes. The first correct accounts of the synthesis of the 1,3-dichloride are those of Downing, *et al.*,[2] who chlorinated $CHF_2–CF_2–CHF_2$ and Young and Murray[3] who chlorinated $CHF_2–CF_2–CF_2Cl$ and also fluorinated $CFCl_2–CF_2–CFCl_2$.

(1) Halogen Chemicals, Inc., 616 King St., Columbia, S. C.

(2) F. B. Downing, *et al.*, U. S. Patent 2,413,696.

(3) E. G. Young and W. S. Murray, THIS JOURNAL, **70**, 2814 (1948).