color as stirring was continued for 0.5 hr. at room temperature. The reaction mixture was hydrolyzed by pouring into cold 1 *N* hydrochloric acid solution. Extraction of the product with ether followed by washing with water and then drying the ether layer led, upon evaporation of the ether, to a brown oily product which was only partially rearranged to the thiolactone; absorption at 1675 cm.$^{-1}$ (α,β-unsaturated thiolactone), 1205 cm.$^{-1}$ (2-methoxythienyl), and 3560 cm.$^{-1}$ (hydroxyl). Retreatment of the product with 2 ml. of 1 *N* hydrochloric acid and enough methanol to maintain homogeneity, followed by warming led to a product which lacked methoxyl and hydroxyl absorption but exhibited a strong band at 1675 cm.$^{-1}$ characteristic of the α,β-unsaturated thiolactone.

Chromatographic separation on silica using petroleum ether (30–60°), benzene, and ether for elution produced several fractions (benzene eluate) which crystallized from methanol in several crops to give 0.33 g. (11%) of the yellow thiolactone, m.p. 78–86°. Several recrystallizations from methanol produced an analytical sample, m.p. 87–88°.

Anal. Calcd. for $C_{12}H_{10}OS$: C, 71.26; H, 4.98. Found: C, 71.11; H, 5.08.

In addition to absorption in the infrared region at 1675 cm.$^{-1}$ the compound absorbed in the ultraviolet at 246 mμ (log ϵ 3.82) and 333 mμ (log ϵ 4.21).

One of the last fractions from the column produced a trace of crystalline material which melted at 108–114°; further characterization of this product was not attempted.

5-Benzylidene-2(5*H*)-thiophenone, IX.—To 5.00 g. (0.047 mole) of redistilled benzaldehyde in 30 ml. of anhydrous ether was added dropwise with stirring 70 ml. of a solution of 5-methoxy-2-thienyllithium prepared from 5.91 g. (0.0518 mole) of 2-methoxythiophene and 0.047 mole of phenyllithium by the method previously described. The mixture was stirred for 1 hr. after the addition was complete and then poured into 1 *N* hydrochloric acid and vigorously stirred. The product was extracted with several portions of ether, and the combined ether layer was then washed successively with water, dilute sodium bicarbonate solution, and water and dried over anhydrous sodium sulfate. Removal of the ether left an oily product; infrared absorption at 3560 cm.$^{-1}$ (hydroxyl), 1205 cm.$^{-1}$ (2-methoxythienyl), and 1675 cm.$^{-1}$ (α,β-unsaturated thiolactone). The oil was diluted with 50 ml. of methanol and 10 ml. of 1 *N* hydrochloric acid, and the solution was then warmed on the steam bath for 5 min. The product obtained partially crystallized from ethanol to give 1.50 g. (17%) of the yellow benzylidene derivative, m.p. 94–97°. Further recrystallization from ethanol produced an analytical sample, m.p. 97.5–98.5°.

Anal. Calcd. for $C_{11}H_8OS$: C, 70.18; H, 4.28. Found: C, 70.21; H, 4.19.

The melting point was not depressed when the compound was mixed with a sample of the benzylidene derivative prepared by Hurd and Kreuz.[7,16] The infrared spectrum exhibited a band at 1675 cm.$^{-1}$ (α,β-unsaturated thiolactone) and none at 3560 cm.$^{-1}$ and 1250 cm.$^{-1}$ (hydroxyl and 2-methoxythienyl groups, respectively); λ_{max} (Fig. 1) 238 mμ (log ϵ 3.95), 245 mμ (log ϵ 3.96) and 350 mμ (log ϵ 4.39).

Acknowledgment.—The authors wish to thank Henri Arzoumanian and Curtis Diebert for their help in the preparative work. We are especially grateful to Dr. R. M. Teeter for his interpretation of the mass spectrometric analysis and to Dr. Donald S. Noyce for helpful correspondence concerning the mechanism of the reaction.

(16) The sample was generously furnished by Dr. C. D. Hurd of Northwestern University.

Preparation of 1-Aminobenzimidazoles

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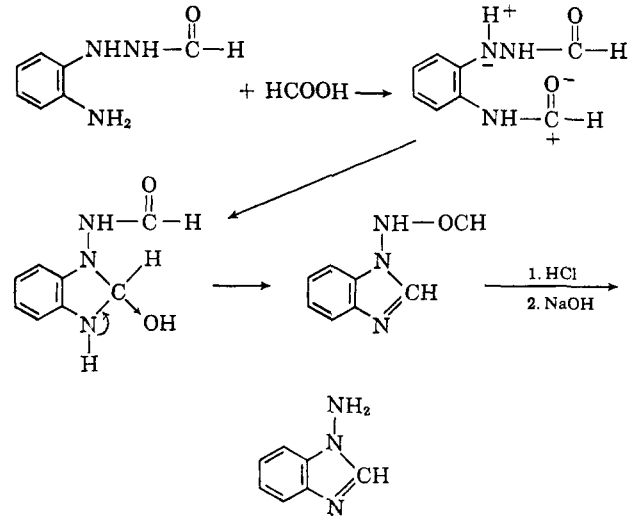
A method has been developed for the syntheses of a number of 1-aminobenzimidazoles. Some of the characteristic reactions of 1-aminobenzimidazole are reported.

The first attempt to prepare 1-aminobenzimidazoles was reported by Ried and Urlass.[1] They prepared 1-nitrosobenzimidazole and 1-nitroso-2-methylbenzimidazole. The compounds were isolated only as their dihydrates. They attempted to reduce these compounds with zinc and acetic acid in methanol solution but recovered only benzimidazole and 3-methylbenzimidazole as products. The reduction of a number of N-nitroso compounds, with lithium aluminum hydride, to the corresponding hydrazines has been reported.[2] In the current work, attempts to reduce 1-nitrosobenzimidazole and 1-nitroso-2-methylbenzimidazole, with lithium aluminum hydride, gave only the hydrogenolysis products.

Abramovitch and Schofield[3] reported that *o*-formhydrazidoaniline was converted to 1-aminobenzimidazole when refluxed with a slightly acidified aqueous solution of sodium *m*-nitrobenzenesulfonate. However, when the formhydrazidoaniline was heated with 4 *N* hydrochloric acid, 1,2,4-benzotriazine was formed (10–20% yields) after oxidation with potassium ferricyanide.[3] In the present study, attempts to repeat the preparation of 1-aminobenzimidazole gave only low yields. A modified method was finally found which gave good results. When the formyl derivative was refluxed in 98% formic acid, an almost quantitative yield of 1-formamidobenzimidazole was obtained. The latter was then converted to 1-aminobenzimidazole



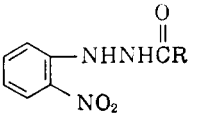
(1) W. Ried and G. Urlass, *Ber.*, **86**, 1101 (1953).

(2) C. G. Overberger, J. G. Lombardino, and R. G. Hiskey, *J. Am. Chem. Soc.*, **79**, 6430 (1957); C. Hanna and F. W. Schueler, *ibid.*, **74**, 3693 (1952).

(3) R. A. Abramovitch and K. Schofield, *J. Chem. Soc.*, 2326 (1955).

TABLE I

o-ACYLHYDRAZINONITROBENZENES

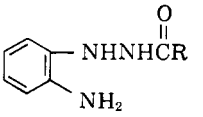


R	M.p., °C	Yield, %	Formula	Carbon, % Calcd.	Carbon, % Found	Hydrogen, % Calcd.	Hydrogen, % Found	Nitrogen, % Calcd.	Nitrogen, % Found
H[a]	181–182	72.5	$C_7H_7N_3O_3$						
CH_3[a]	143–144	56.6	$C_8H_9N_3O_3$						
C_2H_5	121–122	43.2	$C_9H_{11}N_3O_3$	51.70	51.76	5.26	5.35	20.10	19.90
$CH_3(CH_2)_3$	111–112	52.5	$C_{12}H_{17}N_3O_3$	57.35	57.59	6.77	6.91	16.72	16.79
CH_3COOCH_2	156–158	32.4	$C_{10}H_{11}N_3O_5$	47.45	47.32	4.35	4.48	16.60	16.47
$C_6H_5CH_2$	179–181	33.5	$C_{14}H_{13}N_3O_3$	62.00	61.80	4.79	4.62	15.50	15.31

[a] See ref. 3.

TABLE II

o-ACYLHYDRAZINOANILINES



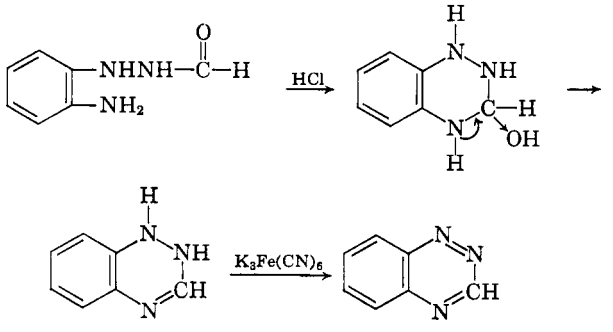
R	M.p., °C.	Yield, %	Formula	Carbon, % Calcd.	Carbon, % Found	Hydrogen, % Calcd.	Hydrogen, % Found	Nitrogen, % Calcd.	Nitrogen, % Found
H[a]	120–121	84	$C_7H_9N_3O$						
CH_3[a]	164–166	72.5	$C_8H_{11}N_3O$						
C_2H_5[b]	126–127	86.0	$C_9H_{13}N_3O$	60.30	60.49	7.26	7.20	23.45	23.26
$CH_3(CH_2)_4$[b]	123–125	70.5	$C_{12}H_{19}N_3O$	65.20	65.08	8.60	8.76	18.98	18.73
CH_3COOCH_2[b]	135	76.7	$C_{10}H_{13}N_3O_3$	53.78	53.92	5.83	5.90	18.82	19.04
$C_6H_5CH_2$[b]	159–161	85.6	$C_{14}H_{15}N_3O$	69.70	69.80	6.22	6.38	17.41	17.30

[a] See ref. 3. [b] Recrystallized from benzene.

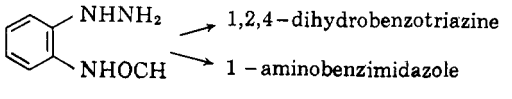
by refluxing with dilute hydrochloric acid and precipitating the free base by making the solution alkaline.

The mechanism (on p. 736) appears to be a reasonable one for the formation of 1-aminobenzimidazole in the present study.

The free amino group must be acylated before ring closure to the imidazole ring is possible. In the absence of an acylating agent and in the presence of dilute hydrochloric acid, 1,2,4-benzotriazine is formed after oxidation with potassium ferricyanide.[3] In this case it would seem that the *o*-formhydrazidoaniline undergoes ring closure directly to form a dihydrotriazine.



In dilute hydrochloric acid some transacylation would be expected with the formation of *o*-formamidophenylhydrazine. The latter could undergo ring closure to form either the benzotriazine or 1-aminobenzimidazole.



Actually, Abramovitch and Schofield[3] isolated a small amount of 2-methylbenzimidazole when they heated *o*-acethydrazidoaniline with 4 *N* hydrochloric acid and subsequently oxidized with potassium ferricyanide. Since they also demonstrated that 1-amino-2-methylbenzimidazole is converted to 2-methylbenzimidazole when oxidized with potassium ferricyanide, it is probable that 1-amino-2-methylbenzimidazole was the source of the 2-methylbenzimidazole. They postulated that "the formation of N-aminobenzimidazoles must involve acyl-group migration from the hydrazine to the amino nitrogen followed by preferential formation of the imidazole ring."

In the present study, it has been found that the most favorable conditions for effecting ring closure of the *o*-acylhydrazidoanilines to the imidazole were those under which acylation could readily occur. When *o*-acylhydrazido anilines were heated with anhydrous organic acids, imidazoles were formed in good yields but no triazines were formed. However as previously noted,[3] when *o*-acylhydrazido anilines are heated with dilute hydrochloric acid, triazines are reported to be the major products.

The acyl derivatives of dihydro-1,2,4-benzotriazines, if they could be isolated, would have the same molecular formulas as the corresponding 1-acylaminobenzimidazoles. It might be argued, therefore, that the 1-acylaminobenzimidazoles reported here are actually acyl derivatives of dihydro-1,2,4-benzotriazines. This does not seem possible for the following reason: the same 1-acylaminobenzimidazoles were obtained by acylating the corresponding 1-aminobenzimidazoles under anhydrous conditions. The 1-aminobenzimidazoles. re-

TABLE III

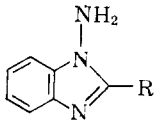
1-ACYLAMINO-2-ALKYLBENZIMIDAZOLES

R	R'	M.p., °C.	Yield, %	Formula	Carbon, % Calcd.	Carbon, % Found	Hydrogen, % Calcd.	Hydrogen, % Found	Nitrogen, % Calcd.	Nitrogen, % Found
H	H	201–203[a]	95	$C_8H_7N_3O$	59.54	59.30	4.35	4.54	26.18	26.14
H	CH_3	212–214[a]	80.5	$C_9H_9N_3O$	61.70	61.65	5.15	5.20	24.00	23.95
H	C_2H_5	138–139[a]	80.5	$C_{10}H_{11}N_3O$	63.50	63.40	5.82	5.70	22.20	22.10
CH_3	CH_3	206–208	43.7	$C_{10}H_{11}N_3O$	63.50	63.70	5.82	6.06	22.20	21.99
C_2H_5	C_2H_5	147–148	72.0	$C_{12}H_{15}N_3O$	66.30	66.51	6.81	6.81	19.34	19.19

[a] Also prepared by acylation of the corresponding 1-aminobenzimidazoles.

TABLE IV

1-AMINO-2-ALKYLBENZIMIDAZOLES

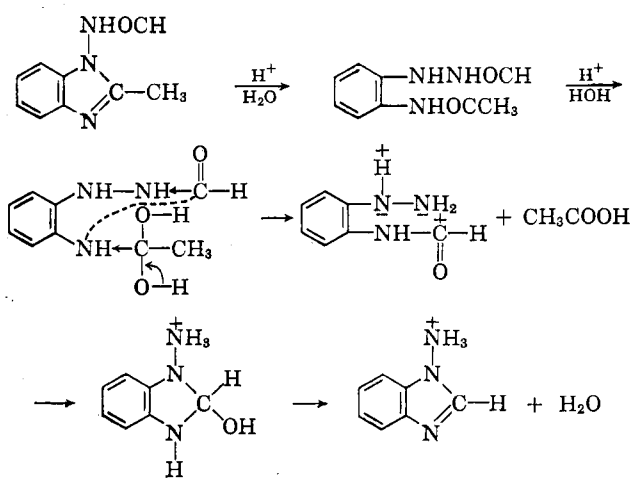


R	M.p., °C.	Yield, %	Formula	Carbon, % Calcd.	Carbon, % Found	Hydrogen, % Calcd.	Hydrogen, % Found	Nitrogen, % Calcd.	Nitrogen, % Found
H	150–152[a]	89.5	$C_7H_7N_3$	63.20	63.23	5.27	5.49	31.59	31.40
CH_3	158–160	58.5	$C_8H_9N_3$	65.30	65.12	6.12	6.26	28.58	28.42
C_2H_5	126–127	94.6	$C_9H_{11}N_3$	67.10	66.96	6.83	7.03	26.08	25.98
$CH_3(CH_2)_4$	136–138	59.0	$C_{12}H_{17}N_3$	70.90	70.83	8.40	8.70	20.70	20.72
$C_6H_5CH_2$	163–165	24.0	$C_{14}H_{13}N_3$	75.40	75.51	5.83	5.64	18.81	18.79

[a] Ref. 3 gives 156–156.5°.

ported in this paper, reacted with nitrous acid to form the corresponding benzimidazoles and with benzaldehyde to form the corresponding hydrazone derivatives. The presence of a primary amino group is thus indicated.

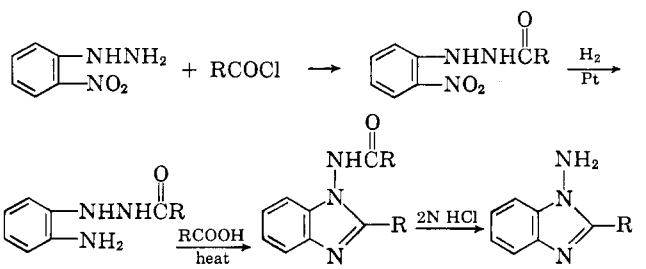
Both 1-formamido-2-methylbenzimidazole and 1-formamido-2-ethylbenzimidazole gave 1-aminobenzimidazole when hydrolyzed with dilute hydrochloric acid. To account for the formation of 1-aminobenzimidazole, it is necesary to assume that ring opening occurs. Before discussing the probable course of reaction which follows the ring opening, it is necessary to consider the nature of the intermediates leading to the formation of dihydrobenzotriazines and benzimidazoles. At this point it appears probable that *o*-acylhydrazidoanilines undergo ring closure only to the dihydrotriazine ring and the *o*-acylamidophenylhydrazines are the immediate predecessors mainly for imidazole formation.



In the above two cases, we postulate the formation of *o*-formamidophenylhydrazine, possibly by a transacylation mechanism, as being necessary for the formation of 1-aminobenzimidazole.

We agree with Abramovitch and Schofield[3] that *o*-formamidophenylhydrazine, while theoretically capable of forming either the triazine ring or the imidazole ring, preferentially undergoes ring closure to the imidazole ring. The above reaction may be reversible, but the equilibrium must lie far to the right since very good yields of 1-aminobenzimidazole are obtained.

If the above course of reaction is correct, it would follow that 2-alkyl-1-aminobenzimidazoles should be readily obtainable from 2-alkyl-1-acylaminobenzimidazoles where the R in the acyl group is identical with the one in the 2-position. This assumption has been confirmed and a sufficient number of 2-alkyl-1-aminobenzimidazoles have been prepared to show that the method is a general one.



1-Aminobenzimidazole, although not a new compound, had been obtained previously only in low yields. From the standpoint of its chemical reactions, it is practically an unknown compound. Consequently a

number of its reactions were studied. Benzimidazole is formed when the 1-amino compound is treated with nitrous acid. Other unsymmetrically disubstituted hydrazines behave similarly with nitrous acid.[4] With isonicotinoyl chloride and *p*-acetamidobenzenesulfonyl chloride, 1-isonicotinamidobenzimidazole and 1-*p*-acetamidobenzenesulfonamidobenzimidazole were formed. Benzaldehyde reacts readily with 1-aminobenzimidazole to form the corresponding hydrazone but acetone failed to react under similar conditions.

Experimental

Attempted Reduction of 1-Nitrosobenzimidazole with Lithium Aluminum Hydride.—A suspension of 1-nitrosobenzimidazole dihydrate[1] (1 g., 0.055 mole) in 100 ml. of tetrahydrofuran was added slowly to a refluxing solution of lithium aluminum hydride (6.5 g., 0.165 mole) in 200 ml. of tetrahydrofuran with stirring. The solution was refluxed for 4 hr. After decomposing the excess lithium aluminum hydride, the filtrate was evaporated and the residue extracted with benzene. Only benzimidazole was recovered.[5]

***o*-Formhydrazidonitrobenzene and *o*-Acethydrazidonitrobenzene.**—These compounds were prepared by the method of Abramovitch and Schofield.[3]

***o*-Propionhydrazidonitrobenzene.** Propionyl chloride (4.82 g., 0.052 mole) was added slowly to a suspension of 7.65 g. (0.05 mole) of *o*-nitrophenylhydrazine in 40 ml. of pyridine with stirring. After standing for 5 days, the solution was poured into cold, dilute hydrochloric acid. The resulting oil was removed and stirred with water until it solidified (3.74 g.). The acidic aqueous solution, after standing for 5 days gave an additional 3.35 g. of solid. The combined solids were recrystallized from benzene with the aid of decolorizing carbon. The pure product separated as yellow crystals.

A similar procedure was used to prepare *o*-caprohydrazidonitrobenzene, *o*-acetylglycolhydrazidonitrobenzene, and *o*-phenylacethydrazidonitrobenzene.

***o*-Acylhydrazinoanilines.**—The corresponding nitrobenzenes were hydrogenated in alcohol solution over platinum as a catalyst.

1-Acylaminobenzimidazoles.—1-Formamidobenzimidazole, 1-formamido-2-methylbenzimidazole, and 1-formamido-2-ethylbenzimidazole were prepared by refluxing *o*-formhydrazidoaniline with 98–100% formic acid, anhydrous acetic acid and anhydrous propionic acid, respectively. The refluxing times with formic acid, acetic acid, and propionic acids were 5 hr., 5 hr., and 21 hr., respectively. The excess acids were removed *in vacuo* and the products recrystallized from benzene–ethanol. Sometimes the crude product separated as an oil, in which case it was triturated with ethanol followed by removal of the ethanol *in vacuo*. This was repeated until solidification occurred.

1-Acetamido-2-methylbenzimidazole and 1-propionamido-2-ethylbenzimidazole were prepared from *o*-acethydrazidoaniline and *o*-propionhydrazidoaniline by refluxing with acetic acid (21 hr.) and propionic acid (48 hr.), respectively.

1-*n*-Caproamido-2-pentylbenzimidazole and 1-phenylacetamido-2-benzylbenzimidazole were obtained only as impure oils which could not be obtained in solid form. They were converted directly to the corresponding 1-aminobenzimidazoles. *o*-Acetylglycolhydrazidoaniline when heated with glycolic acid failed to form the corresponding 1-aminobenzimidazole.

1-Aminobenzimidazoles. 1-Aminobenzimidazole.—1-Formamidobenzimidazole was dissolved in 2 *N* hydrochloric acid and the solution heated on the steam bath for 5 hr. After cooling, the solution was made basic with 10% sodium hydroxide solution and extracted with benzene. The benzene was removed and the residue was recrystallized from benzene.

1-Formamido-2-methylbenzimidazole and 1-formamido-2-ethyl benzimidazole when heated with 2 *N* hydrochloric acid were also converted to 1-aminobenzimidazole. Infrared and analytical data as well as mixed melting point determinations proved the end-products to be identical with 1-aminobenzimidazole.

1-Amino-2-methylbenzimidazole, 1-amino-2-ethylbenzimidazole, and 1-amino-2-benzylbenzimidazole were prepared from 1-acetamido-2-methylbenzimidazole, 1-propionamido-2-ethylbenzimidazole, and 1-phenylacetamido-2-benzylbenzimidazole, respectively, in a similar manner. 1-Amino-2-benzylbenzimidazole was recrystallized from petroleum ether (60–110°).

1-Amino-2-pentylbenzimidazole could not be obtained in pure form by the above method, so it was prepared directly from *o*-caprohydrazidoaniline. *o*-Caprohydrazidoaniline (1.3 g.) and *n*-caproic acid (50 ml.) in 50 ml. of xylene was refluxed for 3 days. The excess caproic acid and xylene were removed *in vacuo*. The residual brown oil was dissolved in 15 ml. of benzene and the benzene solution then extracted with 2 *N* hydrochloric acid. The acid solution was heated on the steam bath for 6 hr. and then made basic with 10% sodium hydroxide solution. The product, obtained on cooling was recrystallized from petroleum ether (60–100°).

Acylation of 1-Aminobenzimidazoles. Formylation of 1-Aminobenzimidazole.—One gram of 1-aminobenzimidazole was refluxed with 50 ml. of 98–100% formic acid for 1 hr. The formic acid was removed *in vacuo* and the residue was recrystallized from benzene–ethanol, yield 80%, m.p. 201–203°. This product was identical in all respects, including the infrared spectrum, with the 1-formamidobenzimidazole obtained from *o*-formhydrazidoaniline and formic acid.

Anal. Calcd. for $C_8H_7N_3O$: C, 59.54; H, 4.35; N, 26.18. Found: C, 59.43; H, 4.45; N, 26.09.

Acetylation of 1-Amino-2-methylbenzimidazole.—One gram of 1-amino-2-methylbenzimidazole was dissolved in 75 ml. of glacial acetic acid and the solution refluxed for 2 hr. during which time slow distillation was permitted. About 40 ml. of the acetic acid distilled in this time. The remaining acetic acid was removed *in vacuo*. The oily residue was solidified by azeotropic evaporation with absolute ethanol and recrystallized from benzene–ethanol, yield 68%, m.p. 206–208°. This product was identical in all respects with the 1-acetamido-2-methylbenzimidazole obtained from *o*-acethydrazidoaniline and acetic acid. Mixed melting point determination showed no depression and the infrared spectra were identical.

Anal. Calcd. for $C_{10}H_{11}N_3O$: C, 63.50; H, 5.82; N, 22.20. Found: C, 63.61; H, 5.90; N, 22.14.

The same product was obtained by mixing 0.35 g. (0.0026 mole) of 1-amino-2-methylbenzimidazole in 10 ml. of pyridine with 0.2 g. (0.9026 mole) of acetyl chloride and heating on a steam bath for 6 hr. The pyridine was removed *in vacuo* and the residual oil washed with a little water. This was solidified by azeotropic evaporation with dry ethanol and then recrystallized from benzene–ethanol. The product was identical in all respects with the one obtained above.

Reactions of 1-Aminobenzimidazole. Reaction with Nitrous Acid.—A slight excess of sodium nitrite in 3 ml. of water was added dropwise to a solution of 0.3 g. of 1-aminobenzimidazole in 1 ml. of concentrated hydrochloric acid. A solid precipitated but redissolved again. The solution was allowed to stand overnight and then made basic with 10% sodium hydroxide. The resulting solid was recrystallized from benzene, yield 93%; m.p. 170–171°. Infrared data, analytical data, and melting point determination proved the compound to be benzimidazole.

Preparation of 1-Isonicotinamidobenzimidazole.—1-Aminobenzimidazole (0.35 g., 0.0026 mole) and 0.47 g. (0.0026 mole) of isonicotinoyl chloride hydrochloride were dissolved in 50 ml. of dry pyridine. The solution was refluxed for 6 hr. Most of the pyridine was removed *in vacuo* and the concentrated solution poured into ice–water. The crude product which precipitated was removed, washed with water, dried, and recrystallized from benzene–ethanol. The yield was 56%, m.p. 224–226°.

Anal. Calcd. for $C_{13}H_{10}N_4O$: C, 65.50; H, 4.20; N, 23.52. Found: C, 65.71; H, 4.43; N, 23.37.

Preparation of 1-*p*-Acetamidobenzenesulfonamidobenzimidazole.—The procedure for making 1-isonicotinamidobenzimidazole was used for this preparation substituting *p*-acetamidobenzenesulfonyl chloride for isonicotinoyl chloride. Yield was 41.3%, m.p. 273–274° dec.

Anal. Calcd. for $C_{15}H_{14}N_4O_3S$: C, 54.59; H, 4.24; N, 16.98; S, 9.70. Found: C, 54.45; H, 4.39; N, 17.07; S, 9.83.

Preparation of 1-Benzalaminobenzimidazole.—A mixture of 0.1 g. of 1-aminobenzimidazole, 1 ml. of benzaldehyde, and 2 ml. of ethanol was heated to boiling on a steam bath and 2 drops of

(4) J. Thiele, *Ann.*, **376**, 239 (1910).

(5) A large excess of lithium aluminum hydride was used to take care of the water in the dihydrate.

concentrated hydrochloric acid added. The solution was refluxed for 15 min. and cooled. The product separated as a hydrochloride, yield 99%, m.p. 234–236° dec. The hydrochloride was dissolved in dilute hydrochloric acid and the solution made alkaline with 10% sodium hydroxide to precipitate the free base. The latter was recrystallized from benzene. The yield was 48%, m.p. 125–126°. This compound was previously made by a somewhat different method,[3] m.p. 126–127°.

Anal. Calcd. for $C_{14}H_{11}N_3$: C, 76.00; H, 4.98; N, 19.00. Found: C, 75.88; H, 4.97; N, 18.87.

Under the same conditions, acetone did not react with 1-aminobenzimidazole.

Pyrimidobenzothiazine Derivatives. II. The Condensation of Isothiocyano Ketones and Aryl Amines

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The heating of equimolar mixture of 2-isothiocyano-2-methyl-4-pentanone with aryl amines, arylamino acids, and arylamino alcohols results in the formation of pyrimidines, benzothiazines, and pyrimidobenzothiazines, respectively.

The reaction of anthranilic acid (III) and 2-isothiocyano-2-methyl-4-pentanone (IV) has been reported[1] to yield a compound $C_{14}H_{14}N_2OS$ which may be represented by either I or II. Although I was preferred on the basis that on treatment with sodium hydroxide, the thiolactone ring opens up to give mercapto acid (VIII), additional information regarding the structure seemed desirable. Additional support for the proposed pyrimidobenzothiazine structure (I) can be gathered from the fact that the reaction of aryl amines (VI) with isothiocyano ketone (IV) leads to the formation of 2-mercaptopyrimidines,[2,3] while aryl amines with 2-mercapto-4,4,6-trimethyl-4*H*[1,3]-thiazine[4] result in the formation of 2-substituted thiazines (VII).

When I or the corresponding mercapto acid (VIII) is treated with alcoholic hydrochloric acid, a mixture of 2-thio-4-oxotetrahydroquinazoline[5] (XI) and 2-amino-4*H*-benzo[1,3]thiazin-4-one (XIa) is obtained.

This may be explained by considering a partial equilibrium between I and VIII. In either case the ring cleavage is occurring through the enamine[6–8] (IX, IXa) to the keto derivative and then to α,β-unsaturated ketones (X) and imino derivatives (XI, XIa). Several additional pyrimidinebenzothiazines (I) were prepared

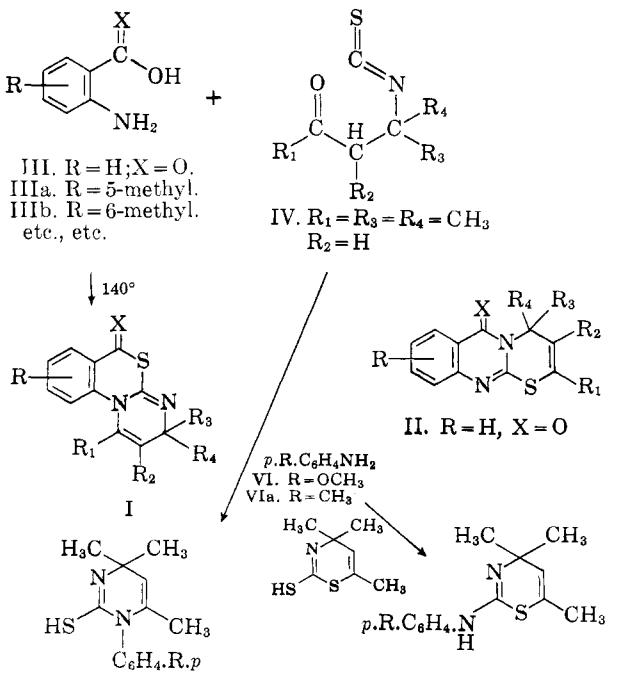

Figure 1

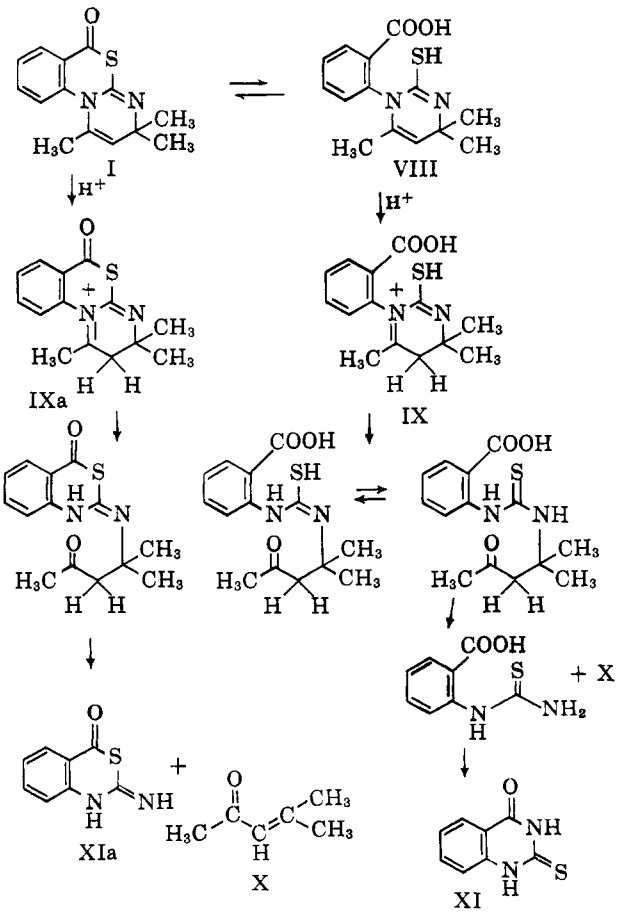

Figure 2

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