(0.5 g.) were dissolved on the steam bath in a mixture of ethanol (30 ml.) and water (5 ml.). After 10 min. the ethanol was evaporated into the water pump at a bath temperature of 50°; the remainder was diluted with 10 ml. of water and acidified with concentrated HCl, whereby a dark oil precipitated which soon crystallized: yield 92%, m.p. 130–136°. The crude adduct was recrystallized from benzene with charcoal yielding XXII in almost colorless thick platelets, m.p. 148–149° dec.

Anal. Calcd. for $C_{11}H_{12}N_2O_4$: C, 55.93; H, 5.12; N, 11.86. Found: C, 56.09; H, 5.02; N, 11.71.

Reaction of Potassium Thiocyanate with Nitrile Oxides.—Mesitonitrile oxide (0.190 g., 1.18 mmoles) dissolved in methanol (20 ml.) was refluxed for 1 hr. with a solution of potassium thiocyanate (0.115 g., 1.18 mmoles) in methanol (10 ml.) and concentrated to 10 ml., 50 ml. of ether was added, and the solution was extracted twice with 20-ml. portions of water. The organic layer was dried over anhydrous sodium sulfate and the solvent was evaporated yielding almost pure **2,4,6-trimethylphenyl isothiocyanate (XX)**. After one recrystallization from aqueous methanol, 0.202 g. of XX (96%), m.p. 62.5–63°, was obtained, which did not depress the melting point of an authentic sample.[17] In the above-obtained aqueous extracts, potassium cyanate was identified by the known conversion into urea (0.6 g., 84%).

When the same reaction was carried out at 25–30° over a period of 7 days, a 93% yield of **methyl 2,4,6-trimethylphenylisothiocarbamate (XXIV)** resulted. After one recrystallization from aqueous methanol, XXIV melted at 94°.

Anal. Calcd. for $C_{11}H_{15}NOS$: C, 63.12; H, 7.22; N, 6.69; S, 15.32; mol. wt., 209. Found: C, 63.05; H, 7.13; N, 6.40; S, 14.87; mol. wt., 210.

In the same manner 2,3,5,6-tetramethylbenzonitrile oxide was converted into **methyl 2,3,5,6-tetramethylphenylisothiocarbamate** (93%), m.p. 145° after recrystallization from aqueous methanol.

Anal. Calcd. for $C_{12}H_{17}NOS$: C, 64.53; H, 7.67; N, 6.27; S, 14.36; mol. wt., 223. Found: C, 64.66; H, 7.48; N, 6.19; S, 14.57; mol. wt., 228.

Mesitohydroximyl Azide (XXV).—Mesitonitrile oxide (1.34 g.) and sodium azide (0.65 g.) were suspended in ice-cold methanol (25 ml.) and stirred at 0° for 2 hr. The homogeneous reaction mixture was neutralized with 1 *N* H_2SO_4, diluted with 50 ml. of water, and extracted twice with 50-ml. portions of ether. The combined ethereal extracts were washed with water, dried over sodium sulfate, and evaporated without heating at the water pump, leaving a crystalline residue (1.65 g., 97%) of the azide XXV. The azide was dissolved at room temperature in a little ether and a large excess of petroleum ether was added, whereupon XXV crystallized on cooling to −10°, (1.44 g.), m.p. 88–89° dec. This product was dried *in vacuo* over P_2O_5 at 0° and then stored in Dry Ice until analyzed.

Anal. Calcd. for $C_{10}H_{12}N_4O$: C, 58.81; H, 5.92; N, 27.44. Found: C, 59.18; H, 6.13; N, 27.67.

The azide XXV decomposed spontaneously after standing for several hours at 25–30° with evolution of nitrogen and nitrogen oxides. The residue crystallized again, melting then at 47–48°, and proved to be almost pure **2,4,6-trimethylbenzonitrile (XXVI)**. After recrystallization from petroleum ether, a product melting at 50–51° was obtained, which did not depress the melting point of an authentic specimen.[16] Decomposition of XXV into XXVI occurred momentarily on contact with nitrogen dioxide or hydrogen chloride.

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1,2-Benzothiazines. III. The Preparation of 2H-1,2-Benzothiazin-4(3H)-one 1,1-Dioxide by the Acid-Catalyzed Deacetylation of β-Diketone

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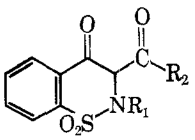
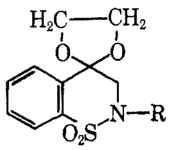
The acid-catalyzed reaction of 3-acetyl-2H-1,2-benzothiazin-4(3H)-one 1,1-dioxide (Ia) with ethylene glycol resulted in deacetylation to give IIa which was hydrolyzed to the ketone IIIa. The reaction did not take place with Ib, Ic, or Id; it did not take place with Ia when ethylene glycol was replaced by monoalcohols. Base-catalyzed condensations of IIIa with aldehydes as well as the conversion of IIa to 2-alkyl, 4-hydroxy, and 4-amino analogs are described.

The preparation of 3-acetyl-2H-1,2-benzothiazin-4(3H)-one 1,1-dioxide (Ia) was described in our previous publication.[1] Continuing our studies in the 1,2-benzothiazine series, we have obtained the ketal IIa in 67% yield by refluxing Ia with ethylene glycol and *p*-toluenesulfonic acid in benzene for 120 hr.; in addition there was isolated 13% of unreacted Ia. This reaction is of particular interest in that it represents an example of the deacylation of a β-diketone under acidic conditions. Although such reactions have been described by Adkins, *et al.*,[2] they do not appear to have enjoyed the widespread application of the classical base-catalyzed procedures.



Ia, $R_1 = H$; $R_2 = CH_3$
b, $R_1 = R_2 = CH_3$
c, $R_1 = CH_2CN$; $R_2 = CH_3$
d, $R_1 = H$; $R_2 = C_6H_5$
e, $R_1 = CH_3$; $R_2 = C_6H_5$



IIa, $R = H$
b, $R = CH_3$
c, $R = CH_2CN$
d, $R = CH_2CH_2N(C_2H_5)_2$

It is evident that the reaction has fairly specific structural requirements since the N-substituted compounds Ib and Ic as well as the N-unsubstituted phenyl analog Id were recovered unchanged when subjected to the same reaction conditions. The lack of reactivity of Id is in accord with the observation of Adkins, *et al.*,[2] that dibenzoylmethane is unaffected by the same treatment with ethanolic hydrogen chloride which readily deacetylates benzoylacetone.

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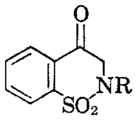
[1] H. Zinnes, R. A. Comes, F. R. Zuleski, A. N. Caro, and J. Shavel, Jr., *J. Org. Chem.*, **30**, 2241 (1965).

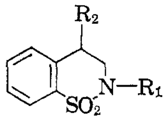
[2] (a) H. Adkins, W. Kutz, and D. D. Coffman, *J. Am. Chem. Soc.*, **52**, 3212 (1930); (b) W. M. Kutz and H. Adkins, *ibid.*, **52**, 4036 (1930). These workers observed the hydrogen chloride catalyzed ethanolysis of a series of simple β-diketones and determined some of the structural parameters affecting the reaction rate.

While we have made no extensive study of the reaction mechanism, it is apparent that the transformation of Ia to IIa must involve participation of both hydroxyls of the ethylene glycol. We have observed that no reaction takes place when the diol is replaced by its monomethyl ether, all other conditions remaining unchanged. Compound Ia was likewise unaffected by refluxing with 4.6 *N* ethanolic hydrogen chloride.[3]

Hydrolysis of IIa gave the ketone IIIa which was characterized by its spectral properties as well as by conversion to the phenylhydrazone, reduction to the alcohol IVa, and reketalization to IIa. Although IIb and IIc could not be obtained directly from Ib and Ic, they were readily prepared by alkylation of IIa. Methylation took place at room temperature in aqueous isopropyl alcohol, using methyl iodide with 1 equiv. of sodium hydroxide; hydrolysis of the crystalline product, IIb, gave the ketone IIIb. The reaction of IIa with chloroacetonitrile also took place at room temperature, but it required the use of sodium hydride in dimethylformamide.[4] In order to effect alkylation of IIa with β-diethylaminoethyl bromide, it was necessary to employ sodium hydride in refluxing 1,2-dimethoxyethane. The product, IId, was not purified but was hydrolyzed directly to IIIc[5] which was reduced to the corresponding alcohol IVb.[5]



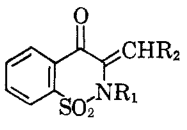
IIIa, $R = H$
b, $R = CH_3$
c, $R = CH_2CH_2N(C_2H_5)_2$

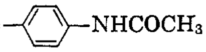
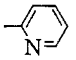


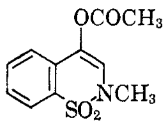
IVa, $R_1 = H$; $R_2 = OH$
b, $R_1 = CH_2CH_2N(C_2H_5)_2$; $R_2 = OH$
c, $R_1 = CH_3$; $R_2 = NH_2$
d, $R_1 = CH_3$; $R_2 =$ 

Raney nickel catalyzed hydrogenation of the oxime of IIIb afforded the 4-amino derivative IVc.[5] The reaction of IIb with pyrrolidine gave an enamine which was reduced to IVd[5] by successive treatment with boron trifluoride and sodium borohydride in isopropyl alcohol.

We have previously described the sodium hydride catalyzed condensation of IIIb with benzaldehyde to give Vb, which was shown to be identical with the product of sodium borohydride reduction of Ie.[1] This reaction has now been extended to the N-unsubstituted ketone IIIa, the products from benzaldehyde, *p*-acetamidobenzaldehyde, and pyridine-2-carboxaldehyde being Va, Vc, and Vd, respectively. The condensations of both IIIa and IIIb with aldehydes were carried out at −20° with dimethylformamide as the solvent. Reaction of IIIb with acetyl chloride under these conditions gave the enol acetate VI, whereas with esters such as ethyl acetate and dimethyl oxalate no reaction took place. Attempts to carry out the condensations at 0° resulted in the formation of an unpurifiable complex mixture. Apparently, the esters were too unreactive to compete with self-condensation reactions of IIIb, since it could be shown by thin layer chromatography that essentially the same mixture of products was obtained in the absence of added ester.[6]



Va, $R_1 = H$; $R_2 = C_6H_5$
b, $R_1 = CH_3$; $R_2 = C_6H_5$
c, $R_1 = H$; $R_2 =$ 
d, $R_1 = H$; $R_2 =$ 



VI

Experimental Section[7]

2H-1,2-Benzothiazin-4(3H)-one 1,1-Dioxide Ethylene Keta (IIa). A. Preparation by Deacetylation of 3-Acetyl-2H-1,2-benzothiazin-4(3H)-one 1,1-Dioxide (Ia).—A mixture of 153.1 g. (0.64 mole) of Ia, 198.4 g. (3.2 moles) of ethylene glycol, 4.0 g. (0.021 mole) of *p*-toluenesulfonic acid monohydrate, and 1600 ml. of benzene was placed in a three-necked flask equipped with a Dean–Stark water separator, reflux condenser, and an efficient stirrer. It was refluxed with vigorous stirring for 120 hr. after which 35 ml. of water had separated. The benzene was then removed by distillation *in vacuo* to give a wet semisolid which was triturated with ten 200-ml. portions of ether. The resulting solid was collected by filtration and triturated well with 75 ml. of ethanol. Filtration and washing with two 50-ml. portions of ethanol gave 104 g. of crystalline product, m.p. 189–191°, which gave a negative ferric chloride test and had no carbonyl absorption. Recrystallization from acetonitrile gave material, m.p. 193–194°, ν_{max} 3196 (s) cm.$^{-1}$, whose p.m.r. spectrum in deuterated dimethyl sulfoxide showed a broad signal at 2.50 (N–H), a triplet at 3.55 with $J = 7$ c.p.s. (OCH_2CH_2O–), a doublet at 4.18 with $J = 3$ c.p.s. (N–CH_2–), and a multiplet at 7.66 (aromatic) p.p.m.

Anal. Calcd. for $C_{10}H_{11}NO_4S$: C, 49.78; H, 4.60; N, 5.81; S, 13.29. Found: C, 49.85; H, 4.57; N, 6.10; S, 13.44.

The combined ether washings were evaporated to a viscous oil which solidified on trituration with several portions of water. The solid was then triturated with 25 ml. of ethanol and allowed to stand at room temperature. It was collected by filtration and washed with 25 ml. of ethanol to give 19.7 g. of material, m.p. 130–137°, which gave a positive ferric chloride test. Infrared and ultraviolet spectra showed this to consist predominantly of Ia.

B. Preparation by Ketalization of 2H-1,2-Benzothiazin-4(3H)-one 1,1-Dioxide (IIIa).—A mixture of 3.94 g. (0.02 mole) of Va, 6.2 g. (0.1 mole) of ethylene glycol, 0.25 g. of *p*-toluenesulfonic acid monohydrate, and 100 ml. of benzene was placed in a flask equipped with a Dean–Stark water separator and was refluxed with vigorous stirring for 24 hr. On cooling to room

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[3] The mechanism proposed by L. J. Beckham and H. Adkins [*J. Am. Chem. Soc.*, **56**, 1119 (1934)] for the acid-catalyzed ethanolysis of simple β-diketones is thus inadequate to explain the conversion of Ia to IIa.

[4] Attempted alkylation with chloroacetonitrile in aqueous isopropyl alcohol was unsuccessful even in the presence of excess sodium iodide.

[5] Compounds IIIc and IVb–d were all isolated and purified as the crystalline hydrochloride salts.

[6] Small amounts of self-condensation products can even be detected after treatment of IIIb with sodium hydride in dimethylformamide at −20° for 24 hr.

[7] Melting points were determined using the Thomas–Hoover capillary melting point apparatus which was calibrated against known standards. The ultraviolet and infrared spectra were obtained, respectively, with a Beckman DKI spectrophotometer and a Baird Model 455 double-beam instrument. Unless otherwise stated, the former were determined as solutions in 95% ethanol and the latter as Nujol mulls. The p.m.r. spectra were determined with the Varian A-60 spectrometer using tetramethylsilane as an internal standard. Thin layer chromatography was carried out on silica gel G (Stahl) using a 50:50 mixture of *n*-heptane and acetone as the eluent, the chromatograms being developed by placing them in a closed vessel containing iodine crystals. The drying agent used throughout was sodium sulfate.

temperature there was obtained 4.5 g. of crystals, m.p. 160–172°. Trituration with 50 ml. of ethanol gave 3.9 g. of product, m.p. 182–185°. Spectral properties were identical with those of the product from method A.

2-Methyl-2H-1,2-benzothiazin-4(3H)-one 1,1-Dioxide Ethylene Ketal (IIb).—To a solution of 72.3 g. (0.3 mole) of IIa in a mixture of 1500 ml. of isopropyl alcohol, 325 ml. of 1 *N* sodium hydroxide, and 350 ml. of water was added 30 ml. of methyl iodide. The solution was allowed to stand at room temperature for 24 hr., diluted with 2000 ml. of water, and extracted with dichloromethane. The dried organic solution was concentrated to a small volume and allowed to stand at room temperature whereupon 70 g. of product, m.p. 90–92°, crystallized out; it showed no NH absorption. Recrystallization from isopropyl alcohol gave material, m.p. 92–93°.

Anal. Calcd. for $C_{11}H_{13}NO_4S$, C, 51.75; H, 5.13; N, 5.48; S, 12.56; mol. wt., 255.3. Found: C, 51.95; H, 5.20; N, 5.76; S, 12.40; mol. wt., 256 (vapor pressure osmometer in dibromomethane).

2H-1,2-Benzothiazin-4(3H)-one 1,1-Dioxide (IIIa).—A mixture of 1.5 g. (0.0062 mole) of IIa, 25 ml. of methanol, and 25 ml. of 9% hydrochloric acid was refluxed for 15 min. and the methanol was distilled off. The solution was cooled and scratched and the resulting solid was collected and dissolved in dichloromethane. This solution was washed with water, dried, and evaporated to give 1.1 g. of product, m.p. 156–158°. Recrystallization from ethanol gave material: m.p. 157–158°; ν_{max} 3240 (s), 1684 (s), 1590 (m) cm.$^{-1}$; λ_{max}, mμ (ϵ), 248 (8500), 286 (1350), 297 (sh) (1200); λ_{min}, mμ (ϵ), 223 (4650), 273 (920).

Anal. Calcd. for $C_8H_7NO_3S$: C, 48.72; H, 3.58; N, 7.10; S, 16.26. Found: C, 48.86; H, 3.55; N, 6.98; S, 16.04.

The phenylhydrazone, recrystallized from isopropyl alcohol, had m.p. 186–187°.

Anal. Calcd. for $C_{14}H_{13}N_3O_2S$: C, 58.52; H, 4.56; N, 14.62; S, 11.16. Found: C, 58.60; H, 4.57; N, 14.66; S, 11.06.

2-Methyl-2H-1,2-benzothiazin-4(3H)-one 1,1-Dioxide (IIIb).—The procedure was carried out as in the previous example using 56 g. (0.22 mole) of IIb to give 42.5 g. of product, m.p. 106–108°. Recrystallization from ethanol gave material: m.p. 107.5–108.5°; ν_{max} 1694 (s), 1588 (m) cm.$^{-1}$; λ_{max}, mμ (ϵ), 248 (8500), 286 (1300), 297 (sh) (1200); λ_{min}, mμ (ϵ), 223 (4700), 273 (1000); the p.m.r. spectrum in deuteriochloroform showed singlets at 2.95 ($N\text{-}CH_3$) and 4.40 (CH_2) and a multiplet at 7.83 (aromatic) p.p.m.

Anal. Calcd. for $C_9H_9NO_3S$: C, 51.17; H, 4.29; N, 6.63; S, 15.18; mol. wt., 211.2. Found: C, 51.05; H, 4.34; N, 6.67; S, 15.21; mol. wt., 229 (vapor pressure osmometer in ethanol), 212 (Rast in camphorquinone).

The semicarbazone, recrystallized from nitromethane, had m.p. 246–250° dec.

Anal. Calcd. for $C_{10}H_{12}N_4O_3S$: C, 44.77; H, 4.51; N, 20.88; S, 11.95. Found: C, 44.89; H, 4.61; N, 20.95; S, 12.08.

The thiosemicarbazone, recrystallized from nitromethane, had m.p. 221–222° dec.

Anal. Calcd. for $C_{10}H_{12}N_4O_2S_2$: C, 42.24; H, 4.25; N, 19.70; S, 22.55. Found: C, 42.46; H, 4.21; N, 19.95; S, 22.76.

The oxime, recrystallized from isopropyl alcohol, had m.p. 173–174°.

Anal. Calcd. for $C_9H_{10}N_2O_3S$: C, 47.78; H, 4.46; N, 12.38; S, 14.17. Found: C, 47.86; H, 4.52; N, 12.18; S, 14.25.

2-(2-Diethylaminoethyl)-2H-1,2-benzothiazin-4(3H)-one 1,1-Dioxide Hydrochloride (IIId).—To a slurry of 0.077 mole of sodium hydride[8] in 1000 ml. of 1,2-dimethoxyethane was added a solution of 16.9 g. (0.07 mole) of IIa and the mixture was refluxed with stirring for 1 hr. It was cooled to room temperature, a solution of 12.6 g. (0.07 mole) of 2-diethylaminoethyl bromide was added, and refluxing was continued for 19 hr. The mixture was filtered and the filtrate was distilled *in vacuo* to give an oil. This was refluxed for 15 min. with a mixture of 800 ml. of methanol and 800 ml. of 9% aqueous hydrochloric acid, and the methanol was distilled off. The aqueous solution was made basic with ammonium hydroxide and extracted with dichloromethane, and the dried organic layer was distilled *in vacuo* to dryness. The residue was dissolved in 1200 ml. of ether and treated with an excess of ethereal hydrogen chloride. The resulting precipitate was triturated with ether and then recrystallized from a mixture of 2-butanone and dichloromethane to give 14.2 g. of product: m.p. 139–141°; ν_{max} 2550–2480 (m), 1696 (s), 1588 (m) cm.$^{-1}$.

Anal. Calcd. for $C_{14}H_{20}N_2O_3S \cdot HCl$: C, 50.52; H, 6.36; Cl, 10.65, N, 8.42; S, 9.63. Found: C, 50.76; H, 6.25; Cl, 10.70; N, 8.64; S, 9.40.

2-Cyanomethyl-2H-1,2-benzothiazin-4(3H)-one 1,1-Dioxide Ethylene Ketal (IIc).—To a slurry of 0.01 mole of sodium hydride[8] in 50 ml. of dimethylformamide was added a solution of 3.27 g. of IIa in 50 ml. of dimethylformamide. The reaction mixture was stirred at room temperature for 2 hr., a solution of 1.5 g. (0.02 mole) of chloroacetonitrile in 20 ml. of dimethylformamide was added, and stirring was continued for 2 hr. It was poured into ice–water and the resulting white precipitate was collected by filtration, washed well with water, and dissolved in dichloromethane. The dried solution was evaporated to dryness and the residue was triturated with petroleum ether (b.p. 30–60°) to give 2.5 g. of product, m.p. 139–140°, which showed no NH absorption. Recrystallization from ethanol gave an analytical sample, m.p. 139–140°.

Anal. Calcd. for $C_{12}H_{12}N_2O_4S$: C, 51.42; H, 4.32; N, 9.99; S, 11.44. Found: C, 51.72; H, 4.15; N, 9.73; S, 11.48.

3,4-Dihydro-4-hydroxy-2H-1,2-benzothiazine 1,1-Dioxide (IVa).—A mixture of 1.97 g. (0.01 mole) of IIIa and 1 g. of sodium borohydride in 60 ml. of isopropyl alcohol was stirred at room temperature for 18 hr. It was poured into ice–water containing excess hydrochloric acid and was extracted with dichloromethane. Evaporation of the dried dichloromethane solution gave a residue which was triturated with petroleum ether (b.p. 30–60°) to give 1.7 g. of material, m.p. 127–128°. Recrystallization from 5 ml. of ethyl acetate gave 0.85 g. of product: m.p. 129–130°; ν_{max} 3440, 3220 cm.$^{-1}$.

Anal. Calcd. for $C_8H_9NO_3S$: C, 48.23; H, 4.55; N, 7.03; S, 16.09. Found: C, 48.16; H, 4.64; N, 6.90; S, 16.21.

3,4-Dihydro-2-(2-diethylaminoethyl)-4-hydroxy-2H-1,2-benzothiazine 1,1-Dioxide Hydrochloride (IVb).—A mixture of 6.9 g. (0.021 mole) of IIIc (hydrochloride) and 2.4 g. (0.063 mole) of sodium borohydride in 350 ml. of ethanol was stirred at room temperature for 20 hr. Most of the ethanol was evaporated off and the residue was partitioned between dichloromethane and water. The water layer was further extracted with ether, and the combined organic solutions were dried and distilled *in vacuo* to dryness. The residue was dissolved in ether and treated with excess ethereal hydrogen chloride. The crude hydrochloride was recrystallized from isopropyl alcohol to give material, m.p. 134–135°, which was devoid of carbonyl absorption. Another recrystallization gave an analytical sample, m.p. 135–136°.

Anal. Calcd. for $C_{14}H_{22}N_2O_3S \cdot HCl$: C, 50.22; H, 6.92; N, 8.37; S, 9.58; Cl, 10.59. Found: C, 50.13; H, 6.86; N, 8.08; S, 9.34; Cl, 10.52.

3,4-Dihydro-2-methyl-4-amino-2H-1,2-benzothiazine 1,1-Dioxide Hydrochloride (IVc).—A solution of 15 g. (0.071 mole) of the oxime of IIIb in 350 ml. of glacial acetic acid was hydrogenated for 20 hr. at 57–60° and 1600 p.s.i., using Raney nickel as the catalyst. The catalyst was filtered off and most of the acetic acid was removed by distillation *in vacuo*. An aqueous solution of the residue was washed with dichloromethane, made alkaline with dilute sodium hydroxide, and extracted with chloroform. The chloroform was distilled off, and the residue was dissolved in ether and treated with an excess of ethereal hydrogen chloride to give 10 g. of crude hydrochloride, m.p. 233–236°. Recrystallization from isopropyl alcohol gave 8.2 g. of material, m.p. 238–239°.

Anal. Calcd. for $C_9H_{12}N_2O_2S \cdot HCl$: C, 43.46; H, 5.27; Cl, 14.25; N, 11.26; S, 12.89. Found: C, 43.57; H, 5.25; Cl, 14.00; N, 11.01; S, 13.08.

3,4-Dihydro-2-methyl-4-(1-pyrrolidinyl)-2H-1,2-benzothiazine 1,1-Dioxide Hydrochloride (IVd).—A mixture of 6.3 g. (0.03 mole) of IIIb, 4.26 g. (0.06 mole) of pyrrolidine, and 150 ml. of benzene was placed in a flask equipped with a Dean–Stark water separator and was refluxed for 72 hr. Evaporation of the benzene gave an oil which crystallized on scratching. This was triturated with ether to give 6.2 g. of enamine, m.p. 138–140°; the infrared spectrum showed the absence of a ketone band and the presence of very weak bands at 1590 and 1540 cm.$^{-1}$. Attempts to obtain an analytically pure sample by recrystallization were unsuccessful.

To a solution of 5.75 g. (0.0218 mole) of the enamine in 500 ml. of isopropyl alcohol was added 4.35 ml. (0.0218 mole) of a 47% ethereal solution of boron trifluoride etherate. The reac-

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[8] Sodium hydride was employed as a 53% dispersion in mineral oil, purchased from Metal Hydrides, Inc.

tion mixture was stirred at room temperature for 1 hr., 7.6 g. (0.02 mole) of sodium borohydride was added, and stirring was continued for 72 hr. It was poured into ice–water containing excess hydrochloric acid and the isopropyl alcohol was distilled off. The aqueous solution was washed with dichloromethane, made basic with dilute sodium hydroxide, and extracted with dichloromethane. The residue obtained on evaporation of the dichloromethane was dissolved in ether and excess ethereal hydrogen chloride was added. The crude hydrochloride was dissolved in a 50:50 mixture of 2-butanone and dichloromethane, and the solution was distilled at atmospheric pressure until crystals began to separate. On cooling there was obtained 6.0 g. of product, m.p. 225–228° dec.

Anal. Calcd. for $C_{13}H_{18}N_2O_2S \cdot HCl$: C, 51.56; H, 6.32; Cl, 11.71; N, 9.25; S, 10.59. Found: C, 51.71; H, 6.30; Cl, 11.53; N, 9.30; S, 10.76.

3-Benzylidene-2H-1,2-benzothiazin-4(3H)-one 1,1-Dioxide (Va).—A slurry of 0.044 mole of sodium hydride[8] in 100 ml. of dimethylformamide was cooled to −20° and a solution of 3.94 g. (0.02 mole) of IIIa in 100 ml. of dimethylformamide was added. The mixture was stirred at −20° for 1 hr. and a solution of 4.24 g. (0.04 mole) of benzaldehyde in 50 ml. of dimethylformamide was added. Stirring at −20° was continued for 1.5 hr. and the reaction mixture was poured into ice–water containing excess hydrochloric acid. The resulting yellow precipitate was collected, washed well with water, and dissolved in dichloromethane. The dried solution was evaporated and the residue was triturated with methanol to give 2.0 g. of material, m.p. 219–222° dec., which was shown by mixture melting point, spectra, and thin layer chromatography to be the same as the product of sodium borohydride reduction of Id.[1]

3-[(*p*-Acetamido)benzylidene]-2H-1,2-benzothiazin-4(3H)-one 1,1-Dioxide (Vc).—The reaction was carried out as in the previously described experiment using 0.46 mole of sodium hydride,[8] 33.7 g. (0.14 mole) of IIIa, and 45.7 g. (0.28 mole) of *p*-acetamidobenzaldehyde. The precipitate was collected from the acidified mixture, washed with water, and dried by azeotropic distillation with benzene. The crude solid was triturated with petroleum ether to give 22.4 g. of material, m.p. 255–260° dec. It was dissolved in 225 ml. of 1 *N* sodium hydroxide and the solution was diluted with water to a volume of 2500 ml. Excess 1 *N* hydrochloric acid was slowly added to cause precipitation of 21 g. of crystalline material, m.p. 272–273° dec. (after azeotroping with benzene and drying *in vacuo* at 80° for 3 hr.). This was recrystallized and dried in the same manner to give an analytical sample: m.p. 275-276° dec.; ν_{max} 3370 (m), 1672 (s), 1582 (s), 1570 sh (s), 1536 (s) cm.$^{-1}$; ν_{max}^{DMSO} 3480 (m), 1692 (s), 1672 (sh) (m), 1585 (s), 1520 (s) cm.$^{-1}$[9]; λ_{max}, mμ (ϵ), 265 (15,100), 374 (23,000); λ_{min}, mμ (ϵ), 231 (7600), 308 (3800).

Anal. Calcd. for $C_{17}H_{14}N_2O_4S$: C, 59.64; H, 4.12; N, 8.18; S, 9.37. Found: C, 59.90; H. 4.22; N, 8.35; S, 9.57.

3-(2-Pyridylmethylene)-2H-1,2-benzothiazin-4(3H)-one 1,1-Dioxide (Vd).—The reaction was carried out as in the previous example using 0.022 mole of sodium hydride,[8] 1.97 g. (0.01 mole) of IIIa, and 2.1 g. (0.02 mole) of pyridine-2-carboxaldehyde. The red precipitate was collected from the acidified mixture and dissolved in dichloromethane, and the solution was evaporated. Trituration of the residue with petroleum ether gave 1.7 g. of solid, m.p. 195–198° dec. Recrystallization from ethanol–dichloromethane gave 1.0 g. of material, m.p. 203–204° dec. Recrystallization from the same solvent combination gave an analytical sample: m.p. 204–205° dec.; ν_{max} 3100 (m, broad), 1670 (s), 1633 (s), 1593 (s), 1570 (s) cm.$^{-1}$; λ_{max}, mμ (ϵ), 282 (12,800), 462 (12,400); λ_{min}, mμ (ϵ), 244 (7200), 322 (3600).

Anal. Calcd. for $C_{14}H_{10}N_2O_3S$: C, 58.73; H, 3.52; N, 9.78; S, 11.20. Found: C, 58.55; H, 3.45; N, 9.65; S, 11.10.

4-Acetoxy-2-methyl-2H-1,2-benzothiazine 1,1-Dioxide (VI).—The reaction was carried out as in the previous experiment using 0.005 mole of sodium hydride,[8] 1.05 g. (0.005 mole) of IIIb, and 0.39 g. (0.005 mole) of acetyl chloride. The acidified mixture was extracted with dichloromethane and the bulk of the solvent was removed by distillation *in vacuo*. The dimethylformamide which remained was removed using a rotary flash evaporator, the maximum temperature being 35°. Trituration of the residue with a small amount of ether gave 0.5 g. of crystals, m.p. 112–115°, which showed a single spot on thin layer chromatography. Recrystallization from isopropyl ether gave material: m.p. 120.5–121.5°; ν_{max} 1758 (s), 1639 (m), 1592 (w) cm.$^{-1}$; λ_{max}, mμ (ϵ), 282 (7800), 304 infl. (6200); λ_{min}, mμ (ϵ), 249 (1900).

Anal. Calcd. for $C_{11}H_{11}NSO_4$: C, 52.16; H, 4.38; N, 5.53; S, 12.66. Found: C, 52.26; H, 4.54; N, 5.52; S, 12.42.

Attempted Reaction of 3-Acetyl-2H-1,2-benzothiazin-4(3H)-one 1,1-Dioxide (Ia) with 2-Methoxyethanol.—A mixture of 9.6 g. (0.04 mole) of Ia, 0.5 g. of *p*-toluenesulfonic acid monohydrate, 15.2 g. of 2-methoxyethanol, and 100 ml. of benzene was placed in a flask equipped with a Dean–Stark water separator and was refluxed with vigorous stirring for 120 hr., after which 0.6 ml. of water had separated. On cooling to room temperature there was obtained 3.5 g. of crystalline material, m.p. 157–158°, which was shown from its spectral properties, mixture melting point, and positive ferric chloride test to be unreacted Ia. The filtrate was distilled *in vacuo* to dryness and the residue was triturated with petroleum ether to give 6.0 g. of material, m.p. 149–151°, which was also shown to be unreacted Ia.

Attempted Reaction of 3-Acetyl-2H-1,2-benzothiazin-4(3H-one 1,1-Dioxide (Ia) with Ethanolic Hydrogen Chloride.—A solution of 7.2 g. (0.03 mole) of Ia in 200 ml. of 4.6 *N* ethanolic hydrogen chloride was refluxed for 113 hr. Cooling to room temperature and dilution with an equal volume of water gave 5.2 g. of crystalline material, m.p. 158–159°, which was shown to be unreacted Ia. Removal of the ethanol by distillation *in vacuo* gave 1.2 g. more of Ia, m.p. 157–159°.

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[9] Note that in the mull the absorption of both carbonyls appears to coincide as a single band which is partially resolved in dimethyl sulfoxide solution.