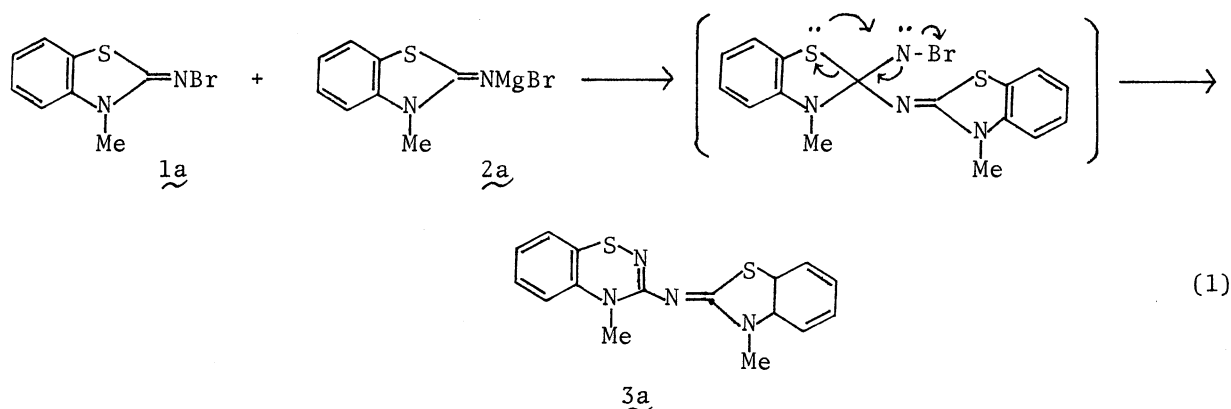


REACTIONS OF N-BROMO DERIVATIVES OF 2-IMINOBENZOTHAZOLINES
WITH THEIR N-GRIGNARD-TYPE REAGENTS

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3-(3'-Methylbenzothiazolinylideneamino)-4-methyl-1,2,4-benzothiadiazine, the ring-enlarged product, was obtained in 67% yield in the reaction of 2-bromoimino-3-methylbenzothiazoline with N-Grignard-type reagent of 2-imino-3-methylbenzothiazoline. On the other hand, bis-[o-(N-phenylcyanamino)phenyl] disulfide was obtained in 65-87% yield in the reaction of 3-substituted 2-bromoiminobenzothiazoline with N-Grignard-type reagent of 2-imino-3-phenylbenzothiazoline which proceeds via the oxidation of the thiolate with the bromide, the former being produced by ring-opening equilibrium of the N-Grignard-type reagent.

In a previous paper, we reported on the reaction of N-nitroso derivatives of 2-iminobenzothiazolines with their N-Grignard-type reagents which gave the corresponding azamethinecyanine hydroxide via diazonium intermediate followed by loss of nitrogen.¹⁾ Now we found that the reaction of N-bromo derivative of 2-imino-3-methylbenzothiazoline (1a) with the corresponding N-Grignard-type reagent (2a) in THF at room temperature under nitrogen afforded the ring-enlarged product, 3-(3'-methylbenzothiazolinylideneamino)-4-methyl-1,2,4-benzothiadiazine (3a, 67%, mp 207.5-208.8 °C), probably via nitrenoid intermediate.



The reaction (1) proceeds through nucleophilic addition of 2a on 2-C of 1a just like the case of N-nitroso compounds and no symmetrical azine was detected.

Then reactions of 1 and 2 were carried out under possible combinations of substituents at 3-N and the results are shown below for the reactions where substituents at 3-N of 2 is a phenyl. For other combinations, complex products were

obtained due to competition of reactions (1) and (2).

A mixture of 3-substituted 2-bromoiminobenzothiazoline (1) and Grignard-type reagent of 2-imino-3-phenylbenzothiazoline (2c) in THF was stirred for 30 min under nitrogen at room temperature. After usual work-up, the reaction mixture was treated with dry column chromatography (SiO_2 , CH_2Cl_2) to afford bis[o-(N-phenylcyanamino)-phenyl] disulfide (4c) and imino compounds (5 and 5c).²⁾ Yields of the products are shown in the Table. In the case of the reaction of 1a or 1b, neither unsymmetrical azine (6) nor unsymmetrical disulfide (7) could be detected.

This result can only be realized by invoking o-(N-phenylcyanamino)benzenethiolate anion (Ac), which should be produced by ring-opening equilibrium of 2c,³⁾ and subsequent oxidation of Ac with 1.

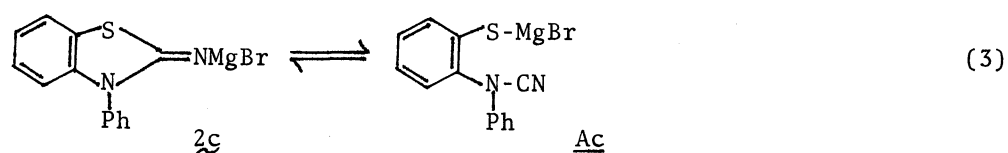
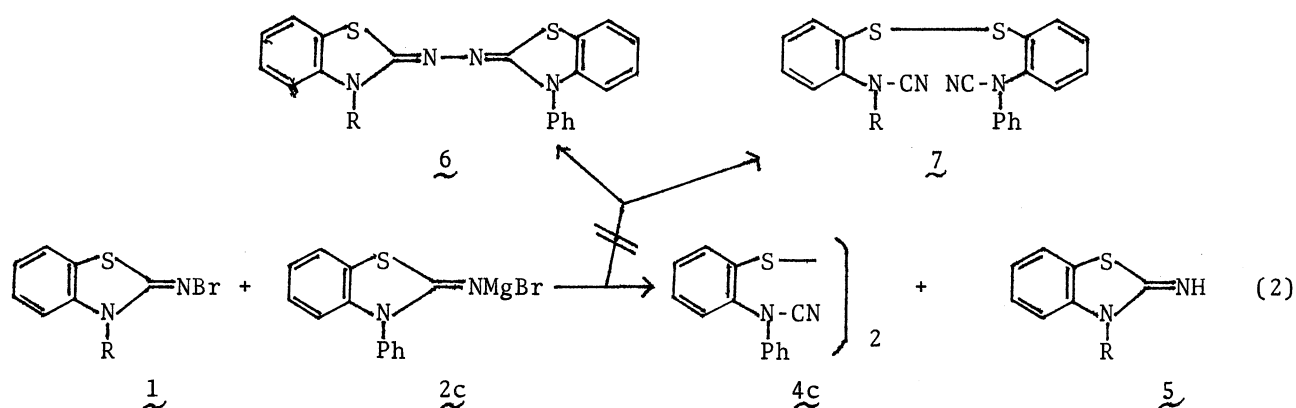
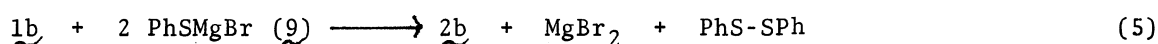
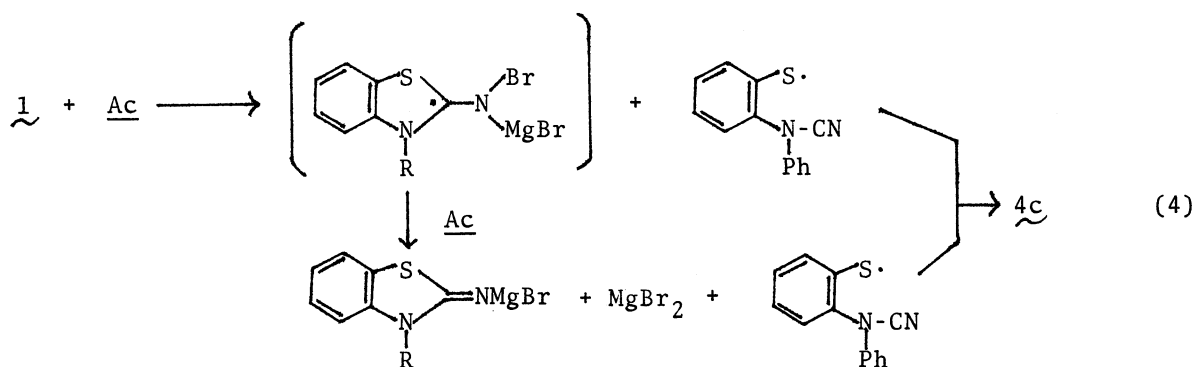


Table Products of Reaction (2)

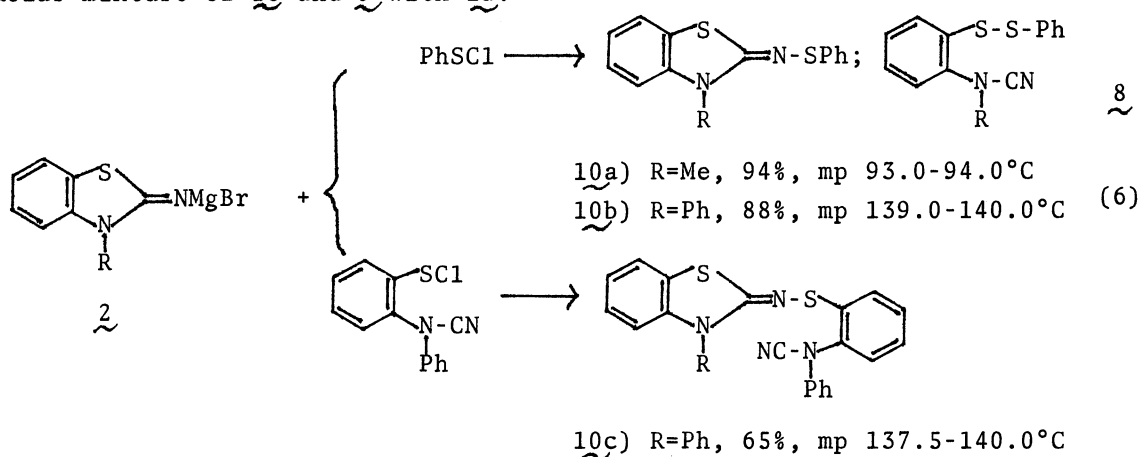
	<u>1</u>	<u>2c</u>	<u>4c</u>		<u>5</u>	<u>5c</u> (recovery)
R	mmol	mmol	mmol	%	mmol	mmol
a) Me	2.0	5.0	1.3	65	1.5	1.4
b) Et	4.0	10.0	2.9	73	3.1	2.5
c) Ph	8.8	15.0	7.7	87	—	3.1

Three possible mechanisms of oxidation of Ac with 1 soon come in mind: i) direct attack on the sulfur of 1 by the thiolate (Ac),⁴⁾ ii) reaction of Ac with the corresponding benzenesulfonyl bromide which may be produced by $\text{MgBr}-\text{Br}$ exchange of Ac with 1, and iii) electron transfer from Ac to 1.

Mechanism iii) was shown to be the most probable one according to the following facts, although there is no direct spectroscopic evidence at present: i.e., a) absence of unsymmetrical disulfide (7), b) quantitative formation of diphenyl disulfide by the reaction of 1b with Grignard-type reagent of benzenethiol (9) [absence of unsymmetrical disulfide (8)],



c) formation of thio-oxime ether (10) by the reaction of 2 with benzenesulfonyl chloride⁵⁾ (absence of 8 shows no contribution of the reaction of A with PhSCl),
 d) formation of almost equal amount of 10a and diphenyl disulfide⁶⁾ in the reaction of benzenesulfonyl chloride with an equimolar mixture of 2a and benzenethiolate (9), each 1.5 times molar to the chloride, showing almost identical reactivity of 2 and 9 toward benzenesulfonyl chloride, and e) sole oxidation of 9 in the reaction of an equimolar mixture of 2c and 9 with 1a.



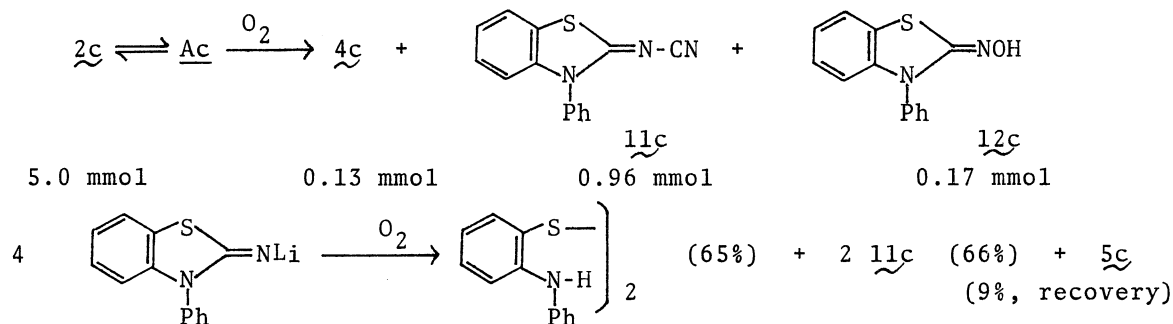
Mechanism i), which seemed quite probable based only on the result of the reaction of 1c with 2c,⁴⁾ can be eliminated based on a) and b), and mechanism ii) can also be ruled out by the facts of c) and d). Mechanism iii) is compatible with these facts, and e) indicates that the equilibrium (3) lies almost to 2c and the reaction (4) is fast compared with the ring-enlargement reaction of 1a with 2c, if any.

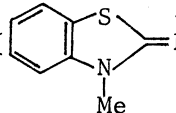
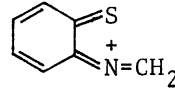
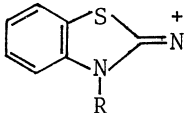
The ring-enlargement of the type of reaction (1) is not known with thiazoline system, although a similar ring-enlargement was reported in the decomposition of the adduct of 1,3-dithiolylium salt with sodium azide.⁷⁾ The ring-opening equilibrium (3) is a rare example among benzothiazole and thiazoline systems,⁸⁾ and the reaction (6) can be used for the preparation of thio-oxime ether of analogous heterocycles. Utility of 1 as a mild oxidizing agent will be of interest and research on this subject is in progress.

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References and Notes

- 1) K. Akiba, K. Ishikawa, and N. Inamoto, *Heterocycles*, **2**, 555 (1974).
- 2) For characterization of 4 and 5, see: K. Akiba, I. Fukawa, N. Nomura, and N. Inamoto, *Bull. Chem. Soc. Jpn.*, **45**, 1867 (1972).
- 3) Air oxidation of N-Grignard-type and N-lithio compound of 5c at room temperature gave the following results which support the equilibrium (3):



- 4) D. E. L. Carrington, K. Clarke, and R. M. Scrowston, *J. Chem. Soc. (C)*, **1971**, 3262.
- 5) W. H. Mueller and P. E. Butler, *J. Am. Chem. Soc.*, **90**, 2075 (1968).
- 6) Excess benzenethiolate is oxidized to diphenyl disulfide by air during work-up.
- 7) E. Fanghänel, *J. Prakt. Chem.*, **318**, 127 (1976).
- 8) G. Bartoli, M. Fiorentino, F. Ciminale, and P. E. Todesco, *Chem. Commun.*, **1974**, 732.
- 9) 1 was prepared from 5 or its hydrobromide and bromine in the presence of sodium hydroxide in methanol: 1a, mp 136-138; 1b, mp 133.5-135.0, and 1c: mp 140.5-141.8°C. 11c (mp 190.0-191.2°C) was prepared from 5c and cyanogen bromide. 12c was prepared from 2-methylthio-3-phenylbenzothiazolium iodide and hydroxylamine, mp 213.0-214.5°C.
- 10) 3, 10, 11, and 12 showed correct elemental analyses.
3; NMR (CDCl₃): δ 3.40 (s, 3H), 3.74 (s, 3H), and 6.5-7.8 (m, 8H);
 MS: 326 (M⁺, 33%), 190 (, 22), and 136 (, 100).
10 shows a strong absorption at 1550-1560 cm⁻¹ (KBr, νC=N), and M⁺(100%) and the strong peak of  in MS.

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