kenes has been developed. Work in this area is continuing.

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Supplementary Material Available: Representative experimental procedures for the preparation of and spectral data for compounds **6**, **9a**, **10a**, **10c**, **12d**, **12e**, **14a**, **14b**, and **16b** (6 pages). Ordering information is given on any current masthead page.

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Intramolecular Cyclization via Onium Salts. A Novel Synthesis of 1,3-Thiazolidines from Chloromethyl (Trimethylsilyl)methyl Sulfide and Nitrogen-Containing Heteroaromatic Compounds

Summary: Polycyclic 1,3-thiazolidines were prepared by the fluoride ion promoted desilylation, followed by intramolecular 1,5-cyclization, of onium salts derived from the sulfide 1 and a variety of heteroaromatics.

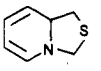
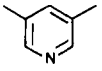
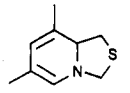
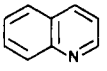
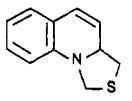
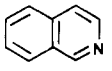
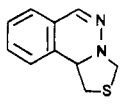
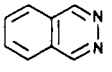
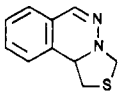
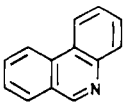
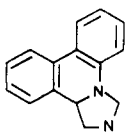
Sir: In the course of our studies on the use of organosilicon compounds to obtain nonstabilized 1,3-dipolar reagents, we have found a new type of desilylation which leads to fused ring 1,3-thiazolidines. In this process, reaction of chloromethyl (trimethylsilyl)methyl sulfide (**1**)[1b] with nitrogen heterocycles (e.g., **2**) including pyridine, quinoline, isoquinoline, phthalazine, and phenathridine gives the isolable onium salts, e.g., **3**. Treatment of these salts with cesium fluoride in acetonitrile at room temperature gave fused polycyclic 1,3-thiazolidines **4** in quite high yields (Scheme I). The results are listed in Table I.

The synthesis of **4** can be conveniently attained without isolation of the onium salts by a one-pot operation starting from a mixture of **1**, heterocycles **2**, and cesium fluoride in acetonitrile at room temperature. Formation of the intermediate onium salts **3** is not confirmed in this case; However, reactions of **1** with heteroaromatics as the heterodipolarophile are presumably stepwise, contrary to reactions of **1** with activated alkenes and alkynes, which give tetrahydro- and dihydrothiophenes.[1b,3]

The present method provides a new type of 1,5-dipolar cyclization reaction which is accompanied by the fluoride ion promoted desilylation[4,5] and is formally a [3 + 2] cycloaddition between the carbon–nitrogen double bond and thiocarbonyl ylide. In this sense, it is the first example of the introduction of the thiocarbonyl ylide synthon to heteroaromatic compounds.

In a typical procedure a mixture of the sulfide **1** (1.2 mmol) and the nitrogen-containing heteroaromatic compound **2** (1.0 mmol) was heated at 60 °C for 1 h and the resulting salt **3** was washed with dry acetone. Dried cesium fluoride (1.0 mmol) and acetonitrile (5 mL) were added and the mixture was stirred at room temperature for the time indicated in Table I. After the addition of water (5 mL) and diethyl ether (30 mL), usual workup and prepa-

Table I. Synthesis of 1,3-Thiazolidines 4[a]

entry	2	% yield[b] of 3	reactn time, h[c]	4	% yield[d] of 4
1	 **3a**	94	25	 **4a**	96
2	 **3b**	91	70	 **4b**	91
3	 **3c**	98	45	 **4c**	95
4	 **3d**	98	48	 **4d**	91
5	 **3e**	96	48	 **4e**	92
6	 **3f**	75	234	 **4f**	43

[a] The synthesis of the salts **3** was conducted at 60 °C for 1 h. All reactions of **3** with cesium fluoride were carried out in acetonitrile at room temperature. [b] Isolated yield. Not optimized. [c] Reaction time for cyclization. [d] Isolated yield by TLC. Not optimized. All products showed satisfactory spectral data.

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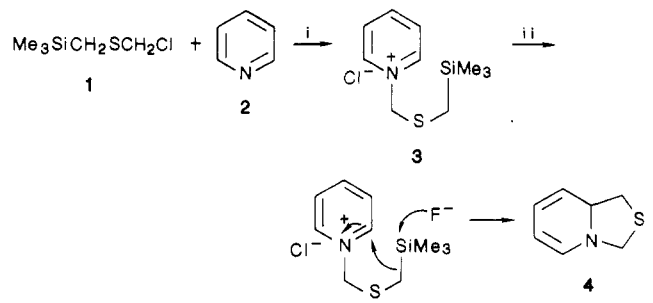
Scheme I[a,3]



[a] Reagents: i, 60 °C, 1 h; ii, CsF, CH_3CN, room temperature.

rative thin layer chromatography on silica gel gave the pure 1,3-thiazolidine (**4**).

Acknowledgment. We thank Torey Silicone Co., Ltd., for a gift of chlorotrimethylsilane. The work was supported in part by the Ministry of Education, Science and Culture (Grants-in-Aid for Scientific Research), the Research Foundation for Pharmaceutical Sciences, the Houan-sha, the Takeda Science Foundation, the Yamada Science Foundation, and the Mitsubishi Foundation.

Supplementary Material Available: Experimental and ^1H NMR, IR, UV, and MS spectral data of **1**, **3**, and **4** (5 pages). Ordering information is given on any current masthead page.

(1) (a) Hosomi, A.; Sakata, Y.; Sakurai, H. *Chem. Lett.* **1984**, 1117. (b) Hosomi, A.; Matsuyama, Y.; Sakurai, H. *J. Chem. Soc., Chem. Commun.* **1986**, 1073.

(2) For simplicity, the substituents on the heteroaromatic ring including benzo-fused derivatives are omitted.

(3) Although an equilibrium between **3** and **1** + **2** and a [3 + 2] cycloaddition of the parent thiocarbonyl ylide derived from **1** and CsF with heteroaromatics may be possible as the actual mechanism, an experiment using **3** and CsF in the presence of excess methyl acrylate did not give any trace of 3-(methoxycarbonyl)tetrahydrothiophene which was expectedly formed by the cycloaddition, if thiocarbonyl ylide was present in this reaction media.[2b] This strongly suggests that the reaction proceeds via the direct desilylation of **3** followed by the intramolecular cyclization.

(4) For the nonstabilized 1,3-dipolar reagents by the desilylation method, see: (a) Aono, M.; Hyodo, C.; Terao, Y.; Achiwa, K. *Tetrahedron Lett.* **1986**, *27*, 4039. (b) Imai, N.; Tokiwa, H.; Aono, M.; Terao, Y.; Akahori, Y.; Achiwa, K. *Heterocycles* **1986**, *24*, 2423. (c) Terao, Y.; Tanaka, N.; Imai, N.; Achiwa, K. *Tetrahedron Lett.* **1985**, *26*, 3011. (d) Tsuge, O.; Kanemasa, S.; Hatada, A.; Matsuda, K. *Chem. Lett.* **1984**, 801. (e) Padwa, A.; Chen, Y.-Y. *Tetrahedron Lett.* **1983**, *24*, 3447. (f) Turro, N. J.; Cha, Y.; Gould, I. R.; Padwa, A.; Gasdaska, J. R.; Tomas, M. *J. Org. Chem.* **1985**, *50*, 4415. (g) Padwa, A.; Dent, W. *J. Org. Chem.* **1987**, *52*, 235. (h) Vedejs, E.; West, F. G. *Chem. Rev.* **1986**, *86*, 941 and references cited therein.

(5) Although α-silyl-substituted onium salts have been readily desilylated by fluoride ion to give the corresponding ylide, the desilylation at the remote site such as **3** is unprecedented.[4h]

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On the Remarkable Stability of Derivatives of Leucomitomycin F. Novel Mitomycin Analogues

Summary: The leuco form of mitomycin F reacts with silica gel in the presence of oxygen to afford 9-epimitomycin B. A notable stability is manifested by hydroquinoid forms (leucomitomycin) bearing a 9,10-exocyclic methylene group.

Sir: Recently, leucomitomycins and leucoaziridinomitosenes have been characterized for the first time.[1,2] Access to these labile systems has allowed us to probe, in a more critical way than had heretofore been possible, the nature of the reductive activation of mitomycins and the chemical characteristics of activation cascade intermediates. Recent results[2] have suggested a key role for the mitomycin semiquinone **1** in the critical ejection of the C_{9a} heterofunction en route to leucoaziridinomitosenes, aziridinomitosenes, and apomitosenes. In our past studies, the intermediate oxidation state was reached by one-electron reduction of the quinone.[2] In the chemistry described below a species such as **1** is approached by one-electron oxidation of a leucomitomycin. We also provide evidence for the remarkable inherent stability of leucomitomycin derivatives bearing an exocyclic (9,10-) methylene group.

Reduction (H_2–Pd/C–pyridine) of mitomycin F (**2**),[3] followed by filtration of the catalyst under strictly anaerobic conditions, generated a solution of leuco compound **3** (Scheme I). After removal of the solvent in vacuo, a solution of **3** in triethylamine/chloroform or diisopropylamine/chloroform was administered to a silica gel prep plate in the presence of oxygen (air). Elution and isolation of the products yielded aziridinomitosene **4** (40–50%), starting mitomycin **2** (30–40%), and a new blue-purple material in 20–30% yield. That this compound was, in fact, 9-epimitomycin B (**5**) was rigorously established by an X-ray crystallographic determination (see ORTEP drawing,[4] Scheme II).

Activation of mitomycins usually leads to ejection of the C_{9a} heterofunction accompanied by loss of the C_9 proton, the result being the formation of mitosene compounds. In the formation of 9-epimitomycin B, these processes have been uncoupled from each other.[5] Control experiments were performed in order to assess the parameters of the reaction. The stability of a solution of leucomitomycin **3** and triethylamine in degassed $CDCl_3$ was determined by high-field NMR analysis. No decomposition of the leucomitomycin was evident. We were thus confident that ejection of the angular substituent was not occuring before the solution was exposed to silica gel and air. In another control experiment, access to oxygen was minimized during exposure to the silica gel.[6] The course of this reaction was very different. The bulk of the material was converted to intractable material, and only traces of **6** and disproportionation product **7** were obtained. No aziridinomitosene **3**, starting mitomycin **2**, or epimitomycin B **5** were formed. Furthermore, the starting mitomycin **2** is not converted to **5** via silica gel chromatography. *We conclude that the active species undergoing conversion of C_{9a} methoxy to C_{9a} hydroxy is intermediate in oxidation level between **3** and **2** (cf. semiquinone **1**).*

With the C_{9a} hydroxy compounds now available, it was of interest to determine whether 9-epimitomycin B (**5**)

(1) Danishefsky, S.; Ciufolini, M. *J. Am. Chem. Soc.* **1984**, *106*, 6424.

(2) Danishefsky, S. J.; Egbertson, M. *J. Am. Chem. Soc.* **1986**, *108*, 4648.

(3) Mitomycin F (*N*-methylmitomycin A) was prepared from mitomycin C by the method of Remers: Cheng, L.; Remers, W. A. *J. Med. Chem.* **1977**, *20*, 767.

(4) A summary of the X-ray analysis including fractional coordinates, temperature factors, bond distances, torsional angles, and anisotropic temperature factors is provided in the supplementary material.

(5) For a previous example of such a decoupling, see: Hornemann, U.; Ho, Y.; Mackey, J. K., Jr.; Srivastava, S. C. *J. Am. Chem. Soc.* **1976**, *98*, 7069. It is not improbable that the apparent displacement is occuring during the reoxidation process.

(6) The silica gel plates were placed in a glovebag filled with nitrogen and preeluted in degassed solvent. They were then allowed to dry while still in the glovebag. The leuco compound was applied to the plates and then eluted with the same degassed solvent.

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