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REARRANGEMENTS OF CYCLIC SULFILIMINES[1)]

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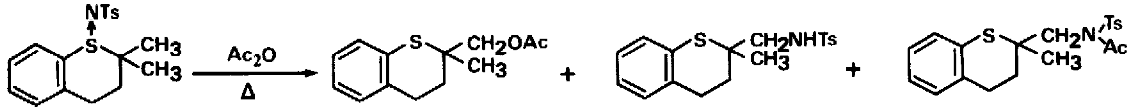
Much attention has been given to the rearrangement of sulfoxides,[2)] especially to that of penicillin 1-oxide into cephalosporins.[3)] On the other hand, investigations on cyclic sulfilimines are little known.[4)] We now wish to report a novel rearrangement of cyclic sulfilimines.

Treatment of 2-methyl substituted-1-(p-toluenesulfonylimino)thiochromans **1**-**2** with acetic anhydride gives 1,3-abnormal Pummerer-type rearrangement products, inter- and intramolecularly. These reactions are quite different from the reaction of the corresponding sulfoxide with acetic anhydride, since the sulfoxide gives the normal Pummerer-type rearrangement product.[5)]

In a previous communication,[4-d)] *we have reported the thermolysis of* **1** *as a* 1,3-abnormal Pummerer-type reaction of sulfilimines. In the case of the cyclic sulfoxides, Morin et al.[5)] found that the reaction of a sulfoxide, having at least one proton at α-position, with acetic anhydride gave the product of a normal Pummerer-type rearrangement which decomposed to olefinic products in the course of the reaction. Although the Pummerer-type reaction of acyclic sulfilimines has been studied,[6)] that of the cyclic analogs has been investigated very little.

Compounds, not only having β-hydrogen such as **1**, but also having an α-hydrogen such as **2** by reaction with acetic anhydride afforded 2-acetoxymethylthiochroman derivatives, 1,3-abnormal Pummerer-type rearrangement product.

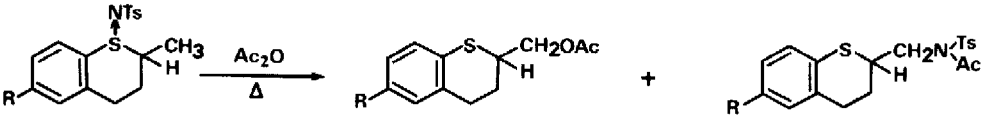
Specifically, compound **1**, when treated with refluxed acetic anhydride for 30 minutes, gave 2-acetoxymethyl-2-methylthiochroman **3**, 2-methyl-2-(p-toluenesulfonylaminomethyl)thiochroman **4** and 2-(N-acetyl-N-p-toluenesulfonylaminomethyl)-2-methylthiochroman **5**, in the yields of 41%, 10% and 28%, respectively.



1 **3** 41% **4** 10% **5** 28%

The Products obtained reveal that this reaction proceeds along an intramolecular path together with an intermolecular path which is believed to be predominant in the case of the Pummerer reaction of sulfoxides.2)

In the presence of sodium acetate, the reaction of **1** with refluxed acetic anhydride for 30 minutes gave **3** and **5** in the yields of 72% and 3%, respectively. Treatment of **1** with refluxed acetic acid for 30 minutes afforded only **3** in an 87% yield. The reaction of 2_{a-d} with refluxed acetic anhydride containing small amounts of sodium acetate for 30 minutes gave the 2-acetoxymethylthiochroman derivatives 6_{a-d} and the 2-(N-acetyl-N-p-toluenesulfonylaminomethyl)thiochroman derivatives 7_{a-d} 7) instead of the 2-methyl-4H-thiochromen derivatives formed by the reaction of 2-methylthiochroman-1-oxide derivatives with acetic anhydride.5) In spite of the presence of the α-hydrogens, the initial stage of the reaction seems to be the β-hydrogen abstraction. This is quite different from the case of the corresponding sulfoxide.

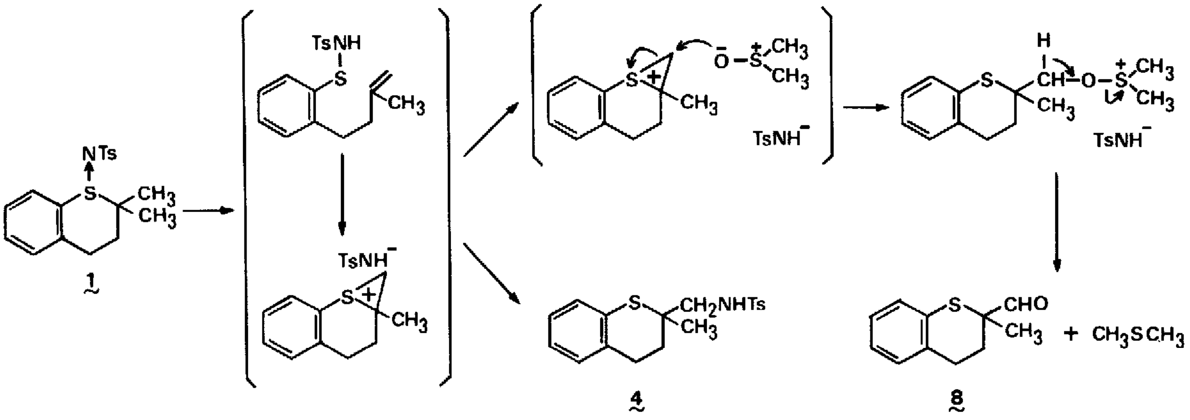


2a,	R : H	**6a**,	90 %	**7a**,	9 %
b,	R : CH_3	**b**,	90 %	**b**,	trace
c,	R : CH_3O	**c**,	90 %	**c**,	trace
d,	R : Cl	**d**,	73 %	**d**,	trace

Thermolysis of cyclic sulfoxides does not take place under these conditions[8)] except for that of strained sulfoxides such as penicillin 1-oxides.[3)] Actually, when the corresponding sulfoxide of 1 or 2 was refluxed in xylene for 2 hours, only starting materials were recovered. It is, therefore, suggested that in the reaction of cyclic sulfoxides with acetic anhydride, the oxygen of the sulfoxides is acetylated initially, followed by α-hydrogen abstraction to give the sulfoxonium ylide as an intermediate which is stabilized with (p-d)π conjugation.[9)]

In the case of cyclic sulfilimines, however, β-hydrogen abstraction involving the five membered transition state seems to predominant over the acetylation of nitrogen of the sulfilimines. This suggests that the products 3-7, may be formed through the episulfonium ion.

Also, we examined the reaction of 1 with sulfoxides to probe for the presence of the episulfonium ion. If we assume that the reaction of 1 with sulfoxides proceeds by the nucleophilic attack of sulfoxides on the carbon of the episulfonium ion, a Kornblum-like reaction[10)] should take place to give the corresponding aldehyde. Actually, a Kornblum-like reaction was found to take place in the reaction of 1 with sulfoxides, producing 8 in addition to 4. The structural assignment of 8 is based on spectral data.[11)] A further chemical transformation of 8 to the 2,4-dinitrophenylhydrazone was done for the purpose of elemental analysis.[12)] A possible mechanism for this reaction is illustrated below.



The proposed nucleophilic attack of sulfoxides appears to be most reasonable only when the β-carbon of the sulfilimine possesses a good leaving group like sulfonium ion.

Table I. Reaction Conditions and Products of the Reaction of **1** with Sulfoxides

Sulfoxides	Solvents	Temp °C	Time hr	Products and Yields(%) Sulfides	**8**	**4**
CH_3SOCH_3		100	1	Volatile	30	35
$C_6H_5SOCH_3$	CH_3CN	reflux	3	9	12	65
$C_6H_5SOC_6H_5$	CH_3CN	reflux	3	-	-	67

References and Notes

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(11) IR, ν_{max}, 1725 cm^{-1}; ^1H-NMR (CCl_4), δ, 1.41(3H,s), 1.82-2.16(2H,m), 2.66-2.70(2H,m), 6.87-7.15(4H,m), 9.17(1H,m); Mass m/e (M^+), 192.

(12) Mp 133-134°C. Found C, 54.83; H, 4.33; N, 15.05, Calcd. for $C_{17}H_{16}N_4O_4S$; C, 54.85; H, 4.35; N, 14.82.