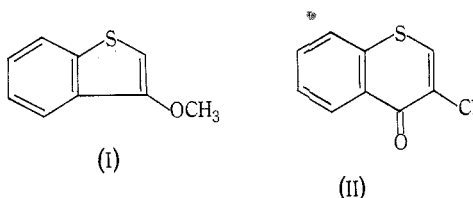


# THE REACTION OF 3-METHOXYBENZO[*b*]THIOPHEN WITH DICHLOROCARBENE. A NEW SYNTHESIS OF THE THIOCHROMONE RING SYSTEM\*

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The reaction of dichlorocarbene with cycloalkenes and certain aromatic molecules has been used to bring about ring expansions in a variety of cases.<sup>1,2</sup> 3-Methoxybenzo[*b*]thiophen (I) is now shown to react with this carbene to give a fair yield of 3-chlorothiochromone (II). This ring expansion is analogous to that described by Parham and co-workers<sup>3</sup> as occurring on reaction of 1-methoxynaphthalene and dichlorocarbene, and provides a convenient synthesis of the thiochromone ring system.



Attempts to prepare 2-methoxybenzo[*b*]thiophen in order to let it react with dichlorocarbene were unsuccessful. Reaction of 2-hydroxybenzo[*b*]thiophen with dimethyl sulphate and alkali gave *o*-methylmercaptophenylacetic acid. This ring-opening is analogous to the base-catalysed conversion of 2-hydroxybenzo[*b*]thiophen to *o*-mercaptophenylacetic acid.<sup>4</sup> Ethereal diazomethane and the 2-hydroxy compound gave an adduct  $C_9H_8N_2OS$  which did not decompose to 2-methoxybenzo[*b*]thiophen on heating. The n.m.r. spectrum of this compound shows a multiplet of four protons at  $\tau$  2.2–2.8, and two singlets each of two protons at  $\tau$  6.47 and 6.53.

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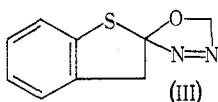
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<sup>1</sup> Kirmse, W., "Carbene Chemistry," p. 169 *et seq.* (Academic Press: New York 1964.)

<sup>2</sup> Hine, J., "Divalent Carbon," p. 56 *et seq.* (Ronald Press: New York 1964.)

<sup>3</sup> Parham, W. E., Bolon, D. A., and Schweizer, E. E., *J. Am. chem. Soc.*, 1961, **83**, 603.

<sup>4</sup> Brower, K. R., and Amstutz, E. D., *J. org. Chem.*, 1954, **19**, 411.



This suggests that the compound may be the spiro-oxadiazole (III), resulting from a 1,3-addition of diazomethane to the keto form of the hydroxybenzothiophen. The lack of geminal coupling between the protons of the methylene groups, which are non-equivalent, is perhaps a little surprising. The structure of the adduct has not been further investigated.

In agreement with the observations of Parham *et al.*,<sup>5</sup> no reaction occurred between benzo[b]thiophen and dichlorocarbene, nor did the carbene react with thiophen. This non-reactivity is in contrast to the observed addition of dichlorocarbene to benzofuran,<sup>5</sup> pyrrole,<sup>6,7</sup> and certain indoles,<sup>8,9</sup> and reflects the lower reactivity of the sulphur heterocycles towards this intermediate.

### Experimental

Microanalyses were carried out by the Australian Microanalytical Service under the direction of Dr K. W. Zimmermann; ultraviolet spectra were measured using a Shimadzu QR50 spectrophotometer. Mass spectra were recorded using an A.E.I. MS9 mass spectrometer. Nuclear magnetic resonance spectra were determined using a Varian HR60 instrument. Melting points are uncorrected.

3-Methoxybenzo[b]thiophen was prepared by the dimethyl sulphate methylation of 3-hydroxybenzo[b]thiophen.<sup>10</sup>

### Ring Expansion

A mixture of 3-methoxybenzo[b]thiophen (32.8 g) and alcohol-free sodium methoxide (10.9 g) in anhydrous ether (200 ml) was cooled with stirring to  $-10^{\circ}$ , and ethyl trichloroacetate (32.3 g) was added in one portion. Stirring at  $-10^{\circ}$  was continued for 2 hr, then water (200 ml) was added and the ethereal layer was separated, washed, and dried ( $\text{MgSO}_4$ ), and the volatile components were distilled. The residue (b.p.  $100^{\circ}/0.2$  mm) was chromatographed on alumina. Elution with light petroleum gave unchanged methoxybenzothiophen, then elution with benzene and light petroleum (1:3) gave 3-chlorothiochromone (3.2 g), needles from benzene/light petroleum m.p.  $149^{\circ}$  (Found C, 55.6; H, 3.0; Cl, 18.3.  $\text{C}_9\text{H}_5\text{ClOS}$  requires C, 55.3; H, 3.0; Cl, 18.1%).  $\lambda_{\text{max}}$  (ethanol) 216, 226, 250sh, 254, 282, 292, 347 m $\mu$  ( $\log \epsilon$  3.96, 4.05, 4.21, 4.22, 3.53, 3.49, 3.96).

The structure of the thiochromone was confirmed by the virtual identity of its ultraviolet spectrum with that of 3-bromothiochromone, synthesized by classical methods as described by Arndt.<sup>11</sup>

No reaction occurred between either thiophen or benzo[b]thiophen and dichlorocarbene generated as described above.

### Attempted Syntheses of 2-Methoxybenzo[b]thiophen

2-Hydroxybenzo[b]thiophen was prepared by the acid-catalysed hydrolysis of 2-piperidylbenzo[b]thiophen.<sup>4</sup> Treatment of the hydroxy compound in alkaline solution with dimethyl sulphate gave *o*-methylmercaptophenylacetic acid, m.p.  $127^{\circ}$  (lit.<sup>12</sup> m.p.  $128^{\circ}$ ).

<sup>5</sup> Parham, W. E., Fritz, C. G., Loeder, R. W., and Dodson, R. M., *J. org. Chem.*, 1963, **28**, 577.

<sup>6</sup> Ciamician, G., and Dennstedt, M., *Ber. dt. chem. Ges.*, 1881, **14**, 1153; 1882, **15**, 1172.

<sup>7</sup> Alexander, E. R., Herrick, A. B., and Roder, T. M., *J. Am. chem. Soc.*, 1950, **72**, 2760.

<sup>8</sup> Robinson, B., *Tetrahedron Lett.*, 1962, 139.

<sup>9</sup> Rees, C. W., and Smithen, C. E., *Chem. Ind.*, 1962, 1022.

<sup>10</sup> Friedlander, P., *Liebigs Ann.*, 1907, **351**, 390.

<sup>11</sup> Arndt, F., *Ber. dt. chem. Ges.*, 1925, **58**, 1612.

<sup>12</sup> Komppa, G., and Weckmann, S., *J. prakt. Chem.*, 1933, **138**, 109.

A solution of the hydroxybenzothiophen in dry ether containing an excess of diazomethane was kept at 0° for 2 hr. Concentration of the solution gave yellow needles of an *adduct*, m.p. 152–153° (Found C, 56.0; H, 4.5; N, 14.2; mol. wt. (mass spectrometry), 192.  $C_8H_8N_2OS$  requires C, 56.3; H, 4.2; N, 14.6%; mol. wt., 192.). The adduct does not react with ketone, nor does it decompose at its melting point.  $\lambda_{\max}$  (ethanol) 220, 250, 280sh, 290, 342, 382 m $\mu$  (log  $\epsilon$  4.70, 4.85, 4.23, 4.17, 3.78, 3.81).

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