# Studies Related to Dihydro-1,4-thiazines. Part VII.[1] Reaction of Methyl (4*S*,6*S*)-5,5,9,9-Tetramethyl-7-oxo-8-oxa-4-thia-1-azabicyclo-[4.3.0]non-2-ene-3-carboxylate 4-Oxide with Acetyl Chloride [2]

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The title compound (1) is converted into methyl (6*RS*)-6-hydroxy-5,5,9,9-tetramethyl-7-oxo-8-oxa-4-thia-1-azabicyclo[4.3.0]non-2-ene-3-carboxylate (4) by acetyl chloride under nitrogen. In the presence of oxygen it is transformed by the reagent into the racemic 6-hydroxy-analogue (2) which reacts further to give methyl 2-chloro-2-[1-methyl-1-(2,2-dimethyl-5-oxo-$\Delta^3$-oxazolin-4-yl)ethylthio]-3-oxopropionate (14).

Treatment of the oxopropionate (14) with triphenylphosphine followed by diazomethane yields methyl 3-methoxy-2-[1-methyl-1-(2,2-dimethyl-5-oxo-$\Delta^3$-oxazolin-4-yl)ethylthio]acrylate (17). Compound (14) undergoes a silica gel- or triethylamine-induced deformylation to give methyl α-chloro-α-[1-methyl-1-(2,2-dimethyl-5-oxo-$\Delta^3$-oxazolin-4-yl)ethylthio]acetate (8). The chlorine atom of compound (8) is replaced by an acetoxy-group with silver(I) perchlorate in acetic acid, by a methoxy-group with either silver(I) perchlorate or sodium methoxide in methanol, and by a hydrogen atom with zinc in acetic acid to give derivatives (9)—(11), respectively. Pyrolysis of the sulphoxide (15), obtained by oxidation of the acetate (11) with *m*-chloroperbenzoic acid, affords 4-isopropenyl-2,2-dimethyl-$\Delta^3$-oxazolin-5-one (16).

RECENTLY we have shown that the thiazine *S*-oxide (1) undergoes racemisation in solution at room temperature.[1,3] In the hope of reducing the derivative to the thiazine (3) to assess its optical purity, a sample {$[\alpha]_D$ −44° ($CHCl_3$)} was treated under nitrogen with acetyl chloride–sodium dithionite (3 mol. equiv. of each) in acetonitrile.[4] The product, however, which was also obtained when sodium dithionite was omitted from the reaction, was the hydroxythiazine (4).[3]

The foregoing reaction presumably involves the intermediacy of the sulphenic anhydride (5), formed from the acetoxysulphonium salt (6) by a β-elimination process. The ethoxysulphonium salt (7) undergoes an analogous reaction in the presence of sodium hydroxide.[3]

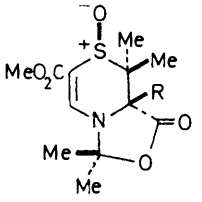
[1] Part VI, R. J. Stoodley and R. B. Wilkins, *J.C.S. Perkin I*, 1974, 1572.

[2] Preliminary communication, R. J. Stoodley and R. B. Wilkins, *J.C.S. Chem. Comm.*, 1974, 796.

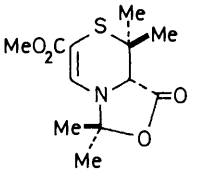
[3] A. G. W. Baxter, J. Kitchin, R. J. Stoodley, and R. B. Wilkins, *J.C.S. Chem. Comm.*, 1973, 285.

[4] G. V. Kaiser, R. D. G. Cooper, R. E. Koehler, C. F. Murphy, J. A. Webber, I. G. Wright, and E. M. Van Heyningen, *J. Org. Chem.*, 1970, **35**, 2430.

When the thiazine *S*-oxide (1) was treated with 2 mol. equiv. of acetyl chloride in acetonitrile in an open flask, the product contained various amounts of two new compounds in addition to the hydroxythiazine (4). The



(1) R=H
(2) R=OH



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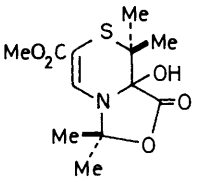

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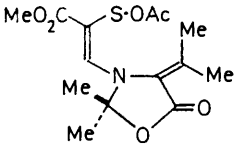

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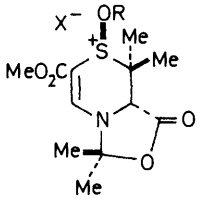


(6) R=Ac, X=Cl
(7) R=Et, X=$BF_4$

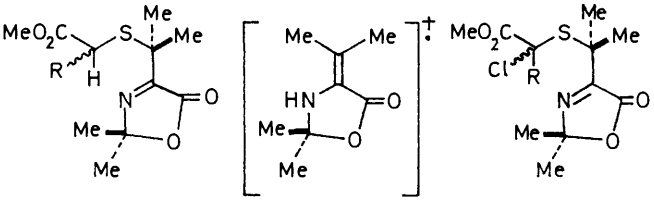
less polar of these new derivatives was observed as a white spot on t.l.c. (iodine vapour) whereas the more polar derivative was stained in the usual manner. When the mixture was subjected to silica-gel chromatography, the latter material was obtained in crystalline form. However, the former material was not recovered from the column; in its place was isolated a component of higher chromatographic mobility which also was observed as a white spot on t.l.c.

Elemental analysis and mass spectroscopy indicated that the crystalline material, which was optically inactive, was derived from the thiazine *S*-oxide (1) by the addition of one oxygen atom. Its i.r. and u.v. spectra were similar to those of the starting material as was its n.m.r. spectrum, which showed signals for two *gem*-dimethyl groups, a methoxycarbonyl group, and a vinylic proton; however, the signal corresponding to the 6-hydrogen atom of the starting material [$\tau$ 5·69 ($CDCl_3$)] was absent and there was a sharp singlet, removed by addition of deuterium oxide, at $\tau$ 1·91 ($CDCl_3$). On this evidence the material is considered to be an *S*-oxide of the hydroxythiazine (4). The dramatic down-field shift of its hydroxy-proton signal, compared with that of the hydroxythiazine (4) [$\tau$ 6·87 ($CDCl_3$)], suggested that the proton was hydrogen-bonded to the sulphinyl oxygen atom. Since the chemical shift of the hydroxy-proton was insensitive to the concentration of the solution (0·03—0·2M), intramolecular hydrogen bonding is indicated. In consequence, the oxide is presumably the racemate of the hydroxythiazine *S*-oxide (2).

In order to confirm the structure (2), the racemic hydroxythiazine (4) was treated with *m*-chloroperbenzoic acid. The derived sulphoxide was identical with the material isolated from the reaction of the thiazine *S*-oxide (1) with acetyl chloride. The overwhelming preference for the formation of the axial sulphoxide is in common with previous results observed for methyl 8-oxa-4-thia-1-azabicyclo[4.3.0]non-2-ene-3-carboxylates.[1,5] It is ascribed to a more demanding steric effect at the transition state for equatorial attack, caused by the developing $A^{1,2}$ interaction[6] between the oxidant and the methoxycarbonyl group.

Mass spectroscopy established that the fast-moving material, which was recovered from the silica-gel column as an optically inactive syrup, possessed the molecular formula $C_{11}H_{16}ClNO_4S$. The substance showed no significant absorption in the u.v. region and i.r. spectroscopy suggested that it contained a $\gamma$-lactone-like carbonyl group, a saturated ester, and an imino-group. The presence of two *gem*-dimethyl groups, a methoxycarbonyl group, and an uncoupled proton [$\tau$ 4·79 ($CDCl_3$)] shown by the n.m.r. spectrum accounted for the hydrogen content of the molecule. On this evidence the derivative is considered to be the chloroacetate (8).

The presence of an activated chlorine atom in substance (8) was corroborated by its reaction with silver(I) perchlorate in acetic acid and in methanol which yielded the acetoxyacetate (9) and the methoxyacetate (10), respectively. Compound (10) was also obtained from the reaction of the chloroacetate (8) with methanolic sodium methoxide. This result indicates that the 2,2-dimethyl-$\Delta^3$-oxazolin-5-one ring is reasonably stable



(8) R=Cl
(9) R=AcO
(10) R=MeO
(11) R=H

(12)

(13) R=D
(14) R=CHO

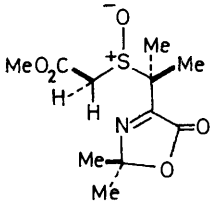
to alkali; by contrast, the oxazolidin-5-one ring of derivative (4) is very susceptible to cleavage by methanolic sodium methoxide.[3] Treatment of the chloroacetate (8) with zinc in acetic acid afforded the acetate (11). The methylene group of the latter compound absorbed at $\tau$ 6·79 ($CDCl_3$) in the n.m.r. spectrum [*cf.* $\tau$ 6·84 ($CDCl_3$) for that of methyl $\alpha$-methylthioacetate], substantiating that it was flanked by a thiol function and a methoxycarbonyl group.

The mass spectra of the derivatives (8)—(11) showed base peaks at *m/e* 155 and prominent peaks at 140 and 110. A mass measurement verified that the base peak corresponded to an ion with the molecular formula $C_8H_{13}NO_2$, in accord with structure (12). The peak at *m/e* 140, which was linked with the base peak by a metastable ion (*m/e* 126·5), corresponded to the loss of a methyl group from species (12). A mass measurement

[5] J. Kitchin and R. J. Stoodley, *Tetrahedron*, 1973, **29**, 3023.
[6] F. Johnson, *Chem. Rev.*, 1968, **68**, 375.

indicated that the ion at *m/e* 110 possessed the molecular formula, $C_5H_{12}N$; it is possibly derived from species (12) by the loss of a hydrogen atom and carbon dioxide. That the formation of species (12) involved an intramolecular hydrogen transfer was confirmed by an examination of the deuteriated chloroacetate (13), obtained by treating the chloroacetate (8) with potassium t-butoxide in methan[$^2$H]ol. The mass spectrum of the deuteriated material showed prominent peaks at *m/e* 156 and 141 (the latter was linked with the former by a metastable ion at *m/e* 127·5) and a base peak at 110.

Thermolysis of the sulphoxide (15) would be expected [7] to give the isopropenyl derivative (16) and methyl α-sulphenoacetate. This degradation would confirm that the sulphur atom was still attached to the



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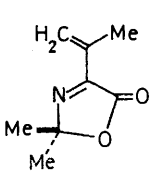

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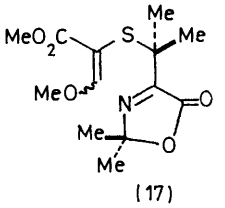


(17)

*gem*-dimethyl group and would provide a $\Delta^3$-oxazolin-5-one free of the sulphur appendage. Treatment of the acetate (11) with *m*-chloroperbenzoic acid afforded a crystalline sulphoxide (15) which was converted into a mixture of less polar materials in refluxing benzene. Rapid silica-gel chromatography afforded the isopropenyl derivative (16), as an unstable syrup, and dimethyl αα′-dithiodiacetate. The latter compound is a known decomposition product of methyl α-sulphenoacetate.[8]

When the racemate of the hydroxythiazine *S*-oxide (2) was treated with 3 mol. equiv. of acetyl chloride in acetonitrile, it was transformed into the unknown compound which was isolated as a syrup. Although the material decomposed to the chloroacetate (8) during normal silica-gel chromatography, a pure sample was obtained by rapid elution. It displayed no detectable optical rotation. Its n.m.r. spectrum showed the presence of two *gem*-dimethyl groups, a methoxycarbonyl group, and a sharp, one-proton singlet at τ 1·71 ($CDCl_3$). Mass spectroscopy showed an ion at *m/e* 322, $C_{12}H_{17}ClNO_5S$; this is considered to represent the molecular ion containing an additional hydrogen atom. On the foregoing evidence the compound is formulated as the oxopropionate (14).

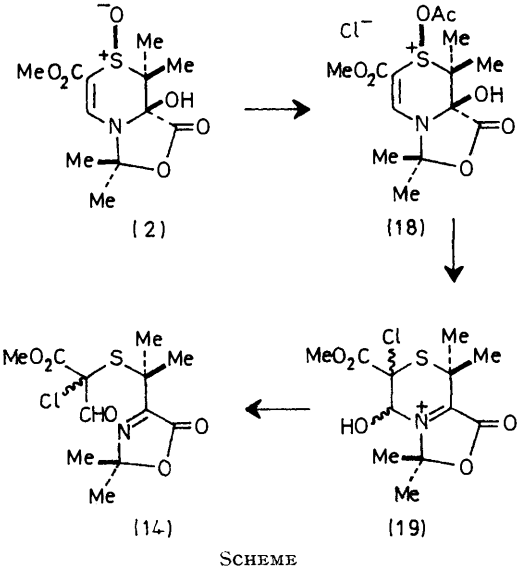
Triethylamine in chloroform was also found to be an effective reagent for converting the oxopropionate (14) into the chloroacetate (8).

To provide further evidence for its structure, the oxopropionate (14) was treated in dioxan with triphenylphosphine, a reagent which effects the dehalogenation of α-halogeno-carbonyl compounds.[9] The product was then treated with diazomethane to give the acrylate (17) as a single isomer.

The foregoing results illustrate that the thiazine *S*-oxide (1) reacts with acetyl chloride in an open flask to give initially a mixture of the hydroxythiazine (4) and the racemate of the hydroxythiazine *S*-oxide (2); subsequently the latter product is transformed into the oxopropionate (14). When the reaction was performed under oxygen (using 2 mol. equiv. of acetyl chloride), the racemate of the hydroxythiazine *S*-oxide (2) and the oxopropionate (14) were the sole products. Derivative (2) was crystallised from the mixture in good yield by addition of ether.

The ready aerial oxidation of the thiazine *S*-oxide (1) to the racemate of hydroxythiazine *S*-oxide (2) is unusual.* When treated under oxygen with acetyl chloride in acetonitrile, the hydroxythiazine (4) was recovered unchanged. Furthermore, no reaction occurred when the thiazine *S*-oxide (1) was left under oxygen in the presence of either acetic acid or hydrogen chloride. In consequence, the acetoxysulphonium salt (6) is probably the species which undergoes the electron transfer.

The transformation of the racemate of the hydroxythiazine *S*-oxide (2) into the oxopropionate (14) probably occurs by way of species (19), formed from the acetoxysulphonium salt (18) by a Pummerer-type reaction [10] and a 1,3-shift of the hydroxy-group (Scheme). There



SCHEME

is some analogy for this behaviour in the reactions of methyl 3,4-dihydro-3-hydroxymethyl-2*H*-1,4-thiazine-6-carboxylate 1-oxides with acetyl chloride.[11] For

* **The behaviour** of penicillin V *S*-oxide towards phenylacetyl chloride in acetone (R. Thomas and D. J. Williams, *J.C.S. Chem. Comm.*, **1973**, 226) provides a possible analogy for this reaction.

[7] C. A. Kingsbury and D. J. Cram, *J. Amer. Chem. Soc.*, 1960, **82**, 1810.

[8] R. J. Stoodley and N. S. Watson, *J.C.S. Perkin I*, 1974, 252.

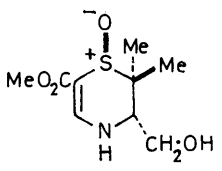
[9] I. J. Borowitz and L. I. Grossman, *Tetrahedron Letters*, 1962, 471; S. Trippett, *J. Chem. Soc.*, 1962, 2337.

[10] G. A. Russell and G. J. Mikol, in ' Mechanisms of Molecular Migrations,' vol. 1, ed. B. S. Thyagarajan, Interscience–Wiley, 1968, p. 157; T. Durst, *Adv. Org. Chem.*, 1969, **6**, 285.

[11] J. Kitchin and R. J. Stoodley, *J.C.S. Chem. Comm.*, 1972, 959; *J.C.S. Perkin I*, 1973, **22**, 2464.

example, the thiazinyl alcohol *S*-oxide (20) is converted into the bicyclic derivative (21) by the reagent.

Although the chemistry of $\Delta^2$-oxazolin-5-ones (azlactones) has been extensively investigated much less



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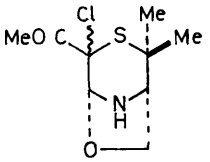

(21)

is known about $\Delta^3$-oxazolin-5-ones (pseudo-oxazolones), particularly those bearing alkyl substituents at position 2.[12] The latter derivatives can be prepared by isomerisation of the former, which are readily available from *N*-acyl amino-acids, when a strongly electron-withdrawing alkyl substituent is present at position 2; normally, however, the $\Delta^2$-oxazolin-5-ones are the thermodynamically favoured isomers. An interesting synthesis of 4-phenyl-$\Delta^3$-oxazolin-5-ones has recently been reported;[13] thus, irradiation of 3-methyl- and 3,3-dimethyl-2-phenylazirine in the presence of carbon dioxide leads to 2-methyl- and 2,2-dimethyl-4-phenyl-$\Delta^3$-oxazolin-5-one.

## EXPERIMENTAL

For general experimental details see Part I.[14] Methan-[$^2$H]ol (99%) was purchased from Fluorochem. Ltd.

*Reaction of the Thiazine* S-*Oxide* (1) *with Acetyl Chloride.*—(*a*) A solution of the thiazine *S*-oxide (1)[1] {$[\alpha]_D$ −44° (1·1% in $CHCl_3$)} (0·057 g, 0·2 mmol) in dry acetonitrile (2 ml) was treated under nitrogen with sodium dithionite (0·105 g, 0·6 mmol) followed by acetyl chloride (0·047 g, 0·6 mmol) in dry acetonitrile (1 ml). After 1·75 h the mixture was diluted with dichloromethane and washed with water (twice). Evaporation of the dried ($MgSO_4$) organic layer left a crystalline residue (0·056 g, 99%), m.p. 173—175° (from $CHCl_3$–$Et_2O$), $[\alpha]_D$ 0° (0·5% in $CHCl_3$), which was identical (i.r. and n.m.r. spectroscopy) with the hydroxythiazine (4).[1]

(*b*) The foregoing experiment was repeated except that sodium dithionite was omitted. Work-up as before gave the hydroxythiazine (4) (99%).

(*c*) Acetyl chloride (0·318 g, 4·0 mmol) in dry acetonitrile (5 ml) was added dropwise to a stirred solution of the thiazine *S*-oxide (1) (0·574 g, 2·0 mmol) in dry acetonitrile (5 ml) contained in a flask fitted with a drying tube ($CaCl_2$). Work-up after 3 h gave a residue (0·575 g) which contained equal amounts of derivatives (2), (4), and (14) (n.m.r. spectroscopy). The mixture was subjected to silica-gel chromatography [$C_6H_6$–$Et_2O$ (7 : 1) as eluant].

The first-eluted component (0·080 g, 16%), observed as a white spot on t.l.c. (iodine vapour), was *methyl α-chloro-α-[1-methyl-1-(2,2-dimethyl-5-oxo-Δ³-oxazolin-4-yl)ethylthio]-acetate* (8), $[\alpha]_D$ 0° (0·91% in $CHCl_3$), $\nu_{max.}$ (film) 1780 (oxazolinone C=O), 1755 (ester C=O), and 1635 cm$^{-1}$ (C=N), $\lambda_{max.}$ (EtOH) 255 nm (ε 640), τ ($CDCl_3$) 8·42 and 8·25 (each 6H, s, 2 *gem*-$Me_2$), 6·28 (3H, s, $MeO_2C$), and 4·79 (1H, s, α-H) (Found: $M^+$, 293·0521. $C_{11}H_{16}ClNO_4S$ requires *M*, 293·0488); *m/e* 155·0932 (base peak; $C_8H_{13}NO_2$ requires 155·0946) 140, and 110 ($C_7H_{12}N$ requires 110·0970).

The second-eluted material (0·140 g, 28%) was identical (t.l.c. and n.m.r. spectroscopy) with the hydroxythiazine (4).[1]

The third-eluted component (0·063 g, 11%) was the *racemate of methyl* (4S,6S)-6-*hydroxy*-5,5,9,9-*tetramethyl*-7-*oxo*-8-*oxa*-4-*thia*-1-*azabicyclo*[4.3.0]*non*-2-*ene*-3-*carboxylate* 4-*oxide* (2), m.p. 168—170° (decomp.) (from $CHCl_3$–$Et_2O$), $[\alpha]_D$ 0° (0·4% in $CHCl_3$), $\nu_{max.}$ (KBr) 3300br (OH), 1800 (oxazolidinone C=O), 1695 (unsat. ester C=O), and 1595 cm$^{-1}$ (C=C), $\lambda_{max.}$ (EtOH) 284 nm (ε 13,400), τ ($CDCl_3$) 9·05, 8·25, 8·13, and 7·88 (each 3H, s, 2 *gem*-$Me_2$), 6·17 (3H, s, $MeO_2C$), 2·25 (1H, s, 2-H), and 1·91 (1H, s, OH) (addition of $D_2O$ caused the signal at τ 1·91 to disappear) (Found: C, 47·3; H, 5·9; N, 4·6%; $M^+$, 303·0757. $C_{12}H_{17}NO_6S$ requires C, 47·5; H, 5·6; N, 4·6%; *M*, 303·0777).

(*d*) Acetyl chloride (0·156 g, 2·0 mmol) in dry acetonitrile (2 ml) was added dropwise to a solution of the thiazine *S*-oxide (1) (0·287 g, 1·0 mmol) in dry acetonitrile (5 ml) under oxygen. Work-up after 0·75 h gave a residue (0·301 g) which contained a mixture (4 : 1) of the hydroxythiazine *S*-oxide (2) and the oxopropionate (14) (n.m.r. spectroscopy). Addition of ether to the mixture induced the crystallisation of derivative (2) (0·205 g, 72%), m.p. 168—170° (decomp.), $[\alpha]_D$ 0° (2·4% in $CHCl_3$).

*Reaction of the Hydroxythiazine* (4) *with* m-*Chloroperbenzoic Acid.*—A cooled ($Me_2CO$–solid $CO_2$), stirred solution of the hydroxythiazine (4) (3·73 g, 13·0 mmol) in dichloromethane (20 ml) was treated dropwise with *m*-chloroperbenzoic acid (2·58 g, 15·0 mmol) dissolved in dichloromethane (80 ml). After 15 min the mixture was diluted with dichloromethane, and washed with sodium hydrogen carbonate solution followed by water. Evaporation of the dried ($MgSO_4$) organic layer gave a crystalline residue (3·39 g, 86%), m.p. 168—170° (from $CHCl_3$–$Et_2O$), identical (i.r., n.m.r., and mass spectroscopy) with the hydroxythiazine *S*-oxide (2).

*Deuteriation of the Chloroacetate* (8).—A trace of potassium t-butoxide was added to a solution of the chloroacetate (8) (0·031 g, 0·1 mmol) in methan[$^2$H]ol (1 ml). After 15 h the solution was diluted with dichloromethane and washed with water. Evaporation of the dried ($MgSO_4$) organic layer left the monodeuteriated chloroacetate (13) (0·031 g, 100%); τ ($CDCl_3$) as for the chloroacetate (8) except that the signal at τ 4·97 was absent; *m/e* 294 ($M^+$), 156, 141, and 110 (base peak).

*Methyl α-Acetoxy-α-[1-methyl-1-(2,2-dimethyl-5-oxo-Δ³-oxazolin-4-yl)ethylthio]acetate* (9).—A solution of the chloroacetate (8) (0·192 g, 0·6 mmol) in acetic acid (5 ml) was treated with silver(I) perchlorate (0·124 g, 0·6 mmol). After 17 h the mixture was filtered, diluted with water, and extracted with chloroform (twice). The organic layer was washed with sodium hydrogen carbonate solution followed by water, dried ($MgSO_4$), and evaporated to give the *acetoxyacetate* (9) (0·110 g, 55%), m.p. 112—114° (from $Et_2O$–light petroleum), $[\alpha]_D$ 0° (0·5% in $CHCl_3$), $\nu_{max.}$ (KBr) 1775 (oxazolinone C=O), 1755 and 1745 (each ester C=O), and 1635 cm$^{-1}$ (C=N), $\lambda_{max.}$ (EtOH) 256 (ε 1000) and 280sh nm (580), τ ($CDCl_3$) 8·40, 8·37, 8·29, and 8·23 (each 3H, s, 2 *gem*-$Me_2$), 7·81 (3H, s, MeCO), 6·27 (3H, s, $MeO_2C$), and 4·32 (1H, s, α-H) (Found: C, 49·0; H, 5·9; N, 4·4%;

[12] W. Steglich, *Fortschr. Chem. Forsch.*, 1969, **12**, 77.
[13] A. Padwa and S. I. Wetmore, jun., *J. Amer. Chem. Soc.*, 1974, **96**, 2414.
[14] A. R. Dunn and R. J. Stoodley, *J.C.S. Perkin I*, 1972, 2509.

$M^+$, 317. $C_{13}H_{17}NO_5S$ requires C, 49·2; H, 6·0; N, 4·4%; $M$, 317).

*Methyl α-Methoxy-α-[1-methyl-1-(2,2-dimethyl-5-oxo-Δ³-oxazolin-4-yl)ethylthio]acetate* (10).—(*a*) A solution of the chloroacetate (8) (0·128 g, 0·4 mmol) in methanol (10 ml) was treated with silver(I) perchlorate (0·083 g, 0·4 mmol). After 3 h the mixture was diluted with water and extracted with chloroform (twice). Evaporation of the dried ($MgSO_4$) organic layer left a residue (0·108 g) which was fractionated by silica-gel chromatography [$C_6H_6$–$Et_2O$ (3 : 1) as eluant] to give the *methoxyacetate* (10) (0·073 g, 63%), $[\alpha]_D$ 0° (0·4% in $CHCl_3$), $\nu_{max.}$ (film) 1780 (oxazolinone C=O), 1745 (ester C=O), and 1630 $cm^{-1}$ (C=C), $\lambda_{max.}$ (EtOH) 260 nm (ε 810), τ ($CDCl_3$) 8·38 and 8·22 (each 6H, s, 2 *gem*-$Me_2$), 6·60 (3H, s, MeO), 6·27 (3H, s, $MeO_2C$), and 5·08 (1H, s, α-H) (Found: $M^+$, 289·0976. $C_{12}H_{19}NO_5S$ requires $M$, 289·0984).

(*b*) A mixture of the chloroacetate (8) (0·064 g, 0·2 mmol) and 0·1M-sodium methoxide (4 ml) was heated under reflux. After 2 h the solution was diluted with dichloromethane and washed with water. Evaporation of the dried ($MgSO_4$) organic layer left a residue (0·045 g, 76%) which was mainly the methoxyacetate (10) (t.l.c. and n.m.r. spectroscopy).

*Methyl α-[1-Methyl-1-(2,2-dimethyl-5-oxo-Δ³-oxazolin-4-yl)ethylthio]acetate* (11).—A vigorously stirred solution of the chloroacetate (8) (0·351 g, 1·2 mmol) in acetic acid (10 ml) was treated with zinc dust (0·156 g, 2·4 mmol). After 7·5 h the mixture was diluted with water and extracted with chloroform (twice). The organic layer was washed with sodium hydrogen carbonate solution followed by water, dried ($MgSO_4$), and evaporated. The residue (0·210 g) was fractionated by silica-gel chromatography [$C_6H_6$–$Et_2O$ (7 : 1) as eluant] to give the *acetate* (11) (0·075 g, 23%), $[\alpha]_D$ 0° (0·4% in $CHCl_3$), $\nu_{max.}$ (film) 1775 (oxazolinone C=O), 1740 (ester C=O), and 1630 $cm^{-1}$ (C=N), $\lambda_{max.}$ (EtOH) 270 (ε 1100) and 290 nm (1900), τ ($CDCl_3$) 8·45 and 8·36 (each 6H, s, 2 *gem*-$Me_2$), 6·79 (2H, s, α-$H_2$), and 6·36 (3H, s, $MeO_2C$) (Found: $M^+$, 259·0904. $C_{11}H_{17}NO_4S$ requires $M$, 259·0878).

*Methyl α-[1-Methyl-1-(2,2-dimethyl-5-oxo-Δ³-oxazolin-4-yl)ethylsulphinyl]acetate* (15).—A cooled ($Me_2CO$–solid $CO_2$), stirred solution of the acetate (11) (0·285 g, 1·1 mmol) in dichloromethane (15 ml) was treated dropwise with *m*-chloroperbenzoic acid (0·220 g, 1·3 mmol) dissolved in dichloromethane (15 ml). After 10 min the mixture was diluted with dichloromethane and washed with sodium hydrogen carbonate solution followed by water. Evaporation of the dried ($MgSO_4$) organic layer gave a residue (0·241 g) which was purified by silica-gel chromatography [$C_6H_6$–$Et_2O$ (4 : 1) as eluant] to give the *S-oxide* (15) (0·118 g, 38%), m.p. 85—87° (from $Et_2O$), $[\alpha]_D$ 0° (0·4% in $CHCl_3$), $\nu_{max.}$ (KBr) 1770 (oxazolinone C=O), 1730 (ester C=O), and 1640 $cm^{-1}$ (C=N), $\lambda_{max.}$ (EtOH) 270 nm (ε 760), τ ($CDCl_3$) 8·41, 8·33, and 8·29 (6H, 3H, and 3H, each s, 2 *gem*-$Me_2$), 6·59 (2H, ABq, $J$ 14·4 Hz, α-$H_2$), and 6·27 (3H, s, $MeO_2C$) (Found: C, 47·7; H, 6·6; N, 5·3. $C_{12}H_{17}NO_6S$ requires C, 47·9; H, 6·3; N, 5·2%).

*Pyrolysis of the S-Oxide* (15).—The *S*-oxide (15) (0·096 g, 0·35 mmol) was heated in benzene (10 ml) under reflux for 1·5 h. Evaporation left a residue containing three major components (t.l.c.), which was fractionated by rapid silica-gel chromatography ($C_6H_6$ as eluant). The first-eluted material, isolated as a syrup (0·032 g, 66%), was *4-isopropenyl-2,2-dimethyl-Δ³-oxazolin-5-one* (16), $\nu_{max.}$ (film) 1775 (oxazolinone C=O), 1630 (C=N), and 1600 $cm^{-1}$ (C=C), $\lambda_{max.}$ (EtOH) 240 nm (ε 3400), τ ($CDCl_3$) 8·43 (6H, s, *gem*-$Me_2$), 7·93 (3H, s, vinylic Me), and 4·3br and 3·30 (each 1H, s, olefinic $H_2$) (Found: $M^+$, 153·0798. $C_{18}H_{11}NO_2$ requires $M$, 153·0790). The material slowly decomposed at room temperature but it could be stored unchanged at −10°. The second-eluted derivative (0·022 g, 65%) was identical (t.l.c., n.m.r., and mass spectroscopy) with methyl αα′-dithiodiacetate.

*Reaction of the Hydroxythiazine S-Oxide* (2) *with Acetyl Chloride.*—Acetyl chloride (1·17 g, 15·0 mmol) in dry acetonitrile (4 ml) was added dropwise to a solution of the hydroxythiazine *S*-oxide (2) (0·909 g, 3·0 mmol) in dry acetonitrile (4 ml). After 2 h the mixture was diluted with dichloromethane and washed with water (twice). Evaporation of the dried ($MgSO_4$) organic layer left *methyl 2-chloro-2-[1-methyl-1-(2,2-dimethyl-5-oxo-Δ³-oxazolin-4-yl)ethylthio]-3-oxopropionate* (14) (0·927 g, 97%) as a syrup observed as a white spot on t.l.c. (iodine vapour). A pure sample of the material, obtained by rapid silica-gel chromatography [$C_6H_6$–$Et_2O$ (7 : 1) as eluant], showed $[\alpha]_D$ 0° (0·2% in $CHCl_3$), $\nu_{max.}$ (film) 1775 (oxazolinone C=O), 1745 (ester C=O), and 1605 $cm^{-1}$ (C=N), $\lambda_{max.}$ (EtOH) 275 (ε 1700), 313 (1100), and 335sh nm (730), τ ($CDCl_3$) 8·37, 8·27, and 8·23 (6H, 3H, and 3H, each s, 2 *gem*-$Me_2$), 6·15 (3H, s, $MeO_2C$), and 1·71 (1H, s, CHO) (Found: $M^+$, 322·0514. $C_{12}H_{17}ClNO_5S$ requires $M$, 322·0516).

*Deformylation of the Oxopropionate* (14).—A sample of the oxopropionate (14) (0·192 g, 0·6 mmol) was slowly passed through a silica-gel column ($C_6H_6$–$Et_2O$ as eluant). The recovered material (0·123 g, 71%) was identical (t.l.c., i.r, and n.m.r. spectroscopy) with the chloroacetate (8).

(*b*) A solution of the oxopropionate (14) (0·963 g, 3·0 mmol) in dichloromethane (5 ml) was treated with triethylamine (0·076 g, 0·75 mmol) in dichloromethane (2 ml). After 20 min the mixture was diluted with dichloromethane and washed with water (twice). Evaporation of the dried ($MgSO_4$) organic layer left a material (0·871 g, 89%) which was identical (t.l.c., i.r., and n.m.r. spectroscopy) with the chloroacetate (8).

*Dechlorination of the Oxopropionate* (14).—A solution of the oxopropionate (14) (0·321 g, 1·0 mmol) in dry dioxan (5 ml) was treated with triphenylphosphine (0·262 g, 1·0 mmol). After 10 min the mixture was diluted with chloroform and washed with water (twice). Evaporation of the dried ($MgSO_4$) organic layer left a syrup which was stirred with an excess of diazomethane in ether for 2 h. Evaporation and fractionation of the derived material by silica-gel chromatography ($C_6H_6$ as eluant) gave *methyl 3-methoxy-2-[1-methyl-1-(2,2-dimethyl-5-oxo-Δ³-oxazolin-4-yl)-ethylthio]acrylate* (17) (0·176 g, 59%) as a single diastereoisomer, m.p. 85—86° (from $Et_2O$–light petroleum), $[\alpha]_D$ 0° (0·5% in $CHCl_3$), $\nu_{max.}$ (KBr) 1780 (oxazolinone C=O), 1715 (ester C=O), 1625 (C=N), and 1600 $cm^{-1}$ (C=C), $\lambda_{max.}$ (EtOH) 248 (ε 10,500) and 295sh nm (1100), τ ($CDCl_3$) 8·50 and 8·37 (each 6H, s, 2 *gem*-$Me_2$), 6·37 and 6·12 (each 3H, s, MeO and $MeO_2C$), and 2·16 (1H, s, 3-H) (Found: C, 51·7; H, 6·4; N, 4·5%; $M^+$, 301. $C_{13}H_{19}NO_5S$ requires C, 51·8; H, 6·3; N, 4·7%; $M^+$, 301).

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