2,3,5,6-Tetrahydro- and 5,6-Dihydro-imidazo[2,1-*b*]thiazoles from Imidazoline-2-thiol Derivatives and Unsaturated or Halogenated Acids and Esters

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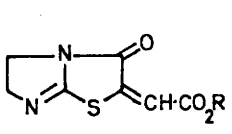
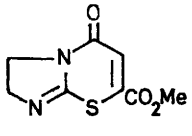
Evidence is presented to show that the products of reactions of imidazoline-2-thiol with acetylenedicarboxylic acid and its dimethyl ester are derivatives of 5,6-dihydroimidazo[2,1-*b*]thiazole-3(2*H*)-one. Other derivatives of this ring system are obtained by reactions of imidazoline-2-thiol with maleic anhydride and with α-bromo-dicarboxylic acids and their diethyl esters. Ethyl 2-chloro- and 4-bromoacetoacetate with imidazoline-2-thiol give derivatives of 5,6-dihydroimidazo[2,1-*b*]thiazole with retention of the ethoxycarbonyl group. 5-Substituted 2-thiohydantoins react in a similar way.

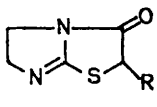
IMIDAZOLINE-2-THIOL reacts readily with dimethyl acetylenedicarboxylate to give a compound claimed by Lown and Ma [1] to have the six-membered ring structure (3). This assignment was based on mass spectral studies of the monocyclic system obtained from thiourea, whose structure nevertheless remains in dispute.[2,3] By treatment of acetylenedicarboxylic acid with imidazoline-2-thiol we obtained a compound whose n.m.r. and i.r. spectra were identical with those of the product of condensation of the imidazothiazolone (4) with glyoxylic acid and is therefore ascribed the five-membered ring structure (1). Reaction between compound (4) and chloral gave the 1-hydroxy-2,2,2-trichloroethyl derivative (6).



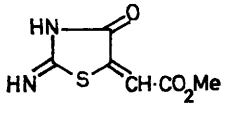
(1) R = H
(2) R = Me



(3)



(4) R = H
(5) R = $CH_2 \cdot CH_2 \cdot OH$
(6) R = $CH(OH) \cdot CCl_3$



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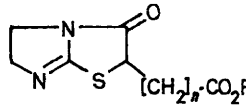
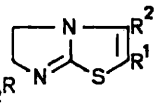
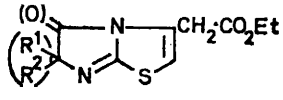


(8) n = 0, R = Et
(9) n = 1, R = Me
(10) n = 2, R = Et
(11) n = 3, R = Et
(12) n = 1, R = H
(13) n = 3, R = H



(14) R^1 = H, R^2 = $CH_2 \cdot CO_2Et$
(15) R^1 = H, R^2 = CH_2CO_2H
(16) R^1 = CO_2Et, R^2 = Me
(17) R^1 = CO_2H, R^2 = Me



(18)

Esterification of the acid (1) with diazomethane gave the ester (2) which was identical (n.m.r. and i.r. spectra, mixed m.p.) with the product obtained by treatment of imidazoline-2-thiol with dimethyl acetylenedicarboxylate. The ^1H n.m.r. spectra of compounds (1) and (2) are consistent with the given structures, although compound (2) in [$^2H_6$]dimethyl sulphoxide gave anomalous and variable spectra, presumably owing to solvent interaction. The i.r. spectra have a characteristic sharp band at 3060 cm^{-1}, ascribed to the exocyclic :CH· group, which is not shown by the saturated acids and esters (8)—(13) described later. Similar products were obtained from reactions of dimethyl acetylenedicarboxylate with 5-methyl-2-thiohydantion and imidazole-2-thiol, but in lower yields. Good evidence has recently been obtained [3] that the reaction between dimethyl acetylenedicarboxylate and thiourea gives the thiazolidine (7). The relationship between this and the bicyclic system is shown by the conversion (7) ⟶ (2) with 1,2-dibromoethane.

The formation of 5,6-dihydroimidazo[2,1-*b*]thiazole-3(2*H*)-one (4) from imidazoline-2-thiol and ethyl chloroacetate has been clearly shown to involve an intermediate sulphide hydrochloride, which gives compound (4) on treatment with ammonia.[4] By a similar procedure, the diethyl esters of α-bromo-dicarboxylic acids gave the esters (8), (10), and (11). Attempted hydrolysis of the ester (10) with methanesulphonic acid resulted in fission of the imidazoline ring to give ethyl 3-[3-(2-aminoethyl)-2,4-dioxothiazolidin-5-yl]propionate. This type of ring opening has been described in the reaction of compound (4) with mineral acid.[4] The acid (13) was obtained directly from 2-bromoadipic acid.

The reaction between maleic anhydride and imidazoline-2-thiol gave the acetic acid (12), whose i.r. spectrum was similar to that of the butyric acid (13). Diazomethane converted the acetic acid (12) into its methyl ester (9), which was oxidised by bromine to give a 50% yield of the unsaturated ester (2). 2-Bromobutyrolactone gave a 2-hydroxyethyl derivative (5) from a reaction with imidazoline-2-thiol, the intermediate being 2-(imidazolin-2-ylthio)butyrolactone hydrobromide.

α-Bromo-ketones react with imidazoline-2-thiol to give 5,6-dihydroimidazothiazoles,[5,6] and, by analogy

[1] J. W. Lown and J. C. N. Ma, *Canad. J. Chem.*, 1967, **45**, 939, 953.
[2] E. N. Cain and R. N. Warrener, *Austral. J. Chem.*, 1970, **23**, 51.
[3] F. W. Short, B. C. Littleton, and J. L. Johnson, *Chem. and Ind.*, 1971, 705.
[4] E. Campaigne and M. C. Wani, *J. Org. Chem.*, 1964, **29**, 1715.
[5] W. Wilson and R. Woodger, *J. Chem. Soc.*, 1955, 2943.
[6] M. Fefer and L. C. King, *J. Org. Chem.*, 1961, **26**, 828.

with the reactions of α-bromo-acids, there is little doubt that the initial substitution takes place at the sulphur atom. The ester obtained by the reaction of ethyl 4-bromoacetoacetate with imidazoline-2-thiol is therefore formulated as (14). The corresponding acid (15) was obtained by hydrolysis with aqueous methanesulphonic acid. Ethyl 2-chloroacetoacetate reacted with elimination of the ketone oxygen atom to give a 2-ethoxycarbonyl derivative (16) which was hydrolysed similarly to the acid (17).

Oxo-derivatives of this system (18) were obtained by reactions of ethyl 4-bromoacetoacetate with various 5-substituted 2-thiohydantoins, but we were unable to establish the relative positions of the 5- and 6-substituents. In attempts to open the imidazoline ring of compound (18; $R^1 = R^2 = Ph$), the action of acid or alkali under various conditions gave only 5,5-diphenylhydantoin. The thiazoline ring of the n-butyl analogue seemed less fragile, since the ethyl ester was hydrolysed to the corresponding acid by aqueous methanesulphonic acid, but we were unable to pursue this further.

EXPERIMENTAL

I.r. spectra were recorded for Nujol mulls with a Perkin-Elmer 237 spectrophotometer, u.v. spectra for solutions in 95% ethanol with a Unicam SP 800 instrument, and ^{1}H n.m.r. spectra at 60 MHz with a Perkin-Elmer R10 spectrometer with tetramethylsilane as internal reference. Alumina used was Spence type H, deactivated with 5% of 10% acetic acid. Microanalyses were determined with a Perkin-Elmer model 240 Elemental Analyser.

2-(2,3,5,6-*Tetrahydro*-3-*oxoimidazo*[2,1-b]*thiazol*-2-*yl-acetic Acid* (12).—Powdered imidazoline-2-thiol [7] (15·3 g) was dissolved quickly in diethylene glycol dimethyl ether (200 ml) at 160° and stirred during rapid addition of a solution of maleic anhydride (15 g) in the same solvent (25 ml). When cool the solution was diluted with ether (225 ml) and the precipitate was recrystallised from ethanol–ethyl acetate to obtain pale yellow *needles* (10·05 g), m.p. 195—196° (decomp.) (Found: C, 42·2; H, 4·2; N, 13·8. $C_7H_8N_2O_3S$ requires C, 42·0; H, 4·0; N, 14·0%), $\nu_{max.}$ 1730, 1615, 1400, 1250, and 1225 cm^{-1}.

The acid (12) (3·6 g) in tetrahydrofuran (140 ml) was esterified at 0° with ethereal diazomethane.[8] Evaporation of the solvent and recrystallisation of the residue from benzene–light petroleum (b.p. 60—80°) and from ligroin (B.D.H.) gave needles (2 g) of the *methyl ester* (9), m.p. 116° (Found: C, 44·8; H, 4·9; N, 13·0. $C_8H_{10}N_2O_3S$ requires C, 44·85; H, 4·7; N, 13·1%), $\nu_{max.}$ 1740, 1640, 1400, 1230, and 1200 cm^{-1}.

2-(2,3,5,6-*Tetrahydro*-3-*oxoimidazo*[2,1-b]*thiazol*-2-*yl-idene)acetic Acid* (1).—*From acetylenedicarboxylic acid.* A stirred ice-cooled solution of imidazoline-2-thiol (2·04 g) in water (80 ml) was treated dropwise during 5 min with a solution of acetylenedicarboxylic acid (2·28 g) in water (10 ml). After a further 0·5 h below 20°, the *solid* (2·8 g) was collected, m.p. 224—226° (decomp.) (from ethanol) (Found: C, 42·2; H, 3·1; N, 13·8. $C_7H_6N_2O_3S$ requires C, 42·4; H, 3·05; N, 14·1%), τ [$(CD_3)_2SO$] 6·15 (2H, t, *J* 7 Hz), 5·6 (2H, t, *J* 7 Hz), and 3·2 (1H, s), $\nu_{max.}$ 3060, 1720, 1675, 1600, and 1240 cm^{-1}.

From glyoxylic acid. 5,6-Dihydroimidazo[2,1-*b*]thiazol-3(2*H*)-one (4) (1·42 g) and glyoxylic acid monohydrate (1·0 g) were dissolved in glacial acetic acid (15 ml). After 0·5 h, the solution was heated for 10 min on a water-bath and evaporated under reduced pressure. Trituration with ether gave the acid (1) as a brown solid (0·35 g), m.p. 225° (decomp.), identified by mixed m.p. and n.m.r. and i.r. spectra.

5,6-*Dihydro*-2-(1-*hydroxy*-2,2,2-*trichloroethyl*)*imidazo*-[2,1-b]*thiazol*-3(2H)-*one* (6).—Imidazoline-2-thiol (3·06 g), chloroacetic acid (2·84 g), and sodium acetate (2·6 g) in glacial acetic acid (25 ml) were heated for 15 min on a water-bath. The solution was cooled to 10° and chloral (4·5 g) was added; the temperature rose to 20°. After 3 h, the mixture was filtered and evaporated under reduced pressure. Material obtained by trituration with water was recrystallised from ethanol–chloroform to give a *solid* (6) (2·0 g), m.p. 172—174° (Found: C, 29·1; H, 2·4; Cl, 36·4; N, 9·5. $C_7H_7Cl_3N_2O_2S$ requires C, 29·0; H, 2·4; Cl, 36·8; N, 9·7%), $\nu_{max.}$ 1740, 1620, 1400, and 1250 cm^{-1}.

Methyl 2-(2,3,5,6-*Tetrahydro*-3-*oxoimidazo*[2,1-b]*thiazol*-2-*ylidene)acetate* (2).—*Method A.* Dimethyl acetylenedicarboxylate (2·84 g) was added dropwise to a solution of imidazoline-2-thiol (2·04 g) in methanol (50 ml) cooled in ice–water. The white solid was filtered off, washed with ether, and recrystallised from methanol to give the *ester* (2) (3·1 g), m.p. 196—197° (Found: C, 45·3; H, 3·9; N, 13·2. $C_8H_8N_2O_3S$ requires C, 45·3; H, 3·8; N, 13·2%), τ ($CDCl_3$) 6·1 (3H, s), 6·12 (2H, t, *J* 7 Hz), 5·5 (2H, t, *J* 7 Hz), and 3·12 (1H, s), $\nu_{max.}$ 3060, 1720, 1690, 1635, and 1610 cm^{-1}, $\lambda_{max.}$ 217 and 308 nm.

In a similar way, 5-methyl-2-thiohydantoin gave a 19% yield of *methyl* 2-[2,3,5,6-*tetrahydro*-6(5)-*methyl*-3,5(6)-*dioxoimidazo*[2,1-b]*thiazol*-2-*ylidene*]*acetate* as a solid, m.p. 187—188° (from methanol–benzene) (Found: C, 45·1; H, 3·4; N, 11·6. $C_9H_8N_2O_4S$ requires C, 45·0; H, 3·4; N, 11·7%), $\nu_{max.}$ 3060, 1755, 1720, 1695, and 1530 cm^{-1}, $\lambda_{max.}$ 212, 242, 265, and 305 nm. Imidazole-2-thiol similarly gave a 62% yield of *methyl* 2-(2,3-*dihydro*-3-*oxoimidazo*-[2,1-b]*thiazol*-2-*ylidene)acetate* as yellow plates, m.p. 184—185° (from methanol) [Found: C, 45·7; H, 2·9; N, 13·35. $C_8H_6N_2O_3S$ requires C, 45·7; H, 2·9; N, 13·3%), $\nu_{max.}$ 3060, 1725, 1690, and 1580 cm^{-1}.

Method B. A solution of the acid (1) (0·3 g) in *NN*-dimethylacetamide (6 ml) was esterified with ethereal diazomethane. The product, which crystallised (0·2 g; m.p. 196—197° after washing with methanol) was the same as that from method A (mixed m.p.; i.r., u.v., and n.m.r. spectra).

Method C. The ester (9) (1·07 g) in glacial acetic acid (10 ml) containing sodium acetate (cryst., 1 g) was treated with bromine (0·8 g) in glacial acetic acid (5 ml). After a further 0·5 h. the solution was concentrated to *ca.* 5 ml. The inorganic precipitate was filtered off and the solid which crystallised from the filtrate was recrystallised from methanol and from methyl acetate to obtain the product (2) (0·53 g), m.p. 196—198°, identical with that from method A (mixed m.p. and i.r. spectrum).

Method D. A mixture of methyl 2-(2-imino-4-oxothiazolidin-5-ylidene)acetate (prepared from dimethyl acetylenedicarboxylate and thiourea [1,3]) (1 g), 1,2-dibromoethane (1·1 g), *NN*-dimethylacetamide (15 ml), and anhydrous potassium carbonate (1 g) was heated for 3 h

[7] C. F. H. Allen, C. O. Edens, and J. Van Allen, *Org. Synth.*, Coll. Vol. 3, 1955, p. 394.
[8] F. Arndt, *Org. Synth.*, Coll. Vol. 2, 1943, p. 165.

on a water-bath, filtered, cooled, and diluted with an equal volume of ether. The product (260 mg; m.p. 195—198°) identical with that from method A (mixed m.p. and i.r. spectrum), slowly separated.

Diethyl α-(2-Imidazolin-2-ylthio)malonate Hydrobromide.—Imidazoline-2-thiol (2·04 g), diethyl bromomalonate (4·8 g), and ethanol (15 ml) were boiled under reflux for 0·5 h; the mixture was cooled and diluted with an equal volume of ether. The precipitate gave *needles* (1·96 g), m.p. 131—133° (from ethanol–ethyl acetate) (Found: C, 35·1; H, 5·2; N, 8·1. $C_{10}H_{17}BrN_2O_4S$ requires C, 35·2; H, 5·0; N, 8·2%).

Ethyl 2,3,5,6-Tetrahydro-3-oxoimidazo[2,1-b]thiazole-2-carboxylate (8).—Ammonia was passed into a solution of the foregoing diethyl ester hydrobromide (4·95 g) in ethanol (25 ml). Stepwise evaporation gave the product (2·8 g) in the early crops; later ones contained ammonium bromide. Recrystallisation from ethanol–ethyl acetate gave *needles* (2·65 g), m.p. 210° (decomp.) (Found: C, 44·8; H, 4·7; N, 13·0. $C_8H_{10}N_2O_3S$ requires C, 44·85; H, 4·7; N, 13·1%), $\nu_{max.}$ 3120, 1690, 1610, 1560, and 1400 cm^{-1}.

Ethyl 3-(2,3,5,6-Tetrahydro-3-oxoimidazo[2,1-b]thiazol-2-yl)propionate (10) *Hydrochloride.*—A solution of imidazoline-2-thiol (10·2 g) and diethyl 2-bromoglutarate [9] (28 g) in ethanol (250 ml) was boiled for 2 h under reflux, evaporated to 25 ml under reduced pressure, and cooled. Ammonia was passed through the solution for about 5 min, the solvent was removed under reduced pressure, and the residual oil was chromatographed on alumina with benzene to obtain the crude ester as a yellow oil. Treatment with ethereal hydrogen chloride gave the *hydrochloride* (5·6 g), m.p. 207—209° (from ethanol–ethyl acetate) (Found: C, 43·1; H, 5·5; N, 9·95. $C_{10}H_{15}ClN_2O_3S$ requires C, 43·1; H, 5·4; N, 10·05%).

Ethyl 3-[3-(2-Aminoethyl)-2,4-dioxothiazolidin-2-yl]propionate.—The crude ester (10) (obtained as in the previous experiment, but from 3·1 g of imidazoline-2-thiol) was boiled under reflux for 1 h with methanesulphonic acid (1·8 g) in water (25 ml). Evaporation under reduced pressure, treatment of the residual oil with ethereal hydrogen chloride, and recrystallisation of the solid from ethanol gave the *hydrochloride* (1·7 g), m.p. 163—164° (Found: C, 40·3; H, 5·8; N, 9·4. $C_{10}H_{17}ClN_2O_4S$ requires C, 40·5; H, 5·8; N, 9·4%), $\nu_{max.}$ 3180, 1730, 1670, 1610, and 1390 cm^{-1}.

Ethyl 4-(2,3,5,6-Tetrahydro-3-oxoimidazo[2,1-b]thiazol-2-yl)butyrate (11).—The crude ester obtained from diethyl 2-bromoadipate [9] (1 g) by the procedure described for the corresponding imidazothiazolylpropionate (10) solidified on cooling and was recrystallised from ethyl acetate–light petroleum (b.p. 60—80°) to give a *solid* (0·55 g), m.p. 83—84° (Found: C, 51·8; H, 6·3; N, 10·8. $C_{11}H_{16}N_2O_3S$ requires C, 51·5; H, 6·3; N, 10·9%), $\nu_{max.}$ 1730, 1710, 1630, and 1410 cm^{-1}.

4-(2,3,5,6-Tetrahydro-3-oxoimidazo[2,1-b]thiazol-2-yl)-butyric Acid (13).—A solution of imidazoline-2-thiol (2·55 g) and 2-bromoadipic acid [10] (5·75 g) in water (10 ml) was heated for 0·5 h on a water-bath, then evaporated to dryness at reduced pressure. The residual gum was triturated with acetone. The product (4·7 g), m.p. 208—210°, assumed to be the hydrobromide of 2-(imidazolin-2-ylthio)adipic acid, was suspended in tetrahydrofuran (50 ml) and stirred vigorously during passage of ammonia for *ca.* 5 min. The solid was dissolved in ethanol and the solution was evaporated stepwise to give the required acid in the early crops. Recrystallisation from ethanol–water gave *needles* (2·55 g), m.p. 187—189° (Found: C, 47·3; H, 5·4; N, 12·2. $C_9H_{12}N_2O_3S$ requires C, 47·4; H, 5·3; N, 12·3%), $\nu_{max.}$ 1720, 1635, and 1400 cm^{-1}.

2-Bromo-4-butyrolactone.—Bromination [11] of 4-butyrolactone (50 g) gave 2,4-dibromobutyric acid (119 g), b.p. 106—122° at 0·3 mmHg, n_D^{25} 1·5358. The dibromo-acid in benzene (230 ml) cooled in ice was treated with pyridine (39 ml) for 10 min. After a further 15 min, the solution was heated for 15 min on a water-bath, cooled, and filtered. The filtrate was evaporated and the residue extracted with ether to obtain an oil which gave the bromolactone (68·8 g) on distillation, b.p. 80—82° at 0·2 mmHg, n_D^{25} 1·5070.

2-(Imidazolin-2-ylthio)-4-butyrolactone Hydrobromide.—A solution of imidazoline-2-thiol (2·04 g) and 2-bromo-4-butyrolactone (3·32 g) in ethanol (40 ml) was boiled for 0·5 h under reflux and evaporated to dryness; the residue was recrystallised from ethanol to obtain a *solid* (3 g), m.p. 165—167° (Found: C, 31·0; H, 4·1; N, 10·1. $C_7H_{11}BrN_2O_2S$ requires C, 31·45; H, 4·15; N, 10·5%), $\nu_{max.}$ 3140, 1765, 1585, and 1160 cm^{-1}.

5,6-Dihydro-2-(2-hydroxyethyl)imidazo[2,1-b]thiazole-3(2H)-one (5).—Ammonia was passed into a solution of the foregoing lactone hydrobromide (10·7 g) in warm ethanol (50 ml) for a few min; the solution was concentrated to *ca.* 10 ml, diluted with acetone (20 ml), and filtered. Evaporation and recrystallisation from ethanol–ethyl acetate gave *needles* (6·5 g), m.p. 98—99° (Found: C, 45·2; H, 5·4; N, 15·0. $C_7H_{10}N_2O_2S$ requires C, 45·1; H, 5·4; N, 15·0%). The *methylsulphonyl derivative* was prepared in pyridine by use of methanesulphonyl chloride; m.p. 129—131° (from ethanol) (Found: C, 36·3; H, 4·6; N, 10·6. $C_8H_{12}N_2O_4S_2$ requires C, 36·35; H, 4·6; N, 10·6%).

Ethyl 2-(5,6-Dihydroimidazo[2,1-b]thiazol-3-yl)acetate (14).—Ethyl 4-bromoacetoacetate [12] (10·5 g) and imidazoline-2-thiol (5·1 g) in ethanol (125 ml) were boiled under reflux for 0·5 h. The hydrobromide (11·3 g; m.p. 196—199°) which crystallised was dissolved in water (30 ml) and made just alkaline with 40% sodium hydroxide solution to precipitate the *product* (14) (4·5 g), m.p. 128—129° (from ethanol) (Found: C, 50·8; H, 5·6; N, 13·5. $C_9H_{12}N_2O_2S$ requires C, 50·9; H, 5·7; N, 13·2%), $\nu_{max.}$ 1700, 1615, and 1180 cm^{-1}.

2-(5,6-Dihydroimidazo[2,1-b]thiazol-3-yl)acetic Acid Hydrobromide (15).—A solution of the foregoing ester hydrobromide (2·93 g) and methanesulphonic acid (0·96 g) in water (10 ml) was heated on a water-bath for 1 h. The hydrobromide which crystallised on cooling gave needles (1·05 g), m.p. 209—210° (from ethanol–water) (Found: C, 31·7; H, 3·5; N, 10·6. $C_7H_9BrN_2O_2S$ requires C, 31·7; H, 3·4; N, 10·6%), $\nu_{max.}$ 3270, 3120, 1735, 1580, and 1185 cm^{-1}.

Ethyl 5,6-Dihydro-3-methylimidazo[2,1-b]thiazole-2-carboxylate Hydrochloride (16).—A hot solution of imidazoline-2-thiol (1·02 g) in ethyl methyl ketone (60 ml) was treated with ethyl 2-chloroacetoacetate [13] (1·7 g) in one portion

[9] E. Schwenk and D. Papa, *J. Amer. Chem. Soc.*, 1948, **70**, 3626.
[10] D. S. Noyce and J. H. Canfield, *J. Amer. Chem. Soc.*, 1954, **76**, 3630.
[11] E. C. Brittan and J. C. Van der Weele, U.S.P. 2,530,348/1950.
[12] A. Burger and G. E. Ullyot, *J. Org. Chem.*, 1947, **12**, 342.
[13] W. R. Boehme, *Org. Synth.*, Coll. Vol. 4, 1963, p. 592.

and boiled for 15 min under reflux. The *hemihydrate* separated on cooling (1·7 g), m.p. 184—185° (decomp.; slow heating) (from ethanol–ethyl acetate) (Found: C, 42·0; H, 5·7; N, 10·9. $C_9H_{13}ClN_2O_2S,0{\cdot}5H_2O$ requires C, 41·95; H, 5·5; N, 10·9%), $\nu_{max.}$ 3400, 3160, 1715, 1615, and 1140 cm^{-1}.

5,6-*Dihydro*-3-*methylimidazo*[2,1-b]*thiazole*-2-*carboxylic Acid* (17) *Hydrochloride*.—A solution of the foregoing ester hydrochloride (7·6 g) and methanesulphonic acid (4 g) in water (10 ml) was heated for 3 h on a water-bath, concentrated to 5 ml, cooled, and diluted with acetone (5 ml). The precipitate was recrystallised from ethanol–water to give a *solid* (1·5 g), m.p. 256° (decomp.) (Found: C, 38·3; H, 4·1; N, 12·8. $C_7H_9ClN_2O_2S$ requires C, 38·1; H, 4·1; N, 12·7%), $\nu_{max.}$ 3200, 1715, 1600, and 1160 cm^{-1}.

6-(*or* 5-)*Substituted Ethyl* 5(6H)-[*or* 6(5H)]*Oxoimidazo*-[2,1-b]*thiazol*-3-*ylacetates* (18).—A solution of the corresponding 5-substituted 2-thiohydantoin (0·01 mol) and ethyl 4-bromoacetoacetate (0·01 mol) in glacial acetic acid (25 ml) was boiled under reflux for 20 min and evaporated to dryness at reduced pressure. The residue was recrystallised from ethanol–ether to obtain the hydrobromides listed in the Table.

2-{5(6)-*Butyl*-5,6-*dihydro*-6(5)-*oxoimidazo*[2,1-b]*thiazol*-3-*yl*}*acetic Acid*.—The corresponding ethyl ester hydrobromide (2 g) in water (20 ml) containing methanesulphonic acid (0·4 ml) was boiled for 20 min under reflux and evaporated under reduced pressure. The residue was recrystallised twice from ethanol–ether to give a solid (1·4 g), m.p. 204—205° (decomp.) (Found: C, 39·5; H, 4·7; N, 8·0. Calc. for $C_{11}H_{15}BrN_2O_3S$: C, 39·4; H, 4·5; N, 8·4%).

Imidazothiazolone (18) hydrobromides

					Found (%)			Calc. (%)		
R^1	R^2	M.p. (°C) (decomp.)	Yield (%)	Formula	C	H	N	C	H	N
H	H	215—216	70	$C_9H_{11}BrN_2O_3S$	35·2	3·55	9·1	35·2	3·6	9·1
Me	H	189—191	40	$C_{10}H_{13}BrN_2O_3S$	37·3	4·0	8·65	37·4	4·1	8·75
Bu^n	H	166—167	47	$C_{13}H_{19}BrN_2O_3S$	42·7	5·2	7·8	43·0	5·2	7·7
Bu^s	H	178—179	40	$C_{13}H_{19}BrN_2O_3S$	42·7	5·1	7·5	43·0	5·2	7·7
Ph	H	192—193	67	$C_{15}H_{15}BrN_2O_3S$	47·2	3·9	7·4	47·0	3·9	7·3
Me	Me	199—201	48	$C_{11}H_{15}BrN_2O_3S$	39·4	4·5	8·3	39·4	4·5	8·4
Ph	Ph	161—161·5	58	$C_{21}H_{19}BrN_2O_3S$	55·1	4·1	6·2	55·0	4·15	6·1

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