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1,2,3-TRIAZOLO[5,1-b]THIAZOLES; SYNTHESIS AND PROPERTIES

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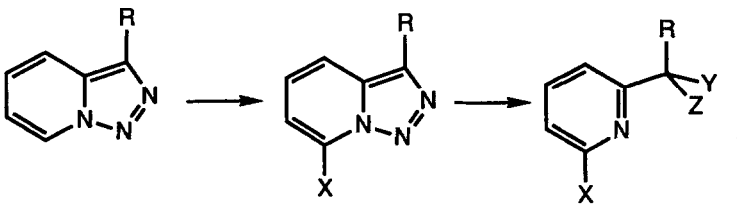
The synthesis of 1,2,3-triazolo[5,1-b]thiazole (15) and its 3-methyl- (16) and 3-phenyl- (17) derivatives is reported, together with their spectra, quaternisation, and ring opening reactions.

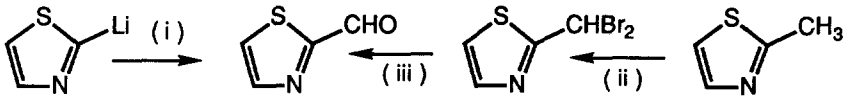
We have reported much interesting chemistry based on 1,2,3-triazolo[1,5-a]pyridines (1), their functionalization, and their use as synthons for 2,6-disubstituted pyridines (Equation 1)[1-5]. We report here, and in the subsequent paper, syntheses of 1,2,3-triazolo[5,1-b]thiazole (15), and 3-substituted derivatives (16) and (17), and their use as synthons for 2,4-disubstituted thiazoles. A short communication has recently appeared reporting the preparation of triazolothiazole (15) and its 6-methyl derivative, but no chemical reactions were reported.[6]



Eq. 1

The most obvious and simple route to the required triazolothiazoles starts from thiazole-2-carboxaldehyde (1), or the 2-acylthiazole (2) or 2-aroylthiazole (3). There are a number of routes reported to the aldehyde (1), four of them being examined by Iversen and Lund[7]. Of their methods the best yields were claimed for the reaction between 2-thiazolyllithium (4) and dimethylformamide (61%). We were unable to obtain such a yield but substitution of N-formylmorpholine[8] in the reaction with the thiazolyllithium (4) gave the aldehyde (1) in 80% yield. We have also prepared the aldehyde (1) from 2-methylthiazole (5) via the dibromomethyl derivative (6), obtained in 79% yield using N-bromosuccinimide, the dibromomethyl derivative (6) being hydrolyzed in virtually quantitative yield to aldehyde (1) using aqueous ethanolic silver nitrate solution. The problem with this second route comes from the difficulty

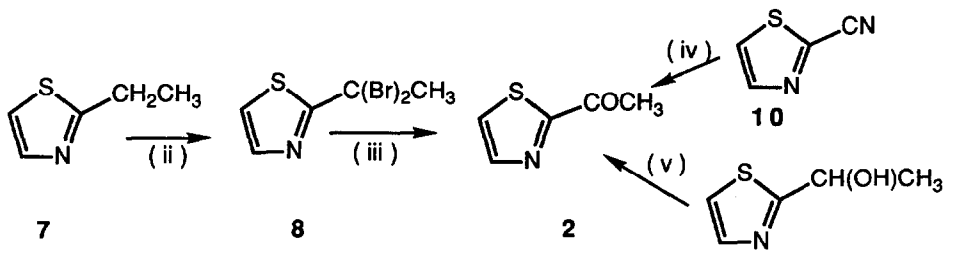
of preparation of 2-methylthiazole (5) in good yields. In our hands yields were low in the reaction between 2-thiazolyllithium and methyl iodide or methyl sulphate[7], in the Hantzsch synthesis[9], and in the dehydrogenation of 2-methylthiazolines by quinones.[10]



4 **1** **6** **5**

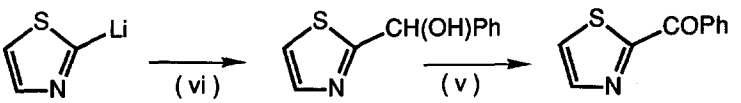
(i) DMF or N-Formylmorpholine (ii) NBS (iii) $AgNO_3$, aq. EtOH

The most successful route to 2-acetylthiazole (2) was from 2-ethylthiazole (7) (prepared by a Hantzsch synthesis[9]) by bromination (NBS) to give the dibromoethylthiazole (8), and hydrolysis to ketone (2) in 91% yield. High yields of ketone (2) were obtained by oxidation of 1-(2-thiazolyl)ethanol (9), or by reaction between 2-cyanothiazole (10) and methylmagnesium iodide, but the required starting materials (9) and (10) for these routes could be obtained only in poor yield.



(iv) MeMgI (v) $Na_2Cr_2O_7$

Reaction between 2-thiazolyllithium (4) and benzaldehyde gave the alcohol (11) in 54% yield, and dichromate oxidation of alcohol (11) gave 2-benzoylthiazole (3) in 90% yield.

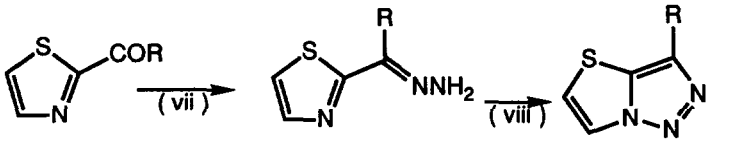


4 **11** **3**

(vi) PhCHO

The carbonyl compounds (1)-(3) when treated with excess hydrazine hydrate at 90-100°C gave hydrazones (12), (13) and (14) in yields of 98, 90, and 66% respectively. In the case of 2-benzoylthiazole (3) two isomeric hydrazones were obtained, assumed to be the *syn* and *anti* forms (14a) and (14b). Both forms could be converted into 3-phenyltriazolothiazole (17). A number of oxidizing agents were examined in attempts to convert hydrazones (12)-(14) into triazolothiazoles (15)-(17). Lead tetraacetate gave 3-methyltriazolothiazole

(16) in 74% yield but gave mixtures in other cases; the most consistent yields were obtained by treating solutions of the hydrazones (12)-(14) in dichloromethane with nickel peroxide[11]. Yields of compounds (15)-(17) were 79, 75, and 96% respectively. By the above methods the triazolothiazoles (15)-(17) are available in 10-30 gm. quantities.



1	**R=H**	**12**	**R=H**	**15**	**R=H**
2	**R=Me**	**13**	**R=Me**	**16**	**R=Me**
3	**R=Ph**	**14**	**R=Ph**	**17**	**R=Ph**

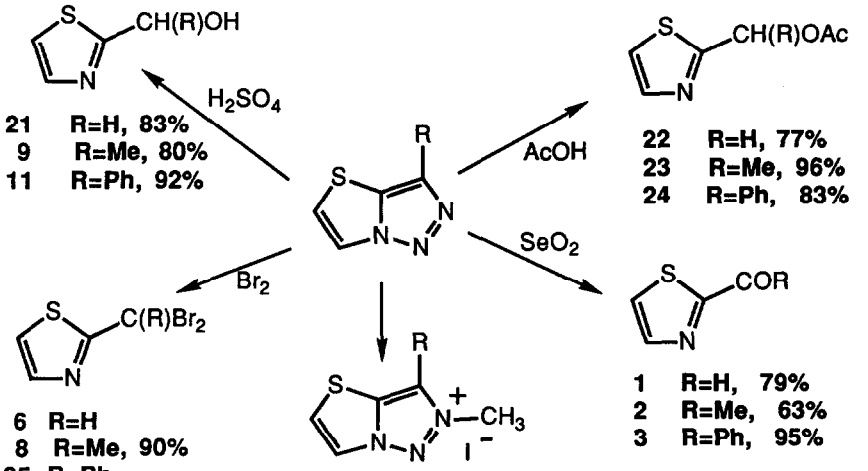
(vii) NH_2NH_2 (viii) Ni Peroxide

The triazolothiazoles were characterized by microanalysis and by n.m.r. and mass spectra. In the ^1H n.m.r. spectrum of compound (15) three signals were present, a singlet at δ7.5 and an AB pair at δ7.15 and 8.0 (J=4 Hz). The same AB pair was present in compound (16) (δ7.1 and 7.95, J=4 Hz) and in compound (17) (δ7.28 and 8.08, J=4.15 Hz). The methyl signal in compound (16) was at δ2.45, the phenyl ring protons in compound (17) at δ7.33-7.59 (3H, m) and δ7.86 (2H, dd, H2', H6', J=8.3 and 1.7 Hz), the latter demonstrating an apparent electron withdrawing (deshielding) effect from the adjacent triazole ring. The more downfield of the AB signals was assigned as H6, by analogy with thiazole and with triazolopyridine.[1] L'Abbe and his coworkers have reported in detail on the equilibrium between triazolothiazole (15) and its open chain diazo tautomer[6]. We have, in general, noted only the triazolothiazole signals. The ^{13}C n.m.r. spectrum of compound (15) showed the expected four signals at δ119.38, 119.75, 123.55 and 137.07, the first three being doublets under off resonance irradiation. The triazolothiazoles (16) and (17) showed off resonance doublets at δ119.26 and 119.36 and at 119.75 and 121.14 respectively, indicating that the signal due to C3 in compound (15) is that at 123.55. We assign the signal at lower field of the pair near 120 p.p.m. of the triazolothiazoles to C6, with that at C5 at slightly higher field. The parent compound (15), as expected, showed the base peak in the mass spectrum to be the molecular ion. Triazolothiazoles (16) and (17) also showed substantial M^+ peaks. All showed substantial peaks at M-28, due to loss of nitrogen from the triazole ring, a feature also of triazolopyridines.[1] The base peak in the methyl derivative (16) was at 58 m.u. (C_2H_2S, the thiirene ion), which is a common fragment in the mass spectra of thiazoles. The electronic absorption spectra of triazolothiazole (15) in ethanol shows maxima at 268 and 352 nm (log10ϵ 3.51 and 2.83), with an inflection at

276 nm. Acidification leaves the 352 nm band unchanged, but the lower wavelength maximum is at 241 nm (log10ϵ 3.33).

We have examined the reaction of the triazolothiazoles (15)-(17) with a number of electrophiles; reactions in general followed the pattern observed with triazolopyridines.[1,3] The triazolothiazoles (15) and (16) reacted with methyl iodide in acetone solutions to give crystalline methiodides (18) and (19) in 100 and 58% yields respectively. Prolonged reaction between triazolothiazole (17) and methyl iodide gave very small amounts of methiodide, even when sulpholane was used as solvent, and this compound (20) was characterized only by ^{1}H n.m.r. spectroscopy. There are two possible sites for alkylation in triazolothiazoles, at N1 and N2. The ^{1}H and ^{13}C shifts for the compounds (18)-(20) are given in the Table and show a large downfield shift in the signal due to H3 of compound (18), and smaller but still substantial downfield shifts in signals due to H5 and H6, these being mirrored in the spectra of compounds (19) and (20). A DIFNOE spectrum of compounds (18) and (19), with irradiation of the quaternary methyl signal showed enhancement of the singlet due to H3 and of the C3 methyl signal respectively, establishing the position of alkylation as N2.

We have reported that most electrophiles react with triazolopyridines to give pyridines, with loss of dinitrogen. We have reacted the triazolothiazoles (15)-(17) with dilute sulphuric acid, with boiling glacial acetic acid, with bromine in dichloromethane, and with selenium dioxide in boiling dioxan, and the results are summarized in the SCHEME.



SCHEME

The reactions with hot dilute sulphuric acid gave the alcohols (9), (11), and (21) of which the first two were identical with materials previously synthesized and the third, compound (21) was characterized by comparison with

literature data, and by its ^{1}H n.m.r. spectrum which showed signals at δ4.9 (2H, s, CH_2OH), 5.1 (1H, brs, OH), 7.2 (1H, d, H5, J=3.5 Hz), and 7.6 (1H, d, H6, J=3.5 Hz). The three acetates (22), (23), and (24) gave correct analysis figures and molecular ions and showed the expected n.m.r. signals. The oxidations using selenium dioxide gave the aldehyde (1) and ketones (2) and (3) identical with synthetic specimens. The reactions with bromine were less satisfactory than those done on triazolopyridines[1]. The parent triazolothiazole (15) gave a mixture of the dibromomethylthiazole (6) and its hydrobromide, and the 3-phenyl derivative gave a virtually quantitative yield of a compound with the correct n.m.r. spectrum for the dibromobenzylthiazole (25) which decomposed when attempts were made to purify it. Attempts to nitrate triazolothiazole (15) gave no identifiable products. The numerous lithiation experiments performed on the triazolothiazoles are reported in the accompanying paper.

EXPERIMENTAL

M.p.s. were determined on a Kofler heated stage and are uncorrected. Chromatography on the Chromatotron used 0.2 mm silica (Merck PF_{254}). N.m.r. spectra were determined for $CDCl_3$ solutions except when otherwise stated.

Thiazole-2-carboxaldehyde (1) a) Prepared by the method of Dondoni et al.[8] in 79% yield, b.p. 62-64°C/15 mm Hg (lit.[8] b.p. 61-63°C/15 mm Hg), δ7.65 (1H, dd, H5, J=2 and 3.5 Hz), 8.0 (1H, d, H4, J=3.5 Hz), 9.95 (1H, d, CHO, J=2 Hz).

b) A mixture of 2-methylthiazole (5) (1.46 g.) and N-bromosuccinimide (5.25 g.) and carbon tetrachloride (38 ml.) was boiled over a 100 w. tungsten bulb (1.75 h.) progress of the reaction being monitored by n.m.r. spectroscopy. Filtration of the cooled mixture and evaporation of the solvent gave virtually pure (by n.m.r.) 2-dibromomethylthiazole (6), (3.0 g., 79%), δ(^{1}H) 6.8 (1H, s, $CHBr_2$), 7.4 (1H, d, H4, J=3 Hz), and 7.7 (1H, d, H5, J=3 Hz). The material was used unpurified for the hydrolysis.

The dibromomethylthiazole (6) (3 g.) in ethanol (45 ml) was mixed with an aqueous solution of silver nitrate (4.17 g., in 15 ml) and the mixture boiled (15 min.). The cooled solution was acidified with concentrated hydrochloric acid (16.8 ml), the silver salts removed by filtration, and the filtrate evaporated under reduced pressure. The residue was neutralized with saturated sodium bicarbonate and extracted with dichloromethane. The organic extracts were dried (Na_2SO_4) and evaporated to give an orange liquid (1.32 g., 100%) shown by n.m.r. spectroscopy to be pure thiazole-2-carboxaldehyde, identical with the sample obtained by route (a).

2-Acetylthiazole (2). - a) Bromination of 2-ethylthiazole (7)[9] as described for compound (5) gave 2-(1,1-dibromoethyl)thiazole (8), b.p. 65°C/0.02 mm Hg, (98% yield). (Found: C, 22.25; H, 1.6; N, 5.25. $C_5H_5Br_2NS$ requires C, 22.15; H, 1.85; N, 5.15%). δ(^{1}H) 2.9 (3H, s), 7.35 (1H, d, H5, J=3 Hz), 7.7 (1H, d, H4, J=3 Hz). m/z 273 (1.4), 271 (2.9), 269 (1.4), 192 ((M+2)-Br, 190 (M-Br). Hydrolysis as

described for compound (6) gave almost pure 2-acetylthiazole (2) b.p. 103-105°C/15 mm Hg).

b) A Grignard solution was prepared from methyl iodide (9.23 g.) and magnesium (1.73 g.) in anhydrous ether (10 ml) and slowly added to a cooled solution of 2-cyanothiazole[13] (6.05 g.) in ether (50 ml). After stirring (3 h.), the mixture was hydrolysed with cold hydrochloric acid (50 ml), (5M), the separated aqueous layer basified with aqueous ammonia (30 ml, 0.880 s.g.) and extracted with ether. The dried ether extracts were evaporated to give 2-acetylthiazole (2), (4.75 g., 68%).

c) A solution of 1-(2-thiazolyl)ethanol (9) (1.8 g.), and sodium dichromate (1.6 g.) in glacial acetic acid (20 ml) and water (2 ml) was heated on a boiling water bath (1 h.), the hot solution poured on to ice, and made alkaline with 4M sodium hydroxide. Steam distillation gave 2-acetylthiazole in 73% yield (1.3 g.).

2-Benzoylthiazole (3). - Prepared by a modification of Kurkjy and Brown's procedure.[14] A solution of 2-bromothiazole (16.4 g., 0.1 mole) in ether (20 ml) was added to n-butyllithium (0.11 moles in hexane) at -40°C. The dark reaction mixture was stirred (15 min.), benzaldehyde (10.61 g., 0.1 mole) added at -30°C and the temperature allowed to rise to -15°C then stirred at this temperature (45 min.). The mixture was poured on to ice/dilute hydrochloric acid, the acid layer separated and basified with ammonia (s.g. 0.880). Extraction with ether, drying (Na_2SO_4), and evaporation gave a light brown residue which solidifed (10.3 g., 54%). A sample of the phenylthiazolylmethanol (11) recrystallized from cyclohexane had m.p. 107-109°C). $\delta(^1H)$ 7.25-7.5 (6H, m), 7.65 (1H, d, H4, J=4 Hz). Oxidation with sodium dichromate[14] gave 2-benzoylthiazole (3), m.p. 44-45°C (petroleum b.p. 60-80°C) (lit.[14] m.p. 44-44.5°C). (Found: C, 63.35; H, 3.6; N, 7.4. Calculated for $C_{10}H_7NOS$, C, 63.5; H, 3.7; N, 7.4%). $\delta(^1H)$ 7.45-7.6 (3H, m), 7.65 (1H, d, H5, J=4 Hz), 8.05 (1H, d, H4 J=4 Hz), 8.5 (2H, dd, H2 and H6', J=3 and 6 Hz).

Formation of Hydrazones (12) - (14). The aldehyde (1) and ketones (2) and (3) were heated at 90-100°C in hydrazine hydrate (roughly 1 part to 3 of hydrazine). Reaction was complete in 30 minutes for compounds (1) and (2), but required 3 days for the benzoylthiazole (3). The cooled reaction mixtures were mixed with an equal volume of 30% aqueous sodium hydroxide extraction with dichloromethane gave, after drying (Na_2SO_4), and evaporation, the hydrazones, in yields of 90, 98, and 66% (**CAUTION:** We have subsequently observed an explosion on evaporation of dichloromethane solutions which have been used to extract organic material from a mixture containing hydrazine; we now use ether for all such extractions).

Hydrazone (12) had b.p. 95°C/0.01 mm Hg (bulb tube) and $\delta(^1H)$ 5.9 (2H, brs, NH_2), 7.1 (1H, d, H5, J=4 Hz), 7.7 (1H, d, H4, J=4 Hz), and 7.9 (1H, s, CH=N). Hydrazone (13) had m.p. 100-103°C (from ethanol). m/z 143 (10.4), 142 (81), 141 (100, M^+), 111 (20%, $M-N_2H_2$). $\delta(^1H)$ 2.3 (3H, s), 5.6 (2H, brs, NH_2), 7.25 (1H,

d, H5, J=4 Hz), and 7.75 (1H, d, H4, J=4 Hz). Hydrazone (14) was separated by chromatography on alumina (Woelm, activity 4), eluting with 5 to 10% of ethyl acetate in petroleum (b.p. 60-80°C). From mixed hydrazone (4 g.) was obtained the anti isomer (14a) as an orange oil (1.48 g.) as an orange oil b.p. 168-172°C/0.5 mm Hg. δ^1H 7.9 (1H, d, H4, J=4 Hz), 7.1-7.7 (6H, m), 8.2-8.8 (2H, brs, NH2). The syn isomer (14b) was a yellow solid, m.p. 79-81°C (0.95 g.); δ(^{1}H) 5.4-5.9 (2H, brs, NH2), 7.1 (1H, d, H5, J=4 Hz), 7.35 (5H, s, phenyl), 7.6 (1H, d, H4, J=4 Hz). Neither isomer could be further purified without partial interconversion. The hydrazones (12)-(14) were oxidized to triazolothiazoles without further purification.

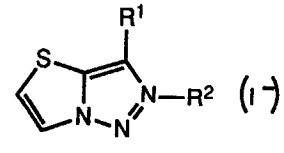
Cyclization of Hydrazones (12)-(14) to 1,2,3-Triazolo[5,1-b]thiazoles (15)-(17). - a) To a stirred solution of lead tetra-acetate (5.5 g.) in anhydrous benzene (100 ml) was added a solution of 2-acetylthiazole hydrazone (13) (1 g.) in anhydrous benzene (145 ml). The mixture was stirred at room temperature (30 min.), then shaken with a saturated aqueous solution of sodium bicarbonate. The separated organic layer was dried (Na_2SO_4) and evaporated to give an orange solid, purified on a Chromatotron plate, eluting with ethyl acetate/petroleum b.p. 60-80°C (1:9) to give 3-methyltriazolothiazole (16) as a yellow solid (0.73 g., 74%), identical with that produced by method (b).

b) General procedure for nickel peroxide oxidation. Freshly prepared nickel peroxide[11] (56.5 g., 0.2125 x 10^{-2} g. oxygen by titration) was added to a well stirred solution of the hydrazone (0.05 mole) in dichloromethane (177 ml.) under a nitrogen atmosphere. Progress of the reaction was monitored by t.l.c. When all hydrazone had been consumed, the mixture was filtered, the spent nickel peroxide well washed with more dichloromethane, and the combined organic solutions evaporated. Mode of purification and physical data are given for each compound.

1,2,3-Triazolo[5,1-b]thiazole (15). Obtained from hydrazone (12) in 79% yield the triazolothiazole (15) had m.p. 81°C (from cyclohexane). (Found: C, 38.05; H, 2.35; N, 33.5. $C_4H_3N_3S$ requires C, 38.4; H, 2.4; N, 33.6%). Spectral data is given in the discussion and Table. The methiodide (18), prepared in acetone, had m.p. 239-241°C (from methanol). (Found: C, 22.45; H, 2.25; N, 15.75. $C_5H_6IN_3S$ requires C, 22.6; H, 2.25; N, 15.2%). N.m.r. data are given in the Table. 3-Methyl-1,2,3-triazolo[5,1-b]thiazole(16). - Obtained from hydrazone (13) in 75% yield, the methyltriazolothiazole(16), had m.p. 126-128°C (from cyclohexane). (Found: C, 43.2; H, 3.7; N, 30.45. $C_5H_5N_3S$ requires C, 43.15; H, 3.6; N, 30.2%). Spectral data is given in the discussion and Table. The methiodide (19), had m.p. 176-178°C (from methanol). (Found: C, 25.65; H, 2.8; N, 14.95%). N.m.r. data are given in the Table.

3-Phenyl-1,2,3-triazolo[5,1-b]thiazole (17). - Obtained from the hydrazone (14a) and from the hydrazone (14b) in 96 and 94% yields respectively, the

TABLE N.m.r. Spectral Details of Triazolothiazoles and Methiodides



(I)

Cpnd.	Solv.	R^1	R^2	H3	H5	H6	Other	JValues(Hz)	C3	C5	C6	C3a	Other
15	C	H	-	7.5(s)	7.15(d)	8.0(d)	-	$J_{5,6}$=4	123.55	119.38	119.25	137.07	-
18	D	H	CH_3	8.96(d)	8.29(d)	8.94(dd)	3.4(3H,s)	$J_{5,6}$=4.15 $J_{3,6}$=0.74	130.12	120.62	125.08	140.86	39.51(CH_3N^+)
16	C	CH_3	-	-	7.1(d)	7.95(d)	2.45(3H,s)	$J_{5,6}$=4	132.32	119.26	119.36	133.93	11.02(CH_3)
19	D	CH_3	CH_3	-	8.33(d)	8.91(d)	3.35(3H,s) 4.32(3H,s)	$J_{5,6}$=4.15	129.33	120.58	132.93	138.12	9.21(CH_3)36.92 (CH_3N^+)
17	C	Ph	-	-	8.30(d)	8.95(d)	7.33-7.59 (3H,m) 7.86(2H, dd)		136.83	119.75	121.14	132.86	125.09 (C3',C5') 127.79(C4'), 129.03 (C2',C6'), 129.98(C1')

C = $CDCl_3$ D = d_6-DMSO

phenyltriazolothiazole (17) had m.p. 167-168°C (from ether). (Found: C, 59.45; H, 3.4; N, 21.05. $C_{10}H_7N_3S$ requires C, 59.7; H, 3.5; N, 20.9%). Physical data are given in the discussion and in the Table.

Reaction of Triazolothiazoles with Aqueous Sulphuric Acid. - A solution of the triazolothiazole in 2M sulphuric acid (approximately 1 part in 10) was boiled; compounds (15) and (16) required 2.5 h., compound (17) required 5 h. The cooled solutions were basified (aq. $NaHCO_3$), and organic products extracted with dichloromethane. The products were 2-hydroxymethylthiazole (21), b.p. 60°C/0.04 mm Hg (bulb distillation) (lit.[15] b.p. 75-76°C/0.2 mm Hg), 2-(1-hydroxyethyl)thiazole, (9), b.p. 70°C/0.3 mm Hg (identical with a synthetic specimen), and α-phenyl-2-thiazolylmethanol (11), m.p. 107-109°C (cyclohexane) (identical with a synthetic specimen).

Reaction of Triazolothiazoles with Glacial Acetic Acid. - A solution of the triazolothiazole in glacial acetic acid (~0.5 g. in 10 ml of acid) was boiled (2 h.). Evaporation of the solvent under reduced pressure, followed by treatment with saturated aqueous $NaHCO_3$ and extraction (dichloromethane), gave the crude products. Compound (22) was purified by bulb tube distillation; compounds (23) and (24) required passage across a Chromatotron plate (eluent ethyl acetate/petroleum, b.p. 60-80°C) (1:9) and then distillation.

2-Acetoxymethylthiazole (22) had b.p. 39-44°C/0.01 mm Hg. (Found: C, 45.8; H, 4.4; N, 8.65. $C_6H_7NO_2S$ requires C, 45.85; H, 4.45; N, 8.9%). m/z 157 4%, M^+), 115 (M-CH_2=C=O, 100%), 114 (M-CH_3CO, 57%), 43 (74%). δ(^{1}H) 2.15 (3H, s, $COCH_3$), 5.4 (2H, s, OCH_2), 7.35 (1H, d, H5, J=3 Hz), 7.8 (1H, d, H4, J=3 Hz). δ(^{13}C) 20.71 (q, CH_3), 62.45 (t, CH_2), 120.35 (d, C5), 142.84 (d, C4), 164.61 (C2, s), 170.28 (s, C=O). (Lit.[16] (^{13}C) 120.2, 142.8).

2-(1-Acetoxyethyl)thiazole (23) had b.p. 50°C/0.08 mm Hg. (Found: C, 49.05; H, 5.55; N, 8.25. $C_7H_9NO_2S$ requires C, 49.1; H, 5.25; N, 8.2%). m/z 171 (M^+, 5.6%), 129 (M-CH2=C=O, 73%), 128 (M-CH3CO, 88%), 43 (100%). δ(^{1}H) 1.7 (3H, d, CH3CH), 2.1 (3H, s, CH3CO), 6.1 (1H, q, CH(CH3), 7.2 (1H, d, H5, J=3.5 Hz), 7.65 (1H, d, H4, J=3.5 Hz).

2-(α-Phenylacetoxymethyl)thiazole (24) had b.p. 130°C/0.07 mm Hg (Found: C, 61.95; H, 4.75; N, 6.0. $C_{12}H_{11}NO_2S$ requires C, 61.8; H, 4.7; N, 6.0%). m/z 233 (M^+, 20%), 191 (M-CH_2=C=O, 92%), 190 (M-CH_3CO, 100%), 174 (M-CH_3CO_2, 29%), 173 (M-AcOH, 26%), 43 (26%). δ(^{1}H) 2.2 (3H, s, CH_3CO), 7.12 (1H, s, CHOAc) 7.29 (1H, dd, H5, J=3.4 and 1.5 Hz), 7.32-7.41 (3H, m), 7.5 (2H, dd, H2' and H6', J=8.05 and 2.2 Hz), 7.76 (1H, dd, H4 J=3.4 and 0.75 Hz). δ(^{13}C) 20.91 (q, CH3), 74.38 (d, CHOAc), 119.45 (d, C5), 127.16 (d, C2' and C6'), 128.65 (d, C3' and C5'), 128.73 (d, C4'), 143.04 (d, C4), 169.21 (s, C2), 169.3 (s, C=O).

Reaction of Triazolothiazoles with Selenium Dioxide. - A solution of the triazolothiazole in anhydrous dioxan (~0.5 g. in 25 ml) was boiled with suspended selenium dioxide (0.5 g., freshly sublimed) and the progress of the

reaction monitored by t.l.c. The cooled suspension was filtered and the precipitate washed with water. The washings were extracted with dichloromethane, and combined organic extracts and filtrate shaken with aq. $NaHCO_3$, then dried (Na_2SO_4) and evaporated. Products were purified by distillation and were identical in all respects with samples of aldehyde (1) and ketones (2) and (3) obtained by synthesis.

Reaction of Triazolothiazoles with Bromine. - A well stirred solution of the triazolothiazole in dichloromethane (~0.5 g. in 10 ml) was treated at 0-5°C dropwise with a solution of an equimolar quantity of bromine in dichloromethane (10 ml). Nitrogen evolution was observed. After addition of the bromine stirring was continued (1-2 h.). In the case of triazolothiazole (15) a gum was obtained. Basification (saturated aq. $NaHCO_3$) and separation of the dichloromethane solution gave, after drying (Na_2SO_4) and evaporation, a brown oil, purified by distillation. Comparison with synthetic specimens confirmed the structures of compounds (6) and (8). Compound (25) decomposed when attempts were made to purify it by passage across a Chromatotron plate.

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