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1,4,5-THIADIAZEPINES—II[1]

A NOVEL RING CONTRACTION GIVING 1,4-THIAZINE DERIVATIVES

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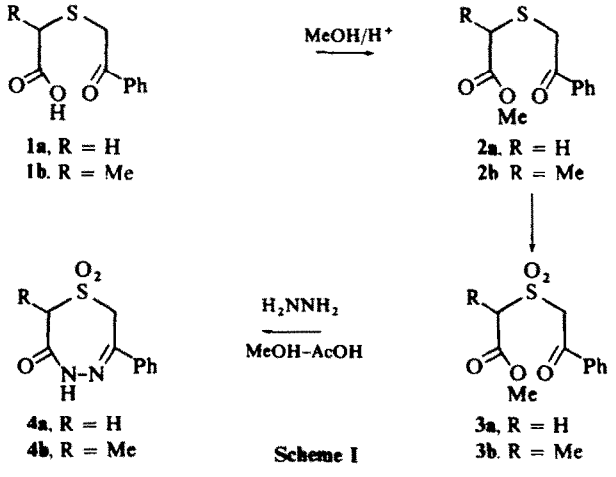
Abstract—Cyclization of methyl (phenacylsulphonyl)acetate (**3a**) and methyl 2-(phenacylsulphonyl)-propionate (**3b**) with hydrazine gave 6-phenyl-2,3,4,7-tetrahydro-1,4,5-thiadiazepin-3-one 1,1-dioxide (**4a**) and its 2-methyl derivative (**4b**), respectively. The new thiadiazepines, unlike previously described derivatives, did not undergo desulphonylation when heated in various solvents. Brief reflux of **4a** in acetic anhydride gave the O-acetyl derivative (**6**), while prolonged reflux resulted in extrusion of one nitrogen atom from the 7-membered ring. The mechanism of the ring contraction is discussed in terms of a bicyclic diaziridine intermediate (**13**).

THE FEW monocyclic 1,4,5-thiadiazepines reported hitherto invariably were 2,7-dihydro-3,6-diaryl derivatives.[1-4] These compounds were found to undergo ring contraction in several different ways, giving pyridazine and pyrazole derivatives.[3] The mechanisms by which these contractions take place, in particular the mechanism of the thermally induced desulphurization and desulphonylation of the 7-membered ring, are not fully known. It was hoped that a study of the properties of 6-phenyl-2,3,4,7-tetrahydro-1,4,5-thiadiazepin-3-one 1,1-dioxide (**4a**) and its 2-methyl derivative (**4b**), in addition to uncovering new thiadiazepine chemistry, may also contribute to an understanding of the known reactions.



1a, R = H
1b, R = Me

2a, R = H
2b R = Me

4a, R = H
4b, R = Me

3a, R = H
3b, R = Me

Scheme I

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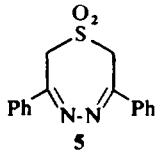
Thiadiazepine **4a** was prepared as outlined in Scheme I. Esterification of (phenacylthio)acetic acid (**1a**) in MeOH gave methyl (phenacylthio)acetate (**2a**), which was oxidized to the corresponding sulphone (**3a**) with *m*-chloroperbenzoic acid. Treatment of **3a** with hydrazine in MeOH and in the presence of some AcOH afforded the desired 7-membered heterocycle in 24% yield. Compound **4b** was prepared similarly, starting with 2-(phenacylthio)propionic acid (**1b**).

The precursor sulphides and sulphones, and the new thiadiazepines, gave spectral data consistent with the structures assigned (Experimental). The NMR spectra of **2b** and **3b** showed AB quartets due to magnetically nonequivalent phenacyl methylene protons, as might be anticipated in view of the presence of an asymmetric center across the sulphur atom.[5] The NMR spectrum of **4a** exhibited singlets for both the C-2 and C-7 methylene groups (at δ 4·28 and 4·91, respectively). The apparent chemical shift equivalence of the protons in each of these methylene groups is contrary to the considerable nonequivalence which is observed in 2,7-dihydro-3,6-diphenyl-1,4,5-thiadiazepine 1,1-dioxide (**5**).* This difference may suggest that the thiadiazepine ring in **4a** is considerably less puckered than in **5**. The fact that the C-7 methylene protons of **4b** gave rise to an AB system (centered at δ 4·89) is not inconsistent with such conclusion. These methylene protons are nonequivalent because one is *cis* and the other is *trans* to the C-2 methyl group.



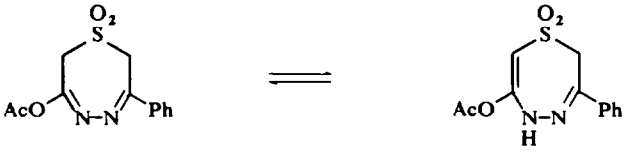
5

In contrast to the facile conversion of **5** to 3,6-diphenylpyridazine in boiling EtOH or AcOH,[3] compound **4a** proved to be quite stable. It was recovered in good yield after prolonged reflux in *n*-BuOH, AcOH, or pyridine. The thermal desulphonylation of **5** may involve initial oxidation of the thiadiazepine ring (*e.g.*, in its N,N′-dihydro tautomeric form, by air) to 3,6-diphenyl-1,4,5-thiadiazepine 1,1-dioxide. The fully unsaturated derivative would be expected to lose SO_2 similarly to 3-benzothiepin 3,3-dioxide.[7] If this is the mechanism, then the failure of **4a** to lose SO_2 could be attributed to its demonstrated resistance to oxidation under these conditions.

Reflux of an Ac_2O solution of **4a** for a few min afforded 3-acetoxy-2,7-dihydro-6-phenyl-1,4,5-thiadiazepine 1,1-dioxide (**6**), identified by IR and NMR spectral data. The IR spectrum showed an intense carbonyl band at 1718 cm^{-1}, while the lactam band at 1668 cm^{-1} was absent. The NMR spectrum exhibited two singlets in the methylene region, in addition to Me and Ph protons. However, attempted recrystallization of **6** from $CHCl_3$–CCl_4 yielded an isomeric compound, tentatively identified as 3-acetoxy-4,7-dihydro-6-phenyl-1,4,5-thiadiazepine 1,1-dioxide (**7**). The IR spectrum of **7** displayed a carbonyl band at 1765 cm^{-1}, but no NH stretching frequency in the usual region around 3400 cm^{-1}, possibly due to a shift of this band

* Under similar conditions, *i.e.* DMSO-d_6 solution at ambient probe temperature, the NMR spectrum of **5** exhibited an AB system (actually AA′BB′, due to additional coupling via the sulphur) centred at δ 4·73 ($\Delta\nu_{AB}$ = 43 Hz, J_{AB} = 14·3 Hz, methylene protons), suggesting considerable ring puckering in this molecule.[6]

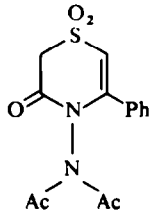
into the CH stretching (Nujol) region. Such a shift may result from strong intramolecular hydrogen bonding between the NH and the carbonyl group, as is the case in IR spectra of various β-amino-α,β-unsaturated ketones.[8,14] The NMR spectrum of **7** indicated the presence of one methylene group and one vinyl proton



6 **7**

in the molecule. Heating of **6** in DMSO gave a mixture containing *ca.* 40% of **6** and 60% of **7**. Isomer **7** reverted completely (by NMR) to **6** when dissolved in Ac_2O, and **6** lost the acetyl group and reverted to **4a** when heated in EtOH.

Reflux of an Ac_2O solution of **4a** for a few hours resulted in extrusion of one nitrogen atom from the 7-membered ring. The ring-contraction product, 4-(diacetylamino)-2,3-dihydro-5-phenyl-4H-1,4-thiazin-3-one 1,1-dioxide (**8**), was assigned this structure on the basis of elemental analysis, mass spectral analysis, and in particular IR and NMR spectral data.



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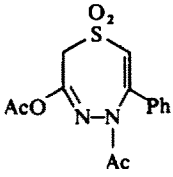
The IR spectrum of **8** exhibited carbonyl absorption bands at 1743 (shoulder), 1731, and 1710 cm^{-1}. Although these frequencies are considerably higher than those reported for N,N-diacetylamines (1692 cm^{-1}),[9] they appear to be typical of triply acylated hydrazine derivatives. Thus, the carbonyl bands of 1,2,2-triacetyl-1-*p*-nitrophenylhydrazine were observed at 1745 and 1720 cm^{-1},[10] and those of 1-benzoyl-2,2-diacetyl-1-phenylhydrazine at 1730 and 1720 cm^{-1}.[11] The NMR spectrum of **8** showed two equivalent acetyl groups, a doublet due to the C-2 methylene protons, and a triplet due to the C-6 vinyl proton. The signal splitting results from coupling of the methylene and vinyl protons across the sulphur atom, a phenomenon known to occur in 1,4-thiazine derivatives.[12,13] The magnetic equivalence of the two acetyl groups was maintained in various solvents (*e.g.* $CDCl_3$, DMSO-d_6, C_6D_6), and is therefore not accidental. This observation rules out alternative structures for the diacetyl derivative (*e.g.* **9**, **10**, or **11**).

Compound **8** was recovered unchanged after a brief treatment of a solution in $CHCl_3$-CCl_4 with bromine. The retardation of bromine addition to the olefinic linkage is attributed to the strong inductive effect of the adjacent sulphonyl group. A similar reluctance to add bromine was observed in various open-chain α,β-unsaturated sulphones.[15,16]



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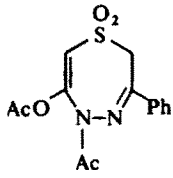

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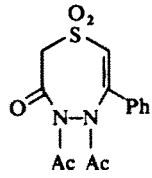

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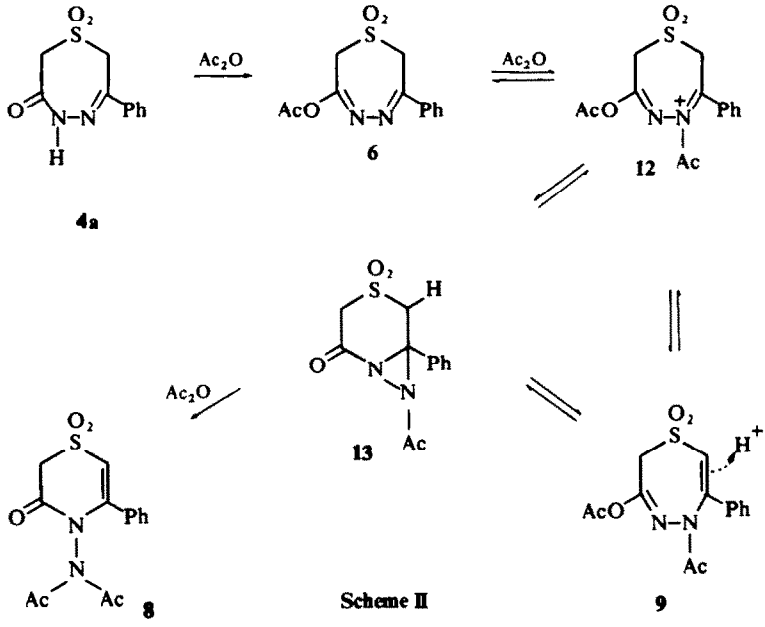
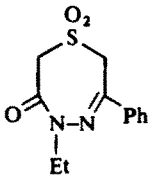
A probable mechanism for the formation of **8** is illustrated in Scheme II. Acetylation of the N-5 atom of compound **6** affords ion **12**. This ion may lose the N-acetyl group and revert to **6**, it may lose the O-acetyl group and give bicyclic intermediate **13**, or it may lose a proton and give diacetyl derivative **9**. Each of these conversions is expected to be reversible in boiling Ac_2O. Bicyclic intermediates similar to **13** have been proposed in rearrangements of several diazepinones,[17–19] and are probably



Scheme II

formed in related ring contractions [20,21] as well. Collapse of the diaziridine ring of **13** under the reaction conditions would be expected to afford diacetyl derivatives **8**, **9**, or **12**. However, only the formation of compound **8** would be irreversible, and therefore its concentration increases with the progress of the reaction. The concentrations of intermediates **9**, **12**, and **13** must be very small at any period during the reaction. When the reaction was monitored by NMR (actually carried out inside an NMR tube), only compounds **6** and **8** were observed, until the transformation was completed.

Treatment of **4a** with bromoethane in boiling acetone and in the presence of K_2CO_3 gave the N-ethyl derivative **14**. This compound was recovered unchanged after a brief reflux in Ac_2O.



14

The ring contraction of **4a** in Ac_2O represents a new route to substituted 1,4-thiazines. The parental relationship of the latter heterocycles to the well-known and psychopharmacologically active phenothiazines renders them of considerable interest. The scope of this reaction is currently under investigation.

It is worth noting that the IR spectra of ketoesters **2a**, **2b**, and **3a** exhibited two ketone carbonyl absorption bands, with a frequency separation of 12–15 cm^{-1}. In the case of sulphone **3a**, CO splitting was observed in CCl_4 but not in $CHCl_3$ solution. A similar CO splitting was previously observed in IR spectra of α-halogen[22] and α-aryloxy[23] carbonyl compounds, and was attributed to different intramolecular field effects in equilibrated *cis* and *gauche* rotamers. However, the electronegativities of carbon and divalent sulphur are very nearly equal, and the C—S bonds in **2a** and **2b** are not expected to possess a significant dipole moment. A split CO band was previously observed[24] also in IR spectra of 1-thiacycloöctan-5-one (a δ-keto cyclic sulphide), and was attributed to the presence of S—C_{CO} interacted and non-interacted conformations. On the other hand, the IR spectrum of ethyl mercapto-acetone ($C_2H_5SCH_2COCH_3$) exhibited only a single CO frequency in various solvents, and was shown by a UV study *not* to contain significant contribution of S—C_{CO} interacted forms.[25] Assuming that the S—C_{CO} orbital interaction in open-chain sulphides is rotamer-dependent, the difference between the acetonyl and phenacyl sulphides could possible be attributed to predominance of a non-interacted rotamer in the first and a more balanced rotamer distribution in the second.

EXPERIMENTAL

M.ps were determined on a Kofler hot stage and are uncorrected. IR spectra were measured with a Perkin–Elmer Model 337 spectrophotometer. NMR spectra were recorded on a Varian A-60 spectrometer, using $CDCl_3$ solutions (unless otherwise noted) with TMS as internal standard.

Methyl (phenacylthio)acetate (**2a**). A soln of 21·0 g (0·1 mol (1) of (phenacylthio)acetic acid (**1a**)[26] in abs MeOH (500 ml) was treated with conc H_2SO_4 (4 ml) and heated under reflux for 22 hr. The MeOH was removed *in vacuo*, the residue dissolved in ether, and the ethereal soln washed with 5% $NaHCO_3$ aq. After drying ($MgSO_4$), the ether was evaporated, yielding 19·7 g (88%) of **2a** as a pale yellow oil: IR (neat) 2946, 1735 (vs, ester C=O), 1675 (shoulder at 1687, ketone C=O), 1598 and 1580 (aromatic C=C), 1449, 1433, 1280, 1200 (Ph—CO—).[29] 1159, 1128, 1012, 1000, 749 and 689 (aromatic CH), 645 cm^{-1}; NMR δ 3·37 (2H, s, $C\underline{H}_2COOR$), 3·74 (3H, s, $COOC\underline{H}_3$), 4·06 (2H, s, $C\underline{H}_2COPh$), 7·36–7·73 (3H, m, aromatic $\underline{H}$), 7·90–8·18 (2H, m, aromatic $\underline{H}$).

The *phenylhydrazone* of **2a** was prepared in the usual way: light yellow needles, m.p. 103–104° (from EtOH): NMR δ 3·25 (2H, s, $C\underline{H}_2COOR$), 3·77 (3H, s, $COOC\underline{H}_3$), 3·90 (2H, s, $C\underline{H}_2C{=}N$), 7·20–7·55 and 7·72–7·98 (10 H), m, aromatic $\underline{H}$). The methylene group adjacent to the hydrazone bond appeared at δ 3·55 in C_6H_6 ($\delta_{CDCl_3} - \delta_{C_6H_6} = 0{\cdot}35$ ppm), suggesting a *syn* relationship with the anilino group.[27] (Found: C, 64·85; H, 5·82. Calc. for $C_{17}H_{18}N_2SO_2$: C, 64·95; H, 5·77%).

2-*(Phenacylthio)propionic acid* (**1b**). A soln of 46·4 g (0·3 mol) of phenacyl chloride in acetone (70 ml)

was added dropwise to a cooled and stirred soln of 37·1 g (0·35 mol) of 2-mercaptopropionic acid in 5N NaOH (140 ml). The mixture was allowed to warm to room temp, the acetone removed, and the aq soln acidified with 1:1 HCl. Extraction with $CHCl_3$, drying ($MgSO_4$) and removal of the solvent, left a colourless solid (63·3 g, mp 87–88°). Recrystallization from CCl_4 gave 55·8 g (83%) of leaflets, m.p. 87·5–88·5° (lit.[28] 88–89°): IR (Nujol) 1700 (broad, C=O), 1594 and 1580 (aromatic C=C), 1420, 1328, 1292, 1246, 1199 (Ph—CO—),[29] 1161, 1081, 999, 984, 930 (broad), 752 and 688 (aromatic CH), 670, 645 cm^{-1}; NMR δ 1·49 (3H, d, J = 7·1 Hz, C—C<u>H</u>$_3$), 3·61 (1H, q, C<u>H</u>), 4·13 (2H, s, C<u>H</u>$_2$COPh), 7·46–7·72 (3H, m, aromatic <u>H</u>), 7·92–8·17 (2H, m, aromatic <u>H</u>), 10·03 (1H, s, COO<u>H</u>).

Methyl 2-(phenacylthio)propionate (**2b**). The same procedure was followed as described for **2a**. Starting with 22·4 g (0·1 mol) of **1b**, 21·4 g (90%) of the ester was obtained as a colourless oil, b.p. 162°/0·1 mm: IR (neat) 2950, 1738 (vs, ester C=O), 1680 (shoulder at 1693, ketone C=O), 1600 and 1582 (aromatic C=C), 1453, 1327, 1279, 1200 (Ph—CO—),[29] 1164, 1071, 1013, 1000, 988, 750 and 691 (aromatic CH), 648 cm^{-1}; NMR δ 1·46 (3H, d, J = 7·2 Hz, C—C<u>H</u>$_3$), 3·60 (1H, q, C<u>H</u>COOR), 3·73 (3H, s, COOC<u>H</u>$_3$), 4·07 (2H, s, C<u>H</u>$_2$COPh), 7·36–7·71 (3H, m, aromatic <u>H</u>), 7·92–8·14 (2H, m, aromatic <u>H</u>): NMR (C_6H_6) δ 3·77 (2H, AB quartet, $\Delta\nu_{AB}$ = 8·6 Hz, J_{AB} = 15 Hz, C<u>H</u>$_2$COPh). (Found: C, 60·26: H, 5·80. Calc. for $C_{12}H_{14}SO_3$: C, 60·48; H, 5·92%).

Methyl (phenacylsulphonyl)acetate (**3a**). A soln of 20·3 g (0·1 mol) of 85% *m*-chloroperbenzoic acid in CH_2Cl_2 (220 ml) was added dropwise to a stirred soln of 11·2 g (0·05 mol) of **2a** in CH_2Cl_2 (50 ml). After one hr, the separated *m*-chlorobenzoic acid was removed by filtration, the filtrate washed twice with 5% $NaHCO_3$ aq, and dried ($MgSO_4$). Evaporation of solvent left an oil which crystallized in EtOH. Recrystallization from EtOH gave 11·0 g (86%) of colourless, long plates, m.p. 58–59°: IR ($CHCl_3$) 3020, 2960, 1746 (ester C=O), 1686 (ketone C=O), 1600 and 1581 (aromatic C=C), 1451, 1440, 1335 (vs, SO_2), 1297, 1280, 1226 (broad), 1182 (w), 1160, 1120 (SO_2), 1001, 988, 887, 682 cm^{-1}; IR (CCl_4) 1695 and 1680 cm^{-1} (split ketone C=O); NMR δ 3·76 (3H, s, COOC<u>H</u>$_3$), 4·34 (2H, s, C<u>H</u>$_2$COOR), 4·91 (2H, s, C<u>H</u>$_2$COPh), 7·38–7·64 (3H, m, aromatic <u>H</u>), 7·81–8·02 (2H, m, aromatic <u>H</u>). Found: C, 51·67; H, 4·73. Calc. for $C_{11}H_{12}SO_5$: C, 51·56; H, 4·72%).

The *phenylhydrazone* of **3a** was prepared in the usual way; colourless, long needles, m.p. 137–138° (from EtOH); IR (Nujol) 3342 (NH), 1746 (ester C=O), 1605, 1552, 1498, 1338, 1293, 1164, 1116, 744 and 685 cm^{-1} (aromatic CH); NMR δ 3·86 (3H, s, COOC<u>H</u>$_3$), 4·07 (2H, s, C<u>H</u>$_2$COOR), 4·83 (2H, s, C<u>H</u>$_2$C=N), 7·23–8·02 (10 H, m, aromatic <u>H</u>). (Found: C, 58·76; H, 5·36. Calc. for $C_{17}H_{18}N_2SO_4$: C, 58·95; H, 5·24%).

Methyl 2-(phenacylsulphonyl)propionate (**3b**). The same procedure was followed as described for **3a**. Starting with 11·9 g (0·05 mol) of **2b**, 12·8 g (95%) of the sulphone was obtained as a thick oil; IR (neat) 2950, 1744 (ester C=O), 1682 (ketone C=O), 1599 and 1580 (aromatic C=C), 1450, 1328 (vs, SO_2), 1277, 1209, 1143, 1128 (SO_2), 1066, 1000, 991, 886, 753 and 688 cm^{-1} (aromatic CH); NMR δ 1·66 (3H, d, J = 7 Hz, C—C<u>H</u>$_3$), 3·78 (3H, s, COOC<u>H</u>$_3$), 3·98 (1H, AX_3 q, C<u>H</u>COOR), 4·56 (2H, AB q, $\Delta\nu_{AB}$ = 6·2 Hz, J_{AB} = 15·6 Hz, C<u>H</u>$_2$COPh), 7·36–7·75 (3H, m, aromatic <u>H</u>), 7·93–8·17 (2H, m, aromatic <u>H</u>). The NMR spectrum showed no impurities and final purification of this sulphone was not attempted.

6-Phenyl-2,3,4,7-tetrahydro-1,4,5-thiadiazepin-3-one 1,1-dioxide (**4a**). To a soln of 7·7 g (0·03 mol) of **3a** in MeOH (200 ml) was added AcOH (5 ml) and 2·5 g (0·05 mol) of hydrazine hydrate. After heating under reflux for 75 hr, the soln was allowed to cool to room temp, and the MeOH partially removed. Filtration of the separated solid and recrystallization from *n*-BuOH gave 1·7 g (24%) of colourless needles, m.p. 303–304° (dec): IR (Nujol) 3202 and 3078 (NH), 1668 (vs, lactam C=O), 1599 (w), 1560 (w), 1445, 1412, 1398, 1356, 1325 (vs, SO_2), 1248, 1160, 1138, 1118 (SO_2), 1008, 920, 839, 774, 731, 689 cm^{-1}; NMR (DMSO-d_6) δ 4·28 (2H, s, C<u>H</u>$_2$CO), 4·91 (2H, s, C<u>H</u>$_2$C–Ph), 7·39–7·67 (3H, m, aromatic <u>H</u>), 7·88–8·11 (2H, m, aromatic <u>H</u>), 11·73 (1H, s, N<u>H</u>). (Found: C, 50·27: H, 4·27. Calc. for $C_{10}H_{10}N_2SO_3$: C, 50·40: H, 4·23%).

2-Methyl-6-phenyl-2,3,4,7-tetrahydro-1,4,5-thiadiazepin-3-one 1,1-dioxide (**4b**). The same procedure was followed as described for **4a**. Starting with 8·1 g (0·03 mol) of **3b**, 1·2 g (16%) of **4b** was collected as colourless plates, m.p. 272–273° (dec): IR (Nujol) 3178 and 3070 (NH), 1667 (vs, lactam C=O), 1600 (w), 1568 (w), 1447, 1412, 1328 (SO_2), 1315, 1265, 1235, 1160, 1128, 1116, 1070, 1010, 912, 780, 736, 688, 632 cm^{-1}; NMR (DMSO-d_6) δ 1·33 (3H, d, J = 6·6 Hz, C–C<u>H</u>$_3$), 4·26 (1H, AX_3 q, C<u>H</u>CO), 4·89 (2H, AB q, $\Delta\nu_{AB}$ = 44 Hz, J_{AB} = 14 Hz, C<u>H</u>$_2$C–Ph), 7·37–7·65 (3H, m, aromatic <u>H</u>), 7·86–8·11 (2H, m, aromatic <u>H</u>). (Found: C, 52·41: H, 4·86. Calc. for $C_{11}H_{12}N_2SO_3$: C, 52·36; H, 4·80%).

Thermal stability of **4a**. Compound **4a** was recovered unchanged after reflux under the following conditions (recovery): (a) *n*-BuOH for 29 hr (84%); (b) AcOH for 18 hr (62%); (c) pyridine for 19 hr (79%); (d) *n*-BuBr for 24 hr (97%); (e) $PhCH_2Cl$ for 3 hr (92%).

Monoacetylation of **4a**. A soln of 0·24 g (1 mmol) of **4a** in Ac_2O (5 ml) was heated under reflux for 8 min. The Ac_2O was evaporated *in vacuo*, the colourless solid residue washed with CCl_4 and dried, yielding 0·28 g (99%) of crude **6**: IR (Nujol) 1718 (ester C=O), 1550, 1333 and 1145 (SO_2), 1263, 1245, 1205 cm^{-1}: NMR (DMSO-d_6) δ 2·50 (3H, s, C$\underline{H}_3$), 4·48 (2H, s, C$\underline{H}_2$C—OAc), 5·15 (2H, s, C$\underline{H}_2$C—Ph), 7·42–7·76 (3H, m, aromatic $\underline{H}$), 7·97–8·20 (2H, m, aromatic $\underline{H}$).

Attempted recrystallization of crude **6** from $CHCl_3$–CCl_4 gave 0·12 g of isomer **7**: colourless needles, m.p. 186–187°, poorly soluble in $CHCl_3$; IR (Nujol) 1765 (ester C=O), 1696 (w), 1358, 1326 and 1130 (SO_2), 1259, 1041 (w), 770, 688 cm^{-1}; NMR (DMSO-d_6) δ 2·34 (3H, s, C$\underline{H}_3$), 4·97 (2H, m, C$\underline{H}_2$C-Ph), 6·48 (1H, d, J = 1·5 Hz, C$\underline{H}$=C), 7·31–7·88 (5H, m, aromatic $\underline{H}$). (Found: C, 51·25; H, 4·48. Calc. for $C_{12}H_{12}N_2SO_4$: C, 51·42; H, 4·32%).

4-(*Diacetylamino*)-2,3-*dihydro*-5-*phenyl*-4H-1,4-*thiazin*-3-*one* 1,1-*dioxide* (**8**). A soln of 0·24 g (1 mmol) of **4a** in Ac_2O (8 ml) was heated under reflux for 6 hr. The Ac_2O was removed *in vacuo*, EtOH added, and the separated solid filtered and dried, yielding 0·16 g (50%) of colourless material, m.p. 198–200°. Recrystallization from EtOH gave colourless prisms, m.p. 202–203°; IR (Nujol) 3071, 1743 (shoulder), 1731, 1710, 1630, 1368, 1318 (SO_2), 1294, 1259, 1218, 1137, 1123, 998, 901, 843, 745, 698, 601 cm^{-1}: NMR δ 2·26 (6H, s, C$\underline{H}_3$), 4·49 (2H, d, J = 1·4 Hz, C$\underline{H}_2$CO), 6·38 (1H, t, C$\underline{H}$=C), 7·20–7·65 (5H, m, aromatic $\underline{H}$). (Found: C, 51·98; H, 4·56. Calc. for $C_{14}H_{14}N_2SO_5$: C, 52·17; H, 4·38%).

4-*Ethyl*-6-*phenyl*-2,3,4,7-*tetrahydro*-1,4,5-*thiadiazepin*-3-*one* 1,1-*dioxide* (**14**). In a flask were placed 0·6 g (2·5 mmol) of **4a**, dry acetone (45 ml), 5·4 g (50 mmol) of bromoethane, and 4 g (29 mmol) of anhyd. K_2CO_3 in this order. After heating under reflux for 15 hr, the mixture was cooled, filtered, and the solvent evaporated, leaving a solid residue. Recrystallization from EtOH gave 0·22 g (33%) of colourless needles, m.p. 149–150°: IR ($CHCl_3$) 3018, 1666 (vs, lactam C=O), 1557 (w), 1447, 1398, 1341 (SO_2), 1321, 1280, 1242, 1205, 1143 (SO_2), 1127, 1092, 838, 689, 568 cm^{-1}: UV (EtOH) 206 (ε 8920), 217 (ε 8580), 260 (ε 8250), 315 mμ (ε 4220): NMR δ 1·28 (3H, t, J = 7·3 Hz, C$\underline{H}_3$), 4·00 (2H, q, N—C$\underline{H}_2$), 4·06 (2H, s, C$\underline{H}_2$CO), 4·55 (2H, s, C$\underline{H}_2$C-Ph), 7·43–7·73 (3H, m, aromatic $\underline{H}$), 7·92–8·16 (2H, m, aromatic $\underline{H}$). (Found: C, 54·21; H, 5·34. Calc. for $C_{12}H_{14}N_2SO_3$: C, 54·12; H, 5·30%).

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