Synthesis of 6-Alkoxy-3-aryl-6-trimethylsilyloxy-5,6-dihydro-4*H*-1,2-oxazines and Their Acid-catalysed Hydrolysis Leading to 3-Aryl-5,6-dihydro-4*H*-1,2-oxazin-6-ones and/or 4-Aryl-4-(hydroxyimino)butyric Acid Esters

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The cycloaddition of α-nitrosostyrene and its ring-substituted derivatives, which are generated by the reaction of α-chloroacetophenone oxime and its ring-substituted derivatives with K_2CO_3 in tetrahydrofuran, with ketene trimethylsilyl acetals proceeds to afford 6-alkoxy-3-aryl-6-trimethylsilyloxy-5,6-dihydro-4*H*-1,2-oxazines. These oxazines are susceptible to hydrochloric acid-catalysed hydrolysis affording 3-aryl-5,6-dihydro-4*H*-1,2-oxazin-6-one and/or 4-aryl-4-(hydroxyimino)butyric acid esters.

Transient nitroso alkenes, which can be easily generated by the reaction of α-halogeno oximes with base, undergo cycloaddition with olefinic compounds affording 5,6-dihydro-4*H*-1,2-oxazines. α-Chloroacetophenone oxime,[1–4] 2-bromo-4′-nitroacetophenone oxime,[2] 2-bromo-3,4-dihydronaphthalen-1(2*H*)-one oxime,[4] ethyl 3-bromo-2-(hydroxyimino)propionate[5] as well as a few 1-chloroalkane-2,3-dione 2-oximes[1] have been employed as the precursors of nitroso alkenes. On the other hand, several enol ethers,[1] trimethylsilyl enol ethers,[3,4,6] allylsilanes,[5] substituted styrenes[2] as well as cyclohexa-1,3-diene[2] have been employed as the reaction partners for the nitroso alkenes. Several kinds of 5,6-dihydro-4*H*-1,2-oxazines have been synthesized by the combination of one of the α-halogeno oximes and the olefinic compounds mentioned above. Further, it has been shown that the 5,6-dihydro-4*H*-1,2-oxazines are susceptible to acid-catalysed ring opening by cleavage of the C(6)-to-endocyclic-oxygen bond.[1] Thus, the conversion of 3-acyl-6-alkoxy-5,6-dihydro-4*H*-1,2-oxazines into the corresponding 2-alkyl-3-methoxypyridine 1-oxides[1] in an aqueous methanol solution saturated with hydrogen chloride, as well as that of 3-ethoxycarbonyl-6-trimethylsilylmethyl-5,6-dihydro-4*H*-1,2-oxazines into the corresponding δ,ε-unsaturated α-ketocarboxylic acid ethyl esters[5] by the action of perchloric or hydrochloric acid, are caused by this ring cleavage. The rearrangement of 3-phenyl-6-trimethylsilyloxy-5,6-dihydro-4*H*-1,2-oxazine into 3,4-dihydro-2-methoxy-5-phenyl-2*H*-pyrrole 1-oxide in methanol containing hydrogen chloride, as well as the acid-catalysed fragmentation of 3-phenyl-6-(trimethylsilyl)oxy-5,6-dihydro-4*H*-1,2-oxazine having a trimethylene or pentamethylene bridge from C-5 to C-6 affording α-methylenecyclopentanone or α-methylenecycloheptanone, have been reported in the literature.[7] These reactions also involve the cleavage of the C-6 to endocyclic oxygen bond.

We report here that the cycloaddition of α-nitrosostyrene and its ring-substituted derivatives, which are the intermediates in the reaction of α-chloroacetophenone oxime and its ring-substituted derivatives with K_2CO_3 in tetrahydrofuran (THF), with ketene trimethylsilyl acetals proceeds smoothly to afford 6-alkoxy-3-aryl-6-trimethylsilyloxy-5,6-dihydro-4*H*-1,2-oxazines **1** in moderate yields and that the obtained oxazines **1** are susceptible to hydrochloric acid-catalysed hydrolysis affording 3-aryl-5,6-dihydro-4*H*-1,2-oxazin-6-ones **2** and/or 4-aryl-4-(hydroxyimino)butyric acid esters **3**. In order to find the best reaction conditions for the cycloaddition, we selected 1-ethoxy-2-methylprop-1-enyloxy(trimethyl)silane as the representative ketene trimethylsilyl acetal and allowed it to react with α-chloroacetophenone oxime in the presence of various bases while changing the reaction medium and time (Table 1). From the experimental data summarized in Table 1, it has been found that the employment of K_2CO_3 and THF as the base and solvent, respectively, provides the best result (the shortest reaction time and highest yield). We have also found in separate experiments that the employment of 5 and 6 mol equiv., respectively, of 1-ethoxy-2-methylprop-1-enyloxy(trimethyl)-silane and K_2CO_3 (per α-chloroacetophenone oxime) is most adequate. The best reaction conditions for synthesizing **1a** have thus been adopted for synthesizing **1b–q**. The results are summarized in Table 2.

Table 1 Reaction of 1-ethoxy-2-methylprop-1-enyloxy(trimethyl)-silane with α-chloroacetophenone oxime in the presence of various bases with changing solvent and reaction times[a]

Base	Solvent	Temp./°C	Time/h	Yield of **1a**(%)[b]
Na_2CO_3	Et_2O	25	120	59
Na_2CO_3	THF	25	20	65
K_2CO_3	Et_2O	25	24	65
K_2CO_3	THF	25	6	71
Et_3N	THF	25	24	0
KOH	THF	25	72	0

[a] To a suspension of 1-ethoxy-2-methyl-1-propenyloxy(trimethyl)-silane(15 mmol) and the base (18 mmol) in solvent (50 cm^3) was added a solution of α-chloroacetophenone oxime (3 mmol) in the same solvent (10 cm^3) at room temperature (25 °C) and stirred at the same temperature. [b] Yields are for isolated **1a**.

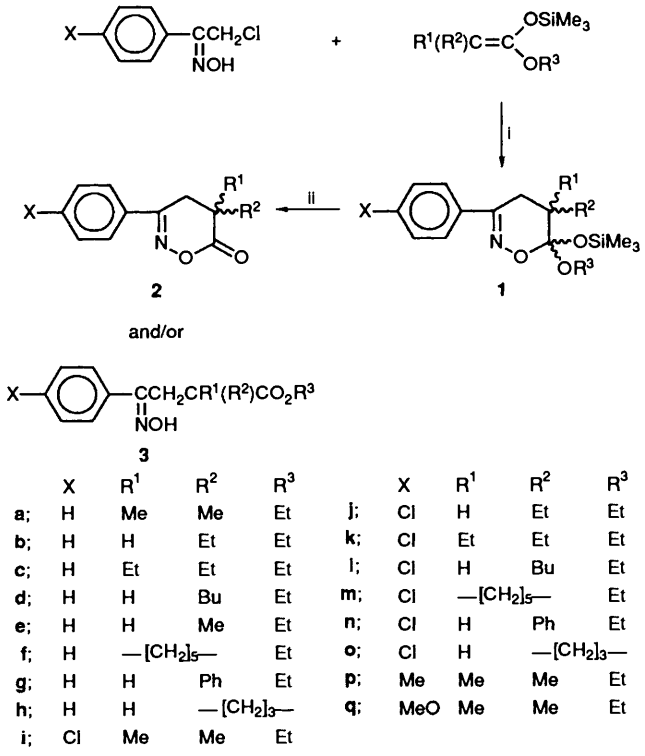
The ^1H NMR spectra of **1** enabled assignment of their structures. In order to determine the regioselectivity of cycloaddition, we selected **1b** as representative of compounds **1** and examined the signals for the two 4-H atoms. Thus, the two 4-H in **1b** appear at δ 2.44 (dd, 1 H, *J* 17.8 and 11.6 Hz) and at δ 2.79 (dd, 1 H, *J* 17.8 and 6.0 Hz).† Therefore, the neighbouring C-5 of **1b** possesses one hydrogen atom, so that C-6 bears the alkoxy and trimethylsilyloxy groups introduced by 1-ethoxybut-1-enyloxy(trimethyl)silane. This implies that the structure of **1b** shown in Scheme 1 is correct. The ^1H NMR spectrum of **1b** suggests that, in general, the cycloaddition of α-nitrosostyrene and its ring-substituted derivatives, generated by the reactions of α-chloroacetophenone oxime and its ring-substituted derivatives with K_2CO_3 in THF, with ketene trimethylsilyl acetals occurs in such manner that the carbon

† These coupling constants indicate that 5-H in **1b** occupied equatorial position.

Table 2 Synthesis of **1** and their acid-catalysed hydrolysis leading to **2** and/or **3**

X in α-halogeno oxime	Acetal R^1	R^2	R^3	Product **1**	Yield[a] (%)	Hydrolysis product [and yield[b] (%)]
H	Me	Me	Et	**1a**	71	**2a** (98)
H	H	Et	Et	**1b**	60	**3b** (49)
H	Et	Et	Et	**1c**	54	**2c** (42)
						3c (35)
H	H	Bu	Et	**1d**	62	**3d** (67)
H	H	Me	Et	**1e**	—[c]	**3e** (34)[d]
H	$-[CH_2]_5-$		Et	**1f**	61	**3f** (48)
H	H	Ph	Et	**1g**	40	**3g** (40)
H	H	$-[CH_2]_3-$		**1h**	70	**3h** (35)
Cl	Me	Me	Et	**1i**	54	**2i** (90)
Cl	H	Et	Et	**1j**	42	**3j** (63)
Cl	Et	Et	Et	**1k**	43	**2k** (53)
						3k (35)
Cl	H	Bu	Et	**1l**	53	**3l** (56)
Cl	$-[CH_2]_5-$		Et	**1m**	58	**2m** (12)
						3m (12)
Cl	H	Ph	Et	**1n**	44	**3n** (45)
Cl	H	$-[CH_2]_3-$		**1o**	50	**3o** (48)
Me	Me	Me	Et	**1p**	54	**2p** (80)
MeO	Me	Me	Et	**1q**	45	**2q** (65)

[a] Yields are for isolated **1**. [b] Yields of isolated products based on **1**. [c] It was impossible to isolate **1e** by column chromatography, because it rapidly decomposes during column chromatography. [d] The crude **1e** obtained by the removal of reaction medium, without the column-chromatographic purification, was submitted to hydrolysis. The value 34% is the total yield of **3e** throughout both the cycloaddition and the hydrolysis.



	X	R^1	R^2	R^3		X	R^1	R^2	R^3
a;	H	Me	Me	Et	j;	Cl	H	Et	Et
b;	H	H	Et	Et	k;	Cl	Et	Et	Et
c;	H	Et	Et	Et	l;	Cl	H	Bu	Et
d;	H	H	Bu	Et	m;	Cl	$-[CH_2]_5-$		Et
e;	H	H	Me	Et	n;	Cl	H	Ph	Et
f;	H	$-[CH_2]_5-$		Et	o;	Cl	H	$-[CH_2]_3-$	
g;	H	H	Ph	Et	p;	Me	Me	Me	Et
h;	H	H	$-[CH_2]_3-$		q;	MeO	Me	Me	Et
i;	Cl	Me	Me	Et					

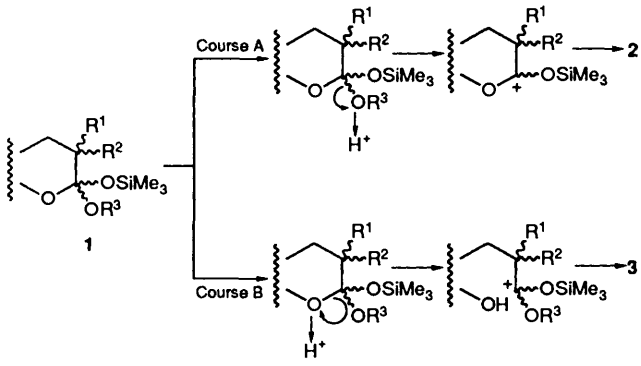
Scheme 1 *Reagents:* i, base; ii, HCl.

atom bearing the alkoxy and trimethylsilyloxy groups of the acetals takes part in the formation of O–C(6) bond of the oxazines **1**.

The compounds **1** obtained by the above cycloadditions have been submitted to hydrochloric acid-catalysed hydrolysis affording 3-aryl-5,6-dihydro-4*H*-1,2-oxazin-6-ones **2** and/or 4-aryl-4-(hydroxyimino)butyric acid esters **3**. Initially, to a solution of **1a** in dichloromethane was added an excess of 20% aqueous hydrochloric acid and the obtained heterogeneous mixture was stirred vigorously at room temperature. By this procedure, **1a** has been hydrolysed to 5,5-dimethyl-3-phenyl-5,6-dihydro-4*H*-1,2-oxazin-6-one **2a** in a high yield. This prompted us to investigate the hydrolysis of **1** with an excess of 20% aqueous hydrochloric acid under the reaction conditions mentioned above in order to prepare a series of 5,6-dihydro-4*H*-1,2-oxazin-6-ones **2**. However, the results, which are summarized in Table 2, failed to come up to our expectations. The majority of compounds **1** were converted to the corresponding 4-aryl-4-(hydroxyimino)butyric acid esters **3** *via* a process involving the cleavage of the C(6)-to-endocyclic-oxygen bond which has been described before. As is shown in Table 2, only **1a**, **1i**, **1p** and **1q** provided the corresponding compounds **2a**, **2i**, **2p** and **2q**, respectively, as single products. Also, when **1c**, **1k** and **1m** were hydrolysed, they were converted to a mixture of the corresponding 3-aryl-5,6-dihydro-4*H*-1,2-oxazin-6-one **2** and 4-aryl-4-(hydroxyimino)butyric acid ester **3**. Our expectation, that the hydrolysis not involving ring-opening of **1** is more facile than that involving ring-opening, has been realized only in compounds **1** having two methyl groups as R^1 and R^2. In contrast, in the cases where compounds **1** had two ethyl groups or a pentamethylene group as R^1 and R^2, the bulkiness of these groups prevented the coordination of a proton to the oxygen of OR^3, so that reactions leading to ring opening (Course B) occurred in competition. However, this reasoning must be investigated further, because it seems unreasonable that the difference in pathway is caused only by the difference in bulkiness of R^1 and R^2. In the cases where compounds **1**, in which either one of R^1 and R^2 is hydrogen, were employed, the indicative effect of only one alkyl group would be insufficient to establish the pathway depicted as in Course A.

Experimental

M.p.s were determined with a Yamato M-21 capillary melting-point apparatus and are uncorrected. ^{1}H NMR spectra were determined on a Varian VXR-200 spectrometer in $CDCl_3$ with $SiMe_4$ as an internal standard; all *J*-values are in Hz. The IR spectra were recorded on a JASCO IR-810 spectrophotometer. The microanalyses were performed using a Yanaco MT-3.



Scheme 2

Except for 2-chloroacetophenone, which is commercially available, 2,4′-dichloro-, 2-chloro-4′-methyl- and 2-chloro-4′-methoxy-acetophenone were synthesized by the procedure in the literature.[8] These ketones including 2-chloroacetophenone were converted to the corresponding oximes according to known methods.[9] Ketene trimethylsilyl acetals were prepared by the method of Ainsworth and co-workers.[10]

Reaction of Ketene Trimethylsilyl Acetals with α-Chloro Oximes in the Presence of K_2CO_3 in THF.—General procedure. To a suspension of a ketene trimethylsilyl acetal (15 mmol) and anhydrous K_2CO_3 (18 mmol) in THF (50 cm^3) was added slowly the α-chloro oxime (3 mmol) in THF (10 cm^3) at room temperature. The suspension was stirred under an argon atmosphere for *ca.* 6 h at the same temperature. The reaction mixture was then filtered through Celite. The solvent was removed and the residue was subjected to flash column chromatography on silica gel (2–3% ethyl acetate–hexane as eluent). The following oxazines **1** were thus prepared.

6-*Ethoxy*-5,5-*dimethyl*-3-*phenyl*-6-*trimethylsilyloxy*-5,6-*dihydro*-4H-1,2-*oxazine* **1a**. Colourless liquid (Found: C, 63.3; H, 8.5; N, 4.15. $C_{17}H_{27}NO_3Si$ requires C, 63.51; H, 8.47; N, 4.36%); δ 0.29 (s, 9 H), 1.02 (s, 3 H), 1.10 (t, 3 H, *J* 7.0), 1.13 (s, 3 H), 2.40 (d, 1 H, *J* 17.8), 2.78 (d, 1 H, *J* 17.8), 3.62 (dq, 1 H, *J* 9.4 and 7.0), 3.63 (dq, 1 H, *J* 9.4 and 7.0) and 7.34–7.70 (m, 5 H).

6-*Ethoxy*-5-*ethyl*-3-*phenyl*-6-*trimethylsilyloxy*-5,6-*dihydro*-4H-1,2-*oxazine* **1b**. Colourless liquid (Found: C, 63.45; H, 8.4; N, 4.3. $C_{17}H_{27}NO_3Si$ requires C, 63.51; H, 8.47; N, 4.36%); δ 0.25 (s, 9 H), 1.08 (t, 3 H, *J* 7.2), 1.25 (t, 3 H, *J* 7.2), 1.42–1.95 (m, 2 H), 1.75–1.95 (m, 1 H), 2.44 (dd, 1 H, *J* 17.8 and 11.6), 2.79 (dd, 1 H, *J* 17.8 and 6.0), 3.61 (dq, 1 H, *J* 9.8 and 7.0), 3.67 (dq, 1 H, *J* 9.8 and 7.0) and 7.32–7.74 (m, 5 H).

5,5-*Diethyl*-6-*ethoxy*-3-*phenyl*-6-*trimethylsilyloxy*-5,6-*dihydro*-4H-1,2-*oxazine* **1c**. Colourless liquid (Found: C, 65.2; H, 8.75; N, 3.85. $C_{19}H_{31}NO_3Si$ requires C, 65.29; H, 8.94; N, 4.01%); δ 0.15 (s, 9 H), 0.95 (t, 6 H, *J* 7.2), 1.23 (t, 3 H, *J* 7.0), 1.73 (dq, 2 H, *J* 14.4 and 7.2), 1.75 (dq, 2 H, *J* 14.4 and 7.2), 2.88 (s, 2 H), 3.71 (q, 2 H, *J* 7.0) and 7.44–7.75 (m, 5 H).

5-*Butyl*-6-*ethoxy*-3-*phenyl*-6-*trimethylsilyloxy*-5,6-*dihydro*-4H-1,2-*oxazine* **1d**. Colourless liquid (Found: C, 65.1; H, 8.9; N, 3.9. $C_{19}H_{31}NO_3Si$ requires C, 65.29; H, 8.94; N, 4.01%); δ 0.25 (s, 9 H), 0.89 (t, 3 H, *J* 7.4), 1.09 (t, 3 H, *J* 7.2), 1.16–1.95 (m, 6 H), 1.77–2.00 (m, 1 H), 2.46 (dd, 1 H, *J* 17.8 and 11.8), 2.78 (dd, 1 H, *J* 17.8 and 6.0), 3.62 (dq, 1 H, *J* 9.8 and 7.2), 3.67 (dq, 1 H, *J* 9.8 and 7.2) and 7.34–7.72 (m, 5 H).

6-*Ethoxy*-3-*phenyl*-6-*trimethylsilyloxy*-5,6-*dihydro*-4H-1,2-*oxazine*-5-*spirocyclohexane* **1f**. Colourless liquid (Found: C, 66.25; H, 8.85; N, 3.65. $C_{20}H_{31}NO_3Si$ requires C, 66.44; H, 8.64; N, 3.87%); δ 0.25 (s, 9 H), 1.03 (t, 3 H, *J* 7.2), 1.10–1.32 (m, 4 H), 1.40–1.68 (m, 4 H), 1.96–2.11 (m, 2 H), 3.07 (s, 2 H), 3.51 (q, 4 H, *J* 7.2) and 7.28–7.74 (m, 5 H).

6-*Ethoxy*-3,5-*diphenyl*-6-*trimethylsilyloxy*-5,6-*dihydro*-4H-1,2-*oxazine* **1g**. Colourless liquid (Found: C, 67.9; H, 7.3; N, 3.9. $C_{21}H_{27}NO_3Si$ requires C, 68.26; H, 7.36; N, 3.79%); δ 0.23 (s, 9 H), 1.25 (t, 3 H, *J* 7.2), 2.89 (dd, 1 H, *J* 16.4 and 5.4), 3.39 (dd, 1 H, *J* 16.2 and 7.6), 3.60–3.82 (m, 1 H), 3.95–4.28 (m, 2 H) and 7.20–7.80 (m, 10 H).

3-*Phenyl*-8a-*trimethylsilyloxy*-4,4a,5,6-*tetrahydro*-7H,8aH-*pyrano*[3,2-e]-1,2-*oxazine* **1h**. M.p. 100–102 °C (without recrystallization) (Found: C, 62.75; H, 7.3; N, 4.5. $C_{16}H_{23}NO_3Si$ requires C, 62.92; H, 7.59; N, 4.59%), δ 0.19 (s, 9 H), 1.48–1.96 (m, 4 H), 2.49 (dd, 1 H, *J* 17.8 and 1.4), 1.95–2.12 (m, 1 H), 3.05 (dd, 1 H, *J* 17.8 and 7.0), 3.82–4.08 (m, 2 H) and 7.32–7.75 (m, 5 H).

3-(p-*Chlorophenyl*)-6-*ethoxy*-5,5-*dimethyl*-6-*trimethylsilyloxy*-5,6-*dihydro*-4H-1,2-*oxazine* **1i**. Colourless liquid (Found: C, 57.3; H, 7.3; N, 3.9. $C_{17}H_{26}ClNO_3Si$ requires C, 57.37; H, 7.36; N, 3.94%); δ 0.27 (s, 9 H), 1.00 (s, 3 H), 1.09 (t, 3 H, *J* 7.2), 1.24 (s, 3 H), 2.35 (d, 1 H, *J* 18.0), 2.74 (d, 1 H, *J* 18.0), 3.60 (dq, 1 H, *J* 9.2 and 7.0), 3.62 (dq, 1 H, *J* 9.2 and 7.2) and 7.29–7.66 (m, 4 H).

3-(p-*Chlorophenyl*)-6-*ethoxy*-5-*ethyl*-6-*trimethylsilyloxy*-5,6-*dihydro*-4H-1,2-*oxazine* **1j**. Colourless liquid (Found: C, 57.2; H, 7.1; N, 3.9. $C_{17}H_{26}ClNO_3Si$ requires C, 57.37; H, 7.36; N, 3.94%); δ 0.25 (s, 9 H), 0.98 (t, 3 H, *J* 7.0), 1.08 (t, 3 H, *J* 7.2), 1.50–1.72 (m, 1 H), 1.76–2.00 (m, 2 H), 2.42 (dd, 1 H, *J* 17.8 and 11.6), 2.74 (dd, 1 H, *J* 17.8 and 5.8), 3.60 (dq, 1 H, *J* 9.8 and 7.0), 3.67 (dq, 1 H, *J* 9.6 and 7.0) and 7.28–7.70 (m, 4 H).

3-(p-*Chlorophenyl*)-5,5-*diethyl*-6-*ethoxy*-6-*trimethylsilyloxy*-5,6-*dihydro*-4H-1,2-*oxazine* **1k**. Colourless liquid (Found; C, 59.9; H, 7.8; N, 3.6. $C_{19}H_{30}ClNO_3Si$ requires C, 59.43; H, 7.88; N, 3.65%); δ 0.27 (s, 9 H), 0.81 (t, 3 H, *J* 7.6), 0.92 (t, 3 H, *J* 7.6), 1.09 (t, 3 H, *J* 7.2), 1.21–1.47 (m, 1 H), 1.52–1.83 (m, 1 H), 2.47 (s, 2 H), 3.59 (dq, 1 H, *J* 9.4 and 7.2), 3.65 (dq, 1 H, *J* 9.4 and 7.2) and 7.28–7.66 (m, 4 H).

5-*Butyl*-3-(p-*chlorophenyl*)-6-*ethoxy*-6-*trimethylsilyloxy*-5,6-*dihydro*-4H-1,2-*oxazine* **1l**. Colourless liquid (Found: C, 59.45; H, 7.8; N, 3.55. $C_{19}H_{30}ClNO_3Si$ requires C, 59.43; H, 7.88; N, 3.65%); δ 0.26 (s, 9 H), 0.92 (t, 3 H, *J* 7.0), 1.08 (t, 3 H, *J* 7.0), 1.18–1.96 (m, 6 H), 1.76–2.02 (m, 1 H), 2.40 (dd, 1 H, *J* 17.8 and 11.6), 2.73 (dd, 1 H, *J* 17.8 and 6.0), 3.59 (dq, 1 H, *J* 9.8 and 7.0), 3.68 (dq, 1 H, *J* 9.8 and 7.0) and 7.28–7.70 (m, 4 H).

3-(p-*Chlorophenyl*)-6-*ethoxy*-6-*trimethylsilyloxy*-5,6-*dihydro*-4H-1,2-*oxazine*-5-*spirocyclohexane* **1m**. Colourless liquid (Found: C, 61.05; H, 7.45; N, 3.5. $C_{20}H_{30}ClNO_3Si$ requires C, 60.66; H, 7.64; N, 3.54%); δ 0.28 (s, 9 H), 1.07 (t, 3 H, *J* 7.0), 1.10–1.72 (m, 10 H), 2.51 (d, 1 H, *J* 18.0), 2.83 (d, 1 H, *J* 18.0), 3.59 (dq, 1 H, *J* 12.4 and 7.0), 3.60 (dq, 1 H, *J* 12.6 and 7.0) and 7.30–7.70 (m, 4 H).

3-(p-*Chlorophenyl*)-6-*ethoxy*-5-*phenyl*-6-*trimethylsilyloxy*-5,6-*dihydro*-4H-1,2-*oxazine* **1n**. Colourless liquid (Found: C, 62.1; H. 6.5; N, 3.75. $C_{21}H_{26}ClNO_3Si$ requires C, 62.44; H, 6.49; N, 3.47%); δ 0.15 (s, 9 H), 1.25 (t, 3 H, *J* 7.2), 2.86 (dd, 1 H, *J* 16.6 and 5.6), 3.35 (dd, 1 H, *J* 16.6 and 9.8), 3.30–3.45 (m, 1 H), 4.09 (dq, 1 H, *J* 17.8 and 7.2), 4.14 (dq, 1 H, *J* 17.8 and 7.2) and 6.96–7.50 (m, 9 H).

3-(p-*Chlorophenyl*)-8a-*trimethylsilyloxy*-4,4a,5,6-*tetrahydro*-7H,8aH-*pyrano*[3,2-e]-1,2-*oxazine* **1o**. M.p. 123–125 °C (without recrystallization) (Found: C, 56.75; H, 6.35; N, 4.25. $C_{16}H_{22}ClNO_3Si$ requires C, 56.54; H, 6.52; N, 4.12%); δ 0.18 (s, 9 H), 1.32–1.85 (m, 4 H), 1.96–2.12 (m, 2 H), 2.43 (dd, 1 H, *J* 18.0 and 1.4), 3.00 (dd, 1 H, *J* 18.0 and 7.0), 3.82–4.15 (m, 2 H) and 7.30–7.68 (m, 4 H).

6-*Ethoxy*-5,5-*dimethyl*-3-(p-*tolyl*)-6-*trimethylsilyloxy*-5,6-*dihydro*-4H-1,2-*oxazine* **1p**. Colourless liquid (Found: C, 64.55; H, 8.55; N, 4.35. $C_{18}H_{29}NO_3Si$ requires C, 64.44; H, 8.71; N, 4.17%); δ 0.27 (s, 3 H), 1.01 (s, 3 H), 1.09 (t, 3 H, *J* 7.0), 1.13 (s, 3 H), 2.36 (s, 3 H), 2.40 (d, 1 H, *J* 17.4), 2.75 (d, 1 H, *J* 17.4), 3.61 (dq, 1 H, *J* 9.2 and 7.0), 3.62 (dq, 1 H, *J* 9.0 and 7.0) and 7.12–7.63 (m, 4 H).

6-*Ethoxy*-3-(p-*methoxyphenyl*)-5,5-*dimethyl*-6-*trimethylsilyloxy*-5,6-*dihydro*-4H-1,2-*oxazine* **1q**. Colourless liquid (Found: C, 61.35; H, 8.35; N, 3.75. $C_{18}H_{29}NO_4Si$ requires C, 61.50; H, 8.32; N, 3.98%); δ 0.27 (s, 9 H), 1.01 (s, 3 H), 1.09 (t, 3 H, *J* 7.0), 1.12 (s, 3 H), 2.37 (d, 1 H, *J* 17.6), 2.74 (d, 1 H, *J* 17.6), 3.61 (dq, 1 H, *J* 9.0 and 7.0), 3.62 (dq, 1 H, *J* 9.0 and 7.0), 3.81 (s, 3 H) and 6.82–7.66 (m, 4 H).

Hydrochloric Acid-catalysed Hydrolysis of Compounds **1** *Affording* 3-*Aryl*-5,6-*dihydro*-4H-1,2-*oxazin*-6-*ones* **2** *and/or* 4-*Aryl*-4-(*hydroxyimino*)*butyric Acid Esters* **3**.—*General procedure*. To a solution of the oxazine **1** (1.5 mmol) in dichloromethane (10 cm^3) was added 20% aqueous hydrochloric acid (10 cm^3). The mixture was stirred vigorously at room temperature for 4–5 h, the organic layer was separated, and the aqueous layer was extracted with dichloromethane (3 × 7 cm^3). The combined organic extract was dried ($MgSO_4$) and concentrated *in vacuo* to afford a residue, which was subjected to column chromatography on silica gel (9% ethyl acetate–hexane as eluent). The following compounds **2** or **3** or both were thus obtained.

5,5-*Dimethyl*-3-*phenyl*-5,6-*dihydroy*-4H-1,2-*oxazine*-6-*one* **2a**. Obtained from **1a**. M.p. 99–100 °C (without recrystallization) (Found: C, 70.75; H, 6.35; N, 6.85. $C_{12}H_{13}NO_2$ requires C, 70.92; H, 6.45; N, 6.89%); δ 1.35 (s, 6 H), 2.89 (s, 2 H) and 7.40–7.74 (m, 5 H); ν_{max}/cm^{-1} 1750 (CO).

2-*Ethyl*-4-*hydroxyimino*-4-*phenylbutyric acid ethyl ester* **3b**. Obtained from **1b**. Colourless liquid (Found: C, 67.15; H, 7.45; N, 5.55. $C_{14}H_{19}NO_3$ requires C, 67.45; H, 7.68; N, 5.62%); δ 0.88 (t, 3 H, *J* 7.2), 1.19 (t, 3 H, *J* 7.2), 1.44–1.76 (m, 2 H), 2.60–2.76 (m, 1 H), 3.02 (dd, 1 H, *J* 13.4 and 7.8), 3.10 (dd, 1 H, *J* 13.4 and 7.0), 3.84–4.10 (m, 2 H), 7.30–7.62 (m, 5 H) and 8.20–8.40 (br s, 1 H); ν_{max}/cm^{-1} 3400 (OH) and 1730 (CO).

5,5-*Diethyl*-3-*phenyl*-5,6-*dihydro*-4H-1,2-*oxazin*-6-*one* **2c** *and* 2,2-*diethyl*-4-*hydroxyimino*-4-*phenylbutyric acid ethyl ester* **3c**. Obtained from **1c**. Compound **2c**; white crystal (m.p. was not measured) (Found: C, 72.55; H, 7.4; N, 5.95. $C_{14}H_{17}NO_2$ requires C, 72.70; H, 7.41; N, 6.06%); δ 0.94 (t, 6 H, *J* 7.4), 1.73 (dq, 2 H, *J* 14.2 and 7.2), 1.75 (dq, 2 H, *J* 14.2 and 7.4), 2.88 (s, 2 H) and 7.36–7.75 (m, 5 H); ν_{max}/cm^{-1} 1730 (CO).

Compound **3c**; colourless liquid (Found: C, 68.9; H, 8.2; N, 4.9. $C_{16}H_{23}NO_3$ requires C, 69.29; H, 8.36; N, 5.05%); δ 0.77 (t, 6 H, *J* 7.0), 1.06 (t, 3 H, *J* 7.0), 1.40–1.90 (m, 4 H), 3.11 (s, 2 H), 3.62 (q, 2 H, *J* 7.0) and 7.28–7.80 (m, 5 H); ν_{max}/cm^{-1} 3300 (OH) and 1760 (CO).

2-*Butyl*-4-*hydroxyimino*-4-*phenylbutyric acid ethyl ester* **3d**. Obtained from **1d**. Colourless liquid (Found: C, 69.25; H, 8.3; N, 5.0. $C_{16}H_{23}NO_3$ requires C, 69.29; H, 8.36; N, 5.05%); δ 0.83 (t, 3 H, *J* 7.2), 1.10 (t, 3 H, *J* 7.2), 1.18–1.35 (m, 4 H), 1.40–1.76 (m, 2 H), 2.65–2.83 (m, 1 H), 3.02 (dd, 1 H, *J* 13.2 and 8.0), 3.08 (dd, 1 H, *J* 13.2 and 7.0), 3.93 (dq, 1 H, *J* 10.7 and 7.2), 3.94 (dq, 1 H, *J* 10.7 and 7.2) and 7.32–7.61 (m, 5 H); ν_{max}/cm^{-1} 3400 (OH) and 1730 (CO).

4-*Hydroxyimino*-2-*methyl*-4-*phenylbutyric acid ethyl ester* **3e**. Obtained from the crude **1e**. Colourless liquid (Found: C, 66.4; H, 7.2; N, 5.7. $C_{13}H_{17}NO_3$ requires C, 66.36; H, 7.28; N, 5.95%); δ 1.15 (t, 3 H, *J* 7.0), 1.16 (d, 3 H, *J* 6.6), 2.76–2.95 (m, 1 H), 3.08 (d, 2 H, *J* 7.4), 4.00 (dq, 1 H, *J* 11.6 and 7.0), 4.01 (dq, 1 H, *J* 11.6 and 7.2), 7.32–7.64 (m, 5 H) and 8.30–8.85 (br s, 1 H); ν_{max}/cm^{-1} 3400 (OH) and 1730 (CO).

2-[1-(*Ethoxycarbonyl*)*cyclohexanyl*]*acetophenone oxime* **3f**. Obtained from **1f**. Colourless liquid (Found: C, 70.1; H, 7.95; N, 4.75. $C_{17}H_{23}NO_3$ requires C, 70.56; H, 8.01; N, 4.84%); δ 1.04 (t, 3 H, *J* 7.2), 1.06–1.36 (m, 4 H), 1.38–1.62 (m, 4 H), 1.90–2.15 (m, 2 H), 3.05 (s, 2 H), 3.57 (q, 2 H, *J* 7.2) and 7.28–7.76 (m, 5 H); ν_{max}/cm^{-1} 3400 (OH) and 1720 (CO).

4-(*Hydroxyimino*)-2,4-*diphenylbutyric acid ethyl ester* **3g**. Obtained from **1g**. Colourless liquid (Found: C, 72.55; H, 6.3; N, 4.7. $C_{18}H_{19}NO_3$ requires C, 72.71; H, 6.44; N, 4.71%), δ 1.22 (t, 3 H, *J* 7.2), 3.31 (dd, 1 H, *J* 13.6 and 7.8), 3.49 (dd, 1 H, *J* 13.6 and 7.6), 3.83–4.32 (m, 3 H), 7.04–7.46 (m, 10 H) and 8.30–8.54 (br s, 1 H); ν_{max}/cm^{-1} 3400 (OH) and 1730 (CO).

2-(2-*Oxotetrahydropyran*-3-*yl*)*acetophenone oxime* **3h**. Obtained from **1h**. Colourless liquid (Found: C, 66.9; H, 6.4; N, 5.95. $C_{13}H_{15}NO_3$ requires C, 66.94; H, 6.48; N, 6.00%); δ 1.48–2.05 (m, 4 H), 2.76–2.94 (m, 1 H), 3.05–3.42 (m, 2 H), 4.27 (t, 2 H, *J* 5.4), 7.30–8.02 (m, 5 H) and 8.40–8.66 (br s, 1 H); IR spectrum was not recorded.

3-(p-*Chlorophenyl*)-5,5-*dimethyl*-5,6-*dihydro*-4H-1,2-*oxazin*-6-*one* **2i**. Obtained from **1i**. M.p. 106–108 °C (without recrystallization) (Found: C, 60.3; H, 4.95; N, 5.75. $C_{12}H_{12}ClNO_2$ requires C, 60.64; H, 5.09; N, 5.89%); δ 1.35 (s, 6 H), 2.86 (s, 2 H) and 7.28–7.72 (m, 4 H); ν_{max}/cm^{-1} 1760 (CO).

4-(p-*Chlorophenyl*)-2-*ethyl*-4-(*hydroxyimino*)*butyric acid ethyl ester* **3j**. Obtained from **1j**. Colourless liquid (Found: C, 58.95; H, 6.35; N, 4.85. $C_{14}H_{18}ClNO_3$ requires C, 59.26; H, 6.39; N, 4.94%); δ 0.89 (t, 3 H, *J* 7.4), 1.13 (t, 3 H, *J* 7.0), 1.40–1.70 (m, 2 H), 2.60–2.80 (m, 1 H), 2.90 (dd, 1 H, *J* 13.4 and 8.0), 3.05 (dd, 1 H, *J* 13.4 and 7.0), 3.85–4.10 (m, 2 H), 7.28–7.60 (m, 4 H) and 8.00–8.35 (br s, 1 H); ν_{max}/cm^{-1} 3420 (OH) and 1740 (CO).

3-(p-*Chlorophenyl*)-5,5-*diethyl*-5,6-*dihydro*-4H-1,2-*oxazin*-6-*one* **2k** *and* 4-(p-*chlorophenyl*)-2,2-*diethyl*-4-(*hydroxyimino*)-*butyric acid ethyl ester* **3k**. Obtained from **1k**. Compound **2k**; white crystal (m.p. was not measured) (Found: C, 63.15; H, 6.0; N, 5.25. $C_{14}H_{16}ClNO_2$ requires C, 63.28; H, 6.07; N, 5.27%); δ 0.93 (t, 6 H, *J* 7.6), 1.52–1.86 (m, 4 H), 2.85 (s, 2 H) and 7.24–7.72 (m, 4 H); IR spectrum was not recorded.

Compound **3k**; colourless liquid (Found: C, 61.5; H, 6.95; N, 4.35. $C_{16}H_{22}ClNO_3$ requires C, 61.63; H, 7.11; N, 4.49%); δ 0.77 (t, 6 H, *J* 7.4), 1.08 (t, 3 H, *J* 7.0), 1.41–1.77 (m, 4 H), 3.07 (s, 2 H), 3.66 (q, 2 H, *J* 7.0) and 7.24–7.72 (m, 4 H); IR spectrum was not recorded.

2-*Butyl*-4-(p-*chlorophenyl*)-4-(*hydroxyimino*)*butyric acid ethyl ester* **3l**. Obtained from **1l**. Colourless liquid (Found: C, 61.35; H, 7.35; N, 4.8. $C_{16}H_{22}ClNO_3$ requires C, 61.63; H, 7.11; N, 4.49%); δ 0.84 (t, 3 H, *J* 7.0), 1.18 (t, 3 H, *J* 7.2), 1.18–1.35 (m, 4 H), 1.54–1.70 (m, 2 H), 2.65–2.83 (m, 1 H), 2.96 (dd, 1 H, *J* 13.4 and 8.0), 3.03 (dd, 1 H, *J* 13.4 and 7.0), 3.93 (dq, 1 H, *J* 10.8 and 7.0), 3.97 (dq, 1 H, *J* 10.8 and 7.2), 7.30–7.59 (m, 4 H) and 8.00–8.32 (br s, 1 H); IR spectrum was not recorded.

3-(p-*Chlorophenyl*)-6-*oxo*-5,6-*dihydro*-4H-1,2-*oxazine*-5-*spirocyclohexane* **2m** *and* 4′-*Chloro*-2-[1-(*ethoxycarbonyl*)*cyclohexanyl*]*acetophenone oxime* **3m**. Obtained from **1m**. Compound **2m**; white crystals (m.p. was not measured) (Found: C, 68.4; H, 5.7; N, 4.95. $C_{15}H_{16}ClNO_2$ requires C, 64.87; H, 5.81; N, 5.04%), δ 1.36–1.74 (m, 8 H), 1.85–2.05 (m, 2 H), 2.90 (s, 2 H) and 7.38–7.72 (m, 4 H); IR spectrum was not recorded.

Compound **3m**; colourless liquid (Found: C, 62.9; H, 6.7; N, 4.1. $C_{17}H_{22}ClNO_3$ requires C, 63.06; H, 6.85; N, 4.33%); δ 1.07 (t, 3 H, *J* 7.0), 1.00–1.45 (m, 5 H), 1.40–1.65 (m, 3 H), 1.95–2.15 (m, 2 H), 3.01 (s, 2 H), 3.64 (q, 2 H, *J* 7.0), 7.28–7.46 (m, 4 H) and 9.00–9.15 (br s, 1 H); IR spectrum was not recorded.

4-(p-*Chlorophenyl*)-4-*hydroxyimino*-2-*phenylbutyric acid ethyl ester* **3n**. Obtained from **1n**. Colourless liquid (Found: C, 65.1; H, 5.8; N, 4.4. $C_{18}H_{18}ClNO_3$ requires C, 65.16; H, 5.47; N, 4.22%); δ 1.12 (t, 3 H, *J* 7.0), 3.26 (dd, 1 H, *J* 13.4 and 8.0), 3.44 (dd, 1 H, *J* 13.4 and 7.4), 3.55–3.68 (m, 1 H), 3.95–4.20 (m, 2 H), 7.18–7.46 (m, 9 H) and 8.40–8.72 (br s, 1 H); IR spectrum was not recorded.

4′-*Chloro*-2-(2-*oxotetrahydropyran*-3-*yl*)*acetophenone oxime* **3o**. Obtained from **1o**. Colourless liquid (Found: C, 58.35; H, 5.5; N, 5.25. $C_{13}H_{14}ClNO_3$ requires C, 58.32; H, 5.27; N, 5.23%); δ 1.48–2.10 (m, 4 H), 2.74–2.92 (m, 1 H), 3.20 (dd, 1 H, *J* 14.0 and 9.4), 3.30 (dd, 1 H, *J* 14.0 and 5.4), 4.28 (t, 2 H, *J* 6.0), 7.28–7.62 (m, 4 H) and 8.58–8.90 (br s, 1 H); IR spectrum was not recorded.

5,5-*Dimethyl*-3-(p-*tolyl*)-5,6-*dihydro*-4H-1,2-*oxazin*-6-*one* **2p**. Obtained from **1p**. M.p. 114–116 °C (without recrystallization) (Found: C, 71.8; H, 6.95; N, 6.2. $C_{13}H_{15}NO_2$ requires C, 71.87; H, 6.96; N, 6.45%); δ 1.34 (s, 6 H), 2.40 (s, 3 H), 2.86 (s, 2 H) and 7.23–7.66 (m, 4 H); ν_{max}/cm^{-1} 1760 (CO).

3-(p-*Methoxyphenyl*)-5,5-*dimethyl*-5,6-*dihydro*-4H-1,2-*oxazin*-6-*one* **2q**. Obtained from **1q**. White crystals (m.p. was not measured) (Found: C, 67.15; H, 6.5; N, 6.05. $C_{13}H_{15}NO_3$ requires C, 66.94; H, 6.48; N, 6.00%); δ 1.34 (s, 6 H), 2.85 (s, 2 H), 3.85 (s, 3 H) and 7.38–7.72 (m, 4 H); IR spectrum was not recorded.

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Paper 1/02925H
Received 17*th June* 1991
Accepted 27*th August* 1991