Base-catalysed Reactions of α-Bromo-*N*-benzyl-propionamide and -isobutyramide. Formation of 2-Amino-oxazolidinones †

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α-Bromo-*N*-benzyl-propionamide and -isobutyramide react with sodium hydride yielding 2-amino-oxazolidinones. Dioxopiperazines are formed only from the halogeno-propionamide. The structure and stereochemistry of a 2-amino-oxazolidinone have been demonstrated by an *X*-ray crystal analysis. A cycloaddition onto an amide carbonyl is suggested in order to explain the formation of the oxazolidinone derivatives.

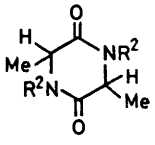
DEHYDROHALOGENATION of *N*- or α-halogenoamides (1) and (2) affords a variety of products: α-lactams (3) are possible reaction intermediates, being isolated when R^1 and/or R^2 are t-butyl groups or the like; they undergo thermal decomposition or nucleophilic attack, nucleophiles reacting at either the sp^3 or the carbonyl carbon.[1]

(1) (2) (3)

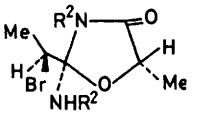
More recently, complex reactions of aziridinones (3) with organometallic halides have been observed,[2] although the identities of the insertion–alkylation derivatives have been questioned;[3] moreover, reduction and dimerization products have been observed in the reactions of *N,N*-dimethyl-2-halogeno-2,2-diphenylacetamide with methoxide.[4] We believe, as reported by others,[2] that reactions of stabilized α-lactams (3) are not fully representative of the properties of (3) as synthons; conversely, reactions of α-halogenoamides unable to give stable α-lactams, with bases of low nucleophilicity, would provide interesting systems, both in the presence and in the absence of other reagents.

RESULTS AND DISCUSSION

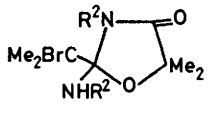
Reactions of racemic α-bromo-*N*-benzylpropionamide (2a) with sodium hydride gave: (i) *cis*- and *trans*-1,4-dibenzyl-3,6-dimethyl-2,5-dioxopiperazines (4) and



(4) *cis*
(5) *trans*



(6a)

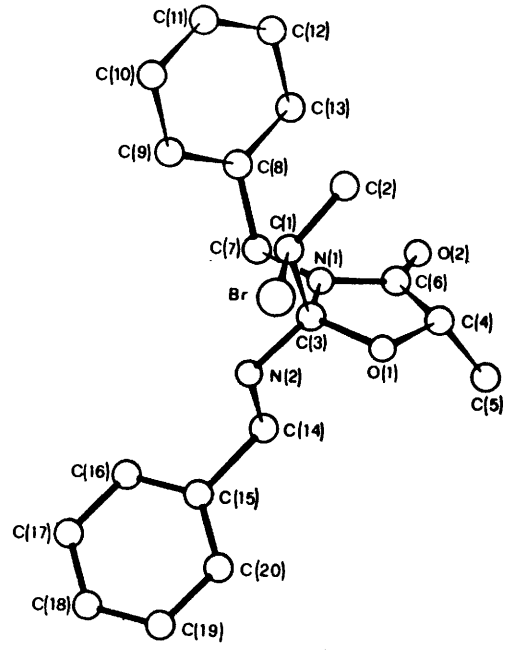


(6b)

$R^2 = CH_2Ph$

(5) (12—20% each);[5] (ii) a product (m.p. 104—105 °C) and an intractable mixture of isomeric $C_{20}H_{23}BrN_2O_2$ materials (*ca.* 30%). An *X*-ray analysis demonstrated that the product, m.p. 104—105 °C is 2-benzylamino-2-(1-bromoethyl)-3-benzyl-5-methyloxazolidinone.

The molecular structure, as deduced from the *X*-ray crystal study, is shown in the Figure along with the crystallographic numbering used. The final parameters, with the e.s.d.'s of the non-hydrogen atoms, are reported in Table 1; in Table 2 bond lengths and



X-Ray crystal structure of 2-benzylamino-2-(1-bromoethyl)-3-benzyl-5-methyloxazolidin-4-one (6a)

valence angles for all non-hydrogen atoms, uncorrected for changes due to thermal vibration, are given. The conformational features of the molecule are characterized by the torsion angle values about the non-rigid bonds (Table 3); C(3), C(4) and C(1) assume *R,S,S* (and *S,R,R*) chiralities. The oxazolidinone ring is nearly planar and both C(4)–O(1) and C(3)–O(1) distances are very close to single bond values; the C(7)–C(8) and C(14)–C(15) distances of 1.49 and 1.50 Å are as expected for a

† G. Cavicchioni, A. C. Veronese, and F. D' Angeli, presented in part at the Xth National Meeting on Organic Chemistry, Sorrento, Italy, September 1979.

TABLE 1

Atomic co-ordinates with e.s.d.'s in parentheses

	x/a	*y/b*	*z/c*
Br	0.170 21(8)	0.001 38(8)	0.0
O(1)	0.470 7(5)	0.095 5(5)	0.075 1(3)
O(2)	0.841 6(6)	0.097 4(5)	0.023 2(4)
N(1)	0.635 4(7)	−0.023 7(5)	0.018 1(4)
N(2)	0.439 8(8)	−0.120 9(6)	0.078 8(4)
C(1)	0.378(1)	−0.012 3(8)	−0.025 5(5)
C(2)	0.412(1)	0.093(1)	−0.074 3(6)
C(3)	0.480(1)	−0.018 0(7)	0.036 6(5)
C(4)	0.601 6(9)	0.166 8(8)	0.064 1(5)
C(5)	0.652(1)	0.223 4(9)	0.131 8(6)
C(6)	0.710 5(9)	0.079 9(7)	0.033 2(5)
C(7)	0.704 0(9)	−0.131 6(7)	−0.013 5(5)
C(8)	0.692(1)	−0.133 1(8)	−0.089 9(5)
C(9)	0.596(1)	−0.214 6(9)	−0.121 5(6)
C(10)	0.576(1)	−0.212(1)	−0.191 3(7)
C(11)	0.650(1)	−0.132(1)	−0.232 1(8)
C(12)	0.745(1)	−0.050(1)	−0.201 4(6)
C(13)	0.768(1)	−0.051 1(9)	−0.130 5(6)
C(14)	0.642(1)	−0.146 7(9)	0.128 9(6)
C(15)	0.473 0(9)	−0.242 2(8)	0.183 3(5)
C(16)	0.459(1)	−0.358 1(8)	0.154 4(6)
C(17)	0.409(1)	−0.455(1)	0.196 4(7)
C(18)	0.380(1)	−0.440(1)	0.263 0(7)
C(19)	0.402(1)	−0.328(1)	0.292 2(8)
C(20)	0.448(1)	−0.230(1)	0.252 1(6)

TABLE 2

Intramolecular bond distances and angles with e.s.d.'s in parentheses

Br–C(1)	1.94(1)	C(2)–C(1)–Br	107.0(7)
C(1)–C(2)	1.53(1)	C(2)–C(1)–C(3)	114.0(8)
C(1)–C(3)	1.52(1)	C(3)–C(1)–Br	112.5(6)
C(3)–O(1)	1.45(1)	C(1)–C(3)–N(2)	109.5(7)
O(1)–C(1)	1.43(1)	N(2)–C(3)–O(1)	111.0(7)
C(4)–C(5)	1.53(1)	C(1)–C(3)–N(1)	112.8(8)
C(4)–C(6)	1.49(1)	N(1)–C(3)–O(1)	102.9(6)
C(6)–O(2)	1.21(1)	N(2)–C(3)–N(1)	110.6(7)
C(6)–N(1)	1.35(1)	C(1)–C(3)–O(1)	109.9(7)
N(1)–C(3)	1.45(1)	C(3)–N(1)–C(6)	113.2(6)
N(1)–C(7)	1.47(1)	C(3)–N(1)–C(7)	123.2(6)
C(3)–N(2)	1.44(1)	C(7)–N(1)–C(6)	123.7(7)
N(2)–C(14)	1.47(1)	N(1)–C(6)–C(4)	107.0(7)
C(14)–C(15)	1.50(1)	N(1)–C(6)–O(2)	125.8(8)
C(15)–C(16)	1.39(1)	C(4)–C(6)–O(2)	127.2(8)
C(16)–C(17)	1.41(1)	C(6)–C(4)–O(1)	104.8(6)
C(17)–C(18)	1.33(2)	C(6)–C(4)–C(5)	114.2(7)
C(18)–C(19)	1.37(1)	C(5)–C(4)–O(1)	109.7(7)
C(19)–C(20)	1.39(1)	C(4)–O(1)–C(3)	109.9(6)
C(15)–C(20)	1.37(1)	N(1)–C(7)–C(8)	113.3(7)
C(7)–C(8)	1.49(1)	C(3)–N(2)–C(14)	115.1(7)
C(8)–C(9)	1.39(1)	N(2)–C(14)–C(15)	110.9(8)
C(9)–C(10)	1.37(1)	C(14)–C(15)–C(16)	121.9(6)
C(10)–C(11)	1.36(1)	C(15)–C(16)–C(17)	119(1)
C(11)–C(12)	1.38(1)	C(16)–C(17)–C(18)	122(1)
C(12)–C(13)	1.40(1)	C(17)–C(18)–C(19)	119(1)
C(8)–C(13)	1.38(1)	C(18)–C(19)–C(20)	120(1)
		C(19)–C(20)–C(15)	122(1)
		C(14)–C(15)–C(20)	119.9(9)
		C(20)–C(15)–C(16)	118.0(9)
		C(7)–C(8)–C(13)	121.8(8)
		C(7)–C(8)–C(9)	119.7(8)
		C(8)–C(9)–C(10)	120(1)
		C(9)–C(10)–C(11)	122(1)
		C(10)–C(11)–C(12)	118(1)
		C(11)–C(12)–C(13)	121(1)
		C(12)–C(13)–C(8)	120(1)
		C(13)–C(8)–C(9)	119(1)

C(sp^2)–C(sp^3) bond length, while C(1)–C(3) and C(4)–C(5) are rather short for a C(sp^3)–C(sp^3) distance. The presence of three asymmetric carbons requires the formation of three racemates in addition to the configurational isomer 2*R*, 5*S*, 1′*S*-(6a) (Figure) and its enantiomer: spectroscopic data indicate that they are the components of the intractable mixture.

TABLE 3

Torsion angles (°). The torsion angle of the bonded group A–X–Y–B is the angle between the planes A–X–Y and X–Y–B: it is positive when clockwise (W. Klyne and V. Prelog, *Experientia*, 1960, **16**, 521).

N(2)–C(14)–C(15)–C(16)	49	C(3)–N(1)–C(6)–C(4)	0
C(15)–C(14)–N(2)–C(3)	179	C(6)–N(1)–C(3)–O(1)	−10
C(1)–C(3)–N(2)–C(14)	−178	C(2)–C(1)–C(3)–N(2)	180
C(4)–O(1)–C(3)–N(2)	133	C(4)–O(1)–C(3)–N(1)	16
C(3)–O(1)–C(4)–C(6)	−17	C(3)–N(1)–C(7)–C(8)	16
O(1)–C(4)–C(6)–N(1)	10	N(1)–C(7)–C(8)–C(9)	107

Deviations of the atoms from the least-squares plane of the oxazolidinone ring. The equation of the plane is in the form $AX + BY + CZ = D$, in orthogonal Å space with X parallel to a^*, Y parallel to $c \times a^*$ and Z to c. Asterisks denote atoms not used in the plane calculation.

$$0.2790x - 0.3825y + 0.8808z = 1.9786$$

O(1)	0.10	C(4)	−0.08
N(1)	0.03	C(6)	0.03
C(3)	−0.08	O(2)*	0.14
C(7)*	0.11	C(1)*	−1.41
N(2)*	0.97	C(5)*	0.98

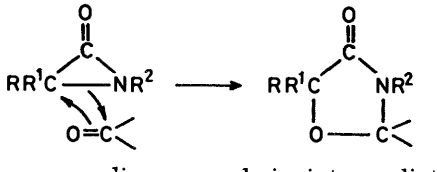
In similar reactions of (2b) with sodium hydride, no dioxopiperazines were found, but (6b), whose structure is assigned on spectroscopic grounds, was formed (25—43% yield). A basic derivative ($C_{22}H_{28}N_2O_3$) was also present in the reactions of (2b): the amino-ester-amide structure (7b) explains the spectroscopic and

$Me_2C(NHR^2)CO_2C(Me_2)CONHR^2$ (7b); $R^2 = CH_2Ph$

$BrCRMeCO_2CRMeCONHR^2$ (8); a; R = H, b; R = Me

analytical data quite satisfactorily. We proved that (7b) arises from the oxazolidinone (6b) in the presence of sodium hydride; a water molecule is needed in the interconversion and it must derive from moisture or the work-up procedure. Mild acid hydrolysis of the oxazolidinones (6a) and (6b), transforms the orthoester type function (at C-2) into an ester function: the α-halogeno-ester amides (8a) and (8b) and benzylamine are obtained; on stereochemical grounds, (8a) must consist of a diastereoisomeric mixture. A differential behaviour was however observed when the oxazolidinones were heated at 100 °C in the presence of SiO_2; whereas (6a) again yielded the α-halogenoester amides (8a), (6b) gave the aminoester amide (7b).

It is possible to consider the cyclic products (6a) and (6b) as arising from a cycloaddition reaction of an α-lactam



(3) or a corresponding open-chain intermediate,[1] with the carbonyl group of a (second) halogenoamide molecule.

The cycloadditition may be concerted or may take place through a two-step ionic mechanism.

Studies on the mechanism and the scope of the present reactions are in progress in this laboratory.

EXPERIMENTAL

Sodium hydride was a 55—60% dispersion in oil, from Fluka; it was washed with light petroleum of b.p. 40—60 °C, immediately before use. I.r. spectra were recorded on a Perkin-Elmer 157-G spectrophotomer. ^{1}H N.m.r. spectra were determined with a Perkin-Elmer R32 spectrometer at 90 MHz for deuteriochloroform solutions, unless stated otherwise. Chemical shifts are expressed in δ p.p.m. downfield from the signal of $SiMe_4$, which was used as an internal standard. Molecular weights were determined using a Vapour Pressure Osmometer (VPO 302B) in chloroform, using biphenyl as a standard. T.l.c. was performed on 0.25-mm silica-gel plates (Merck): R_{F_1} and R_{F_2} refer to the systems ethyl acetate–toluene (1 : 1) and (1 : 4), other systems being indicated. Column chromatography was performed on silica (KG-60). M.p.s were determined with a Reichert Kofler block and are uncorrected.

Reactions of Compound (2a) *with Sodium Hydride.*—(a) *2-Benzylamino-2-(1-bromoethyl)-3-benzyl-5-methyloxazolidin-4-one* (6a) *and Diastereoisomers.* A sample of (2a) (2.42 g, 0.01 mol) [n.m.r.: 1.81 (3 H, d, Me), −4.38 (m, C*H*Me and CH_2NH), 6.8br (CONH), and 7.25 (s, C_6H_5)],[6] dissolved in anhydrous benzene (15 ml), was added during 5 min to sodium hydride (0.48 g, 0.02 mol), covered with benzene (15 ml). The mixture was stirred at room temperature until the production of hydrogen ceased (15—17 h); it was centrifuged free from sodium bromide and some unchanged hydride. The solution was washed with water (3 × 20 ml), dried (sodium sulphate), and concentrated to dryness. The crude oily mixture (1.4 g) was fractionated by chromatography on a column with ethyl acetate–toluene (1 : 4). Work-up and recrystallization from 95% ethanol of the oily product (R_{F_1} 0.8) (0.55 g) gave colourless prisms, m.p. 104—105 °C (0.2—0.3 g, 10—15%) and a viscous mixture which resisted chromatographic separation with over 20 different solvent systems; on t.l.c. with ethanol–hexane (1 : 4), the product m.p. 104—105 °C (6a) and the unresolved mixture had respectively R_F 0.66 and R_F 0.53, visualized as brown spots with I_2–NaN_3 or as red-violet spots after heating for a few min at 105 °C: the nature of this colour has not been elucidated. I.r. (6a) (KBr), 3 340, 1 700, 1 410, and 1 105 cm^{-1}; ($CHCl_3$) 3 365, 1 710, 1 410, 1 095 cm^{-1}; the mixture had similar spectra: in $CHCl_3$, a broad absorption was present at 3 350 cm^{-1} and a strong CO signal extended to 1 730 cm^{-1}: (6a) n.m.r. 1.28 (3 H, d, *J* 6.8 Hz, 5-Me), 1.54 (3 H, d, *J* 6.8 Hz, MeCBr), 4.02 (1 H, q, *J* 6.8 Hz, 5-H), 4.57 (1 H, q, *J* 6.8 Hz, HCBr), 3.1 (1 H, dd, ABC, *J* and J'_{NH-CH} 10 and 2.7 Hz, NH), 3.38 and 3.85 (2 H, dd, ABC, J_{HH} 12.4 Hz, J_{NH-CH} 10 Hz J'_{NH-CH} 2.7 Hz, CH_2NH) 4.15 and 4.84 (2 H, AB; *J* 14.4 Hz, CH_2–N), and 7.32 (10 H, m, 2 C_6H_5). Double-resonance experiments uncoupled the methyl at 1.28 upon irradiation of the CH at 4.02, and the methyl at 1.54 upon irradiation at 4.57; the addition of D_2O caused the NH signal at 3.1 to disappear, and the ABC to collapse to an AB system (*J* 12.4 Hz) in 2—3 min. (6a) (Found: C, 59.7; H, 5.75; Br, 19.65; N, 6.8%; the unresolved mixture (Found: C, 60.0; H, 5.7; Br, 17.8; N, 6.8%; $C_{20}H_{23}BrN_2O_2$ requires C, 59.56; H, 5.75; Br, 19.81; N, 6.94%).

Crystal data. $C_{20}H_{23}BrN_2O_2$, m.p. 104—105 °C, orthorhombic, a = 9.010(6), b = 10.937(6), c = 19.468(9) Å, V = 1 918.42 Å^3, Z = 4, D_c = 1.40 g cm^{-3}. Space group $Pna2_1$, μ(Mo-K_α) = 20.88 cm^{-1}, the crystals were obtained from a solution of absolute ethanol. Intensities were collected on a Philips PW 1100 four-circle diffractometer, with Mo-K_α radiation, monochromatized by a graphite crystal.

A total of 1 500 independent reflections, up to θ = 28° were measured; 1 093 had intensities greater than 2.5 times their standard deviation (σ). Intensities were corrected for Lorentz and polarisation effects and an experimental absorption correction was applied.[7] The structure was solved by the heavy-atom technique. The refinement was carried out by full-matrix least-squares analysis. All hydrogen atoms were located and included in the refinement in calculated idealized positions, with isotropic thermal parameters equivalent to the anisotropic ones of the atoms to which the hydrogens are bonded.[8] The quantity minimized was $\Sigma w\Delta^2$, ($\Delta = [F_o] - [F_c]$), $w = 2.64\ [\sigma^2(F_o) + 0.001\ F_o^2]^{-1}$.

Throughout the analysis, the scattering factors from ref. 9 were used; both the real and imaginary components of anomalous dispersion were included for bromine only.[9] The final R value for the 1 093 observed reflections with $I \geqslant 2.5\ \sigma(I)$ was 0.041 (R_w = 0.047).

The calculations were carried out on the CYBER 76 computer of ' C.I.N.E.C.A.' with the SHELX 76 system of crystallographic programs.[10] Observed and calculated structure factors and thermal parameters are listed in Supplementary publication No. SUP 22820 (9 pages).*

Elution of the column with methanol (200 ml) gave a semisolid mass (28%) consisting of compounds (4) and (5), which are described in (b).

(b) cis- *and* trans-*1,4-Dibenzyl-3,6-dimethyl-2,5-dioxopiperazines* (4) and (5). A reaction mixture consisting of (2a) (0.97 g, 4 mmol), NaH (0.115 g, 4.8 mmol), and benzene (12 ml) was stirred for 15 h at room temperature. After work-up, the crude oil was chromatographed on a column using ethyl acetate–benzene (1 : 1) as eluant: (6a) and its isomers (25%) were eluted first, followed by compound (4), a small amount of unchanged (2a), and pure compound (5). Compound (4) (133 mg, 20%): R_{F_1} 0.42; R_{F_2} 0.22, m.p. 80 °C (lit.,[5] 80 °C), i.r.: $\nu_{max.}$ ($CHCl_3$) 1 660 cm^{-1}; n.m.r. 1.48 (6 H, d, *J* 7 Hz, 2*Me*CH), 3.98 (2 H, q, *J* 7 Hz, 2 MeC*H*), 4.06 and 5.13 (4 H, AB, *J* 14.8, 2 CH_2), and 7.25 (10 H, s, 2 C_6H_5); (5) (124 mg, 19%), R_{F_1} 0.54; R_{F_2} 0.35, m.p. 141 °C from ethanol–light petroleum (lit.,[5] 141 °C), i.r.: $\nu_{max.}$ 1 660 cm^{-1}; n.m.r. 1.52 (6 H, d, *J* 7 Hz, 2 *Me*CH), 4.0 (2 H, q, *J* 7 Hz, 2 MeC*H*), 4.08 and 5.31 (4 H, AB, *J* 15 Hz, 2 CH_2), and 7.28 (10 H, s, 2 C_6H_5).

(c) Similar results were observed in ether, tetrahydrofuran (THF), or dimethylformamide at room temperature or in benzene, toluene, or the xylenes at reflux for 15—30 min.

Reactions of α-Bromoisobutyramide (2b) *with Sodium Hydride.*—(a) *2-Benzylamino-2-(1-bromoisopropyl)-3-benzyl-5-dimethyloxazolidin-4-one* (6b). A solution of the bromoamide (2b) (2.56 g, 0.01 mol) [i.r. (CCl_4): 3420sh, 1 690, and 1 520 cm^{-1}; n.m.r. ($CDCl_3$): 2.0 (6 H, s, 2 Me), 4.48 (2 H, d, 5.4 Hz, CH_2), 7 br (CONH), and 7.3 (5 H, s, C_6H_5)],[11] in anhydrous THF (4 ml), was added over 5 min to sodium hydride (0.48 g, 0.02 mol) covered with THF (8 ml) and the

* For details of the Supplementary publications scheme, see Notice to Authors No. 7 in *J.C.S. Perkin I*, 1979, Index issue.

mixture was stirred for 2 h at room temperature; after centrifugation, the solution was concentrated to dryness. The oil was dissolved in toluene (20 ml) and the solution was extracted with 1N-hydrochloric acid (5 × 6 ml), washed with water, dried (sodium sulphate), and concentrated to dryness: the thick oil (1.4 g) was triturated (95% ethanol) and the resulting solid was recrystallized from chloroform–light petroleum to give colourless prisms, m.p. 93—94 °C (0.67 g, 31%); single spot R_{F_1} 0.8, R_{F_2} 0.6, pink with Ninhydrin, yellow with I_2–NaN_3; i.r.: $\nu_{max.}$ ($CHCl_3$) 3 400, 3 360, 1 720, and 1 710 cm^{-1}; n.m.r. 1.58, 1.60 (6 H, 2s, Me_2C-5), 1.77, 1.88 (6 H, 2s, Me_2CBr), 2.85 (1 H, dd, ABC, J,J'_{NHCH} 9 and 3 Hz, NH) 3.16 and 3.88 (2 H, dd, *ABC*, J_{HH} 12 Hz, J_{NH-CH} 8 Hz, J'_{NH-CH} 3 Hz, CH_2NH), 4.67, 4.85 (2 H, AB, J 15 Hz, CH_2N), and 7.1—7.5 (10 H, m, 2 C_6H_5). On addition of D_2O, the NH signal at 2.85 disappears and the ABC collapses to an AB system (Found: C, 61.05; H, 6.45; Br, 18.25; N, 6.50; *M* 438. $C_{22}H_{27}BrN_2O_2$ requires C, 61.2; H, 6.30; Br, 18,52; N, 6.51%; *M* 431.3). From the acid washings, some compound (7b) crystallized out as the hydrochloride; it could be obtained more conveniently as indicated below.

(b) 1-*Benzylcarbamoyl*-1-*methylethyl* 2-*benzylaminoisobutyrate* (7b) *hydrochloride*. A reaction mixture consisting of the bromoamide (2b) (1.06 g, 4 mmol) and sodium hydride (0.105 g, 4.4 mmol) in benzene (12 ml) was heated under reflux for 3 h. Extraction with 1N-hydrochloric acid (3 × 7 ml) gave an aqueous solution from which a solid separated out in *ca.* 1 h: a further amount was obtained upon extraction with chloroform and dilution with light petroleum. Colourless prisms were obtained from chloroform–light petroleum (34%), m.p. 224—225 °C, R_{F_1} 0.35, yellow spot with I_2–NaN_3; i.r.: $\nu_{max.}$ (KBr) 3 270 (NH), 3 040—2 390, 1 740 (ester CO), 1 665 (amide CO), and 1 140 cm^{-1} (C–O–C); n.m.r. [$CDCl_3$–$(CD_3)_2SO$, (1 : 1)] 1.75 and 1.76 (12 H, 2 s, 2 Me_2), 4.15br (2 H, $CH_2\overset{+}{N}$), 4.45 (2 H, d, J 6 Hz, CH_2NCHO), 7.3 (5 H, s, C_6H_5), 7.3—7.5 and 7.6—7.8 (3 H and 2 H, 2 m, C_6H_5), 8.5 (1 H, t, J 6 Hz, CONH), and 10.3 (2 H, s, $H_2\overset{+}{N}$). Addition of D_2O caused the disappearance of the NH_2 signal at 10.3 in 1 min, and of the CONH signal at 8.5 in 1—2 h; concurrently, both signals at 4.15 and 4.45 collapsed to singlets (Found: C, 64.95; H, 7.55; Cl, 9.3; N, 6.7. $C_{22}H_{29}ClN_2O_3$ requires C, 65.24; H, 7.21; Cl, 8.76; N, 6.91%).

The free base (7b). A solution of (7b) hydrochloride (0.21 g, 0.5 mmol) in chloroform (22 ml) was shaken with saturated aqueous sodium hydrogen carbonate (3 × 5 ml), washed with water until neutral, dried (Na_2SO_4), and concentrated to dryness. The resulting solid (0.18 g, 92%) was recrystallized from chloroform–light petroleum to give colourless prisms, m.p. 90 °C, R_{F_1} 0.4, brown with I_2–NaN_3; i.r. $\nu_{max.}$ (KBr) 3 340 (amide NH), 1 730 (ester CO), 1 665 (amide CO), 1 540, 1 370, and 1 120 cm^{-1} (ether); $\nu_{max.}$ (CCl_4) 3 460 (amide NH), 1 740 (ester CO), 1 690 (amide CO), 1 510, and 1 140 cm^{-1} (ether); n.m.r. 1.35 (6 H, s, Me_2C–N), 1.7 (6 H, s, Me_2C–O), 1.9 (1 H, s, NH), 3.68 (2 H, s, CH_2NH), 4.48 (2 H, d, J 6, CH_2NHCO), 6.3br (1 H, NHCO), and 7.3 (10 H, s, 2 C_6H_5). In $(CD_3)_2SO$, the NHCO signal was at 8.2. Addition of D_2O caused the disappearance of the NH at 1.9 in 2—3 min., and of the NH at 6.3 in *ca.* 6 h (Found: C, 71.9; H, 7.55; N, 7.5; *M* ($CHCl_3$) 365. $C_{22}H_{28}N_2O_3$ requires C, 71.71; H, 7.66; N, 7.60%; *M* 368.5). T.l. and column chromatography showed some free base (7b) prior to the acid treatment.

Hydrolysis of the Oxazolidinones.—1-*Benzylcarbamoyl*-1-*methylethyl* 2-*bromoisobutyrate* (8b). The oxazolidinone (6b) (215 mg, 0.5 mmol) in anhydrous ethanol (6 ml) was heated under reflux for 15 min with 5N-hydrochloric acid (0.1 ml, 0.5 × 10^{-3} mol equiv.). The solution was taken to dryness and the oily product was triturated with ether. Benzylamine hydrochloride remained undissolved (90%); the ether solution was taken to dryness and worked up with n-hexane: the resulting solid (136 mg, 80%) was recrystallized from n-hexane as colourless prisms, m.p. 91—93 °C, R_{F_1} 0.57, brown with I_2–NaN_3; i.r. $\nu_{max.}$ ($CHCl_3$) 3 430 (amide NH), 1 745 (ester CO), 1 685 (amide CO), 1 510, 1 465, 1 455, 1 140, and 1 110; (KBr) 3 350 (amide NH), 1 735 (ester CO), 1 660 (amide CO) 1 535, 1 140, and 1 110 cm^{-1}; n.m.r. 1.7 (6 H, s, Me_2C–O), 1.9 (6 H, s, Me_2C–Br), 4.5 (2 H, d, J 7 Hz, CH_2), 6.55br (1 H, coupled with the signal at 4.5, CONH), and 7.3 (5 H, s, C_6H_5) (Found: C, 53.35; H, 6.25; Br, 23.55; N, 4.15. $C_{15}H_{20}BrNO_3$ requires C, 52.64; H, 5.89; Br, 23.34; N, 4.09%).

1-*Benzylcarbamoylethyl* 1-*bromopropionate* (*unresolved mixture*) (8a). An identical reaction of (6a) gave benzylamine hydrochloride (80%) and an oily product: column chromatography with ethyl acetate–toluene (1 : 4) of the latter gave a product which, on trituration with n-hexane, gave a solid (72 mg, 50%); m.p. 74—77 °C; R_{F_1} 0.53, R_{F_2} 0.21, yellow spot with I_2–NaN_3, unreactive with Ninhydrin; i.r. $\nu_{max.}$ ($CHCl_3$) 3 420 (amide NH), 1 740 (ester CO), 1 665 (amide CO), 1 520, 1 450, 1 110, and 1 080; $\nu_{max.}$ (KBr) 3 270 (amide NH), 1 735 (ester CO), and 1 655 (amide CO); n.m.r. 1.56 (3 H, d, J 8 Hz, CH_3C–O), 1.84 (3 H, d, J 8 Hz, CH_3C–Br), 4.5 (1 H, unresolved m, HC–Br, 2 H, d, J 7 Hz, CH_2), 5.35 (1 H, unresolved m, HC–O), 6.48br (1 H, NH), 7.3 (5 H, s, C_6H_5). Irradiation of the NH caused the coalescence of the signal at 4.5 (Found: C, 50.25; H, 5.2; Br, 25.55; N, 4.31. $C_{13}H_{16}BrNO_3$ requires C, 46.69; H, 5.13; Br, 25.43; N, 4.45%.)

Behaviour of the Oxazolidinones in the Presence of SiO_2.—(*a*) A sample of (6b) was thoroughly mixed with a four-fold excess of SiO_2 and kept for 30 min. at *ca.* 100 °C. Extraction with absolute ethanol gave a solid: colourless prisms, m.p. 230—232 °C from chloroform (40%): its i.r. spectrum (KBr) and behaviour on t.l.c. were identical to those of (7b) hydrochloride, indicating that it was (7b) hydrobromide: on neutralization, it yielded the free base (7b).

(*b*) Samples of (6a), treated with SiO_2, for 30 min, at 100 °C gave red mixtures: extraction with water gave benzylamine hydrobromide (50%); subsequent extraction with chloroform gave compound (8a) (40%).

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