

Reactions of Anions of *N*-Benzylidenebenzylamines and Related Compounds. A Simple Route to α -Substituted Benzylamines

By John E. Arrowsmith and Michael J. Cook,* School of Chemical Sciences, University of East Anglia, Norwich NR4 7TJ

David J. Hardstone, Chemistry Research Laboratories, Pfizer Central Research, Sandwich, Kent CT13 9NJ

The generation of anions of substituted *N*-benzylidenebenzylamines and some pyridinoid analogues is described. The site of alkylation of the ambident anion is critically dependent upon the nature and pattern of ring substitution. Anions derived from *N*-mesitylidenebenzylamines react with alkyl halides and ethyl chloroformate mainly or exclusively at the carbon atom α to the aryl group originating from the benzylamine precursor. The synthetic implications of the study are discussed.

REMOVAL of a proton α to the nitrogen atom of Schiff bases provides ambident anions of type (1) and these are generated readily when at least one of the R groups is electron-withdrawing. Such anions can be

the imine (2) has given access to α -vinyl and α -ethynyl alanine.^{8,9} Among simple amines, methylamine has been chain lengthened^{10,11} *via* the anion of (3), and the anion (4) of *N*-benzylidenebenzylamine shown to react

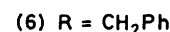
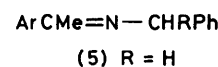
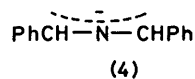
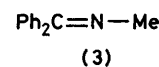
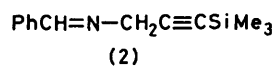
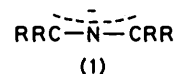
TABLE I
Preparation and characterisation of Schiff bases, ArCH=N-CH₂Ar'

No.	Compound		Yield (%)	M.p./b.p.	Lit. m.p. b.p.	Ref.	Formula	Found (%)			Requires (%)			δ (H-imidoyl)
	Ar	Ar'						C	H	N	C	H	N	
(7)	Ph	4-ClC ₆ H ₄	85	34.5—35	36—37	<i>a</i>							8.24	
(8)	4-MeC ₆ H ₄	Ph	68	130/1 mmHg	210/25 mmHg	<i>a</i>							8.19	
(9)	4-MeOC ₆ H ₄	Ph	90	41—42	42	<i>b</i>							8.12	
(10)	Ph	4-MeOC ₆ H ₄	75	147—150/1 mmHg	217/17 mmHg	<i>b</i>							8.15	
(11)	4-Pyr	Ph	93	56—58			C ₁₃ H ₁₂ N ₂	79.8	6.2	14.1	79.6	6.1	14.3	8.21
(12)	Ph	Ph	89	130—132/1.5 mmHg	200/20 mmHg	<i>c</i>							8.16	
(13)	4-Me ₂ NC ₆ H ₄	Ph	74	73.5—74	75	<i>a</i>							8.15	
(14)	4-MeOC ₆ H ₄	4-ClC ₆ H ₄	95	57—58			C ₁₅ H ₁₄ ClNO	69.2	5.3	5.3	69.4	5.4	5.4	8.63
(15)	4-MeOC ₆ H ₄	4-MeOC ₆ H ₄	93	178—180/0.5 mmHg			C ₁₆ H ₁₇ NO ₂	74.9	6.5	5.9	75.3	6.7	5.5	8.19
(16)	2,4,6-Me ₃ C ₆ H ₂	4-MeOC ₆ H ₄	87	28—32			C ₁₆ H ₂₁ NO	80.35	7.9	5.4	80.0	8.3	5.5	8.62
(17)	2,4,6-Me ₃ C ₆ H ₂	Ph	89	146—148/0.2 mmHg			C ₁₇ H ₁₉ N	86.15	8.2	6.1	86.0	8.1	5.9	8.67
(18)	2,4,6-Me ₃ C ₆ H ₂	3-Pyr	97	137—140/0.5 mmHg			C ₁₆ H ₁₈ N ₂	80.4	7.5	11.8	80.6	7.6	11.75	8.66
(19)	2,4,6-Me ₃ C ₆ H ₂	4-ClC ₆ H ₄	99	68—69.5			C ₁₇ H ₁₈ ClN	75.0	6.5	5.2	75.1	6.7	5.2	8.67
(20)	2,4,6-Me ₃ C ₆ H ₂	2,4-Cl ₂ C ₆ H ₃	94	94—96			C ₁₇ H ₁₇ Cl ₂ N	66.35	5.55	4.8	66.7	5.6	4.6	8.71
(21)	2,4,6-Me ₃ C ₆ H ₂	2,3-Cl ₂ C ₆ H ₃	85	78—80			C ₁₇ H ₁₇ Cl ₂ N	66.7	5.5	4.9	66.7	5.6	4.6	8.63
(22)	2,4,6-Me ₃ C ₆ H ₂	3,4-Cl ₂ C ₆ H ₃	97	57.5—58.5			C ₁₇ H ₁₇ Cl ₂ N	67.1	5.55	4.9	66.7	5.6	4.6	8.68
(23)	Ph	2,4,6-Me ₃ C ₆ H ₂	83	45.5—46.5			C ₁₇ H ₁₉ N	85.6	7.8	6.3	86.0	8.1	5.9	8.04

* C. W. Shoppee, *J. Chem. Soc.*, 1931, 1225. ^b C. K. Ingold and C. W. Shoppee, *J. Chem. Soc.*, 1929, 1199. ^c A. T. Mason and G. R. Winder, *J. Chem. Soc.*, 1894, 65, 191.

regarded as masked α -amino-carbanions and for this reason are potentially useful intermediates in synthesis.† Thus anions of benzaldehyde imine or *p*-nitrobenzaldehyde imine derivatives of 6-aminopenicillanic acid esters have been used to incorporate a substituent at C-6,²⁻⁴ and analogous conversions were also reported for the cephalosporin series.² Recently, attention has been directed towards using anions of Schiff bases in amino-acid synthesis; anions of benzaldehyde imine⁵ and ketimine⁶ derivatives of simple amino-acid esters have been treated with electrophiles and an attractive refinement utilising Schiff-base precursors derived from chiral ketones provided α -alkylated amino-acids having high optical purity.⁷ Sequential base-catalysed alkylation and methoxycarbonylation (using ClCO₂Me) of

with ketones¹⁰ and also to undergo addition to alkenes.¹² Very recently, treatment of (5) with two equivalents each of base and benzyl chloride has been shown to give the monoalkylation product (6) in 37% yield.¹³



† For a review of masked α -amino-carbanions see ref. 1.

Here we report the generation of the ambident anions of a series of *N*-benzylidenebenzylamines and related compounds (7)–(23) (see Table 1). The site of reaction of the anions with alkylating agents is investigated and conditions are established whereby reaction proceeds quantitatively with high or complete regioselectivity. Hydrolytic cleavage of the alkylated products affords α -alkylated benzylamines in good yield; oxidative cleavage provides access to ketones.

RESULTS AND DISCUSSION

Alkylation Studies.—Imines were prepared (Table 1) by warming aldehyde and amine together in the absence of solvent. ¹H n.m.r. data are consistent with the presence of only one isomer, a conclusion in accord with those of other studies on various members and analogues of the series.^{14–16} The isomer present is presumed to have the *E*-configuration.

The generation of anions was attempted using various base systems (see Experimental section procedures A–D) and the results of the subsequent alkylation reactions are reported in Table 2. In all cases consumption of the anion, assessed by the discharge of colour, was complete within 3 h. Experiments (I)–(VII) refer to alkylations in which potassium *t*-butoxide in dimethoxyethane (DME) was used as base. Here

alkylation of the imine only proceeded quantitatively (as judged by n.m.r.) when one of the aromatic rings was electron withdrawing. In contrast, starting material was consumed completely in alkylation reactions catalysed by butyl-lithium (BuLi) in tetrahydrofuran (THF) but a competing reaction, believed to be addition across the C=N bond became significant for electron-rich imines, *e.g.* experiment (XI). This problem was largely overcome by the use of lithium di-isopropylamide (LDA) in THF as exemplified by the quantitative alkylations of the electron-rich imines of experiments (XIV) and (XV). However alkylation of *N*-benzylidenemesitylamine (23) was accompanied by unknown side reactions when both BuLi and LDA were used as a base; for this imine clean quantitative alkylation was achieved using KOBu^t in hexamethylphosphoramide, experiment (XXIX).

The site of alkylation was found to be critically dependent upon the pattern and nature of ring substitution. The ratio of the isomers resulting from alkylation, *m* : *n* in Table 2, was determined by analysis of the products of subsequent hydrolysis, normally the aldehyde fraction. The results, Table 2, show that alkylation proceeds preferentially at the carbon atom α to the more electron-deficient system. This feature is particularly apparent for the *N*-pyridylidenebenzylamine (11), *i.e.* experiments (V) and (VI), where reaction

TABLE 2
Generation and alkylation of Schiff-base anions;

$$\text{ArCH=N-CHAr}' \rightarrow \text{ArCH}^{\ominus}\text{-N-CHAr}' \rightarrow \underset{m}{\text{ArCH=N-CHRAr}'} + \underset{n}{\text{ArCHR-N=CHAr}'}$$

Experiment no.	Compound		Base	Solvent	Alkylating agent	Time (h)	% Alkylation ^a	Ratio <i>m</i> : <i>n</i>	% Yield of isolated alkylated amine
	Ar	Ar'							
(I)	Ph	4-ClC ₆ H ₄	KOBu ^t	DME	MeI	2	100	65 : 35	
(II)	4-MeC ₆ H ₄	Ph	KOBu ^t	DME	MeI	2½	50 ^b	<i>c</i>	
(III)	4-MeOC ₆ H ₄	Ph	KOBu ^t	DME	MeI	2	30 ^b	<i>c</i>	
(IV)	Ph	4-MeOC ₆ H ₄	KOBu ^t	DME	MeI	2	30 ^b	<i>c</i>	
(V)	4-Pyr	Ph	KOBu ^t	DME	Pr ⁱ I	2	100	0 : 100	74
(VI)	4-Pyr	Ph	KOBu ^t (× 2) ^d	DME	MeI (× 2) ^d	6 ^d	100	0 : 100	74
(VII)	Ph	Ph	KOBu ^t	DME	MeI	2½	80 ^b	<i>e</i>	
(VIII)	Ph	Ph	LDA	THF	MeI	2	100	<i>e</i>	98
(IX)	Ph	Ph	LDA	THF	<i>c</i> -C ₆ H ₁₁ Br	2½	100	<i>e</i>	
(X)	Ph	Ph	LDA	THF	<i>n</i> -C ₇ H ₁₅ Br	2	100	<i>e</i>	
(XI)	4-Me ₂ NC ₆ H ₄	Ph	BuLi	THF	MeI	1½	83 ^f	81 : 19	
(XII)	4-MeOC ₆ H ₄	4-ClC ₆ H ₄	BuLi	THF	MeI	2	100	82 : 18	
(XIII)	4-MeOC ₆ H ₄	4-ClC ₆ H ₄	BuLi	THF	PhCH ₂ Br	2	100	86 : 14	55 ^g
(XIV)	4-MeOC ₆ H ₄	4-MeOC ₆ H ₄	LDA	THF	Pr ⁱ I	2	100	<i>e</i>	65
(XV)	2,4,6-Me ₃ C ₆ H ₂	4-MeOC ₆ H ₄	LDA	THF	Pr ⁱ I	1	100	96 : 4	93 ^g
(XVI)	2,4,6-Me ₃ C ₆ H ₂	Ph	LDA	THF	MeI	1½	100	86 : 14	96 ^g
(XVII)	2,4,6-Me ₃ C ₆ H ₂	Ph	BuLi	THF	MeI	1½	40 ^f	87 : 13	
(XVIII)	2,4,6-Me ₃ C ₆ H ₂	Ph	BuLi	THF	PhCH ₂ Br	1½	100	95 : 5	95 ^g
(XIX)	2,4,6-Me ₃ C ₆ H ₂	Ph	BuLi	THF	Pr ⁱ I	1½	100	100 : 0	83
(XX)	2,4,6-Me ₃ C ₆ H ₂	3-Pyr	BuLi	THF	Bu ⁿ Br	2	100	100 : 0	89
(XXI)	2,4,6-Me ₃ C ₆ H ₂	3-Pyr	BuLi	THF	Pr ⁱ I	1	100	100 : 0	91
(XXII)	2,4,6-Me ₃ C ₆ H ₂	4-ClC ₆ H ₄	BuLi	THF	Pr ⁱ I	1	100	100 : 0	79
(XXIII)	2,4,6-Me ₃ C ₆ H ₂	4-ClC ₆ H ₄	BuLi	THF	<i>c</i> -C ₆ H ₁₁ Br	3	100	100 : 0	80
(XXIV)	2,4,6-Me ₃ C ₆ H ₂	2,4-Cl ₂ C ₆ H ₃	BuLi	THF	BrCH ₂ CO ₂ Et	2	100	100 : 0	71
(XXV)	2,4,6-Me ₃ C ₆ H ₂	2,4-Cl ₂ C ₆ H ₃	BuLi	THF	Pr ⁱ I	1	100	100 : 0	74
(XXVI)	2,4,6-Me ₃ C ₆ H ₂	2,3-Cl ₂ C ₆ H ₃	BuLi	THF	Pr ⁱ Br	2	100	100 : 0	49
(XXVII)	2,4,6-Me ₃ C ₆ H ₂	3,4-Cl ₂ C ₆ H ₃	BuLi	THF	Pr ⁱ Br	2	100	100 : 0	90
(XXVIII)	2,4,6-Me ₃ C ₆ H ₂	3,4-Cl ₂ C ₆ H ₃	BuLi	THF	ClCO ₂ Et	1½	100	100 : 0	56
(XXIX)	Ph	2,4,6-Me ₃ C ₆ H ₂	KOBu ^t	HMPA	Pr ⁱ Br	1½	100	100 : 0	

^a Assessed by disappearance of the CH₂ singlet in the n.m.r. spectrum. ^b Unconsumed starting material remained on completion of reaction. ^c Not measured. ^d Sequential double alkylation; one-pot reaction; ^e 6 h represents total time required. ^f Symmetrical anion formed. ^g All starting material consumed, apparently *via* an addition reaction across C=N. ^h Total yield of mixed amines.

TABLE 3
Molecular orbital indices for selected Schiff-base anions,

Anion		Charge density		Electrophilic 'super-delocalizability'		
Ar	Ar'	C	C'	C	C'	Ratio C : C'
4-NMe ₂ C ₆ H ₄	Ph	-0.218	-0.253	10.82	11.80	0.916
4-MeOC ₆ H ₄	Ph	-0.220	-0.245	19.66	20.72	0.949
4-ClC ₆ H ₄	Ph	-0.231	-0.220	397.18	393.13	1.012
4-Pyr	Ph	-0.223	-0.202	17.04	16.46	1.035
2,4,6-Me ₃ C ₆ H ₃	Ph	-0.214	-0.255	11.75	12.76	0.921

TABLE 4
Characterisation of α -substituted amines, ArCRR'NH₂

Amine			R'	Derivative	M.p. (°C)	Formula	Found (%)			Requires (%)			
Ar	Me	R					C	H	N	C	N	N	
Ph			H	HCl salt	157 (lit.,* 158)								
Ph	Pr ^l		H	picrate	185.5—187.5	C ₁₆ H ₁₆ N ₄ O ₇	50.9	4.9	14.5	50.8	4.8	14.8	
4-MeOC ₆ H ₄	Pr ^l		H	HCl salt	227—232	C ₁₁ H ₁₅ ClNO	61.0	8.2	6.6	61.25	8.4	6.5	
4-ClC ₆ H ₄	Pr ^l		H	HCl salt	258.5—255.9	C ₁₀ H ₁₅ Cl ₂ N	54.5	6.6	6.3	54.6	6.9	6.4	
4-ClC ₆ H ₄	c-C ₆ H ₁₁		H	HCl salt	274—275	C ₁₃ H ₁₆ Cl ₂ N	59.9	7.3	5.4	60.0	7.4	5.4	
2,4-Cl ₂ C ₆ H ₃	CH ₂ CO ₂ Et		H	picrate	183—185	C ₁₇ H ₁₆ N ₄ O ₈ Cl ₂	41.4	3.4	11.4	41.6	3.3	11.4	
2,4-Cl ₂ C ₆ H ₃	Pr ^l		H	HCl salt	243—245	C ₁₀ H ₁₄ Cl ₃ N	46.9	5.7	5.55	47.2	5.5	5.5	
2,3-Cl ₂ C ₆ H ₃	Pr ^l		H	HCl salt	254 (decomp.)	C ₁₆ H ₁₄ Cl ₃ N	47.5	5.5	5.45	47.2	5.5	5.5	
3,4-Cl ₂ C ₆ H ₃	Pr ^l		H	HCl salt	304—306.5	C ₁₀ H ₁₄ Cl ₃ N	47.3	5.5	5.7	47.2	5.5	5.5	
3,4-Cl ₂ C ₆ H ₃	CO ₂ Et		H	HCl salt	190—194	C ₁₀ H ₁₂ Cl ₃ NO ₂	41.9	4.2	5.2	42.2	4.25	4.9	
3-Pyr	Bu ⁿ		H	bis-HCl salt	219—222	C ₁₀ H ₁₅ Cl ₂ N ₂	50.5	7.65	11.5	50.6	7.65	11.8	
3-Pyr	Pr ^l		H	bis-HCl salt	258.5—259	C ₉ H ₁₆ Cl ₂ N ₂	48.3	7.3	12.3	48.4	7.2	12.55	
4-Pyr	Pr ^l		H	HCl salt	249.5—250.5	C ₉ H ₁₅ ClN ₂	57.7	7.9	14.8	57.9	8.1	15.0	
4-Pyr	Me		Me	bis-HCl salt	257—263	C ₉ H ₁₄ Cl ₂ N ₂	45.7	6.4	13.3	45.95	6.75	13.4	

* J. Tassel, *Chem. Ber.*, 1889, **22**, 1854.

proceeded exclusively at the carbon atom α to the pyridine ring, with overall transposition of the C=N double bond. Experiments (XV)—(XXVIII) provide data for the alkylation of anions of *N*-mesitylidenebenzylamines (16)—(22). In this series, steric factors associated with the *o*-methyl groups, combine with the electron-donating properties of all three aromatic methyl groups and direct anion alkylation to the carbon atom remote from the mesityl ring. Regioselectivity is high even when the other aromatic ring bears an electron-donating group [experiment (XV)] and is higher for bulkier alkylating agents [experiments (XVII)—(XIX)], illustrating the role of steric factors. As expected, isopropylation of (23), experiment (XXIX), gave the same product as that obtained from isopropylation of the isomeric imine (17). Change of base from BuLi to LDA was found to have no effect on the ratio of methylation products of (17), experiments (XVI) and (XVII).

Calculations were performed on selected anions using the Hückel approximation to the LCAO-MO method.¹⁷ Electrophilic 'super-delocalizability' and charge-density data at the sites of alkylation are collected in Table 3; inspection reveals that the preferred site of alkylation corresponds to the centre of higher electron density and higher electrophilic 'super-delocalizability'. The steric role of the *o*-methyl groups is not taken into account in these calculations.

The overall trends found in the alkylation reactions

* For a review of the use of α -metallated isocyanides see U. Schöllkopf, *Angew. Chem. Internat. Edn.*, 1977, **16**, 339.

find analogy in recent data reported for the kinetic quenching of propenyl anions bearing aryl substituents.¹⁸ In a different area, base-catalysed imine \rightleftharpoons imine equilibration of *N*-benzylidenebenzylamines has also been shown to favour the imine in which the C=N bond conjugates with the more electron-rich ring,¹⁵ a principle used to advantage for converting amines into aldehydes.¹⁹

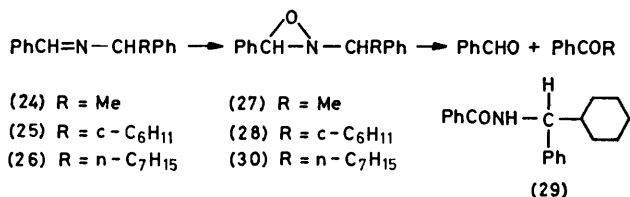
Synthetic Applications.—The ready alkylation of Schiff bases and the ease of recovering amines from them provides a convenient route for α -alkylating benzylamines which should usefully supplement existing methods applicable for α -alkylating primary amines.^{1,20,*} Furthermore, by exploiting systems where transposition of the double bond occurs during alkylation the α -alkylated amine can be prepared from the corresponding aromatic aldehyde, experiments (V), (VI), and (XXIX). In the present work alkylated amines, Table 2, other than those containing a pyridine ring, were recovered by acid hydrolysis (see Experimental section; procedure E) in high yield and characterised as the picrate or hydrochloride, Table 4. The Schiff bases containing a pyridine ring were resistant to this type of hydrolysis but were successfully cleaved using Brady's reagent (procedure F).

For general synthetic work, the α -alkylation of simple ring-substituted benzylamines would be most conveniently achieved using the aldehyde bearing the same ring substitution pattern, see experiments (VII)—(X) and (XIV), because only one alkylation product is possible from the symmetrical anion. However, where

the corresponding aldehyde is not commercially available (e.g. 2,3-dichloro- and 3,4-dichloro-benzaldehydes), then mesitaldehyde provides a very satisfactory substitute [experiments (XXVI)—(XXVII)], particularly as it is recoverable on work-up. Introduction of other substituents α to the amino-group is also feasible although this has not been fully explored in this study. However, experiment (XXVIII) illustrates the potential value of the approach for preparation of novel amino-acid esters.

The conversion of benzylamine into aromatic ketones was realised by oxidative cleavage of the alkylated imines (see Scheme). The imines (24)—(26) were readily converted into the corresponding oxaziridines and the latter exposed to acidic ²¹ or basic ²² hydrolysis.*

The oxaziridine (27) in ethanol-water-hydrochloric acid was smoothly converted into benzaldehyde and acetophenone in nearly quantitative yield as judged by g.l.c., but acid hydrolysis of (28) under various conditions gave mixtures of products which included aniline (see ref. 23) and, in daylight, the amide (29) (see ref. 24). Base-catalysed hydrolysis using KOH-water-acetone-DMF ²² was more satisfactory, giving 37% yield of cyclohexyl phenyl ketone and 67% n-heptyl phenyl ketone from (28) and (30) respectively.



SCHEME

EXPERIMENTAL

M.p.s were measured on a Reichert hot-stage melting-point apparatus and are uncorrected. I.r. spectra were recorded on a Perkin-Elmer 237 spectrophotometer system and n.m.r. spectra at 60 MHz measured using a Perkin-Elmer R12 spectrometer system operating at 32 °C.

Molecular-orbital indices were obtained using the SUSIE program ¹⁷ on a PDP-11/45 computer. Coulomb and resonance integrals were those of Pullman, and methyl groups were treated by the heteroatom approximation.

Materials.—Dimethoxyethane and tetrahydrofuran were dried prior to use by refluxing over and distilling from lithium aluminium hydride. Hexamethylphosphoramide was dried over molecular sieves, type 3A. Alkyl halides were refluxed over and distilled from phosphorus pentoxide and then stored in brown bottles in the dark. Ethyl chloroformate and ethyl bromoacetate were stood over CaCl₂ for 6 h, fractionally distilled, and then stored in brown bottles over 3A molecular sieves.

All the aldehydes and all but two of the amines were commercial samples, and were used without further purification. Mesitylamine, b.p. 60–66 °C/0.2 mmHg (lit., ²⁵ 98.5/100 mmHg), was obtained by reduction of mesitaldehyde oxime with LiAlH₄. Throughout ether refers to diethyl ether.

* For an early review see E. Schmitz, *Adv. Heterocyclic Chem.*, 1963 **2**, 83.

Preparation of 2,3-Dichlorobenzylamine. Following the method of Nystrom and Brown ²⁶ 2,3-dichlorobenzonitrile (3 mmol) was reduced with lithium aluminium hydride (4 mmol) in ether solution, giving 2,3-dichlorobenzylamine isolated as its hydrochloride salt (2.43 mmol, 81%), m.p. 265.5–268 °C (Found: C, 39.3; H, 3.7; N, 6.5. C₇H₈Cl₂N requires C, 39.6; H, 3.8; N, 6.6%).

Preparation of Schiff bases. A mixture of the aldehyde (4.8 mmol) and amine was heated at 100 °C for 1 h. The product was dissolved in ether (50 ml), dried (MgSO₄), and the solvent evaporated. The residue was then distilled under reduced pressure or recrystallised from light petroleum (b.p. 40–60 °C) as appropriate.

Alkylation Procedure.—(A) *Using potassium t-butoxide in DME.* To a stirred solution of imine (7.5 mmol) in dry DME cooled to –70 °C under a N₂ atmosphere was added solid potassium t-butoxide (8 mmol), causing an immediate intense colour to occur. After 0.5 h at room temperature the solution was cooled to –70 °C and a solution of alkyl halide (8 mmol) in dry DME (3 ml) was added dropwise. After the mixture had been stirred for 1–3 h at room temperature the intense colour was discharged, and the solvent removed. The residue was taken up in ether, and the solution washed with brine, dried, and evaporated to give the product as a yellow oil.

(B) *Using butyl-lithium.* This method was the same as that in (A) except dry THF was used in place of DME with 1.6M-butyl-lithium in hexane as base.

(C) *Using lithium di-isopropylamide.* To a stirred solution of LDA (8 mmol) in dry THF (25 ml) [prepared by adding dropwise 5 ml (8 mmol of a 1.62M) n-butyl-lithium solution in hexane to 0.9 ml of di-isopropylamine in THF (25 ml) at –70 °C under N₂] cooled to –70 °C under N₂ was added dropwise a solution of imine (7 mmol) in dry THF (5 ml). After 1 h at –70 °C, a solution of alkyl halide (8 mmol) in dry THF (3 ml) was added. Stirring was continued for a further 1–3 h at room temperature before the solvent was removed. The residue was taken up in ether, and the solution washed with brine, dried, and evaporated to give the product as a yellow oil.

(D) *Using potassium t-butoxide in HMPA.* To a stirred solution of the imine (7.5 mmol) in dry HMPA (40 ml) cooled to –20 °C under a nitrogen atmosphere was added solid potassium t-butoxide (8 mmol) causing an immediate intense colour to occur. After 0.5 h at room temperature the solution was cooled to –20 °C and a solution of alkyl halide (8 mmol) in dry HMPA (4 ml) was added dropwise. After the mixture had been stirred for 1½ h at room temperature the colour was discharged and water (100 ml) was added. The aqueous solution was extracted with ethyl acetate (4 × 40 ml) and the combined organic extracts were washed with brine, dried (MgSO₄), and evaporated to give the product as a yellow oil.

Hydrolysis of Schiff Bases.—*Procedure (E).* A solution of the alkylated Schiff base (8 mmol) in ethanol (10 ml) and 2N-hydrochloric acid (10 ml) was heated at reflux for 0.5 h. The cooled solution was poured into water (50 ml) and extracted with ether (2 × 40 ml). The aqueous fraction was neutralized with 2N-sodium hydroxide and extracted with ether (2 × 40 ml). This second ether extract was dried and evaporated to give the crude amine as a lightly coloured liquid. Where the alkyl side-chain contained an ester group [expts. (XXIV) and (XXVIII)] selective hydrolysis of the imino-function was achieved by stirring the solution at room temperature for 1 h.

Procedure (F). In cases where acid hydrolysis failed to cleave the Schiff base [expts. (V) and (VI)] cleavage was achieved by displacing the amine with 2,4-dinitrophenylhydrazine as follows. To a solution of the alkylated imine (8 mmol) in ethanol (25 ml), water (1 ml), and acetic acid (1 ml) was added 2,4-dinitrophenylhydrazine (8.5 mmol). After being heated under reflux for 20 min the solution was diluted with water (25 ml) and filtered to remove the hydrazone precipitate. The filtrate was extracted into chloroform (2 × 35 ml), dried, and evaporated. The brown residue was distilled under vacuum to give the product as a colourless liquid.

Preparation of Oxaziridines.—Oxaziridines were prepared by the method of Black and Blackman,²¹ affording the following: 2-(α -methyl)benzyl-3-phenyloxaziridine which was hydrolysed without further purification, ν_{\max} (thin film) 1 605 and 1 590 cm^{-1} (aromatic C=C); $\delta(\text{CCl}_4)$ 7.49—7.03 (10 H, m), 5.06, 4.42 (1 H, s, H-3 of *E*- and *Z*-isomers), 3.18 (1 H, q), and 1.57 (3 H, d); 2-(α -cyclohexyl)benzyl-3-phenyloxaziridine, colourless needles from hexane (94%), m.p. 146—148 °C (Found: C, 82.0; H, 7.7; N, 4.7. $\text{C}_{20}\text{H}_{23}\text{NO}$ requires C, 81.9; H, 7.9; N, 4.8%); ν_{\max} (Nujol) 1 605 and 1 590 cm^{-1} (aromatic C=C); $\delta(\text{CCl}_4)$ 7.40—6.89 (10 H, m), 5.07, 4.95, 4.47, 4.22 (1 H, s, H-3 of oxaziridine ring), 2.84 (1 H, d), and 2.30—0.61 (11 H, m); 2-(α -n-heptyl)benzyl-3-phenyloxaziridine, colourless needles from light petroleum (92%), m.p. 38—40.5 °C (Found: C, 81.2; H, 8.6; N, 4.5. $\text{C}_{21}\text{H}_{27}\text{NO}$ requires C, 81.5; H, 8.8; N, 4.5%), ν_{\max} (Nujol) 1 600 and 1 585 cm^{-1} (aromatic C=C); $\delta(\text{CCl}_4)$ 7.45—7.03 (10 H, m), 5.01, and 4.35 (1 H, s, H-3 of *E*- and *Z*-isomers).

Acid-catalysed Hydrolysis of Oxaziridines.—A solution of the oxaziridine (8 mmol) in ethanol (45 ml) and 2*N*-hydrochloric acid (35 ml) was stirred at room temperature until t.l.c. (ethyl acetate) indicated the absence of starting material (4—20 h). Water (100 ml) was added to the chilled solution and the whole extracted with chloroform (2 × 70 ml). The combined organic extracts were dried (MgSO_4) and evaporated to leave a brown oil which was analysed by g.l.c.

By the above procedure (27) afforded benzaldehyde (94%) and acetophenone (86%).

In normal daylight 2-(α -cyclohexyl)benzyl-3-phenyloxaziridine (28) gave, prior to the addition of water, a precipitate of *N*-(α -cyclohexyl)benzylbenzamide (29) (29%), m.p. 214—215 °C (Found: C, 81.6; H, 8.0; N, 4.85. $\text{C}_{20}\text{H}_{23}\text{NO}$ requires C, 81.9; H, 7.9; N, 4.8). However, in the dark no amide was formed and the products, worked up as above, were found to contain benzaldehyde (39%), cyclohexylphenylketone (23%), and aniline (24%).

Base-catalysed Hydrolysis of Oxaziridines.—Hydrolyses were performed following the procedure of Dinizo and Watt²² using KOH in the water-acetone-DMF medium reported by these workers.

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