# The Mass Spectra of Small-ring Heterocycles. IV.



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Both the high and low resolution mass spectra of fourteen isomeric *trans*- and *cis*-aroylaziridines are presented. In contrast to earlier low resolution mass spectral work on these compounds [1], a new fragmentation pathway for the loss of hydroxyl is presented. Also, the simple fission of the *N*-alkylnitrogen bond is described. Detailed fragmentation mechanisms are presented and discussed for the major ions found in the mass spectra.

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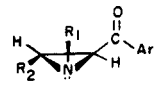
In order to extend the earlier work done on aroylaziridines [1] both the high and low resolution mass spectra of the following new synthesized aziridines were obtained: *trans*- and *cis*-1-cyclohexyl-2-phenyl-3-benzoylaziridines, **1a** and **1b**, (Figures Ia and Ib, respectively) [2]; *trans*- and *cis*-1-(2-*endo*-norbornyl)-2-phenyl-3-benzoylaziridines, **2a** and **2b**; *trans*- and *cis*-1-(2-*exo*-norbornyl)-2-phenyl-3-benzoylaziridines, **3a** and **3b**, (Figures II and IIb, respectively); *trans*- and *cis*-1-ethyl-2-phenyl-3-(*p*-phenylbenzoyl)aziridines, **4a** and **4b**, (Figures IIIa and IIIb, respectively); *trans*- and *cis*-1-isopropyl-2-phenyl-3-(*p*-phenylbenzoyl)aziridines, **5a** and **5b**; *trans*- and *cis*-1-neopentyl-2-phenyl-3-benzoylaziridines, **6a** and **6b** (Figures IVa and IVb, respectively); *cis*-1-benzhydryl-2-phenyl-3-benzoylaziridine, (**7b**); and *cis*-1-cyclohexyl-2-methyl-3-benzoylaziridine (**8b**). The compounds *trans*-1-benzhydryl-2-phenyl-3-benzoylaziridine, (**7a**), and *trans*-1-cyclohexyl-2-methyl-3-benzoylaziridine, (**8a**), were mixtures of both the *trans*- and *cis*-isomers, and therefore they were not employed in this study. The structures of these aroylaziridines are depicted in Table I. All compounds have previously been characterized by ir, $^1$H nmr and elemental analysis (see Experimental).

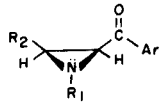
In addition, the proposed overall fragmentation mechanisms for the aziridines were tested by studies of the mass spectra of the following deuterated aziridines: *trans*- and *cis*-1-cyclohexyl-2-phenyl-3-$d_5$-benzoylaziridines, **1a'** and **1b'**, (Figures Va and Vb, respectively). Also, other previously synthesized deuterated aziridines were examined by high resolution mass spectrometry as required [1].

The favored ionization of molecules such as an aroylaziridine involves the non-bonding electrons of one of the heteroatoms. It is generally accepted that nitrogen is more capable of stabilizing a positive charge than oxygen owing to its lower electronegativity [3]. However, for aroylaziridines, the carbonyl function is attached to an aromatic system, and a positive charge on oxygen may be stabilized by resonance interactions with the aromatic ring. Therefore, the initial removal of a non-bonding electron from oxygen is considered to be an equally, if not more, important process for these aziridines.

Table I

Selected *trans*- and *cis*-1-Alkyl-2-aryl(alkyl)-3-aroylaziridines




| Compound | $R_1$ | $R_2$ | Ar |
|---|---|---|---|
| **1a** or **1b** |  | Ph | Ph |
| **2a** or **2b** |  | Ph | Ph |
| **3a** or **3b** |  | Ph | Ph |
| **4a** or **4b** | $-CH_2CH_3$ | Ph | Ph-Ph-*p* |
| **5a** or **5b** | $-CH(CH_3)_2$ | Ph | Ph-Ph-*p* |
| **6a** or **6b** | $-CH_2C(CH_3)_3$ | Ph | Ph |
| **7a**[a] or **7b** | $-CHPh_2$ | Ph | Ph |
| **8a**[a] or **8b** |  | $CH_3$ | Ph |

[a] Obtained as the isomeric mixture with the *cis*-isomer.

## Elimination of OH.

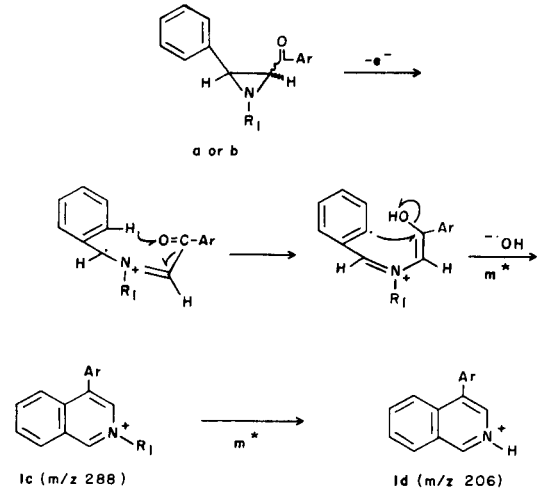
An interesting fragmentation is the formation of $[M-17]^+$ which was postulated to occur as a 1,5 shift of hydrogen (6-membered ring intermediate) to the carbonyl followed by expulsion of OH [1]. More recently, the loss of OH *via* a seven-centered rearrangement-elimination reaction has been reported for *N*-methylated aminobenzophenones [4]. In addition, rearrangement of substituted benzophenones leads to OH elimination for only the *ortho* isomers [5]. A third example of OH loss *via* a rearrangement reaction in carbonyl compounds is provided in a study of *n*-alkyl esters of *p*-methoxybenzoic acid [6].

It is now postulated, in lieu of the original proposal, that the hydroxyl loss is preceded by an eight-centered rearrangement of hydrogen originating from the *ortho* position of the phenyl group at position 2 of the aziridine ring (see Scheme I). Following loss of OH, an alkene is eliminated as a neutral fragment (presumably *via* a 4 centered rearrangement) to give the 4-phenylisoquinolinium ion (**d**). Alternatively, the alkene loss may occur first followed by loss of hydroxyl to give the same isoquinolinium ion (**d**) (see Scheme II). Both pathways to form **d** were confirmed by observation of metastable ions in the normal spectra as well as in linked accelerating voltage electrostatic analyzer (ESA) defocused spectra of deuterium enriched compounds **1a'**, **1b'**, and of *cis*- and *trans*-1-(2,2,6,6-$d_4$-cyclohexyl)-2-phenyl-3-benzoylaziridines [7].

Also of great importance for the mechanism of $[M-17]^+$ ion loss in aziridines is the non-stereoselectivity of this decomposition; *i.e.*, both *trans*- (**a**) and *cis*- (**b**) give the same result. The inference is that the first step in the mechanism involves a stereospecific 1,2-conrotatory ring opening of the molecular ion to give a common radical cation (see again Scheme I and II). Results from solution chemistry support the formation of such a species. For example, the thermal process of ring cleavage of carboaziridines involves a stereospecific conrotatory ring opening to form an ylid which may then be trapped in dipolar addition reactions [8].

Scheme I

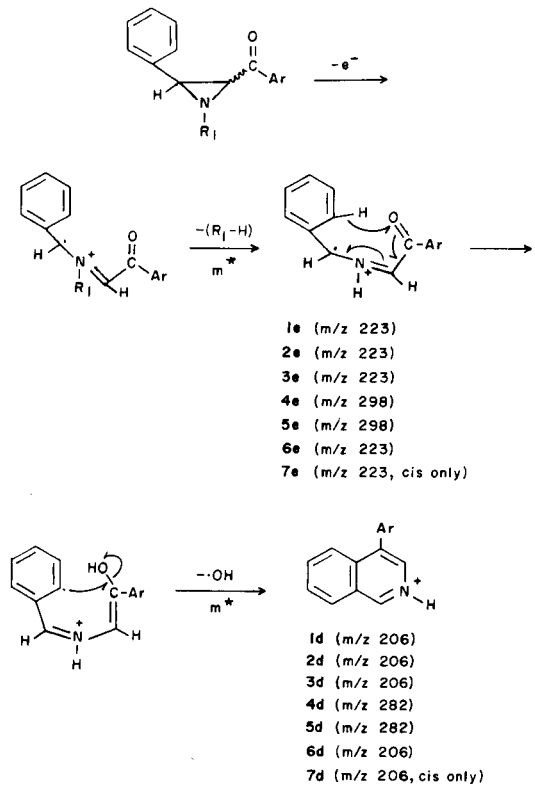
Mechanism for losses of OH and alkene from *trans*- or *cis*-1-alkyl-2-phenyl-3-aroylaziridines




## α-Cleavages and Consecutive Reactions.

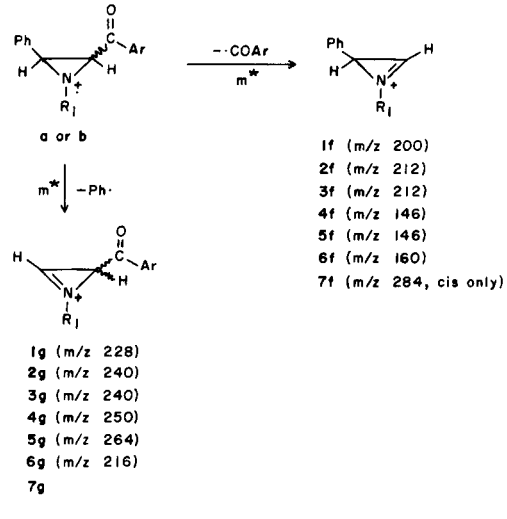
The main fragmentation process for the series of aroylaziridines proceeds *via* homolytic or heterolytic cleavage of the bonds α to the nitrogen (Scheme III).

Scheme II




Mechanism for losses of alkene and OH from *trans*- or cis-1-alkyl-2-phenyl-3-aroylaziridines

Scheme III

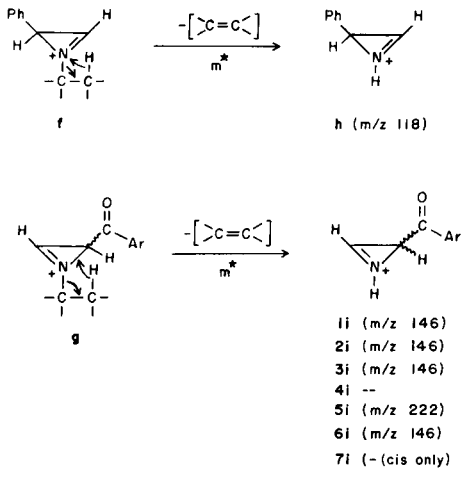



Major fragments arising from homolytic cleavage α- to nitrogen atom

All pairs, except **7** for which only the *cis*-isomer was examined, show fragments of large relative abundance which result from the homolytic cleavage of the C-ring substituents aroyl and aryl. Of course, the loss of aroyl can also occur from a molecular ion formed by removal of an oxygen non-bonding electron by an $\alpha$-cleavage. However, what is more important is the fact that loss of the aroyl group is by far the more significant occurrence in the electron ionization (EI) spectra of arylaroylaziridines.

An interesting carbon to nitrogen hydrogen shift occurs presumably in a 1,3-manner for ions **f** and **g** to give ions **h** and **i**, respectively (Scheme IV). The driving force for these two rearrangements appears to be loss of a neutral molecule (an alkene). Here the three membered ring appears to be conserved during the time of the [1,3]-sigmatropic shift which generates, in each instance, an *N*-unsubstituted azirinium cation. For **7**, this process appears quite minor since the portion lost from **f** and **g** would be $:C(C_6H_5)_2$ which cannot be obtained *via* a [1,3]-sigmatropic shift mechanism.

Scheme IV



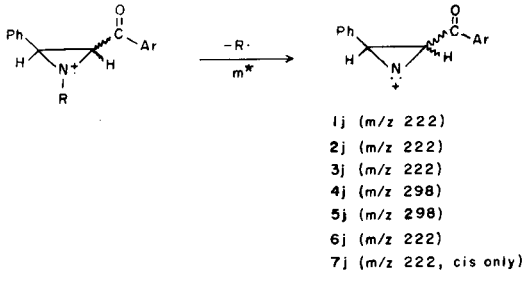

Loss of neutral alkene from azirinium cations, **f** and **g**

## Cleavage of the C-N Bond.

Simple scission of the 1-alkylnitrogen bond is generally considered to be an unusual process in the spectra of amines [9]; however, it is one of the major fragmentations of $\alpha$-lactams [10]. This process also seems to be a favored one for these aziridines possibly because relief of the steric strain may be the driving force. The best example of this is shown in the spectrum of **7**. Here the loss of the benzhydryl group affords the base peak. Another factor in the formation of **j** (see Scheme V) is the stability of the alkyl radical formed in the cleavage. (Note: in terms of radical stability, tertiary > secondary > primary). Also the fact that a singlet aziridinium cation is formed in each instance may be a driving force for the reaction. Hence, for **2a, 2b, 3a** and **3b**, loss of the norbornyl radical accounts for 4.3, 4.0, 5.1, and 5.9 percent of the total ion current, respectively. Furthermore, loss of the benzhydryl radical accounts for 17.3% of the total ion current in the mass spectrum of **7**. As expected, loss of the ethyl and neopentyl radicals accounts for a much smaller amount (<2%) of the total ion current for pairs **4** and **6**.

In the fragmentation of **6a** and **6b**, as well as **4a** and **4b**, but to a much smaller extent, cleavage of the *N*-alkylcarbon $\alpha$ to the nitrogen is observed to occur also. In **6a** and **6b**, loss of the *t*-butyl group accounts for the base peak in each instance with total ion currents of 17.3% and 12.3%, respectively.

Scheme V




Cleavage of the $\alpha$-*N*-alkylcarbon in aroylaziridines

The driving force for this reaction would appear to be loss of the *t*-butyl radical, which is of far greater stability than the neopentyl radical. The latter loss accounts for only 1.1% and 0.9% of the total ion currents, respectively. Hence, formation of the *t*-butyl radical is favored over the neopentyl radical by a factor of 14 to 16 in the 70 eV induced decompositions of these species. As expected, the $[M-15]^+$ ions for **4a** and **4b** are quite small owing to the intrinsic instability of the methyl radical *vs.* the $\alpha$-cleavage product, the ethyl radical. Following formation of fragment **j**, subsequent fragmentation, as indicated by the presence of the appropriate metastable ions, occurs *via* losses of neutral HCN and CO to give a diarylcarbonium ion at m/z 167 for **1, 2, 3, 6**, and **7** and at m/z 243 for **4** and **5**. The m/z 167 ($C_{13}H_{11}^+$) then decomposes by loss of neutral $C_6H_6$ and $C_6H_4$ to give m/z 89 and m/z 91 respectively (as confirmed by metastable ions).

Whether or not the ring system is intact in ion **h** is open for debate. That is to say, if an aroylaziridine is envisioned as undergoing a thermally allowed 1,2-conrotatory ring opening of the type in Scheme VI, then expulsion of the neutral alkene from the *N*-substituent follows the same route as in the fragmentation of *N*-alkyl secondary and *N*-alkyl tertiary amines. A similar rearrangement is seen in the mass spectrum of *N,N,N*-methylisopropylbutylamine [11].

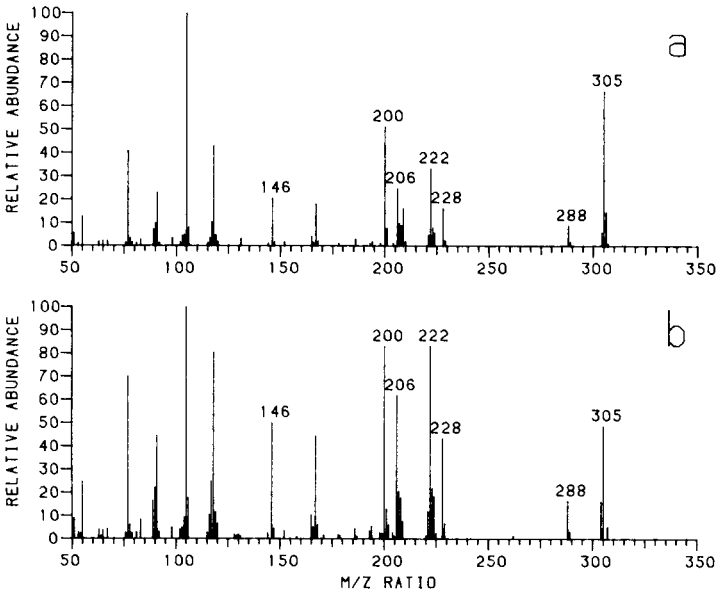



Figure I. a. Mass spectrum of *trans*-1-cyclohexyl-2-phenyl-3-benzoylaziridine (**1a**). b. Mass spectrum of the *cis*-isomer (**1b**).

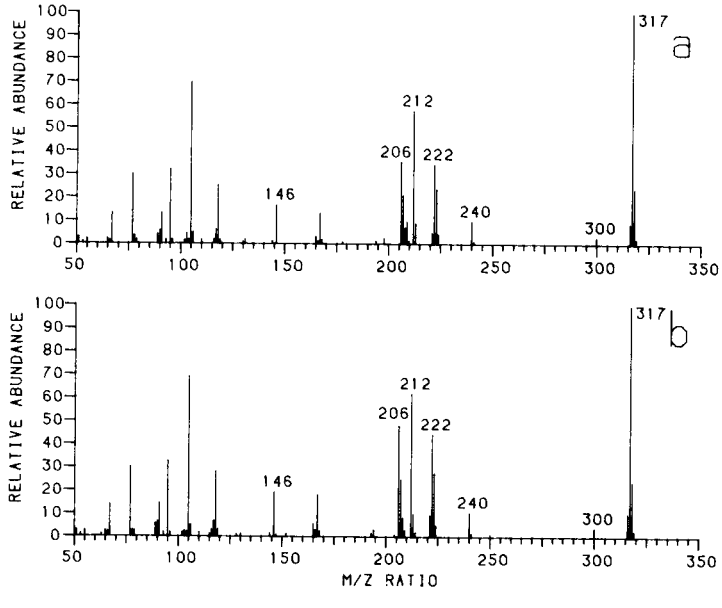
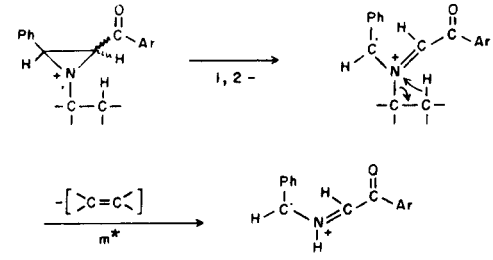



Figure II. a. Mass spectrum of *trans*-1-(2-*exo*-norbornyl)-2-phenyl-3-benzoylaziridine (**3a**). b. Mass spectrum of the *cis*-isomer (**3b**).

Ion **j** appears also to undergo an $\alpha$-cleavage reaction with elimination of the aroyl radical, to yield the fragment at m/z 117 ($C_8H_7N^{\cdot}$). Another route to m/z 117 is *via* $\alpha$-cleavage of alkyl function attached to nitrogen in ion **f** (confirmed by observation of the appropriate metastable ions). The $C_8H_7N^{\cdot}$ then decomposes by loss of HCN to give $C_7H_6^{\cdot}$.

Scheme VI

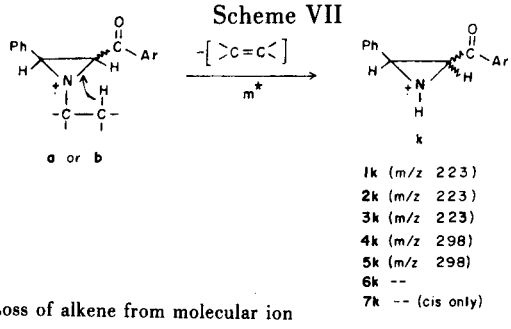



Alternate pathway in the fragmentation pattern in aroylaziridines

A common ion in the mass spectra of all of these compounds is $ArCO^+$ (where Ar is $C_6H_5$ or $C_{12}H_9$). Metastable ion studies verify that this ion originates, at least impart, from ion **g** and from the molecular ion. Decarbonylation of $ArCO^+$ to give $Ar^+$ was observed for all compounds and is the expected fragmentation of acylium ions.

In addition to the 1,3-carbon to nitrogen hydrogen shift occurring in ions **f** and **g** (see Scheme II), it can also take place in the unrearranged molecular ions **a** and **b** (see Scheme VII). Here, ion **k** can form *via* a four centered

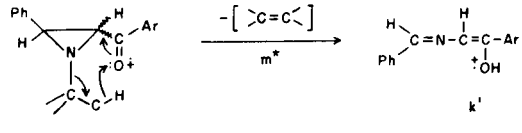
Scheme VII




Loss of alkene from molecular ion

rearrangement with subsequent loss of a neutral alkene fragment. Alternatively, ion **k′**, which is isomeric with ion **k**, may arise *via* a hydrogen migration to the carbonyl oxygen (Scheme VIII).

Scheme VIII




McLafferty-type rearrangement with loss of alkene

Therefore, if ionization initially removes a nonbonding electron from the oxygen, a McLafferty-type rearrangement with extrusion of a neutral alkene molecule could occur to give the desired fragment. However, scission of the aziriding ring occurs for **k′**. It is interesting to note that the direct loss of the neutral alkene does not occur to any significant extent for **6a**, **6b**, and **7b** (only the C-13-containing ion for m/z 222 is present). This appears quite reasonable since both the neopentyl and benzhydryl

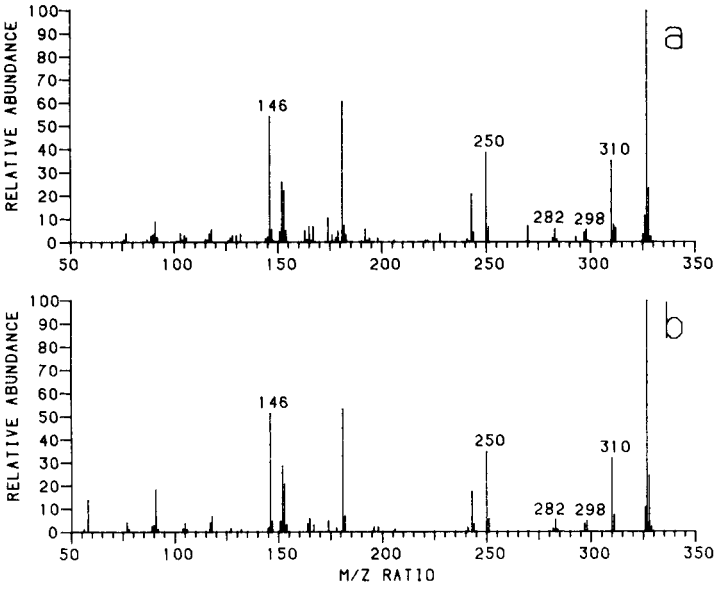



Figure III. a. Mass spectrum of *trans*-1-ethyl-2-phenyl-3-(*p*-phenylbenzoyl)aziridine (**4a**). b. Mass spectrum of the *cis*-isomer (**4b**).

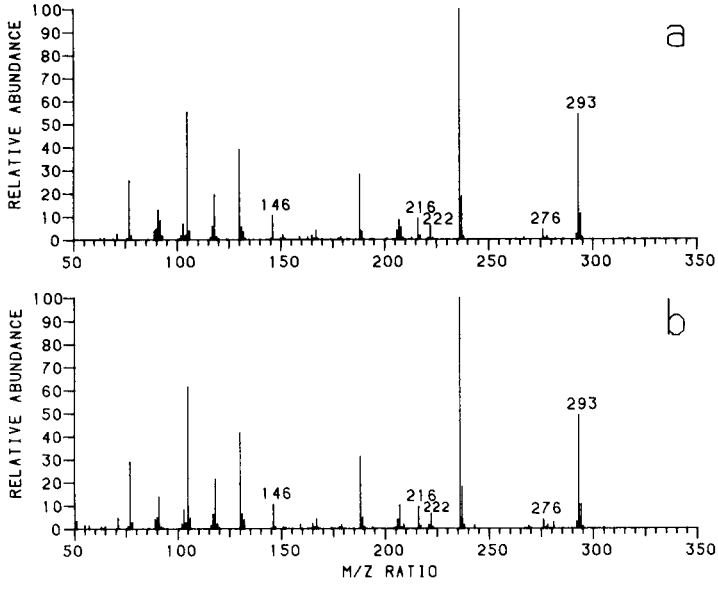


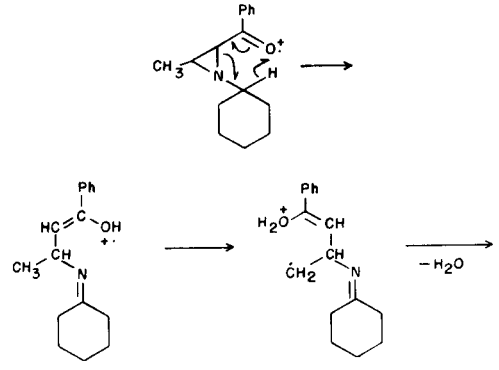

Figure IV. a. Mass spectrum of *trans*-1-neopentyl-2-phenyl-3-benzoylaziridine (**6a**). b. Mass spectrum of the *cis*-isomer (**6b**).

groups lack $\beta$-hydrogen atoms on their *N*-alkyl groups.

Loss of Water.

The presence of an $[M-18]^+$ peak rather than an $[M-17]^+$ peak in the spectra of **8b** can best be rationalized on the basis of a double McLafferty-type rearrangement [12], followed by loss of a molecule of water (Scheme VIII). It should be noted that there is no $[M-17]^+$ peak in **8b**, as confirmed by calculation [13]; rather the ion of that mass is due to the C-13 isotope of the $[M-18]^+$ fragment [14].

Scheme VIII




Scheme for loss of water

Furthermore, the cumulative loss of $C_6H_{12}O$ to give m/z 143 is not a two step expulsion of OH and $C_6H_{11}$ but rather a two step process involving water and $C_6H_{10}$ losses as indicated by observation of the appropriate metastable ions. Except for this stepwise process, which gives fragment ions of minor abundance, all fragmentation reactions of **8b**, an alkylaroylaziridine, are analogous to those of the arylaroylaziridines studied here.

## EXPERIMENTAL

Both high and low resolution mass spectra were obtained with a Kratos MS-50 mass spectrometer equipped with an INCOS Model 2000 data system. All elemental compositions assigned to the ions discussed in this paper were obtained from exact mass measurements within at least 3 ppm (relative error). Metastable transitions were observed either in the accelerating voltage/ESA linked mode [15] or the Daly mode [16].

These isomeric 1-alkyl-2-aryl(alkyl)-3-aroylaziridines were prepared by known procedures: **1a** and **1b** [17], **2a,b**, **3a,b**, **4a,b**, **5a,b**, **6a,b**, **7b** and **8b** [18]. See reference [17] for the characterization of **1a** and **1b** by mp, ir and $^1H$ nmr; and reference [18] for this same characterization of the rest. Listed below is the high resolution mass spectral data for the major ions observed for the *trans*- and *cis*-arylaroylaziridine systems [19].

Benzaldehyde-$d_5$ (98% Stohler) was employed in the synthesis of *cis*- and *trans*-1-cyclohexyl-2-phenyl-3-$d_5$-benzoylaziridines, (**1a'**) and (**1b'**), *via* an established route [18].

*trans* and *cis*-1-Cyclohexyl-2-phenyl-3-benzoylaziridines, **1a** and **1b**.

Molecular weight calculated for $C_{21}H_{23}NO$ = 305.1779. High resolution mass spectrum (major peaks) m/z (% relative intensity) = 305.1778 ($M^+$, 100.00), 288.1777 (6.71), 228.1395 (15.78), 223.0961 (6.53), 222.0911 (35.95), 209.0970 (14.88), 206.0966 (20.48), 200.1442 (47.50), 167.0856 (12.87), 151.0007 (14.88), 146.0616 (14.26), 118.0656 (31.37), 117.0596 (6.13), 116.0504 (1.21), 105.0338 (71.91), 91.0541 (14.39), 90.0460 (4.58), 89.0385 (2.63), 77.0386 (25.77).

Molecular weight calculated for $C_{21}H_{23}NO$ = 305.1779. High resolution mass spectrum (major peaks) m/z (% relative intensity) = 305.1801 ($M^+$, 59.08), 288.1738 (3.62), 228.1381 (15.70), 223.0971 (9.99), 222.0918 (37.20), 209.0984 (2.82), 206.0999 (27.57), 200.1436 (36.25), 167.0854 (27.74), 152.0634 (2.71), 146.0859 (25.07), 144.0804 (1.36), 118.0654 (55.15), 117.0584 (19.58), 116.0509 (5.75), 105.0339 (100.00), 91.0531 (24.05), 90.0455 (13.87), 89.0380 (9.57), 77.0391 (42.07).

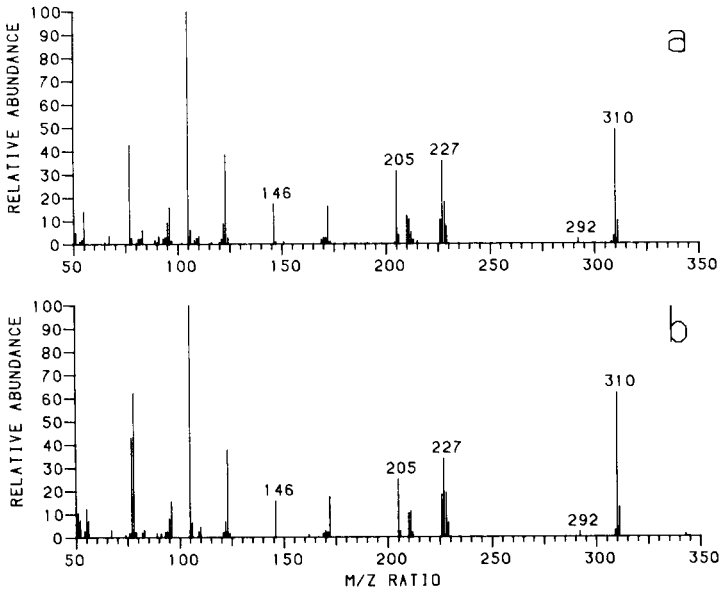



Figure V. a. Mass spectrum of *trans*-1-cyclohexyl-2-phenyl-3-$d_5$-benzoylaziridine (**1a'**). b. Mass spectrum of the *cis*-isomer (**1b'**).

*trans* and *cis*-1-(2-*endo*-Norbornyl)-2-phenyl-3-benzoylaziridines, **2a** and **2b**.

Molecular weight calculated for $C_{22}H_{23}NO$ = 317.1780. High resolution mass spectrum (major peaks) m/z (% relative intensity) = 317.1793 ($M^+$, 94.17), 300.1744 (1.57), 240.1405 (9.54), 223.0975 (16.92), 222.0909 (29.59), 212.1435 (100.00), 209.0973 (19.80), 207.0850 (20.50), 206.0969 (20.41), 167.0850 (13.32), 146.0610 (12.98), 146.0973 (9.03), 144.0800 (2.23), 118.0657 (28.55), 117.0607 (7.24), 116.0511 (2.58), 105.0343 (83.14), 95.0855 (35.23), 91.0545 (22.28), 90.0467 (7.20), 89.0389 (5.54), 77.0389 (44.11).

Molecular weight calculated for $C_{22}H_{23}NO$ = 317.1780. High resolution mass spectrum (major peaks) m/z (% relative intensity) = 317.1792 ($M^+$, 100.00), 300.1733 (0.76), 240.1414 (8.63), 223.0979 (14.21), 222.0914 (22.87), 212.1429 (88.66), 209.0961 (6.43), 207.0837 (15.00), 206.0974 (17.87), 167.0844 (7.11), 146.0981 (4.50), 146.0616 (8.42), 144.0822 (0.70), 118.0656 (15.38), 117.0591 (1.90), 105.0341 (42.87), 95.0856 (19.91), 91.0543 (13.19), 90.0453 (2.28), 89.0386 (1.49), 77.0385 (20.82).

*trans* and *cis*-1-(2-*exo*-Norbornyl)-2-phenyl-3-benzoylaziridines, **3a** and **3b**.

Molecular weight calculated for $C_{22}H_{23}NO$ = 317.1780. High resolution mass spectrum (major peaks) m/z (% relative intensity) = 317.1780 ($M^+$, 93.34), 300.1697 (1.19), 240.1373 (8.94), 223.0984 (24.73), 222.0916 (37.68), 212.1449 (30.26), 209.0991 (4.70), 207.0877 (9.62), 206.0981 (14.61), 167.0855 (11.75), 146.0956 (3.72), 144.0590 (14.91), 144.0794 (1.92), 118.0656 (35.02), 117.0586 (10.69), 116.0520 (3.24), 105.0347 (100.00), 95.0863 (55.93), 91.0541 (21.70), 89.0389 (6.86), 77.0384 (55.26).

Molecular weight calculated for $C_{21}H_{23}NO$ = 317.1780. High resolution mass spectrum (major peaks) m/z (% relative intensity) = 317.1765 ($M^+$, 100.00), 300.1751 (1.48), 240.1370 (8.23), 223.0982 (24.19), 222.0911 (38.51), 212.1456 (48.54), 209.0989 (2.55), 207.0888 (18.78), 206.0986 (33.10), 167.0868 (14.07), 146.0967 (2.82), 146.0601 (12.91), 144.0792 (1.10), 118.0654 (26.84), 117.0582 (6.50), 116.0505 (2.33), 105.0341 (70.24), 95.0860 (36.36), 91.0547 (14.13), 89.0392 (5.20), 77.0389 (30.06).

*trans* and *cis*-1-Ethyl-2-phenyl-3-(*p*-phenylbenzoyl)aziridines, **4a** and **4b**.

Molecular weight calculated for $C_{23}H_{21}NO$ = 327.1623. High resolution mass spectrum (major peaks) m/z (% relative intensity) = 327.1587 ($M^+$, 56.72), 310.1581 (34.31), 299.1300 (2.15), 298.1175 (12.97), 297.1120 (41.66), 283.1142 (5.73), 250.1231 (29.36), 243.1172 (14.69), 241.1016 (13.40), 196.0907 (12.94), 181.0660 (63.39), 167.0862 (5.86), 166.0749 (3.11), 165.0701 (16.87), 146.0966 (51.25), 118.0665 (10.76), 117.0597 (5.82), 116.0517 (2.48), 105.0329 (23.41), 91.0552 (46.33), 77.0395 (18.96).

Molecular weight calculated for $C_{23}H_{21}NO$ = 327.1623. High resolution mass spectrum (major peaks) m/z (% relative intensity) = 327.1651 ($M^+$, 100.00), 310.1614 (35.17), 299.1298 (0.78), 298.1665 (5.12), 297.1265 (0.22), 283.1149 (3.91), 282.1217 (1.13), 243.1209 (20.82), 241.1047 (1.47), 181.0675 (60.85), 167.0883 (6.88), 166.0777 (1.02), 165.0733 (6.90), 146.1011 (54.27), 118.0685 (5.52), 117.0614 (3.71), 116.0542 (1.03), 105.0350 (2.94), 91.0579 (9.11), 77.0404 (3.75).

*trans* and *cis*-1-Isopropyl-2-phenyl-3-(*p*-phenylbenzoyl)aziridines, **5a** and **5b**.

Molecular weight calculated for $C_{23}H_{23}NO$ = 341.1780. High resolution mass spectrum (major peaks) m/z (% relative intensity) = 341.1830 ($M^+$, 90.77), 324.1805 (6.11), 299.1298 (6.87), 298.1251 (32.35), 282.1290 (6.37), 264.1425 (16.38), 243.1204 (46.00), 222.0924 (9.26), 220.1116 (2.54), 181.0673 (93.85), 167.0870 (5.84), 165.0735 (10.35), 162.1302 (100.00), 160.1111 (24.27), 153.0742 (33.04), 118.0683 (17.67), 117.0609 (6.72), 116.0537 (2.14), 91.0565 (77.38), 77.0401 (5.66).

Molecular weight calculated for $C_{23}H_{23}NO$ = 341.1780. High resolution mass spectrum (major peaks) m/z (% relative intensity) = 341.1793 ($M^+$, 100.00), 324.1775 (5.67), 299.1299 (5.55), 298.1268 (25.64), 282.1309 (4.07), 264.1431 (17.09), 243.1209 (48.94), 222.0926 (12.91), 220.1138 (3.12), 181.0684 (88.94), 167.0894 (1.63), 165.0742 (7.04), 162.1310 (1.48), 160.1120 (23.23), 153.0752 (23.23), 118.0690 (15.94), 117.0608 (4.45), 116.0525 (4.45), 91.0585 (6.87), 77.0421 (6.31).

*trans* and *cis*-1-Neopentyl-2-phenyl-3-benzoylaziridines, **6a** and **6b**.

Molecular weight calculated for $C_{20}H_{23}NO$ = 293.1780. High resolution mass spectrum (major peaks) m/z (% relative intensity) = 293.1780 ($M^+$, 49.41), 276.1748 (4.06), 236.1071 (100.00), 222.0913 (6.61), 216.1383 (9.57), 209.0945 (1.98), 206.0970 (3.99), 188.1442 (31.40), 167.0853 (4.21), 165.0705 (2.23), 146.0603 (10.77), 130.0655 (41.91), 118.0657 (21.73), 117.0576 (4.21), 116.0503 (1.55), 106.0377 (4.85), 105.0341 (60.99), 91.0545 (14.04), 90.0465 (5.13), 89.0389 (4.06), 77.0387 (29.31).

Molecular weight calculated for $C_{20}H_{23}NO$ = 293.1780. High resolution mass spectrum (major peaks) m/z (% relative intensity) = 293.1779 ($M^+$, 50.75), 276.1750 (4.44), 236.1070 (100.00), 222.0916 (6.00), 216.1393 (9.23), 209.0946 (0.98), 206.0970 (4.16), 188.1439 (28.28), 167.0861 (4.28), 165.0708 (2.07), 146.0607 (10.61), 130.0657 (39.17), 118.0656 (19.70), 117.0575 (4.29), 116.0500 (1.17), 106.0376 (4.03), 105.0339 (55.01), 91.0545 (13.18), 90.0467 (4.91), 89.0387 (4.03), 77.0391 (25.89).

*trans* and *cis*-1-Benzhydryl-2-phenyl-3-benzoylaziridines (**7b**).

Molecular weight calculated for $C_{28}H_{23}NO$ = 389.1780. High resolution mass spectrum (major peaks) m/z (% relative intensity) = 389.1789 ($M^+$, 3.01), 284.1447 (2.69), 222.0917 (100.00), 206.0963 (1.12), 167.0861 (64.75), 166.0772 (12.62), 165.0705 (32.36), 117.0574 (7.27), 116.0506 (3.03), 105.0340 (82.49), 91.0545 (9.45), 90.0466 (11.54), 89.0389 (10.75), 77.0391 (38.29).

*cis*-1-Cyclohexyl-2-methyl-3-benzoylaziridine (**8b**).

Molecular weight calculated for $C_{16}H_{21}NO$ = 243.1623. High resolution mass spectrum (major peaks) m/z (% relative intensity) = 243.1618 ($M^+$, 12.32), 288.1387 (32.28), 225.1518 (2.25), 160.0762 (20.77), 147.0810 (33.67), 146.0607 (100.00), 144.0808 (2.21), 143.0738 (2.38), 138.1284 (33.71), 124.1126 (14.19), 105.0706 (13.77), 105.0342 (31.83), 91.0547 (5.13), 90.0467 (0.76), 89.0388 (0.76), 77.0387 (24.52), 56.0501 (15.63), 55.0421 (2.33), 54.0344 (1.89).

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