

PHOTO-BECKMANN REARRANGEMENTS OF ANDROSTERONE OXIME
AND 13 α -ANDROSTERONE OXIME (1)

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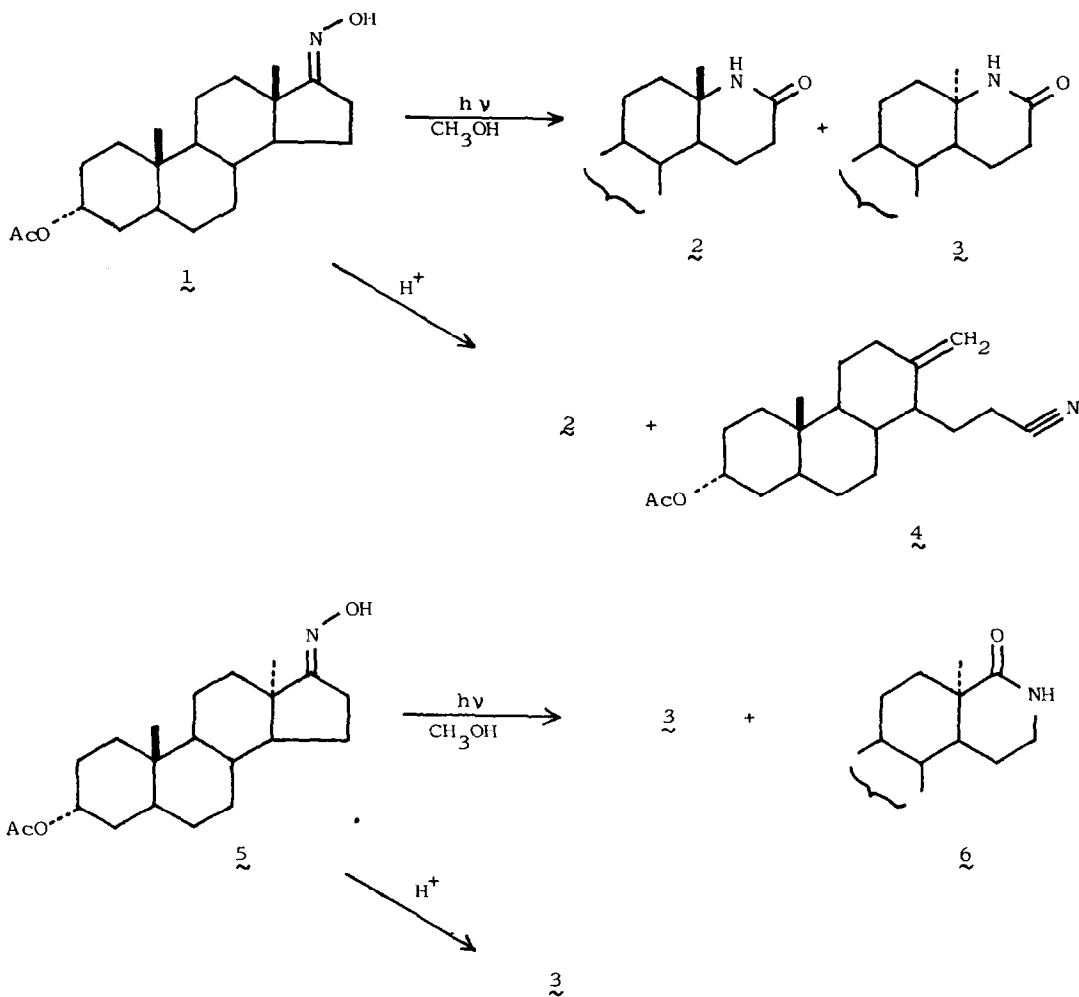
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In previous papers we have shown that in the photo-Beckmann rearrangements of some steroidal oximes the bond migration of the oximes to lactams proceeded in a stereospecific manner, the migration of carbon α to the oximino group occurring with the retention of the original configuration, and in these unsymmetrically α -substituted oximes the relative amounts of the two isomeric lactams due to the migration of the tri-substituted carbon (C₅) and the di-substituted carbon (C₇) were not significantly different. (2)

On the basis of these findings, we suggested that the rearrangement of oxaziridines to lactams proceeded without the dissociation of the α -carbon and oxaziridine carbon bond and probably involved a concerted breakdown of oxaziridine. (3) Later, Just and co-workers reported a similar results with menthone oxime and isomenthone oxime. (4)

In this paper we wish to report on further investigation with respect to the stereospecificity of the migration stage in the photo-Beckmann rearrangement by using the title steroidal substrates.

Photolysis of O-acetyl androsterone oxime 1 (5) in methanol by a 15 W low pressure Hg arc lamp (6) proceeded slowly and after 30 hrs afforded a product in which the presence of four major compounds was evidenced by tlc analysis. Careful preparative tlc of the lactam part afforded O-acetyl-D-homo-5 α -17 α -aza-androsterone 2 (7) and O-acetyl-D-homo-5 α -17 α -aza-13 α -androsterone 3, m.p. 180-182°C, albeit poor yields (3% and 1%). (8) The lactams 2 and 3 were identified by the direct comparisons with the lactams obtained by the ground state Beckmann



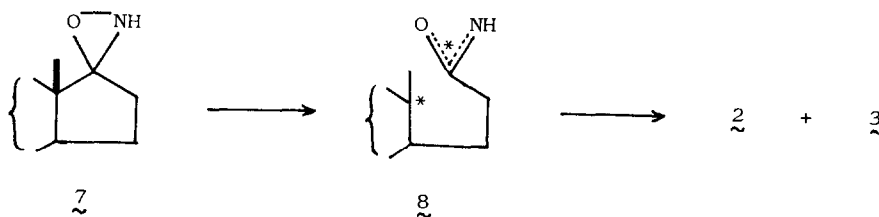
rearrangements of **1** and O-acetyl-13 α -androsterone oxime **5**. Ordinary Beckmann rearrangement of **1** with SOCl_2 afforded **2** (51%), (7) and a new nitrile **4** (31%) due to the Beckmann fission. Treatment of hitherto undescribed oxime **5**, m.p. 186-187 $^\circ\text{C}$, with SOCl_2 afforded the lactam **3**, (49%), which was confirmed by the mass spectrum. (9)

The photolysis of the oxime **5**, m.p. 186-187 $^\circ\text{C}$, was then performed under the same conditions as with **1** to afford products, and tlc analysis of them indicated a similar pattern as in the photolysis of **1**. Preparative tlc of the lactam part afforded **3** (1%) and an amorphous **6** (3%) (10). The n.m.r. and i.r.

spectra of $\underline{6}$, unobtainable in the pure crystalline form, revealed it to be probably O-acetyl-13 α -D-homo-5 α -17aza-androsterone $\underline{6}$. (i.r., the NH band at around 3400^{-1} , OAc at 1733 cm^{-1} , CONH at 1643 cm^{-1} ; n.m.r., τ 9.32 (3H, C-10 methyl), τ 8.77, (3H, C-13 methyl) τ 7.98 (3H, OAc), τ 5.05 (1H, 3 β H) τ 6.2-7.0 (2H, C-16 methylene)).

It should be noted that no nitrile was found in the photolysates of $\underline{1}$ or $\underline{5}$, since camphor oxime in which one of the α -carbon is tetra-substituted has been reported to give solely nitriles, due to the photo-Beckmann fission. (11)

The formation of an epimeric pair of lactams from an oxime is at variance with the mechanistic pattern on the breakdown of oxaziridine we suggested, (12) and requires the intervention of a radical or a charged intermediate such as $\underline{8}$, in which C₁₃-C₁₇ bond of the androsterone framework is broken.



Although the stereochemistry of the reaction alone is not sufficient to make any definite comments on the migration step, on the basis of the results obtained by us together with those by others the following possibilities on the mode of the formation of lactam from oxaziridine may be considered.

- a) a unified mechanism for the saturated oximes involving the intervention of an intermediate in which C-C bond between oxaziridine and the migrating α -carbon is cleaved. If this is the case, our previous results on the oximes of cholestane series should be reinterpreted in terms of the involvement of an intermediate with the configurationally stable ion pairs or radical pairs.
- b) oximes of cholestan-6-ones, menthone, isomenthone and norcamphor bear the tri-substituted migrating carbon whereas in the oximes of androsterone, and 13 α -androsterone, one of the migrating carbon is tetra-substituted. Thus, we might suspect that the dual mechanisms are operative in the saturated oximes,

depending on their structural features, particularly the immediate surrounding of the relevant oximino group, and the oxime which can afford stable ionic or radical species by the cleavage would be able to rearrange through an intermediate in which the migrating group becomes free of the migration terminus. This latter mechanism may not exclude the possibility of amide formation without an involvement of the intermediary oxaziridine.

Between these a unified mechanism would have some difficulty in accommodating the fact that the two isomeric lactams are formed in nearly equal amounts in the case of cholestan-6-one oximes, (2) 3 α ,5-cyclo-5 α -cholestan-6-one oxime, (2) unsymmetrically α -substituted cyclohexanone oximes (4) and norcamphor oxime. (13)

More experiments on the different substrates obviously will be required to clear up the problem.

REFERENCES AND NOTES

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- 10) Other products isolated were O-acetylandrosterone (11%). The amount of the recovered oxime was 6%.
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- 12) The lactam 8 reveals u.v. absorption maximum at 207 nm (ϵ ; 7300, CH₂OH). The possibility that the lactam 3 might be formed via the lactam 2 is excluded by the fact that the separate irradiation of the lactam 2 did not afford 3.
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ACKNOWLEDGEMENT

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