Migration of *ortho*-Substituents in Enamide Photocyclisation

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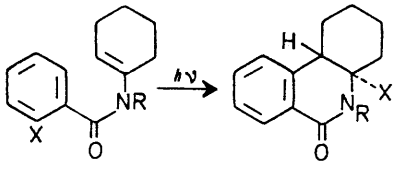
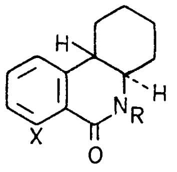
Summary Irradiation of certain enamides of *N*-benzoylenamines and *N*-acylanilides, substituted with groups such as CO_2Me, Ac, CN, and $CONH_2$, caused 1,5-migration of the substituent group.

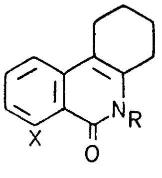
N-Benzoylenamines[1] and *N*-acylanilides[2] have been shown to undergo photocyclisation to afford lactams by means of an electrocyclic mechanism.[1,3] During work on the photocyclisation of enamides having substituents on the benzene ring,[4] we found that a ready 1,5-migration takes place with groups such as *o*-OMe, CO_2Me, Ac, CN, and $CONH_2$.



(1a–c) (2)



(3)



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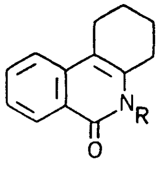
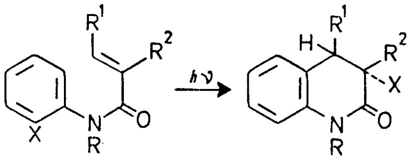
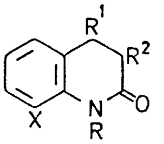


(5)

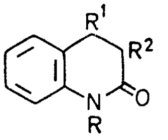
(1a–c)		Yield (%)			
	X	(2)	(3)	(4)	(5)
a	OMe	30	–	–	18
b	NH_2	–	50	–	–
c	CO_2Me	–	–	2·5	1·5



(6a–e) (7)

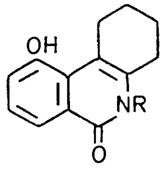


(8)



(9)

(6a–e)				Yield (%)		
	R^1	R^2	X	(7)	(8)	(9)
a	$-[CH_2]_4-$		OMe	–	25	–
b	$-[CH_2]_4-$		CO_2Me	54	–	–
c	H	Me	CO_2Me	40	–	–
d	H	Me	$CONH_2$	15		15
e	H	Me	CO_2H	–	–	70

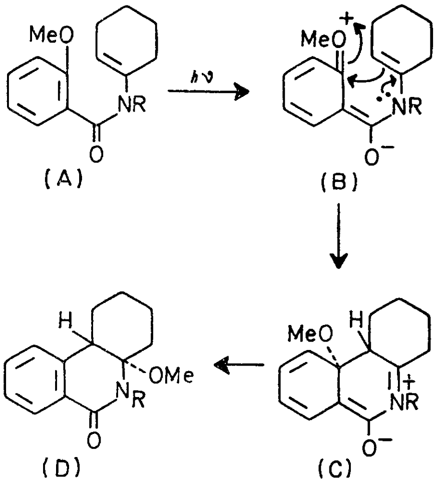


(10)

$R = CH_2Ph$

Irradiation of an ethereal solution of (**1a**) with a low-pressure mercury lamp afforded the product (**2a**),† homogeneous on t.l.c. and n.m.r., together with the dehydrolactam (**5**), which could be readily obtained by heating (**2a**). Photocyclisation of the *N*-acylanilide (**6a**) proceeded normally in the same way as unsubstituted enamides.[2]

However, photocyclisation of enamides with CO_2Me, Ac, CN, and $CONH_2$ groups gave contrasting results. For example, irradiation of (**1c**), which has an *ortho*-ester group, gave only small amounts of the products (**4c**) and (**5**), but photocyclisation of the *N*-acylanilides (**6b**) and (**6c**) proceeded smoothly to afford the B/C *trans*-ester-migrated products (**7b**) and (**7c**), respectively, as the sole product. The structures of the products (**7b**) and (**7c**) were established from their n.m.r. spectra [the *trans*-junction was indicated by the peaks at δ 2·89 (dd, J 6 and 10 Hz, C-10a)] and from chemical correlation with an authentic sample.[5] It was confirmed that a novel 1,5-shift of an *ortho*-ester group had occurred

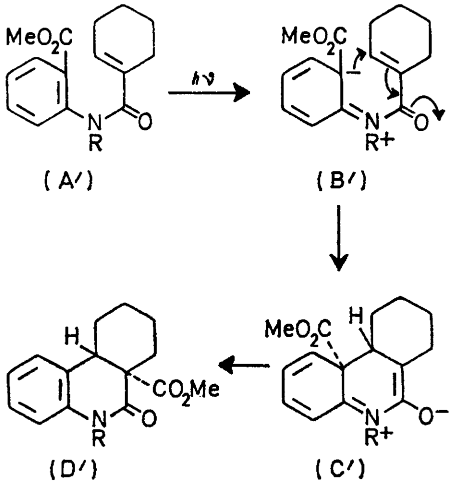


Scheme 1

Hydrogen abstraction was observed in the photocyclisation of the *N*-acylanilide (**6d**) which has an *ortho*-carbamoyl group. Besides the carbamoyl-migrated product (**7d**), the product (**9d**), which had no carbamoyl group, was obtained. The formation of this product (**9d**) was more typically observed from irradiation of the *N*-acylanilide (**6e**) which has a carboxy-group at an *ortho*-position.

Photocyclisation of (**1b**) which has an *ortho*-amino-group, proceeded smoothly to afford the normally cyclised lactam (**3b**), presumably due to hydrogen bonding between NH_2 and CO groups, which would fix the conformation of the enamide in a form suitable for cyclisation.

When an *ortho*-OCH_2O group was present in the *N*-benzoylenamine, photocyclisation afforded the hydroxy-lactam (**10**), a reaction which can be applied to the synthesis of natural products.



Scheme 2

The most likely explanation for these photochemical transformations would seem to require involvement of the *ortho*-substituent, as shown in Schemes 1 and 2. The methoxy-substituted enamide (A) after excitation (B) would undergo photochemical cyclisation to the cyclic intermediate (C), followed by a [1,5]-shift to the product (D), presumably having a *trans*-configuration.‡ On the other hand, the carbonyl-substituted enamide (A′), after excitation (B′), would undergo a conrotatory cyclisation to the *trans*-intermediate (C′), followed by a shift to the *trans*-product (D′).

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† Structures were established mainly from i.r. and n.m.r. data.

‡ Stereochemistry has not been determined yet.

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