Ring Expansion of Azidoquinolines to Benzo-1,4-diazepines

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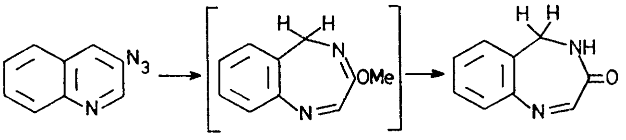
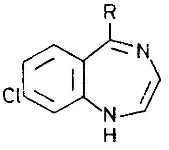
Summary Benzo-1,4-diazepines are obtained by the photolysis of 3-azido- and 4-azido-quinoline in the presence of amines or methoxide ions.

Monocyclic aryl azides undergo ring expansion to azepines on decomposition in some nucleophilic solvents[1] and analogous ring expansions of bicyclic aryl azides are also known but rare.[2,3] We report the first example of an azide substituted *N*-heteroaromatic ring undergoing expansion to give a 1,4-diazepine. Irradiation of 3-azidoquinoline (Scheme) in a 1 : 1 mixture of potassium methoxide (3 M) in methanol and dioxan with a medium-pressure mercury lamp using a quartz filter, gives the benzo-1,4-diazepinone (**1**) (43%) and 3-aminoquinoline (24%). The structure of (**1**) was assigned from its i.r. [ν (Nujol) 3370 (free NH), 3150 (hydrogen-bonded NH), and 1655 cm^{-1} (-NHC:O)] and n.m.r. spectra [τ ($CDCl_3$) 6·07 (d, 2H, 5-CH_2), 2·30—3·45 (m, 4H, ArH), 1·4 (t, NH, exchanges with D_2O), and 0·15 (s, 2-H)]. Irradiation of the NH (τ 1·4) triplet caused the CH_2 doublet to collapse to a singlet, confirming the orientation of the diazepinone ring.†

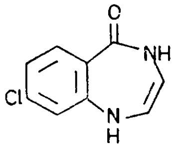


(1)

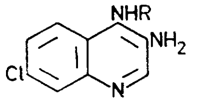
Scheme



	R
(2)	OMe
(4)	NHC_6H_{11}
(5)	$NHPr^i$
(6)	$NHPr^n$
(7)	$NHBu^t$
(8)	$NHBu^n$
(9)	$NHCH_2Ph$
(10)	$NH[CH_2]_2NEt_2$
(11)	$NH[CH_2]_2NMe_2$



(3)



	R
(12)	C_6H_{11}
(13)	Pr^i
(14)	Pr^n
(15)	$PhCH_2$

Photolysis of 4-azido-7-chloroquinoline, under similar conditions to those used for 3-azidoquinoline and in a series of primary amines, gave the benzo-1,4-diazepines

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† Analytical and mass spectral data are also consistent with the proposed structure.

TABLE. Products of photolysis of 4-azido-7-chloroquinoline.

Solvent	1,4-Diazepine/%	*o*-Diamine/%	4-Amino-7-chloroquinoline/%
3M KOMe–MeOH–dioxan	(**2**), 20		
	(**3**), 20		
3M KOMe–MeOH–TMEDA[a]	(**2**), 50		
	(**3**), 20		
$C_6H_{11}NH_2$	(**4**), 40	(**12**), 15	2
Pr^iNH_2	(**5**), 35	(**13**), 20	5
Pr^nNH_2	(**6**), 42	(**14**), 20	5
Bu^tNH_2	(**7**), 35	—	10
Bu^nNH_2	(**8**), 45	—	10
$PhCH_2NH_2$	(**9**), 55	(**15**), 25	5
$Et_2NH[CH_2]_2NH_2$	(**10**), 20	—	10
$Me_2NH[CH_2]_2NH_2$	(**11**), 15	—	10

[a] TMEDA = Tetramethylethylenediamine.

(**2**)—(**9**)‡ and in some cases the *o*-diamines (**12**)—(**15**) and the triplet product 4-amino-7-chloroquinoline (*cf.* Table). The enamine structure at positions N-1 to C-3 in the diazepine rings of (**2**)—(**9**) was confirmed by ^{13}C n.m.r. spectrometry.

In contrast to 4-azido-7-chloroquinoline, 3-azidoquinoline does not undergo ring expansion on photolysis in cyclohexylamine; instead a 78% yield of 3-aminoquinoline is obtained. We consider that the mechanism of these ring expansions is essentially as previously proposed.[3] The diazepinones observed in this work probably arise by hydrolysis of the first formed methoxydiazepine during neutralisation chromatography on alumina.

These results suggest that the potassium methoxide–methanol–dioxan system might prove of even greater synthetic value for expanding bicyclic aromatic azides to benzazepines and benzodiazepines than was at first thought.[4]

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‡ All of these compounds gave i.r., ^1H n.m.r., and mass spectra and analytical data in accord with the proposed structures.

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