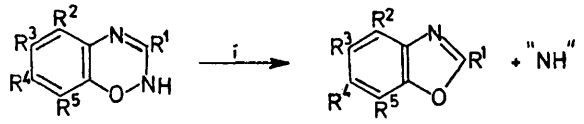
Ring Contraction of 1,2,4-Benzoxadiazines to Benzoxazoles

By THOMAS L. GILCHRIST, C. JOHN HARRIS, MICHAEL E. PEEK, and CHARLES W. REES
(*The Robert Robinson Laboratories, University of Liverpool, P.O. Box* 147, *Liverpool* L69 3BX)

Summary 1,2,4-Benzoxadiazines (**1**) are converted into the corresponding benzoxazoles (**2**) in good yields by heating in solvents at 80—140 °C; a mechanism involving $_{\pi}4_a + _{\pi}2_a$ cyclisation of an *ortho*-quinoneimine intermediate is suggested.

1,2,4-BENZOXADIAZINES (**1**) can be prepared from anilines either by conversion into *N*-arylsulphimides and reaction with nitrile oxides,[1] or by conversion into amidoximes and subsequent oxidation.[2] When (**1a**) was heated in PhCl at reflux for 2 h, (**2a**) was isolated (80%); ammonia (18%) was also detected. Compound (**2a**) (79%) was also obtained when (**1a**) was heated under reflux in C_6H_6 for 37 h.



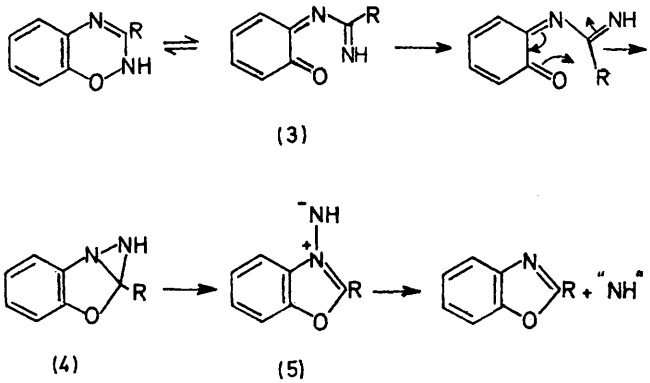
(1) (2)

(1)	Isolated (not optimized) yield of (2)/%
a: R^1=*p*-Me C_6H_4, R^2=R^3=R^4=R^5=H	80
b; R^1=*p*-Me C_6H_4, R^2=R^3=R^5=H, R^4=Cl	80
c; R^1=*p*-Me C_6H_4, R^3=R^4=R^5=H, R^2=Ph	77
d; R^1=*p*-Me C_6H_4, R^2=Cl, R^3=R^4=H, R^5=NO_2	74
e: R^1=*p*-Me C_6H_4, R^2=R^3=R^5=H, R^4=NO_2	33
f; R^1=CO_2Et, R^2=R^3=R^5=H, R^4=NO_2	56

i, Typical conditions: the benzoxadiazine (1 mmol) heated in chlorobenzene (20 ml) at reflux under N_2 for 2 h.

Similar results were obtained when the benzoxadiazines (**1b**)—(**1f**) were heated in C_6H_6 or PhCl. The reaction is of some synthetic use since the benzoxazoles are ultimately derived from anilines rather than from 2-aminophenols, the usual precursors.

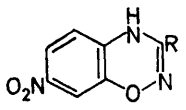
The reaction appears to be insensitive to changes of solvent: benzoxazoles were also obtained by heating the benzoxadiazines in CF_3CO_2H, $(MeCO)_2O$, butan-2-ol, C_6F_6, and in the melt at 170 °C. Besides ammonia (18—31%), anilines were also detected in low yields in the reactions carried out in aromatic solvents: thus, (**1b**) gave aniline (12%) when heated in C_6H_6 for 18 h, and it gave a mixture of chloroanilines (2%) when heated in PhCl for 1 h. The formation of anilines is consistent with the generation of a reactive intermediate capable of delivering a nitrene fragment NH to the solvent; this fragment was not intercepted, however, when reactions were performed in Me_2SO or in the presence of dibenzoylethylene.



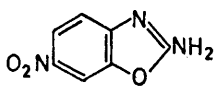
SCHEME

A possible mechanism for this unusual reaction is shown in the Scheme. A quinoneimine (**3**) is generated by electrocyclic ring-opening of the benzoxadiazine, the weak N–O bond being broken. This then rearranges to (**4**) which aromatises to the *N*-imide (**5**). The transformation of (**3**) into (**4**) can be represented as a concerted intramolecular $_{\pi}4_a + _{\pi}2_a$ reaction, the new N–N and C–O bonds being formed as the C=NH bond is twisted out of the plane of the quinoneimine skeleton. Antarafacial–antarafacial cycloadditions are very rare but in the present system the geometry for this reaction is quite favourable. A similar mechanism has been proposed for the rearrangement of octamethylcyclo-octatetraene to octamethylsemibullvalene.[3]

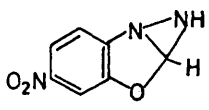
An analogy for the reverse of the conversion of (**3**) into (**4**) is provided by the pyrolysis of the adduct of phthalimidonitrene and benzofuran, in which an *ortho*-quinonoid system is generated.[4]



(6) R=H
(7) R=CO_2H



(8)



(9)

In an early study of the chemistry of benzoxadiazines, Semper and Lichtenstadt reported that 7-nitro-1,2,4-benzoxadiazine (**6**) was formed by the mild thermal decarboxylation of the 3-carboxylic acid (**7**).[5] We have found that the product is not (**6**) but an isomer, 2-amino-6-nitrobenzoxazole (**8**). This may be formed from (**7**) by a variant of the mechanism shown in the Scheme, the tricyclic intermediate (**9**) now having a hydrogen atom at C-2, which by migrating to nitrogen could give the benzoxazole (**8**).

Ring contractions of this type should also be possible in heterocyclic systems related to 1,2,4-benzoxadiazines, particularly those with a weak bond between atoms at the 1 and 2 positions.

(*Received, 22nd September* 1975; *Com.* 1074.)

[1] T. L. Gilchrist, C. J. Harris, and C. W. Rees, *J.C.S. Chem. Comm.*, 1974, 485.
[2] T. L. Gilchrist, M. E. Peek, and C. W. Rees, *J.C.S. Chem. Comm.*, 1975, 913.
[3] R. B. Woodward and R. Hoffmann, *Angew. Chem. Internat. Edn.*, 1969, **8**, 781.
[4] D. W. Jones, *J.C.S. Perkin I*, 1972, 225.
[5] L. Semper and L. Lichtenstadt, *Annalen*, 1913, **400**, 302.