A Mild and Efficient Preparation of *cis*-1,2-Diols from 1,2,4-Trioxanes

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3,3-Unsubstituted *cis*-fused bicyclic 1,2,4-trioxanes, on treatment with benzylamine, gave the corresponding *cis*-1,2-diols in 85—99% yield.

Much interest attaches to the construction of *cis*- and *trans*-1,2-dihydro-diols of polycyclic aromatic compounds because of their biological and environmental importance.[1] A concern is to find procedures which are selective and gentle enough to install and maintain the diol grouping within an inherently unstable arrangement such as that exemplified by *cis*-1,2-dihydroxy-1,2-dihydronaphthalene (**1**).[2]

In the course of our study on the chemistry of 1,2,4-trioxanes,[3,4] we now report that certain *cis*-fused bicyclic dervatives can be smoothly converted into *cis*-1,2-diols in high yield. The clue to this discovery lay in the difference in behaviour of 3-mono- and un-substituted trioxanes (**2**) and (**3**). Triethylamine isomerized (**2**) exclusively to the diol monoester (**4**), whereas (**3**) gave a nearly 1 : 1 mixture of the diol monoformate (**5**) and the naphthol (**7**).[3] It appeared that (**7**) arose from (**5**) by two successive processes, namely aromatization to the formate (**6**) by elimination of a molecule of water, and ester hydrolysis. If the conditions could be found for solvolysing the formate substituent without causing dehydration, then trioxanes like (**3**) would be useful intermediates for generating *cis*-1,2-diols. In fact, non-aqueous aminolysis proved to be ideal in effecting cleavage of the trioxane ring and the formyl group in a single operation. The treatment of (**3**) (0.1—0.6 M) with benzylamine or di-isopropylamine in CH_2Cl_2 (50—90% v/v) for several days at 20—24 °C followed by evaporation at 0.01 Torr gave the pure 1,2-diol (**8**) in 93—96% yield after chromatography on silica gel (10—20% EtOAc in CH_2Cl_2 as eluant)† (Table 1, entry 1). In contrast, the same bases with 3-monosubstituted 1,2,4-trioxanes, *e.g.*

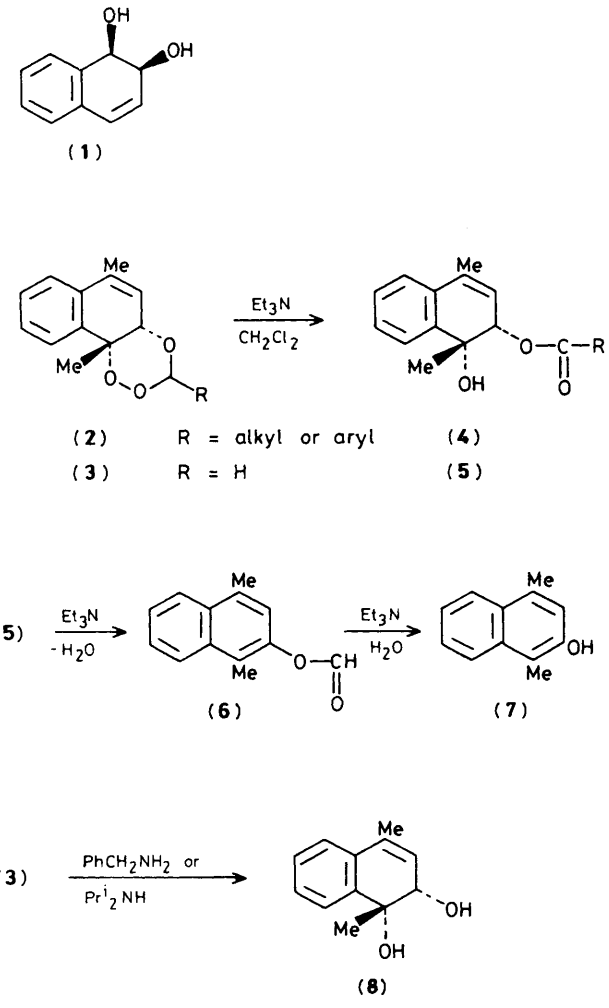
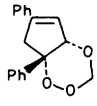
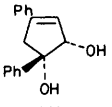
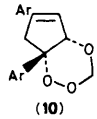
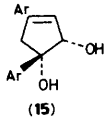
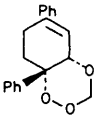
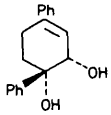
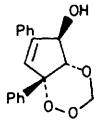
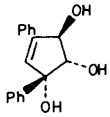
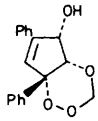
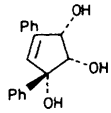


Table 1. Preparation of some 1,2-diols from 1,2,4-trioxanes[a] by treatment with benzylamine at 20—24 °C.

Entry	Trioxane[b,c]	1,2-Diol[c]	Reaction time (days)	Yield[d] (%)
1	(**3**)	(**8**)	15	93
2	 (**9**)	 (**14**)	7	94
3	 (**10**)	 (**15**)	6	92
4	 (**11**)	 (**16**)	7	99
5	 (**12**)	 (**17**)	3	85
6	 (**13**)	 (**18**)	7	94

[a] For the preparation of the trioxanes (**9**) and (**12**) see ref. 5; (**10**) and (**11**) were obtained in 80—100% yield by the same method (ref. 6.). Oxidation of (**12**) with pyridinium chlorochromate followed by stereoselective reduction with $NaBH_4/CeCl_3$ (ref. 7) afforded (**13**) in 75% yield. [b] Ar = *p*-MeC_6H_4. [c] All new compounds [(**8**), (**10**), (**11**), (**13**), and (**14**)—(**18**)] gave satisfactory analytical and spectral data. [d] Yields refer to chromatographically isolated products.

† The by-product *N*-benzylformamide was isolated by subsequent elution with neat EtOAc.

(**2**; R = *p*-ClC_6H_4) produced a complex mixture, thereby confirming that a CH_2 in position 3 is essential for diol formation.

The foregoing procedure worked equally well with the representative 1,2,4-trioxanes (**9**)—(**13**). Excellent yields of the corresponding 1,2-diols (**14**)—(**18**) were consistently obtained with benzylamine; di-isopropylamine was less reliable (Table 1, entries 2—6). The conversions were clean and their completion was conveniently monitored by t.l.c. Proof that the diols so obtained have the *cis* geometry was provided by the formation of the corresponding *cis*-fused acetonides on treatment with dry acetone and powdered anhydrous copper sulphate.[8]

The present results show that 3,3-unsubstituted 1,2,4-trioxanes can be considered as masked 1,2-diols. Moreoever, unlike protecting groups such as acetal, the trioxane system has the advantage of being stable to acid,[4,5] but easily removable under mild, basic conditions and thus may find applications in synthesis.

Lastly, the procedure can be regarded as a solution to the otherwise difficult problem of the selective 1,2-functionalization of conjugated dienes,[9,10] from which the 1,2,4-trioxanes are prepared.[5,6]

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