

Reaction of Cyclohexane-*cis*- and -*trans*-1,2-diol with Methylene Halides

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ALTHOUGH much is known¹ of acid-catalysed diol-aldehyde reactions affording cyclic acetals, there have been few reports² of cyclic acetal formation under alkaline conditions using, for example, an alkylidene halide and a base.

At room temperature, cyclohexane-*cis*-1,2-diol with methylene chloride (or bromide) in dimethylformamide containing suspended sodium hydride gave mainly *cis*-hexahydro-1,3-benzodioxolan (I) (which was also the main product of the acid-catalysed reaction³) together with 4,5,9,10-bis-cyclohexano-1,3,6,8-tetraoxacyclodecane (II) (*A*, *ca.* 2%, m.p. 142—143°). Compound *A*, which has the *cis,syn,cis*- or *cis,anti,cis*-structure, is an

example of an apparently hitherto unknown ring system although a tetrathia-analogue has recently been obtained⁴ in the acid-catalysed reaction of cyclopentane-*trans*-1,2-dithiol with acetone.

Similar methylenation of cyclohexane-*trans*-1,2-diol gave mainly *trans*-hexahydro-1,3-benzodioxolan (III) (b.p. 50—51°/15 mm., n_D^{20} 1.4571) together with small amounts of *trans*-hexahydro-1,3,5-benzotrioxepan³ (IV) [possibly formed from di(bromomethyl) ether during the isolation procedure] and a tetraoxacyclodecane derivative (II) (*B*, m.p. 166—167.5°). In contrast, the acid-catalysed methylenation³ of the *trans*-diol gave mainly the trioxepan (IV) together with small

¹ J. A. Mills, *Adv. Carbohydrate Chem.*, 1955, **10**, 1.

² S. K. Graves, A. C. Jain, and T. R. Seshadri, *Tetrahedron*, 1964, **20**, 555 and references cited therein; N. Baggett, J. M. Duxbury, A. B. Foster, and J. M. Webber, *Chem. and Ind.*, 1964, 1832.

³ F. S. H. Head, *J. Chem. Soc.*, 1960, 1778.

⁴ M. Kyaw and L. N. Owen, *J. Chem. Soc.*, 1965, 1298.

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amounts of the diastereoisomeric forms (*C* and *D*) of di-(*trans*-2-hydroxycyclohexyloxy)methane. Methylenation under basic conditions of diastereoisomer *C* (m.p. 80–83°), kindly provided by Dr. F. S. H. Head, gave compound *B* whereas similar treatment of diastereoisomer *D* (m.p. 101–102°) afforded a new tetraoxacyclodecane derivative (II) (*E*, m.p. 103–104°).

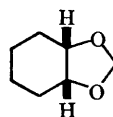
The n.m.r. spectrum (determined on 10–20% solutions in CDCl₃ with a 6% solution of tetramethylsilane in chloroform as external reference) of the tetraoxacyclodecane *E* had a singlet (as also did isomer *A*) for methylene protons at τ 5.13 indicative of conformational instability whereas that for isomer *B* had an AB quartet (τ 5.05, J 7 c./sec.) indicative of non-equivalent methylene protons and a stable conformation. It is possible that isomer *B* has the thermodynamically most stable arrangement of a tetraoxacyclodecane (II) derived from cyclohexane-*trans*-1,2-diol, viz. the *trans,syn,trans*-structure (V) which involves a BCB conformation⁵ of the ten-membered ring, contains non-equivalent methylene protons, and is derived from *meso*-di-(*trans*-2-hydroxycyclohexyloxy)methane.

The following methylene proton signals were also observed (*cf.* ref. 6): compound (I), AB quartet, τ 4.95, J ca. 1 c./sec.; compound (III), singlet, 4.93; compound (IV), AB quartet, 4.96, J ca. 6.5 c./sec.

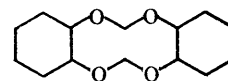
⁵ J. B. Hendrickson, *J. Amer. Chem. Soc.*, 1964, **86**, 4854.

⁶ T. A. Crabb and R. C. Cookson, *Tetrahedron Letters*, 1964, 679.

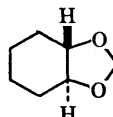
Methylenation under basic conditions of methyl 4,6-*O*-benzylidene- α -D-gluco- and galacto-pyranoside gave, in each case, a 2,3-*O*-methylene derivative {m.p. 118–119°, $[\alpha]_D + 123^\circ$ in CHCl₃, τ (O·CH₂·O) singlet at 4.83 and m.p. 199–200°, $[\alpha]_D + 153^\circ$ in CHCl₃, τ (O·CH₂·O) AB quartet at 4.85 (J ca. 1 c./sec.) respectively}.



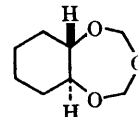
(I)



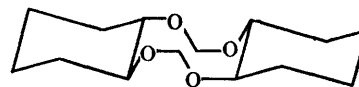
(II)



(III)



(IV)



(V)

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