Synthesis and Clathrate Cavity Geometry of a 2-Nor-analogue of Dianin's Compound; *X*-Ray Crystal Structure

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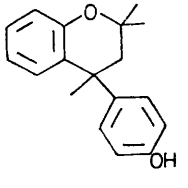
Summary A new clathrate host (II), which corresponds to specific removal of one of the geminal methyl groups of Dianin's compound (I), has been synthesised; the resulting fundamental modification of the cavity shape has been elucidated by *X*-ray methods.

AN important feature of the cage structure formed by Dianin's compound (I) is a waist situated approximately halfway along the cavity, this constriction being formed by six inward-pointing methyl groups, one from each of six host molecules.[1] We now report that removal of these apparently crucial methyl groups does not lead to collapse of the cage structure, but rather leads to a new cavity in which the waist has been completely eliminated.

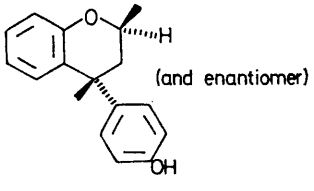
The required host (II), which lacks the 2-methyl group *cis* to the *p*-hydroxyphenyl substituent of Dianin's compound (I), was prepared by the action of anhydrous hydrogen chloride on a mixture of phenol and pent-3-en-2-one, product isolation involving the use of silicic acid and gel permeation chromatography (200 × 2·5 cm column of Sephadex LH-20 modified[2] with Nedox 1114, elution with methanol).

The structure (II) was indicated by the following data: *m/e* 254 (M^+), i.r. (KBr disc, CCl_4 clathrate) ν(O–H) 3275 cm^{-1}, and ^1H n.m.r. τ ($CDCl_3$), 8·74 (3H, d, *J* 6·5 Hz), 8·30 (3H, s), *ca.* 8·0 (2H, m, diastereotopic CH_2), 6·15 (1H, m), 5·2 (1H, s, OH), and *ca.* 2·7—3·4 (8H, partially overlapping ArH ABCD and XX'YY'systems).

The CCl_4 clathrate of (II), for which a host : guest ratio of 6 : 1 was found by microanalysis for chlorine, crystallises



(I)



(II)

in the trigonal system with lattice constants referred to a hexagonal unit cell containing 18 molecules of $C_{17}H_{18}O_2$ and 3 molecules of CCl_4, $a = 26{\cdot}936(6)$ and $c = 10{\cdot}796(1)$ Å. The space group is $R\bar{3}$; the structure was solved by direct

methods employing 2397 independent reflections measured with Mo-K_α radiation on a Hilger and Watts automatic diffractometer, and has been refined to a current R factor of 0·117. During the course of the analysis all 18 host hydrogen atoms were located and allowed for though effective allowance for the disordered guest molecule has not yet been made.

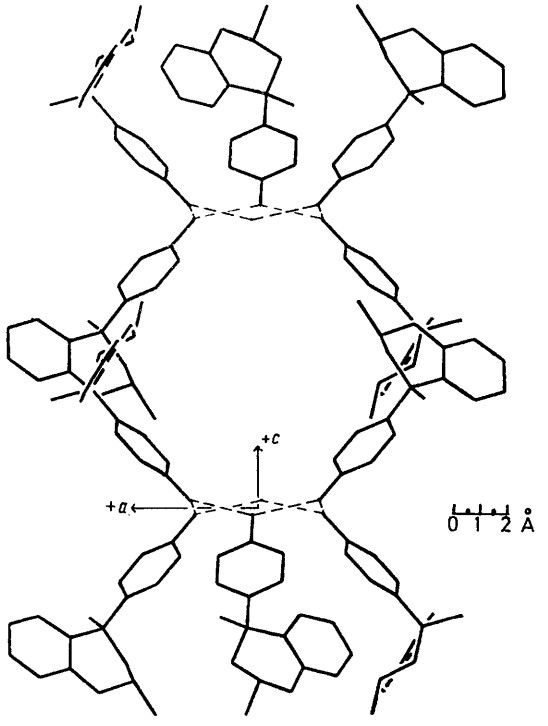


FIGURE 1. Structure of compound (II) looking onto the *ac* plane, the two host molecules lying above and below the cavity as viewed in this direction having been excluded, apart from their hydroxy-oxygen atoms. The disordered guest molecule, CCl_4, is not shown.

Figure 1 illustrates the host structure of (II) which is related to that of Dianin's compound; groups of six molecules are linked by a network of hydrogen bonds involving their hydroxy-groups such that the oxygen atoms form a distorted hexagon, alternate molecules lying on opposite sides of its plane. Two such groups of six molecules are stacked along the *c*-axis such that their bulkier parts interlock forming a cage.

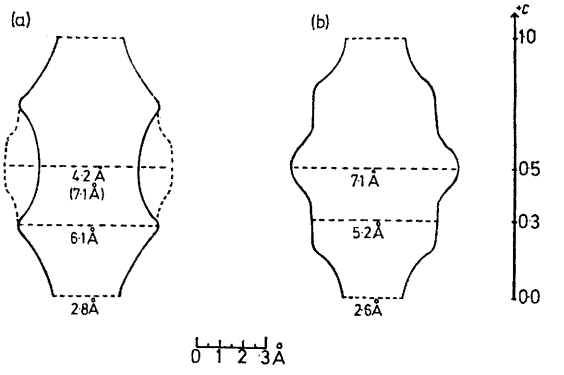


FIGURE 2. Section through the van der Waals' surface of the cavity for: (a) Dianin's compound (I) as chloroform clathrate, replotted from data of ref. 1; the curved broken lines represent the effect of the formal removal of the waist methyl groups (see text), (b) compound (II) as CCl_4 clathrate.

The marked change in cavity shape, brought about by the removal of the six inward-pointing methyl groups of Dianin's compound, is most readily appreciated by a consideration of the van der Waals' surfaces shown in Figure 2. Comparison of these surfaces shows that the waist has been successfully eliminated in (II). It is interesting to note that the new cage geometry of (II) corresponds closely to that following from the *formal* removal of the appropriate waist-forming methyl groups of the host structure of (I), this formal replacement of methyl by hydrogen being denoted by the curved broken lines in Figure 2(a).

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[2] J. Ellingboe, E. Nystrom, and J. Sjovall, *Biochim. Biophys. Acta*, 1968, **152**, 803; *J. Lipid Res.*, 1970, **11**, 266.