165. *Studies on Agar-agar. Part III. Isolation of Hepta-acetyl* dl-*Galactose from* 3 : 6-*Anhydro*-β-*methyl*-d-*galactoside.*

By T. L. Cottrell and E. G. V. Percival.

It is shown that 3 : 6-anhydro-β-methyl-*d*-galactoside yields hepta-acetyl *dl*-galactose on treatment with acetic anhydride and sulphuric acid. The conclusion is drawn that the hepta-acetyl *dl*-galactose isolated in the same manner from agar by Pirie arises by a similar reaction with the 3 : 6-anhydro-*l*-galactose units.

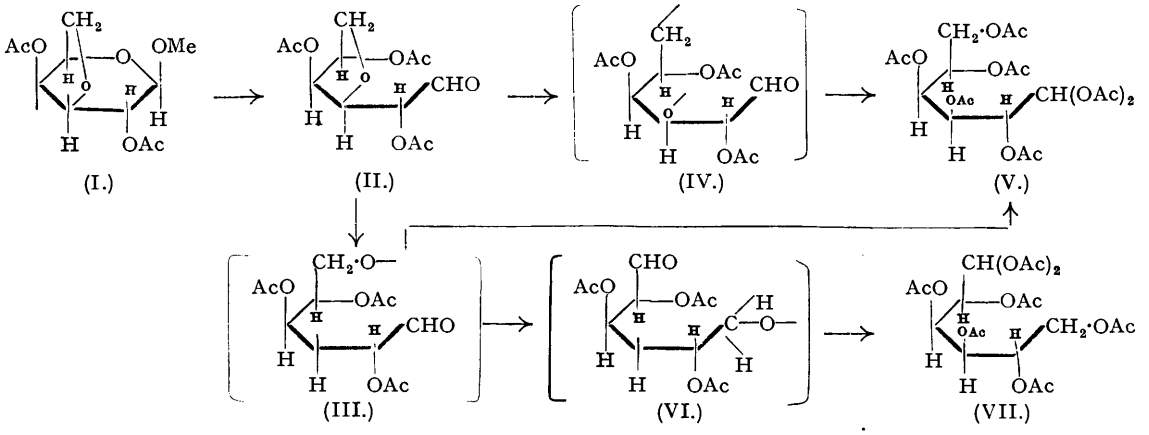
The isolation of hepta-acetyl *dl*-galactose from agar by treatment with acetic anhydride and sulphuric acid by Pirie (*Biochem. J.*, **1936**, **30**, 369) was at first thought to indicate that galactose in the aldehydo-form was present in the molecule. Freudenberg and Soff (*Ber.*, **1937**, **70**, 264) showed, however, that aldehydo-*d*-glucose hepta-acetate could be obtained under similar conditions from glucopyranose derivatives, and, despite the subsequent proof of the presence of *l*-galactose in agar as 3 : 6-anhydro-*l*-galactose (Part II, J., **1939**, 1844; Hands and Peat, *Chem. and Ind.*, **1938**, **57**, 1937), the observations of Micheel, Ruhkopf, and Suckfüll (*Ber.*, **1935**, **68**, 1523) that hepta-acetyl *dl*-galactose could be prepared from tetra-acetyl *d*-galactose 6-iodohydrin, made it uncertain that the hepta-acetate in question came from the *l*-galactose fragment in agar.

Jones and Peat (this vol., p. 225) have suggested that the isolation of the *dl*-galactose hepta-acetate can be accounted for by the acid hydrolysis of a sulphuric ester residue attached to the *l*-galactose residue to give *l*-galactose and this with the *d*-galactose already present is converted into hepta-acetyl *dl*-galactose under the experimental conditions.

We have now proved that 3 : 6-anhydro-β-methyl-*d*-galactoside, when treated with acetic anhydride and sulphuric acid, gives hepta-acetyl *dl*-galactose and we therefore consider that in the case of agar the hepta-acetyl *dl*-galactose is formed exclusively from the 3 : 6-anhydro-*l*-galactose residues which are linked to other residues by 1 : 4-linkages. This is supported by the fact that the yield of hepta-acetyl *dl*-galactose (10—20% by weight) agrees with the estimate of the proportion of 3 : 6-anhydro-*l*-galactose in agar. Pirie (*loc. cit.*) was unsuccessful in attempts to obtain hepta-acetyl *d*-galactose from *d*-galactose, β-penta-acetyl *d*-galactopyranose and β-penta-acetyl *d*-galactofuranose under the same conditions.

In the experiment under review it is reasonable to suppose that 3 : 6-anhydro-β-methyl-*d*-galactoside is transformed into hepta-acetyl *dl*-galactose through the following stages, in which it may be assumed that 2 : 4-diacetyl 3 : 6-anhydro-β-methylgalactoside (I) is first formed, and is hydrolysed and acetylated to give

2 : 4 : 5-triacetyl 3 : 6-anhydro-aldehydo-*d*-galactose (II). Cleavage of the 3 : 6-anhydro-ring may then give either of the transient forms (III) or (IV) in the same way as the rupture of an ethylene oxide ring with alkali (Peat, *Ann. Reports*, 1939, 262). (IV) then yields with the acetic anhydride hepta-acetyl *d*-galactose (V). The formation of an equivalent amount of hepta-acetyl *l*-galactose (VII) may be supposed to result from the formation of (VI) from (III) by the migration of a hydrogen atom, C_1 and C_6 being in close proximity in space, followed by acetylation to yield (VII). Since (III) could also yield (V) on acetylation, an alternative explanation would be that (III) is the product of the rupture of the anhydride ring and that an equilibrium exists between (III) and (VI).



Experimental.

3 : 6-Anhydro-β-methyl-*d*-galactoside (m. p. 118°, $[\alpha]_D$ −113°, 4 g.) was treated for 54 hours at 37° with acetic anhydride (18 c.c.) and sulphuric acid (3 c.c.). The mixture was then poured on ice and, after addition of sodium acetate (10 g.), extracted several times with chloroform; the extract was washed with sodium bicarbonate solution and water, dried with sodium sulphate, and evaporated to a syrup, which crystallised on solution in alcohol and treatment with a nucleus of hepta-acetyl *dl*-galactose. The crystalline material (0·5 g.) so obtained had m. p. 126°, not depressed by hepta-acetyl *dl*-galactose (m. p. 126°) isolated from agar by Pirie's method (*loc. cit.*). The m. p. (132°) recorded by Pirie could not be reached after six recrystallisations. $[\alpha]_D^{18°}$ +0° in chloroform (*c*, 3·0) (Found : C, 48·2; H, 5·8; CH_3·CO, 60·1. Calc. for $C_{20}H_{28}O_{14}$: C, 48·8; H, 5·7; CH_3·CO, 61·1%).

[With T. G. H. Thomson.] Washed agar (60 g.), treated according to Pirie for 26 hours at 38°, gave 3·0 g. of hepta-acetyl *dl*-galactose and for 33 hours 4·8 g.; none was isolated after 2 hours' acetolysis.

Thanks are expressed to Mr. R. B. Duff, B.Sc., for the preparation of 3 : 6-anhydro-β-methylgalactoside, and to Imperial Chemical Industries, Ltd., and the Earl of Moray Endowment for grants.

King's Buildings, University of Edinburgh. [*Received, October 22nd*, 1942.]