CCCXCVIII.—*The Structure of* 2 : 3 : 4-*Trimethyl Glucose.*

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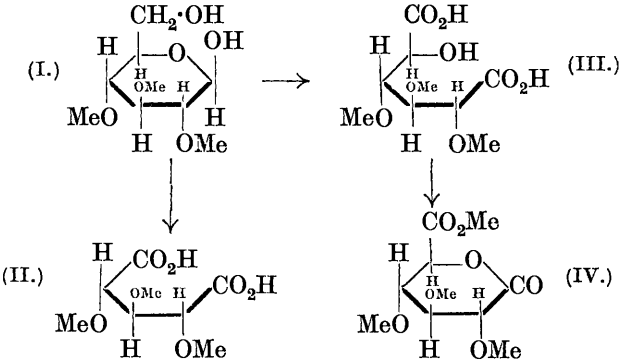
THE characterisation of 2 : 3 : 4-trimethyl glucose (I) has been accomplished by its oxidation with nitric acid. Two products have been isolated as crystalline derivatives. The first of these is a degradation product represented by *i*-xylo-trimethoxyglutaric acid (II), which yields a crystalline methylamide identical with an authentic specimen obtained directly by oxidation of xylose, followed by methylation and methylamide formation. Simultaneously there is also formed a derivative of 2 : 3 : 4-trimethyl saccharic acid (III), which was isolated as the crystalline methyl ester of 2 : 3 : 4-trimethyl δ-saccharolactone (IV) (compare Robertson and Waters, this vol., p. 1709).



The determination of the structure of the above sugar is important inasmuch as it has a bearing on the constitution of the disaccharides gentiobiose and melibiose. A preliminary account of the oxidation to *i*-xylo-trimethoxyglutaric acid has been published (Haworth, " Constitution of Sugars," Arnold & Co., 1929, p. 57), but the present more detailed experimental account has been unintentionally delayed, since it was completed three years ago. The identification of 2 : 3 : 4-trimethyl glucose will be considerably simplified by the procedure now outlined for the preparation of 2 : 3 : 4-trimethyl β-methylglucoside. This was obtained in a higher yield than was hitherto found possible in the earlier papers on the constitution of disaccharides (Haworth and Wylam, J., 1923, **123**, 3120; Haworth, Hirst, and Ruell, *ibid.*, p. 3125; Charlton, Haworth, and Hickinbottom, J., 1927, 1527). Other work establishing the constitution

of the reducing residue in melibiose (Haworth, Loach, and Long, J., 1927, 3146) has, however, been published in the interim, and has provided an independent proof of the structure of 2 : 3 : 4-trimethyl glucose.

EXPERIMENTAL.

2 : 3 : 4-*Trimethyl* β-*Methylglucoside.*—The following modification of the usual procedure led to the isolation of the above crystalline glucoside in a yield of 40% of the theoretical. 2 : 3 : 4-Trimethyl glucose (2·5 g.) prepared by the hydrolysis of heptamethyl methylmelibioside was dissolved in dry methyl alcohol (160 g.) containing 1% of hydrogen chloride, and the solution boiled under reflux for 5 hours; all reducing action had then disappeared. Sodium bicarbonate in very slight excess was added to remove the hydrogen chloride, and the solution evaporated to dryness under diminished pressure. The residue was dissolved in a small volume of water and extracted three times with chloroform, which left behind any traces of unchanged sugar along with mineral salts. From the dried chloroform extract, 2·5 g. of a yellow oil were obtained which crystallised immediately on nucleation with 2 : 3 : 4-trimethyl β-methylglucoside prepared from methylated gentiobiose. After 36 hours the semi-solid mass was transferred to a porous tile, which rapidly absorbed the liquid portion. The yield of purified crystalline glucoside was 28%. The porous tile was extracted with chloroform in a Soxhlet apparatus and yielded 1·5 g. of a yellow syrup. This was dissolved in 5% hydrochloric acid (100 c.c.) and hydrolysed by boiling for 6 hours. The solution was neutralised with barium carbonate, filtered, and evaporated to dryness under diminished pressure. The residue was dissolved in chloroform to remove barium chloride and after evaporation the syrup was redissolved in dry methyl alcohol (100 c.c.) containing 1% of hydrogen chloride, and treated subsequently as described above. This recovery and regeneration of the glucoside were twice repeated.

Oxidation of 2 : 3 : 4-*Trimethyl Glucose.*—2 : 3 : 4-Trimethyl glucose obtained by the hydrolysis of crystalline 2 : 3 : 4-trimethyl β-methylglucoside was oxidised at 70° for 1 hour with concentrated nitric acid and the temperature was afterwards raised to 100° for ½ hour. When the production of nitrous fumes had almost ceased, the nitric acid was removed in the usual manner by distillation under diminished pressure, the distillation being accompanied by continued dilution with water. Finally the product was dried by distillation with large quantities of ethyl alcohol, and an ethylalcoholic solution of the residue containing 3—4% of hydrogen chloride was heated under reflux for 5 hours and then at 70° for 3 hours. The solution was neutralised by barium carbonate and

filtered, and barium chloride precipitated from the alcoholic solution by the addition of ether. After filtration the clear solution was evaporated to a viscid syrup and traces of the barium chloride were removed by extracting the ester with chloroform. The ester was then distilled and divided into two fractions : (1) Bath temperature 130—133°/0·1 mm., (2) bath temperature 140—150°/0·1 mm. Fraction (1) was fairly mobile. Fraction (2) represented the greater part of the product. It consisted largely of the ethyl ester of trimethyl saccharolactone (see below). Fraction (1) was dissolved in ethyl alcohol, and the solution was saturated with dry methylamine, kept for $2\frac{1}{2}$ days at room temperature, and evaporated to half its bulk. The crystals deposited were collected and washed with ethyl acetate. The washings and mother-liquors were evaporated to dryness and redissolved; after some time further crops were obtained of the same crystalline substance, m. p. 167—168°, after several recrystallisations from ethyl acetate (Found : C, 48·3; H, 8·25. Calc. for $C_{10}H_{20}O_5N_2$: C, 48·35; H, 8·1%). This substance was identified as the methylamide of *i*-xylo-trimethoxyglutaric acid by direct comparison with a specimen prepared from other sources (Haworth and Jones, J., 1927, 2349) and by mixed m. p. determination (167—168°).

2 : 3 : 4-Trimethyl glucose (1·25 g.) was dissolved in 20 c.c. of dilute nitric acid (*d* 1·26) and heated as described above. After removal of the nitric acid by repeated evaporation and dilution there remained a syrup (1·12 g.). This was esterified with 1·25% methyl-alcoholic hydrogen chloride and after isolation in the usual way the mixture of esters was distilled. Fraction (1) b. p. 122—127°/0·2 mm., 0·4 g.; fraction (2) b. p. 140—150°/0·2 mm., 0·6 g. After some time the fractions yielded crystals, *e.g.*, fraction (2) gave 0·25 g. of a crystalline product, m. p. 107°; $[\alpha]_D^{22°}$ + 104·3° in ethyl alcohol; $[\alpha]_D^{24°}$ + 98° in chloroform; $[\alpha]_D^{18°}$ + 146·5° in benzene (Found : C, 48·4; H, 6·7; OMe, 49·6. Calc. for $C_{10}H_{16}O_7$: C, 48·4; H, 6·6; OMe, 50·0%). This substance was identified as the methyl ester of 2 : 3 : 4-trimethyl saccharolactone.

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[*Received, September 21st,* 1931.]