128. *Synthetical Studies on the Constitution of Polyhydroxycyclohexane.*

Part I. l-Tetrahydroxymannocyclitol.

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1:6-Diiodo-2:3:4:5-tetrabenzoyl mannitol has been prepared by the method of A. Müller,¹⁾ as follows;

10 g of diiodo-tetrabenzoyl-mannitol (I) were mixed with 7 g of molecular silver. The mixture was heated at 125–130°C for 6 h, when the reaction had been ended. The product was removed into an ethereal solution, the ether evaporated off, and a syrupy mass obtained. The syrup was saponified with 5% methyl alcoholic baryta, baryta and benzoic acid having been removed by using sulfuric acid and ether, and a crystalline substance was obtained in the yield of 0.5 g (27% of the theory). The yield has been much improved by using dioxan addition product instead of iodohydrine itself (40% of the theory); m.p.: 146–147°C, m.w. (Rast's method): 150.2 (calc. 148), C: 48.37, H: 7.88% (C: 48.64, H: 8.18 as $\text{C}_6\text{H}_{12}\text{O}_4$), $[\alpha]_D^{25} = -27.7$ (in water). The substance was recrystallized from acetone or acetic ester. A glacial acetic acid solution absorbs Br_2 readily, an aqueous solution decolorizes KMnO_4 solution promptly, while it reduces neither Fehling's solution nor ammoniacal silver nitrate.

Tetracetyl derivative has been prepared in pyridine medium and

1) A. Müller: Ber. **65** (1932), 1051.

recrystallized from ligroin; m.p.: 79° C, m.w. (Rast's method): 322.1 (calc. 316). C: 53.56, H: 6.13% (C: 53.13, H: 6.38 as C₆H₈O₄Ac₄). The acetylated substance has no property of absorbing Br₂ or decolorizing KMnO₄.

Observing the synthetical process either one of the 4 constructions is to be assigned.

(* The antipode of the constitution is laid aside for simplicity.)

The construction II cannot account for the properties of the substance which absorbs 1 mol of Br₂ and decolorizes KMnO₄. Moreover, 1 mol of H₂ adds to the substance under the catalytic action of Pd-BaSO₄, the fact being unexpected with the construction. The substance of the construction (II) was synthesized in the following way, and it shows very different properties from the substance in question. 2 g of 1:6-diiodo-2:3:4:5-tetrabenzoyl mannitol were dissolved in 20 cc of glacial acetic acid and the solution, added by 4 g Zn-powder, was heated for 3 hours on a water bath. A syrupy mass was obtained from the reaction mixture. The mass was saponified with methyl alcoholic baryta and a crystalline substance was separated out from an aqueous solution in the yield of 0.1 g, which was recrystallized from acetic-ester + ligroin; $[\alpha]_D^{25} = +28.57$ (Hg-lamp), m.p.: 150° C, m.w. (Rast's method): 169.1 (calc. 150), C: 48.86, H: 8.21% (C: 48.00, H: 9.33 as C₆H₁₄O₄). It does not reduce KMnO₄ nor absorbs Br₂.

Construction III or IV well accounts for the property of absorbing Br₂ or H₂, in that case, however, this property should be retained after the substance is acetylated. The substance of the construction III or IV, moreover, is expected to have the keto-form by tautomeric change,¹⁾ in the case of which they should reduce Fehling's solution or ammoniacal silver, which is not the case with the substance under discussion. Thus the construction V remains as the only probable one. The H-

1) Helferich & Hirmmen: Ber. **61** (1928), 1825; **62** (1929), 2136.
 Bredereck: Ber. **63** (1930), 959.
 Helferich, Bohm & Winkler: Ber. **63** (1930), 989.

atoms of $-\text{CH}_2-\text{CH}_2-$ group, surrounded by alcohol groups, in a ring, are in active state and are responsible for the substitution of Br_2 and the reduction of KMnO_4 . They are stabilized when hydroxyls are substituted by other radicals such as acetyl groups.

It is unlikely that V is able to absorb H_2 , but here the rupture of the ring, hydrogenolysis, takes place. 0.16 g of tetrahydroxy-mannocyclitol was dissolved in absolute alcohol and was hydrogenated using Pd-BaSO_4 as the catalyst. About 35 cc of H_2 at the room temperature of 32°C had been absorbed. When the solvent was evaporated, a crystalline substance was obtained in an almost theoretical yield. When it was recrystallized from warm acetone; m.p: $123-125^\circ\text{C}$, m.w. (Rast's method): 180 (calc. 150), C: 47.71, H: 8.88% (calc. C: 48.00, H: 9.33). Its aqueous solution does not show any sign of optical activity. However when borax is added to the solution (6.6%), $[\alpha]^{30} = -24.3$ (Hg-lamp).

The substance formed mono-tritylester (m.p: $124-125^\circ\text{C}$, C: 78.22, H: 5.59% (calc. C: 78.37, H: 5.72 as trityl-tribenzoyl-tetrahydroxyhexane)) and gave formaldehyde on the oxidation with Pb-tetracetate,¹⁾ the facts showing the presence of a primary alcohol group. Propionic aldehyde was not detected among the oxidation products, but a substance which the author considered as α -hydroxy-butyl aldehyde was found.

Now, the center of the rupture in V is supposed to lie between carbons 1:6, 1:2 or 5:6. According to where the rupture of the ring takes place, either one of the 2 substances, II and VI, will be formed, the rupture between the carbons 5:6 or 1:6 resulting in the formation of the same substance. The substance of the construction II is already synthesized by us as above described and it differs with the new compound. Therefore, the substance should have the construction of VI.

The probability of the occurrence of the ring rupture between other pairs of carbons is, of course, to be considered. But by oxidizing the substance with chromic acid, propionic acid (identified as p-bromphenacyl ester: m.p: $61-62^\circ\text{C}$ (C: 48.34, H: 3.95% (calc. C: 48.70, H: 4.08)) was formed, which cannot be expected with these ruptures.

1) Criegee; Ber. **64** (1931), 264; Ann. **495** (1932), 211.

During the course of the work, F. Micheel,¹⁾ published the results of his work. Starting with d-mannitol, he attained to a tetrahydroxymanno-cyclitol in quite a different way. The substance is dextrorotatory, and yet it is not the enantiomorph of the present author's, because the numerical value of the rotation and other properties are discordant. The final aim of the present work is to contribute to the knowledge of the constitution of naturally occurring polycyclitols. It is necessary, therefore, that the shifting of atoms in spacial arrangements is not alleged. By comparing Micheel's work with the author's, however, one has to assume changes in the configuration of hydroxyls in either one of or in both the two reaction processes. This state of affairs embarrassed the author, and he had to reexamine his work, which delayed the publication. The author is now repeating Micheel's process, and hopes to be able to throw some light upon the problem.

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1) F. Micheel: Ann. **496** (1932), 77.