borate buffer (*p*H 10), indicated the presence of only D-glucose, isomaltose and unhydrolyzed material.

The amorphous unhydrolyzed product (250 mg.) was dissolved in 30 ml. of water and reduced with hydrogen at 2000 p.s.i. and 80° with Raney nickel catalyst. The solution was filtered and evaporated to a sirup under reduced pressure; yield 200 mg., $[\alpha]^{20}D$ +114° (*c* 2.5, water). A 50-mg. sample of this material was acetylated with 3 ml. of hot acetic anhydride and 25 mg. of sodium acetate as described above; yield 60 mg. of sirup.

Anal. Calcd. for $C_{18}H_{22}O_6(CH_3CO)_{12}$: mol. wt., 1010.9. Found: mol. wt., 1018 (Rast).

Fragmentation Analysis of the Reduced Trisaccharide (Isomaltotriitol).—An amount of 134 mg. of the reduced and unacetylated product described above was dissolved in 10 ml. of 0.05 *N* sulfuric acid and heated on a boiling water bath for 7 hr. The excess acid was removed by shaking with a slight excess of Duolite A4[19] and filtering. The solution was evaporated under reduced pressure to a sirup which was acetylated with hot acetic anhydride (5 ml.) and sodium acetate (75 mg.) as described above. The resulting sirup was chromatographed on a column (235 × 35 mm., diam.) of Magnesol–Celite (5:1 by wt.) using 1000 ml. of benzene–*t*-butyl alcohol (100:1 by vol.) as developer. Three zones were located on the extruded column by streaking with the alkaline permanganate indicator. These were excised and eluted with acetone. The sirups obtained on solvent removal from the acetone eluates and from the column effluent were crystallized from ethanol. That from a zone located 25–40 mm. from the column top was identified as isomaltitol nonaacetate[28]; yield 3.8 mg. The material was crystallized from ethanol; m.p. 111–113°; X-ray powder diffraction pattern,[22,23] identical with that of authentic material: 10.98vs, 9.31s, 8.35w, 7.22vw, 6.86m, 6.39vw, 5.75vw, 5.14m, 4.72m, 4.43vw, 4.09s, 3.81w, 3.60vw. The product obtained from the zone 55–85 mm. from the column top was identified as β-isomaltose octaacetate[21]; yield 0.5 mg., m.p. 142–144°, X-ray powder diffraction data[14] identical with that of the authentic substance. The crystalline material found in the third zone located 240–290 mm. from the column top was identified as D-glucitol (sorbitol) hexaacetate; yield 0.8 mg., m.p. 95–96°; X-ray powder diffraction pattern,[22,23] identical with that of an authentic sample: 10.34w,, 8.43w, 7.58w, 7.02s, 6.56vw, 6.35vw, 5.96vw, 5.62vw, 5.05vs, 4.69w, 4.37w, 4.20vw, 4.01w, 3.89vw, 3.74m, 3.43s, 3.27vw, 3.18vw, 2.95m, 2.80vw, 2.72vw, 2.65w. The crystalline material from the column effluent was identified as β-D-glucopyranose pentaacetate; yield 25 mg., m.p. (on recrystallization from ethanol) 126–128° unchanged on admixture with an authentic specimen.

β-Maltotriose Hendecaacetate.—The material (1.58 g.) of the faster moving zone B from the paper chromatography of fraction II was placed upon paper and separated by electrophoresis, using a sodium borate buffer at *p*H 10, by the procedure described above for the separation of isomaltotriose. There resulted two zones, the slower of which had an M_G value of approximately 0.33 or that of maltotriose. The material in this zone was isolated; yield 950 mg. Acetylation of this product with hot acetic anhydride and sodium acetate was effected as described above for the acetylation of fraction I. This material failed to crystallize from ethanol and was chromatographed on a column (210 × 42, diam.) of Magnesol–Celite (5:1 by wt.) by development with 1000 ml. of benzene–*t*-butyl alcohol (100:1 by vol.). Two zones were located on the extruded column by streaking with the alkaline permanganate indicator. The amorphous material (180 mg.), obtained from the acetone eluate of a zone located 25–50 mm. from the column top, was not further investigated. The material obtained on solvent removal from the acetone eluate of a zone located 25–50 mm. from the column top, was crystallized from ethanol; yield 120 mg., m.p. 134–136° unchanged on admixture with authentic β-maltotriose hendecaacetate.[6,7]

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(28) M. L. Wolfrom, A. Thompson, A. N. O'Neill and T. T. Galkowski, THIS JOURNAL, **74**, 1062 (1952).

[CONTRIBUTION FROM THE ROBERT W. LOVETT MEMORIAL LABORATORIES FOR THE STUDY OF CRIPPLING DISEASES, MASSACHUSETTS GENERAL HOSPITAL, AND THE DEPARTMENT OF BIOLOGICAL CHEMISTRY, HARVARD MEDICAL SCHOOL]

The Synthesis of D-Gulosamine Hydrochloride[1a,b]

BY ZOFIA TARASIEJSKA AND ROGER W. JEANLOZ

RECEIVED MARCH 5, 1957

D-Gulosamine hydrochloride has been prepared in crystalline form from methyl 2-acetamido-4,6-*O*-benzylidene-2-deoxy-α-D-galactopyranoside and has been characterized through the following crystalline derivatives: *N*-(2′-hydroxy-naphthylidene), methyl *N*-acetyl-α-D-glycoside and methyl *N*-acetyl-3,4,6-tri-*O*-acetyl-α-D-glycoside.

The isolation of a new aminosugar from streptothricin and streptolin B has been reported recently, and the structure of a 2-amino hexose, D-gulosamine (VII), has been proposed for it.[2] This appears to be the first isolation of a 2-amino hexose from natural sources since D-galactosamine was extracted from cartilage 40 years ago and the well known D-glucosamine from chitin nearly a century ago. It seems also to be the first isolation of a natural sugar with the D-gulose configuration.

Confirmation of the structure proposed by van Tamelen, *et al.*, by an unequivocal synthetic procedure seemed of interest. The preparation of D-allosamine from D-glucosamine has been accomplished in our laboratory.[3] In the present study a similar reaction sequence was applied to D-galactosamine and methyl 2-acetamido-4,6-*O*-benzylidene-2-deoxy-α-D-galactopyranoside (I)[4] was transformed into the 3-*O*-methylsulfonyl derivative II. Reaction with sodium acetate in methyl cellosolve[5] failed, however, to proceed in a similar way as described for the glucosamine derivative[3] and the starting material was recovered unchanged. This failure was unexpected, as the benzylidene derivative of galactosamine II possesses the general conformation of a *cis*-decalin, much more flexible than the *trans*-decalin confor-

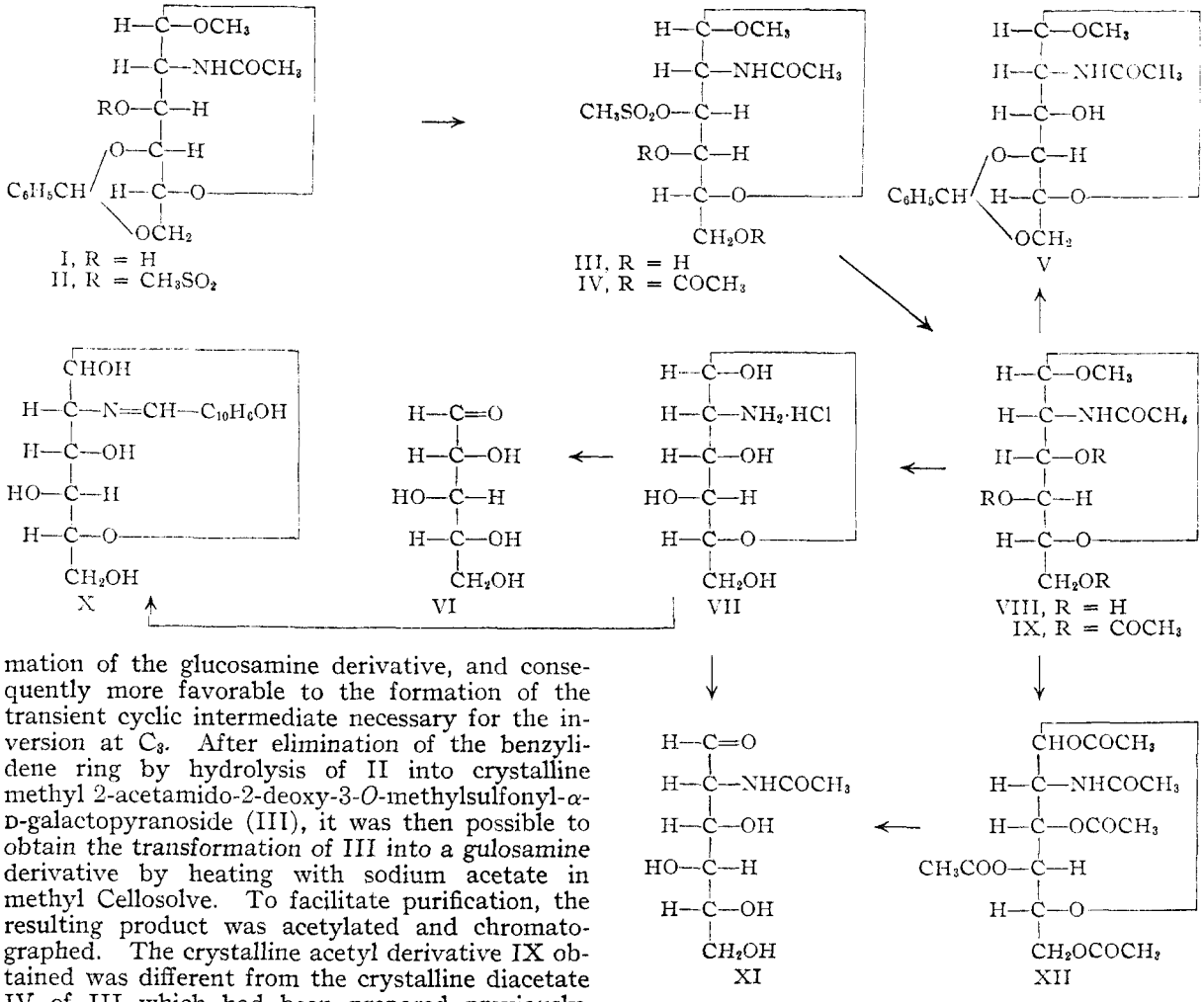
(1) (a) Studies on hyaluronic acid and related substances XVII. This is publication No. 211 of the Robert W. Lovett Memorial Laboratories for the Study of Crippling Diseases, Department of Medicine, Harvard Medical School, Boston, and the Massachusetts General Hospital. This investigation has been supported by a research grant from the National Institute of Arthritis and Metabolic Diseases, National Institutes of Health, Public Health Service (Grant A-148-C3). Presented before the Division of Carbohydrate Chemistry at the 131st Meeting of the American Chemical Society, Miami, Florida, April, 1957. (b) A preliminary note has been published, THIS JOURNAL, **79**, 2660 (1957).

(2) E. E. van Tamelen, J. R. Dyer, H. E. Carter, J. V. Pierce and E. E. Daniels, THIS JOURNAL, **78**, 4817 (1956).

(3) R. W. Jeanloz, *ibid.*, **79**, 2591 (1957).

(4) P. J. Stoffyn and R. W. Jeanloz, *ibid.*, **76**, 561 (1954).

(5) B. R. Baker, R. E. Schaub, J. P. Joseph and J. H. Williams, *ibid.*, **76**, 4044 (1954).



mation of the glucosamine derivative, and consequently more favorable to the formation of the transient cyclic intermediate necessary for the inversion at C_3. After elimination of the benzylidene ring by hydrolysis of II into crystalline methyl 2-acetamido-2-deoxy-3-*O*-methylsulfonyl-α-D-galactopyranoside (III), it was then possible to obtain the transformation of III into a gulosamine derivative by heating with sodium acetate in methyl Cellosolve. To facilitate purification, the resulting product was acetylated and chromatographed. The crystalline acetyl derivative IX obtained was different from the crystalline diacetate IV of III which had been prepared previously. Alkaline hydrolysis of IX afforded a crystalline methyl 2-acetamido-2-deoxy-α-D-glycopyranoside (VIII), different from methyl 2-acetamido-2-deoxy-α-D-galactopyranoside, and consequently belonging to the D-gulosamine series. Acid hydrolysis of VIII gave in a 66% yield the crystalline α-form of 2-amino-2-deoxy-D-gulose hydrochloride (D-gulosamine hydrochloride) (VII). In view of the report of the formation of the 1,6-anhydro derivative of D-gulosamine hydrochloride by acid treatment of VII[2] the mother liquors of the preparation of VII were thoroughly studied. However, no trace of the anhydro compound could be detected by paper chromatography, using as standard of comparison D-galactosamine and 2-amino-1,6-anhydro-2-deoxy-β-D-galactopyranose hydrochloride.[6] The synthetic D-gulosamine exhibited a decomposition range of temperature, a starting and a final mutarotation identical to those of the natural product. It was definitely distinct from D-glucosamine, D-galactosamine and D-allosamine by direct paper chromatography. Degradation with ninhydrin in the presence of pyridine[7] gave rise to D-xylose (VI), identified by paper chromatography. As the free hydrochloride decomposes over a large range of temperature and the comparison of the mutarotation is an unsatisfactory method of identification, the preparation of crystalline derivatives was attempted in addition to the two crystalline glycosides described above. Starting from the hydrochloride VII, preparation of the *N*-acetyl derivative XI gave only a sirupy product. A sirup was also obtained when the *N*-acetyl derivative XI was obtained from the tri-*O*-acetylglycoside IX transformed by acetolysis to the sirupy pentaacetate XII, followed by alkaline *O*-deacetylation. However, the *N*-(2′-hydroxynaphthylidene) derivative X was crystalline. Another crystalline derivative was obtained by condensation of the glycoside VIII with benzaldehyde, to which the structure of a methyl 2-acetamido-4,6-*O*-benzylidene-2-deoxy-α-D-gulopyranoside (V) was ascribed by analogy; however, the possibility of a 3,4-*O*-benzylidene structure cannot be completely discarded.

After this work had been completed, a short note appeared in the literature describing a synthesis of D-gulosamine starting from D-xylose.[8] The structure of the final product is not unequivocally established by this work since two aminosugars,

(6) S. P. James, F. Smith, M. Stacey and L. F. Wiggins, *J. Chem. Soc.*, 625 (1946).

(7) P. J. Stoffyn and R. W. Jeanloz, *Arch. Biochem. Biophys.*, **52**, 373 (1954).

(8) R. Kuhn, W. Kirschenlohr and W. Bister, *Angew. Chem.*, **69**, 60 (1957).

D-gulosamine and D-idosamine, are formed. In addition, the value of the starting mutarotation of the aminosugar obtained differed significantly from the values of both the natural product and the synthetic product described above. Furthermore, no crystalline derivatives with definite melting point were reported.

Experimental[9]

Methyl 2-Acetamido-3-*O*-acetyl-4,6-*O*-benzylidene-2-deoxy-α-D-galactopyranoside.—This compound was obtained for identification purposes by conventional acetylation of methyl 2-acetamido-4,6-*O*-benzylidene-2-deoxy-α-D-galactopyranoside (I)[4] with pyridine and acetic anhydride. Crystallization from a mixture of acetone, ether and pentane gave elongated prisms, m.p. 219–220°, $[\alpha]^{23}D$ +186 ± 1° (in chloroform, *c* 0.74). *Anal.* Calcd. for $C_{18}H_{23}O_7N$: C, 59.17; H, 6.34. Found: C, 59.07; H, 6.39.

Methyl 2-Acetamido-4,6-*O*-benzylidene-2-deoxy-3-*O*-methylsulfonyl-α-D-galactopyranoside (II).—To a solution of 2.0 g. of methyl 2-acetamido-4,6-*O*-benzylidene-2-deoxy-α-D-galactopyranoside (I)[4] in 25 ml. of anhydrous pyridine previously chilled at −20° was added 1.0 ml. of methanesulfonyl chloride. After standing 3 days at 0°, ice was added, and the solution was extracted with chloroform. This extract was washed thrice each time with ice-cold 2 *N* sulfuric acid, saturated sodium bicarbonate and water and dried over sodium sulfate. After evaporation *in vacuo* the residue was dissolved in methanol, filtered through a layer of Darco G-60, and concentrated. Crystallization from mixtures of acetone and ether or acetone and pentane gave 2.14 g. (86%) of elongated prisms, melting at 205–207° dec., when started at room temperature, or at 219–220°, when started at 210°, $[\alpha]^{24}D$ +169 ± 1° (in chloroform, *c* 1.12). *Anal.* Calcd. for $C_{17}H_{23}O_8NS$: C, 50.86; H, 5.77; S, 7.99. Found: C, 50.93; H, 5.86; S, 7.90.

After heating in methyl Cellosolve solution in the presence of sodium acetate and extracting as previously described,[3] a recovery of approximately 90% of starting material was obtained.

Methyl 2-Acetamido-2-deoxy-3-*O*-methylsulfonyl-α-D-galactopyranoside (III).—A solution of 2.75 g. of II in 65 ml. of 60% acetic acid was heated a half-hour on a water-bath. The benzaldehyde and the solvents were removed by distillation *in vacuo*, followed by co-distillation with water then with absolute toluene. The residue was crystallized from a mixture of methanol and ether to give an almost quantitative yield of needles, m.p. 179–180° dec., $[\alpha]^{22}D$ +132 ± 1° (in methanol, *c* 0.88). *Anal.* Calcd. for $C_{10}H_{19}O_8NS$: C, 38.33; H, 6.11. Found: C, 38.48; H, 6.22.

Acetylation of 51 mg. of III with acetic anhydride and pyridine in the usual way gave the **4,6-di-*O*-acetyl** derivative IV. Crystallization from a mixture of methanol and ether gave 59 mg. (91%) of short prisms, m.p. 163–164°, $[\alpha]^{24}D$ +96 ± 2° (in chloroform, *c* 0.83). *Anal.* Calcd. for $C_{14}H_{23}O_{10}NS$: C, 42.31; H, 5.83. Found: C, 42.22; H, 5.79.

Methyl 2-Acetamido-3,4,6-tri-*O*-acetyl-2-deoxy-α-D-gulopyranoside (IX).—A solution of 1.0 g. of III and 0.9 g. of sodium acetate trihydrate in 25 ml. of 95% methyl Cellosolve was heated under reflux for 40 hours. After concentration to dryness *in vacuo*, the residue was acetylated with 10 ml. of anhydrous pyridine and 7 ml. of acetic anhydride overnight at room temperature. The mixture was filtered, the solution concentrated to dryness *in vacuo*, and the residue dissolved in chloroform and chromatographed on 50 g. of silicic acid. Pure ethyl acetate eluted crystalline fractions. Crystallization from a mixture of methanol and ether gave 0.65 g. of triangular prisms, m.p. 123–124°, $[\alpha]^{21}D$ +76 ± 1° (in chloroform, *c* 0.91). *Anal.* Calcd. for $C_{15}H_{23}O_9N$: C, 49.86; H, 6.42. Found: C, 49.71; H, 6.45. The yield based on the starting material III was 56%.

Methyl 2-Acetamido-2-deoxy-α-D-gulopyranoside (VIII).—To a cold solution of 300 mg. of IX in 2 ml. of methanol was added 0.3 ml. of 1.5 *N* barium methylate. After standing overnight at 0°, the solution was neutralized with carbon dioxide and diluted with water at the same time. After filtration through a double layer of Celite and Darco G-60, the last traces of barium were removed by filtering through a short column of Dowex 50 and the solution evaporated *in vacuo*. The residue was crystallized from a mixture of acetone and ether to give 142 mg. (72%) of short prisms, m.p. 79–82°, $[\alpha]^{25}D$ +72 ± 1° (in methanol, *c* 0.74). *Anal.* Calcd. for $C_9H_{17}O_6N$: C, 45.95; H, 7.29. Found: C, 45.80; H, 7.22.

VIII (49 mg.) was shaken overnight with 80 mg. of zinc chloride and 0.3 ml. of benzaldehyde. After addition of 2 ml. of water, the solution was extracted with hexane to remove the benzaldehyde in excess. The water solution was then extracted exhaustively with chloroform. This extract was dried over sodium sulfate, concentrated and chromatographed on 2 g. of silicic acid. After elution of benzoic acid with ether, a crystalline product was eluted with methanol. Crystallization from a mixture of methanol and acetone gave 38 mg. (57%) of prisms, m.p. 111–114°, $[\alpha]^{25}D$ +71 ± 2° (in methanol, *c* 0.90). *Anal.* Calcd. for $C_{16}H_{21}O_6N$: C, 59.43; H, 6.55. Found: C, 59.08; H, 7.07. The structure of **methyl 2-acetamido-4,6-*O*-benzylidene-2-deoxy-α-D-gulopyranoside (V)** was attributed to this compound.

2-Amino-2-deoxy-α-D-gulose Hydrochloride (α-D-Gulosamine Hydrochloride) (VII).—A solution of 227 mg. of VIII in 2.2 ml. of 2 *N* hydrochloric acid was heated on the water-bath for two hours. After evaporation *in vacuo*, the last traces of hydrochloric acid, water and acetic acid were removed by codistillation *in vacuo* with absolute ethanol. The residue was dissolved in aqueous methanol, filtered through a double layer of Celite and Darco G-60 and the solution concentrated. Crystallization from aqueous ethanol gave 138 mg. (66%) of prisms decomposing between 150 and 170°; the largest prisms started to decompose only at 162°. The product showed a complex mutarotation: $[\alpha]^{22}D$ +6.0° (10 minutes), −11° (30 minutes), −21° (one hour); −26° (2 hours), −26° (4 hours), −18 ± 1° (at equilibrium, after 36 hours, in water, *c* 0.90).[10] *Anal.* Calcd. for $C_6H_{14}O_5NCl$: C, 33.26; H, 6.48; N, 6.50; Cl, 16.44. Found: C, 33.47; H, 6.56; N, 6.32; Cl, 16.52. The reaction with ninhydrin was positive. In a descending paper chromatography on Whatman #54 paper in the mixture of *n*-propyl alcohol–water–ammonia 21:9:0.1, VII migrated 1.18, compared to D-glucosamine 1.00, D-galactosamine 0.91, and D-allosamine[3] 1.03. A small amount degraded with ninhydrin and pyridine as previously described[7] gave a spot migrating in paper chromatography with a R_f identical to the one of D-xylose (VI).

The rotation of the mother liquors of VII was $[\alpha]^{24}D$ +5°, showing that a maximum amount of 30% of 1,6-anhydro derivative could be present in it. However, any amount of untransformed starting material could be responsible for this figure. Before crystallization of VII, the crude mixture had an $[\alpha]^{24}D$ −10°, showing the presence of at least 90% of VII. Chromatographed in the mixture *n*-propyl alcohol–ammonia no spot faster than VII could be detected. A small amount of recrystallized VII was heated in 2 *N* hydrochloric acid solution at 100° for 7 hours in a sealed tube. After drying in a desiccator in presence of soda lime, the residue was chromatographed on paper in the mixture *n*-propyl alcohol–ammonia. No spot faster than VII could be detected. By comparison, 2-amino-1,6-anhydro-2-deoxy-β-D-galactopyranose hydrochloride[6] migrated 1.45.

2-Acetamido-2-deoxy-D-gulose (XI) (from IX).—To a mixture of 2.7 ml. of acetic anhydride and 0.05 ml. of concentrated sulfuric acid was added 273 mg. of IX. After standing one hour at room temperature, ice was added. The solution was neutralized with solid sodium bicarbonate, and extracted with chloroform. This solution was dried over sodium sulfate, concentrated and chromatographed on 10 g. of silicic acid. Elution with a mixture of ethyl acetate and acetone 4:1 gave 235 mg. of the sirupy **2-acetamido-1,3,4,6-tetra-*O*-acetyl-2-deoxy-D-gulopyranose (XII)**, which has thus far failed to crystallize; $[\alpha]^{24}D$ +51 ± 1° (in chloroform, *c* 1.08). *Anal.* Calcd. for $C_{16}H_{23}O_{10}N$: C, 49.35; H, 5.95. Found: C, 49.66; H, 5.74.

To a cold solution of 215 mg. of XII in 2.5 ml. of methanol was added 0.2 ml. of 1.5 *N* barium methylate. After 48 hours at 0°, it was diluted with water, neutralized with carbon dioxide, filtered and the solution passed through a short column of Dowex 50. After concentration, a quantitative yield of XI was obtained as a colorless sirup, $[\alpha]^{23}D$

(9) R. W. Jeanloz, THIS JOURNAL, **76**, 555 (1954); R. W. Jeanloz and D. A. Jeanloz, *ibid.*, **79**, 2579 (1957).

(10) E. E. van Tamelen, *et al.*,[3] reported m.p. 152–162° dec. and $[\alpha]^{25}D$ +5.6° (5 min.) → −18.7° (4 h. and final) (in water, *c* 2.9).

$-47 \pm 2°$ (in methanol, *c* 1.32). *Anal.* Calcd. for $C_8H_{15}O_6N$: C, 43.44; H, 6.83. Found: C, 43.26; H, 6.99.

From VII.—To a solution of 19.5 mg. of VII in 1.5 ml. of methanol were added 30 mg. of silver acetate and 0.022 ml. of acetic anhydride. After standing at room temperature overnight, the solution was filtered. One drop of dilute hydrochloric acid was added and after two hours the solution was filtered through a double layer of Celite and Darco G-60. After concentration, a quantitative yield of sirup was obtained; $[\alpha]^{27}D$ $-50 \pm 1°$ (in methanol, *c* 1.82).

2-Deoxy-2-(2′-hydroxynaphthylidenamino)-D-gulose (X).—A solution of 48 mg. of VII and 32 mg. of sodium acetate trihydrate in 1 ml. of water was treated as previously described[11] with 100 mg. of 2-hydroxynaphthaldehyde in 10 ml. of methanol. Purification was carried out by chromatography on 5 g. of silicic acid. The substance was eluted by a mixture of acetone and methanol 9:1. Crystallization from a mixture of methyl Cellosolve and acetone gave 36 mg. (49%) of small yellow crystals, m.p. 186–188° dec., $[\alpha]^{22}_{5461}$ $-150 \pm 5°$ (at equilibrium, in methyl Cellosolve, *c* 0.60). *Anal.* Calcd. for $C_{17}H_{19}O_6N$: C, 61.26; H, 5.75. Found: C, 61.16; H, 5.86.

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(11) R. W. Jeanloz, THIS JOURNAL, **74**, 4597 (1952).

[CONTRIBUTION FROM BIOCHEMICAL LABORATORY, COLLEGE OF AGRICULTURE, KYOTO UNIVERSITY]

An Acyl Migration in Acetohalogenoglucosamines[1]

BY YOSHIYUKI INOUYE, KONOSHIN ONODERA, SHOZABURO KITAOKA AND HIDEO OCHIAI

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The acetobromoglucosamine (2-acetamido-2-deoxy-3,4,6-tri-*O*-acetyl-D-glucosyl bromide) described in the literature was proved to be 1,3,4,6-tetra-*O*-acetyl-α-D-glucosamine hydrobromide, in support of the finding of Micheel, *et al.* However, methyl β-D-glucosaminide and 1-*p*-tolyl-2-amino-2-deoxy-β-D-glucosylamine tetraacetates could be prepared by the Koenigs–Knorr reaction using the freshly prepared chloroform solution obtained from the reaction mixture of *N*-acetyl-tetra-*O*-acetyl-D-glucosamine with hydrogen bromide in acetic acid. A new disaccharide acetate of the trehalose type which consisted of two molecules of D-glucosamine tetraacetate also was prepared from this chloroform solution with silver oxide as the condensing agent. These results indicate that acetobromoglucosamine is actually formed by the usual method of preparation and then rapidly undergoes an acetyl migration. Additional evidence was obtained as well in the case of a crystalline analog, acetochloroglucosamine, which was converted into 1,3,4,6-tetra-*O*-acetyl-α-D-glucosamine hydrochloride, partially upon refluxing in moist chloroform and completely upon refluxing in acid-containing moist chloroform.

Micheel, van de Kamp and Wulff[2] recently have reported that the acetobromoglucosamine (2-acetamido-2-deoxy-3,4,6-tri-*O*-acetyl-D-glucosyl bromide) (IIa) prepared by the method of Moggridge and Neuberger,[3] (in which N-acetyl-tetra-*O*-acetyl-D-glucosamine (Ia) is treated with hydrogen bromide in acetic acid and the reaction mixture is dissolved in chloroform, washed with sodium bicarbonate solution, and the product is crystallized by concentrating the dried chloroform solution *in vacuo*), is actually 1,3,4,6-tetra-*O*-acetyl-α D-glucosamine hydrobromide (IVa). We had been engaged in some synthetic work starting from acetobromoglucosamine and had independently reached the same conclusion. The so-called acetobromoglucosamine obtained by the methods of Moggridge and Neuberger[3] and Baker, Joseph, Schaub and Williams,[4] the latter of which is a modification of the former, was 1,3,4,6-tetra-*O*-acetyl-α-D-glucosamine hydrobromide (IVa), which was identified by conversion into N-acetyl-tetra-*O*-acetyl-α-D-glucosamine (Ib), 2-*N*-(*o*-carboxybenzoyl)-1,3,4,6-tetra-*O*-acetyl-α-D-glucosamine (V) and 2-*N*-anisilydene-1,3,4,6-tetra-*O*-acetyl-α-D-glucosamine (VI). IVa was also converted into 1,3,4,6-tetra-*O*-acetyl-α-D-glucosamine (VII). Our attempts to synthesize the D-glucosaminides and disaccharides containing D-glucosamine as a component starting from IVa had resulted in failure. Similar failures have been described by the above authors.[2–4] However, Kuhn and Kirschenlohr[5] successfully prepared a series of alkyl-β-D-glucosaminide tetraacetates[5a] and 6-*O*-(2-amino-2-deoxy-β-D-glucosyl)-D-glucose and 6-*O*-(2-amino-2-deoxy-β-D-glucosyl)-D-galactose octaacetates[5b] from their acetobromoglucosamine preparation by the use of mercury cyanide as the condensing agent, and Bertho and Koziollek[6] obtained arylamine-*N*-β-D-glucosaminide tetraacetates from their acetobromo compound. However, these authors have given no detailed description of their acetobromoglucosamine preparations.

In our investigations, some of these D-glucosaminides were obtained by employing a slightly modified reaction procedure: *N*-acetyl-tetra-*O*-acetyl-D-glucosamine (Ia) was treated with hydrogen bromide in acetic acid in the usual manner. The reaction mixture was added to chloroform, washed quickly with an aqueous sodium bicarbonate solution and then with water and dried over anhydrous sodium sulfate. *This fresh chloroform solution* could be used to prepare D-glucosaminides. The reaction of this solution with methanol in the presence of silver oxide gave rise to methyl-β-D-glucosaminide tetraacetate (IIIa),[5a] and the reaction with *p*-toluidine yielded *p*-toluidine-*N*-β-D-glucosaminide tetraacetate (IIIb).[6,7]

(1) Presented in part at the Annual Meeting of the Agricultural Chemical Society of Japan, Tokyo, on March 30, 1956. A preliminary communication: *Bull. Agr. Chem. Soc. Japan*, **20**, 157 (1956).

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