CCXXII.—*Glucosides. Part II. The Preparation of α-Glucosides from β-Glucosyl Chlorides.*

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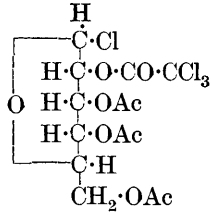
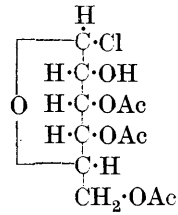
THE ordinary dextrorotatory tetra-acetyl glucosyl chloride and bromide are to be regarded, on Hudson's views (*J. Amer. Chem. Soc.*, 1924, **46**, 462), as belonging to the α-series. In alcoholic solution in presence of silver carbonate, they give rise to β-glucosides, presumably by virtue of a Walden inversion. It should be possible, therefore, to obtain α-glucosides directly from the isomeric β-glucosyl halides by a similar process. Although 2 : 3 : 4 : 6-tetra-acetyl β-glucosyl chloride (III) has been prepared in a pure condition (Schlubach, *Ber.*, 1926, **59**, 840; compare Brigl, *ibid.*, p. 1588; Fischer and Armstrong, *Ber.*, 1901, **34**, 2885), no satisfactory process has been devised for preparing α-glucosides from it. This failure is probably due to the ease with which it changes to the isomeric α-chloride (Schlubach, Stadler, and Wolf, *Ber.*, 1928, **61**, 287; compare Fischer and Armstrong, *loc. cit.*).

A study was made, therefore, of the stability of other β-glucosyl chlorides; the present paper contains an account of an investigation of the behaviour of 2-trichloroacetyl 3 : 4 : 6-triacetyl

β-glucosyl chloride (I) and of 3 : 4 : 6-triacetyl β-glucosyl chloride (II) in alcohols, and of the conditions which favour the formation of α-glucosides.


(I.)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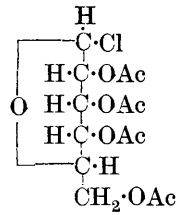

(III.)

2-Trichloroacetyl 3 : 4 : 6-triacetyl β-glucosyl chloride was prepared by heating β-penta-acetyl glucose with phosphorus pentachloride (Brigl, *Z. physiol. Chem.*, 1921, **116**, 1). It is of interest to note that while an acetylated α-glucosyl halide is formed by the action of hydrogen bromide or hydrogen chloride on β-penta-acetyl glucose, phosphorus pentachloride yields a β-glucosyl chloride. 2-Trichloroacetyl 3 : 4 : 6-triacetyl β-glucosyl chloride is a relatively stable substance when compared with 2 : 3 : 4 : 6-tetra-acetyl β-glucosyl chloride; it does not exhibit any appreciable mutarotation when solutions in benzene, acetonitrile, acetone, *o*-chlorophenol, or nitromethane are kept for at least 500 hours and, contrary to the observation of Brigl (*loc. cit.*), only a small increase in rotation occurs in chloroform solution, even after 540 hours. Further, the pure substance may be kept for long periods exposed to the laboratory atmosphere without any appreciable deterioration. It would appear, from qualitative determinations, that the reactivity of the glucosidic chlorine is lower than that of the bromine in tetra-acetyl α-glucosyl bromide.

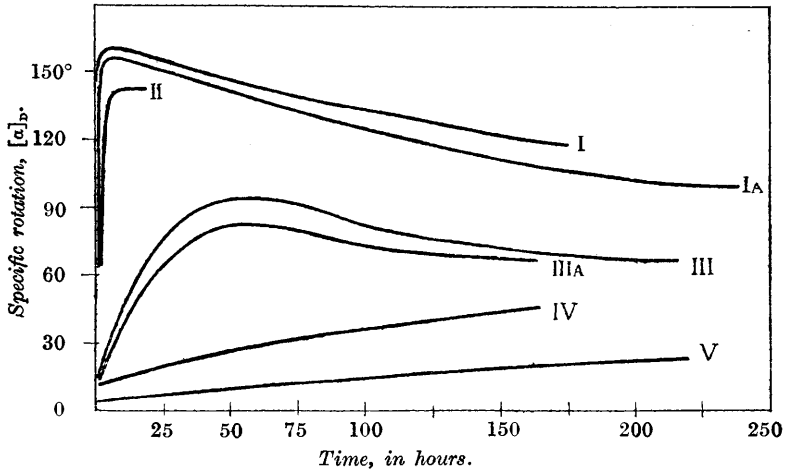
When either 2-trichloroacetyl 3 : 4 : 6-triacetyl β-glucosyl chloride or 3 : 4 : 6-triacetyl β-glucosyl chloride was heated in methyl or ethyl alcohol in presence of silver carbonate or silver oxide, a mixture of α- and β-glucosides resulted, the proportion of α-glucoside under the most favourable conditions being approximately 70%.

Although the formation of β-glucosides from 3 : 4 : 6-triacetyl β-glucosyl chloride may be due in part to the intermediate formation of 3 : 4 : 6-triacetyl glucose 1 : 2-anhydride and its reaction with alcohols to yield β-glucosides (Part I, J., 1928, 3140), this explanation cannot account for the production of β-glucosides from 2-trichloroacetyl 3 : 4 : 6-triacetyl β-glucosyl chloride. Further, it was found that this glucosyl chloride is stable in presence of silver chloride, and is not appreciably affected in benzene solution by dry

silver oxide. It appeared, therefore, that the alcohols may be able to convert the β-glucosyl chlorides into the isomeric α-chlorides, which could then give rise to β-glucosides. Accordingly, an examination of the behaviour of 2-trichloroacetyl 3 : 4 : 6-triacetyl and 3 : 4 : 6-triacetyl β-glucosyl chlorides towards alcohols was made.

The rotation of 3 : 4 : 6-triacetyl β-glucosyl chloride in dry methyl alcohol rises to a maximum ($[\alpha]_D$ = *ca.* + 160°, c = 0·5) in 3 hours at room temperature and then gradually falls to an equilibrium value. In ethyl alcohol, the change of rotation is

FIG. 1.



I. 3 : 4 : 6-*Triacetyl β-glucosyl chloride in methyl alcohol* (c=0·51); *in* IA, c=0·49.
II. ,, ,, ,, ,, ,, *ethyl alcohol.*
III. 2-*Trichloroacetyl* 3 : 4 : 6-*triacetyl β-glucosyl chloride in methyl alcohol* (c= 1·10); *in* IIIA, c=2·11.
IV. 2-*Trichloroacetyl* 3 : 4 : 6-*triacetyl β-glucosyl chloride in ethyl alcohol.*
V. ,, ,, ,, ,, ,, ,, ,, n-*butyl alcohol.*

somewhat slower, the maximum value being reached after about 9 hours (see Fig. 1). 2-Trichloroacetyl 3 : 4 : 6-triacetyl β-glucosyl chloride in methyl alcohol shows a similar behaviour, but the change is comparatively slow, the maximum being attained only after about 50—60 hours, to be succeeded by a slow fall to an equilibrium value. In ethyl- and *n*-butyl-alcoholic solutions, the observations were not continued sufficiently long for a maximum or an equilibrium to be attained (Fig. 1).

The upward trend of the rotation indicates that each β-glucosyl chloride in the solution is being converted into compounds belonging to the α-series—either into the α-glucosides by reaction with alcohol

and subsequent elimination of hydrogen chloride, or into the α-glucosyl chloride by isomerisation. That the β-glucosyl chlorides react with the alcohol to yield glucosides is shown by the development of free hydrogen chloride when their solutions are kept. The formation of glucoside does not, however, proceed to completion. A methyl-alcoholic solution of 2-trichloroacetyl 3 : 4 : 6-triacetyl β-glucosyl chloride, which has been kept till the rotation has attained a maximum, still contains free glucosyl chloride, as demonstrated by the reduction of boiling Fehling's solution and the loss of this reducing power after treatment with silver oxide or carbonate. As a result of the action of silver carbonate, which converts the unchanged glucosyl chloride into glucosides, the solution contains a mixture of α- and β-glucosides, and from it after deacylation pure specimens of α- and β-methylglucosides were isolated by fractional crystallisation. Since, on the current views, a β-glucoside is derived from an α-glucosyl chloride, it is evident that the solution contains a proportion of α-chloride, which in turn is derived from the β-chloride by isomerisation. That this isomerisation is due to the action of the alcohol, and not to the silver oxide, or to the silver chloride formed in the reaction, is supported by the observation that neither silver oxide nor silver chloride has any appreciable effect on the rotation of 2-trichloroacetyl 3 : 4 : 6-triacetyl β-glucosyl chloride in dry benzene.

That a solution of 3 : 4 : 6-triacetyl β-glucosyl chloride in methyl alcohol which has reached a maximum rotation contains an excess of α-glucosyl chloride is demonstrated by the fall in rotation observed on treatment with dry silver oxide or silver carbonate, and by the isolation from the resulting solution of pure specimens of α- and β-methylglucosides after deacetylation. Furthermore, a direct comparison was made between the behaviour of methyl-alcoholic solutions of 3 : 4 : 6-triacetyl β-glucosyl chloride of maximum rotation and solutions of the corresponding α-chloride in methyl alcohol. A methyl-alcoholic solution of 3 : 4 : 6-triacetyl α-glucosyl chloride shows a steady fall in rotation on keeping, with the liberation of free hydrogen chloride, while a freshly prepared solution on treatment with dry silver oxide or carbonate exhibits a marked fall in rotation. These changes are qualitatively comparable with those observed for a solution of the β-glucosyl chloride of maximum rotation : a quantitative agreement cannot be expected owing to the occurrence of side reactions.

It is, therefore, possible to advance a probable explanation of the nature of the changes which occur when 3 : 4 : 6-triacetyl or 2-trichloroacetyl 3 : 4 : 6-triacetyl β-glucosyl chloride is dissolved in methyl alcohol. The initial rise in optical rotation is determined

partly by isomerisation to the α-glucosyl chloride and partly by the reaction of the β-glucosyl chloride to yield an α-methylglucoside. With the attainment of an equilibrium between the α- and β-glucosyl chlorides, the reaction with the solvent becomes the predominant reaction and is principally responsible for the subsequent fall in rotation. It is not unlikely that the isomerising action of the free hydrogen chloride on the methylglucosides already present may also contribute to a small extent to the slow fall in rotation; indeed, some support for this is derived from an examination of the products obtained by interrupting the downward mutarotation at different stages by the addition of silver oxide.

It is evident from this study of the behaviour of the β-glucosyl chlorides in alcohols that, in order to obtain α-glucosides from them in an approximately pure state, the experimental conditions must be so arranged that the rate of replacement of the halogen by the alkyloxy-group is rapid compared with the rate of isomerisation. These conditions do not obtain when 2-trichloroacetyl 3 : 4 : 6-triacetyl β-glucosyl chloride is heated in methyl-alcoholic solution in presence of silver oxide or silver carbonate, the product containing only approximately 70% of the α-glucoside. Somewhat similar proportions of α- and β-glucosides result from 3 : 4 : 6-triacetyl β-glucosyl chloride, although here the problem is complicated further by the possibility of the formation of 3 : 4 : 6-triacetyl glucose anhydride and its reaction with the alcohol to yield a β-glucoside (J., 1928, 3140).

Attempts were made to retard the rate of isomerisation of 2-trichloroacetyl 3 : 4 : 6-triacetyl β-glucosyl chloride by reducing the proportion of alcohol and using an indifferent solvent as a diluent. The product resulting from condensation at room temperature with methyl alcohol in presence of " active " silver oxide and benzene contained a somewhat higher proportion of α-glucoside. The process has the disadvantage of requiring a considerable time for completion, but was applied successfully to the preparation of α-phenylglucoside from 3 : 4 : 6-triacetyl β-glucosyl chloride.

It was found subsequently that the preparation of α-glucosides could be more suitably effected by employing an alcoholic solution of the β-glucosyl chloride in presence of silver nitrate and pyridine (compare Schlubach and Schröter, *Ber.*, 1928, **61**, 1216), whereby the proportion of α-methylglucoside in the product from 2-trichloroacetyl 3 : 4 : 6-triacetyl β-glucosyl chloride was raised to 90%. An increase in the proportion of α-glucoside from 3 : 4 : 6-triacetyl β-glucosyl chloride was also obtained by the same means.

EXPERIMENTAL.

Preparation of 2-Trichloroacetyl 3 : 4 : 6-Triacetyl β-Glucosyl Chloride (I).—The following is a modification of the procedure described by Brigl (*Z. physiol. Chem.*, 1921, **116**, 1). Pure dry β-penta-acetyl glucose (69·6 g.; 1 mol.) was heated with phosphorus pentachloride (151 g.; 4 mols.) in a boiling water-bath till the evolution of hydrogen chloride ceased (2½ hours). The product was freed from acetyl chloride and phosphorus oxychloride under diminished pressure, first at room temperature and finally at 100°. It is necessary that the heating at 100° should not be prolonged unduly, otherwise a dark product may result. The pale yellow, viscous residue was transferred while still hot to a crystallising dish, cooled somewhat, and covered with ether (100 c.c.). Crystallisation commenced soon after contact with the solvent, and was completed by keeping over-night in absence of moisture. The crystalline mass of crude glucosyl chloride was collected, washed with a small volume of ether, and then with ice-cold ethyl alcohol (yield, 24 g.).

The filtrate, when diluted largely with ether, washed with water and dilute sodium bicarbonate solution, dried over calcium chloride, and evaporated, left a residue which, after being quickly crystallised from a small volume of *n*-butyl alcohol and washed with ethyl alcohol, gave a further yield of fairly pure material (6 g., after being freed from alcohol in a vacuum desiccator).

The pure glucosyl chloride was obtained by crystallisation from warm dry ether, from which it separated in long slender needles, m. p. 140°. Its stability in the atmosphere and in various solvents has already been described (p. 1677), but imperfectly purified specimens develop an odour of acetic acid on keeping. When a benzene solution was kept in contact with dry silver oxide for 48 hours no appreciable change of rotation was observed, and 1220 hours' contact with suspended silver chloride produced only a slight change after removal of the silver chloride, $[\alpha]_D$ having risen from + 2·5° to + 5·7° * ($c = 2·57$).

Preparation of 3 : 4 : 6-Triacetyl β-Glucosyl Chloride (II).—This substance was prepared by the regulated deacylation of 2-trichloroacetyl 3 : 4 : 6-triacetyl β-glucosyl chloride by means of a dry ethereal solution of ammonia, following Brigl's directions (*loc. cit.*). The crude product was purified conveniently by dissolving it in the minimum of boiling dry ethyl acetate, and transferring the hot filtered solution to a freezing mixture, or by allowing it to cool in an evacuated vessel. 3 : 4 : 6-Triacetyl β-glucosyl chloride separated

* All the values for $[\alpha]_D$ recorded in this paper were determined in a 2 dcm. tube.

in small glistening platelets, m. p. 152—154° after two such crystallisations. Brigl (*loc. cit.*) gives m. p. 156—158° after 10 crystallisations.

The Behaviour of Acylated β-Glucosyl Chlorides in Alcohols.

2-Trichloroacetyl 3 : 4 : 6-Triacetyl β-Glucosyl Chloride.—(1) *In methyl alcohol.* The rotation of a dilute solution of the β-glucosyl chloride in dry methyl alcohol rises to a maximum, followed by a slow fall to an equilibrium value, on keeping at room temperature (Fig. 1). The following table records the change of specific rotation over a period of 266 hours for a solution ($c = 1{\cdot}10$) at 20—23°.

t (hrs.)	0·15	1·50	3·88	22·80	26·90	46·80	94·80	118·05
$[\alpha]_D$	+13·7°	17·8°	22·8°	66·1°	75·2°	92·5°	85·3°	76·1°
t (hrs.)	191·55	265·80						
$[\alpha]_D$	69·3°	66·1°						

After 266 hours, the solution had an acid reaction, and gave an immediate white turbidity with dry silver oxide. After being warmed with silver oxide till the replacement of the labile chlorine was complete, the solution had $[\alpha]_D + 68{\cdot}1°$ calculated on the basis of the glucoside formed.

In another determination of the change of rotation, the solution ($c = 3{\cdot}31$), originally neutral, showed a faint acid reaction to Congo-red after 20 hours and had $[\alpha]_D + 58{\cdot}8°$. The acidity became more pronounced as the rotation approached a maximum value. A solution showing the maximum rotation contained a considerable proportion of glucosyl chloride in addition to free hydrogen chloride; it reduced Fehling's solution, and after being shaken in the cold for a short time with silver carbonate till all free hydrogen chloride was removed, and then filtered, the solution gave a further precipitate of silver chloride on boiling with silver carbonate.

In other experiments, methyl-alcoholic solutions of the glucosyl chloride were kept until the rotation had attained approximately its maximum value, and then shaken with silver oxide at room temperature till the replacement of the chlorine was complete. In two such experiments silver oxide was added when the solutions had $[\alpha]_D + 74{\cdot}8°$ ($c = 6{\cdot}61$) and $[\alpha]_D + 77{\cdot}4°$ ($c = 6{\cdot}31$); the solutions resulting after this treatment had $[\alpha]_D + 88{\cdot}7°$ and $+ 82{\cdot}4°$, respectively, and contained no free glucosyl chloride. The products so obtained were combined, and deacylated with alcoholic ammonia. A mixture of α- and β-methylglucosides resulted, which yielded by crystallisation from alcohol pure α-methylglucoside, m. p. 164—165°, $[\alpha]_D + 155{\cdot}9°$ ($c = 1{\cdot}02$) in water. The mother-liquors, freed as far as possible from α-methylglucoside by concen-

tration and cooling in a freezing mixture, yielded a crystalline deposit of β-methylglucoside, m. p. 95—97°, on nucleation.

(2) *In ethyl alcohol.* In ethyl-alcoholic solution the change of rotation is slower than in methyl alcohol, the specific rotation rising from + 7·0° (c = 2·15), 0·63 hour after preparation of the solution, to + 44·5° after 165 hours. The observations were not continued over a sufficiently long period for a maximum to be observed or for equilibrium to be reached. The addition of dry silver oxide after 166 hours, followed by filtration when the replacement of the labile halogen was complete, gave a solution of $[\alpha]_D$ + 91°. It is apparent that, even after 166 hours, the solution still contained a considerable proportion of unchanged β-glucosyl chloride.

(3) *In* n-*butyl alcohol.* 2-Trichloroacetyl 3 : 4 : 6-triacetyl β-glucosyl chloride is not readily soluble in *n*-butyl alcohol free from active impurities. The specific rotation of a nearly saturated solution (c = 1·0) rose from + 4·0° initially to + 22·0° after 193·5 hours.

3 : 4 : 6-*Triacetyl β-Glucosyl Chloride in Alcohols.*—3 : 4 : 6-Triacetyl β-glucosyl chloride is not readily soluble in methyl or ethyl alcohol; consequently, only dilute solutions could be employed. The change in rotation is very rapid, a maximum value in methyl alcohol being reached after 2 hours, and in ethyl alcohol after about 5 hours. The following table records the change of specific rotation with time for solutions of the β-glucosyl chloride in methyl alcohol (c = 0·51) at 18—19°.

t (mins.) ...	3	4	7	9	11	14	19	21	24
$[\alpha]_D$	+47·9°	49·0°	61·7°	68·6°	74·5°	84·5°	94·1°	97·0°	106·8°
t (mins.) ...	29	34	44	54	60	86	247		
$[\alpha]_D$	+112·7°	123·5°	131·4°	140·2°	141·6°	155·3°	157·8°		
t (hrs.) ...	23·26	47·7	71·7	96·85	120·85	167·85	215·26		
$[\alpha]_D$	+154·9°	150·9°	137·7°	131·3°	126·5°	119·6°	107·8°		

After 4·2 hrs. the solution was found to be acid to Congo-red. In another determination, when a solution of the glucosyl chloride in methyl alcohol had reached a maximum value of $[\alpha]_D$ + 157·2° it was shaken with silver carbonate; the resulting solution after filtration contained no chloride and had $[\alpha]_D$ + 126·1°. The solution was deacetylated by saturating with dry ammonia at room temperature, evaporated under reduced pressure after standing for 24 hours, and treated with dry ether to remove acetamide. The residue was crystalline, and a warm concentrated solution in ethyl alcohol deposited crystals of α-methylglucoside on cooling. The mother-liquors, freed as completely as possible from α-methylglucoside by concentration and cooling, were nucleated with

β-methylglucoside and yielded a crystalline deposit of this glucoside.

In ethyl alcohol ($c = 0{\cdot}38$) at 19°, the specific rotation changed as follows :

t (hrs.) ...	0·53	0·60	0·68	1·23	1·25	1·35	1·85
$[\alpha]_D$	43·4°	44·8°	55·2°	72·3°	76·8°	80·2°	94·7°
t (hrs.) ...	2·00	3·36	4·0	5·0	9·0	23·0	48·3
$[\alpha]_D$	101·6°	126·3°	130·2°	135·5°	143·4°	144·7°	143·4°

The solution, which gave only a faint acid reaction to moist Congo-red paper, showed no further change in rotation on being kept for a further 48 hours. Shaking with finely powdered silver oxide until all the halogen had been replaced gave a solution having $[\alpha]_D + 113°$ calculated to triacetyl ethylglucoside. The solution evidently contained an excess of α-glucosyl chloride.

3 : 4 : 6-*Triacetyl α-Glucosyl Chloride.*—3 : 4 : 6-Triacetyl α-glucosyl chloride was obtained admixed with some β-chloride on keeping an acetone solution of the β-compound. The product after removal of the solvent under diminished pressure was a gum readily soluble in ether; $[\alpha]_D + 102{\cdot}2°$ in acetone.

The solution in dry methyl alcohol at the ordinary temperature showed a steady fall in rotation with the liberation of free hydrogen chloride. The following table records the change in specific rotation for a solution at room temperature ($c = 5{\cdot}95$) :

t (hrs.)	0·20	0·51	1·93	2·16	2·90	4·0
$[\alpha]_D$	+111·9°	108·2°	93·8°	89·4°	87·1°	72·8°
t (hrs.)	5·0	6·0	22·9	23·5	24·5	
$[\alpha]_D$	+63·4°	53·8°	18·8°	17·8°	17·4°	

A portion of the solution, $[\alpha]_D + 111{\cdot}9°$, was treated with dry silver carbonate shortly after being prepared, and the resulting solution, free from chloride, gave $[\alpha]_D + 54{\cdot}4°$.

Preparation of α-Glucosides.—(1) *By means of "active" silver oxide.* It has been found by Brigl and Keppler (*Ber.*, 1926, **59**, 1588), that 2-trichloroacetyl 3 : 4 : 6-triacetyl β-glucosyl chloride, when heated in methyl alcohol in presence of silver carbonate, gave rise to a mixture of α- and β-glucosides, the proportion of the former being approximately 70% under the most favourable conditions. It is now found that a similar yield of α-glucoside results by the use of "active" silver oxide (Helferich and Klein, *Annalen*, 1926, **450**, 225) in methyl-alcoholic solution of the β-glucosyl chloride. 2-Trichloroacetyl 3 : 4 : 6-triacetyl β-glucosyl chloride (1·188 g.), "active" silver oxide (1 g.), and methyl alcohol (50 c.c.) heated under reflux yielded a product which, after deacylation and drying, had

$[\alpha]_D$ + 101·1° in water (c = 1·3), corresponding to the presence of 69·6% of α-methylglucoside in the mixture.

(2) *In methyl-alcoholic solution of silver nitrate and pyridine.* It was found that the proportion of α-glucoside could be increased by effecting the replacement of the chlorine in methyl-alcoholic solution containing a slight excess of equimolecular proportions of silver nitrate and dry pyridine. Dry methyl alcohol (40 c.c.) and 9·4 c.c. of a solution of pyridine and silver nitrate in this solvent (theory 9·3 c.c.) were added to 1·203 g. of 2-trichloroacetyl 3 : 4 : 6-triacetyl β-glucosyl chloride. The chloride dissolved, and precipitation of silver chloride soon started. The mixture was gently boiled under reflux for 3 hours, and made up to 100 c.c.; it then had $[\alpha]_D$ + 109·3° calculated on the basis of the methylglucoside formed.

The solution of the methylglucoside was evaporated under diminished pressure, leaving a colourless gum containing embedded in it long white crystals of pyridine nitrate; this was dissolved in chloroform, washed with a small volume of water, and evaporated after drying over anhydrous sodium sulphate. 2-Trichloroacetyl 3 : 4 : 6-triacetyl methylglucoside remained as a transparent colourless gum, $[\alpha]_D$ + 150·7° (c = 3·48) in ethyl alcohol. It could not be induced to crystallise. Deacylation with alcoholic ammonia and evaporation under diminished pressure, followed by treatment with dry ether to remove amides, furnished a crystalline residue of crude α-methylglucoside, $[\alpha]_D$ + 138·0° in water (c = 1·32), corresponding to a mixture of 89·6% α- and 10·4% β-methylglucoside. Crystallisation from ethyl alcohol furnished pure α-methylglucoside, m. p. 164—165°, $[\alpha]_D$ + 155·2° in water (c = 1·93).

In a control experiment, the β-glucosyl chloride was heated in methyl-alcoholic solution with silver oxide, and after treatment as described above, the resulting mixture of α- and β-methylglucosides showed $[\alpha]_D$ + 71·4° in water.

The following table summarises the results obtained.

The preparation of methylglucosides from 2-trichloroacetyl 3 : 4 : 6-triacetyl β-glucosyl chloride.

Wt. of chloride, g.	Reagent employed.	$[\alpha]_D$ of resulting solution.	$[\alpha]_D$ of acylated glucosides in ethyl alcohol.	$[\alpha]_D$ of deacylated glucosides in water (c=*ca.* 1·0).	α-Methyl-glucoside, %.
1·2552	$AgNO_3$ & C_5H_5N	+106·5°	+143·7°	+137·0°	88·9
0·7578	Ag_2O	+74·6	+112·0	—	—
1·2029	$AgNO_3$ & C_5H_5N	+109·3	+150·7	+138·0	89·6
1·1233	Ag_2O	+62·5	+98·3	+71·4	54·4
1·2906	$AgNO_3$ & C_5H_5N	+107·8	+132·9	+142·1	91·6
2·17	$AgNO_3$ & C_5H_5N	—	+141·5	+132·1	86·8

The Preparation of α-Methylglucoside from 3 : 4 : 6-Triacetyl β-Glucosyl Chloride.—(1) *In methyl alcohol in presence of silver oxide or carbonate.* It was found that 3 : 4 : 6-triacetyl β-glucosyl chloride reacts with methyl alcohol in presence of "active" silver oxide or silver carbonate to yield a mixture of triacetyl α- and β-methylglucosides. Pure 3 : 4 : 6-triacetyl β-glucosyl chloride (1 g.), added to 30 c.c. of dry methyl alcohol containing 0·8 g. of freshly precipitated dry silver carbonate in suspension, rapidly gave a precipitate of silver chloride in the cold. The reaction was completed by heating under reflux for 20 minutes. The product, after removal of suspended matter, was saturated with dry ammonia, and kept for 24 hours. Evaporation of the solution left a residue which solidified on trituration with dry ether, and after crystallisation from ethyl alcohol furnished pure α-methylglucoside, m. p. 165°.

The use of silver oxide instead of silver carbonate gave similar results. The crude methylglucoside resulting after condensation and deacylation usually had specific rotations of + 90° to + 100° (see later), and on crystallisation from ethyl alcohol yielded pure α-methylglucoside; the ethyl-alcoholic mother-liquors yielded further crops on concentration. When as much of the α-compound as possible had been removed, the remaining solution on nucleation gave a deposit of β-methylglucoside.

(2) *In methyl-alcoholic solution of silver nitrate and pyridine.* A higher yield of α-glucoside resulted when the glucosyl chloride was allowed to react with methyl alcohol in presence of the equivalent amount of the silver nitrate–pyridine reagent (see p. 1685). To 3 : 4 : 6-triacetyl β-glucosyl chloride (1·6184 g.) were added 17·2 c.c. of silver nitrate–pyridine reagent (calc., 17·0 c.c.) diluted with 35 c.c. of dry methyl alcohol. Precipitation of silver chloride commenced very shortly after mixing, and the reaction was completed by heating under reflux for 2 hours. After being diluted to 100 c.c. and filtered, the solution had $[\alpha]_D$ + 137·5°. It was evaporated under diminished pressure, dissolved in 50 c.c. of chloroform, washed twice with water to remove pyridine nitrate, and dried. Evaporation of the solvent left a colourless glass, $[\alpha]_D$ + 136·1° (c = 5·37) in ethyl alcohol. Deacetylation with alcoholic ammonia yielded a crystalline mixture of methylglucosides, $[\alpha]_D$ + 118·3° (c = 1·40) in water, from which pure α-methylglucoside, m. p. 164—165°, $[\alpha]_D$ + 157·5° in water (c = 1·0) was obtained by crystallisation from ethyl alcohol.

A control was carried out simultaneously: the β-glucosyl chloride was heated in methyl alcohol with silver oxide for 2 hours, and the solution filtered and deacetylated, the resulting mixture of α- and β-methylglucosides having $[\alpha]_D$ + 91·9° in water (c = 1·01).

Preparation of α-methylglucoside from 3 : 4 : 6-triacetyl β-glucosyl chloride.

Wt. of chloride, g.	Reagent employed.	$[\alpha]_D$ of resulting solution.	$[\alpha]_D$ of acylated glucosides in ethyl alcohol.	$[\alpha]_D$ of deacylated glucosides in water (c=*ca.* 1·0).	Methyl-glucoside, %.
1·6184	$AgNO_3$ & C_5H_5N	+137·5°	+136·1°	+118·9°	79·4
0·7473	Ag_2O	+87·2	+100·0	+91·9	71·0
0·2200	$AgNO_3$ & C_5H_5N	+143·1	—	—	—
0·5526	$AgNO_3$ & C_5H_5N	+122·0	—	—	—
0·2645	Ag_2O	+85·0	—	—	—

The Preparation of α-Phenylglucoside from 3 : 4 : 6-Triacetyl β-Glucosyl Chloride.—Dry silver oxide (1 g.) was added gradually to a solution of phenol (10 g.) in dry chloroform containing a suspension of 3 : 4 : 6-triacetyl β-glucosyl chloride (1 g.). The mixture was shaken mechanically for 15 hours. After collection of the insoluble silver salts, the chloroform solution was evaporated under diminished pressure, and the phenol removed by prolonged evaporation in aqueous vapour at 40°. The residue, deacetylated with alcoholic ammonia, furnished crystalline α-phenylglucoside hydrate, m. p. 148—150°, $[\alpha]_D$ + 143° (c = 1·52) in water, after crystallisation from moist ethyl acetate. Acetylation in pyridine solution gave 2 : 3 : 4 : 6-tetra-acetyl α-phenylglucoside, m. p. 112° alone or admixed with a specimen obtained previously from 3 : 4 : 6-triacetyl glucose anhydride (J., 1928, 3147).

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