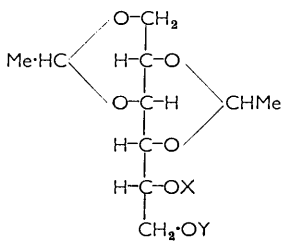
798. *Studies of Trifluoroacetic Acid. Part XVI.* The Use of* 1 : 3-2 : 4-*Di*-O-*ethylidene*-6-O-*trifluoroacetyl*-D-*glucitol in the Synthesis of Some* 5- *and* 6-*Substituted* D-*Glucitols.*

By E. J. Bourne, (Mrs.) C. E. M. Tatlow, J. C. Tatlow, and R. Worrall.

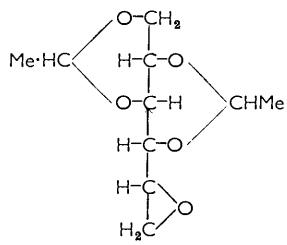
Trifluoroacetylation of 1 : 3-2 : 4-di-*O*-ethylidene-D-glucitol gave the 5 : 6-bistrifluoroacetate, from which, by controlled alcoholysis, the 6-trifluoroacetate was obtained. The latter with acetic anhydride–pyridine or with acetic acid–trifluoroacetic anhydride gave the 5-acetate 6-trifluoroacetate, which was converted into the 5-acetate by alcoholysis. Toluene-*p*-sulphonylation of this afforded the known 5-acetate 6-toluene-*p*-sulphonate. Methylation of the 5-acetate, or of the 5-acetate 6-trifluoroacetate, gave, by a process involving acetyl migration, the 6-*O*-acetyl-5-*O*-methyl derivative. This was converted by deacetylation into 1 : 3-2 : 4-di-*O*-ethylidene-5-*O*-methyl-D-glucitol, which was prepared also from the known 6-benzoate ester of this series by methylation and debenzoylation.

This paper describes another example of the use of the trifluoroacetyl residue as a blocking group in organic synthesis. Since our preparation of partially substituted glucoses from trifluoroacetate ester intermediates,[1] other investigations have been carried out on carbohydrates,[2] polypeptides,[3] and other compounds.[4,5] *O*-Trifluoroacetyl residues can be removed by alcoholysis, and *N*-trifluoroacetyl residues by hydrolysis with very mild alkali, so that whilst they can protect hydroxyl or amino-groups during many reactions at other centres in a molecule, they can subsequently be removed easily and selectively.

	X	Y		X	Y
(I)	H	H	(VII)	Me	Ac
(II)	CF_3·CO	CF_3·CO	(VIII)	Me	H
(III)	H	CF_3·CO	(IX)	H	Bz
(IV)	Ac	CF_3·CO	(X)	Me	Bz
(V)	Ac	H	(XI)	H	Me
(VI)	Ac	Ts	(XIII)	Ac	Me
			(XIV)	Bz	H



(I—XI)
(XIII, XIV)



(XII)

The present work, which was completed several years ago, started from 1 : 3-2 : 4-di-*O*-ethylidene-D-glucitol (I). This, with trifluoroacetic anhydride–sodium trifluoroacetate, gave the 5 : 6-bistrifluoroacetate (II). Controlled alcoholysis of this diester (II) with *iso*pentyl alcohol removed one trifluoroacetyl residue, to give a 1 : 3-2 : 4-di-*O*-ethylidene-*O*-trifluoroacetyl-D-glucitol (III). The monoester (III) was acetylated, with formation of the diester (IV), whence methyl alcohol removed the trifluoroacetyl group, giving an acetate (V), toluene-*p*-sulphonylation of which afforded the known 5-*O*-acetyl-1 : 3-2 : 4-di-*O*-ethylidene-6-*O*-tosyl-D-glucitol [6] (VI).

* Part XV, *J.*, 1958, 3268.

[1] Bourne, Tatlow, and Tatlow, *J.*, 1950, 1367; Bourne, Stacey, Tatlow, and Tatlow, *J.*, 1951, 826.
[2] Bourne, Huggard, and Tatlow, *J.*, 1953, 735; Butler, Lloyd, and Stacey, *J.*, 1955, 1531.
[3] Taurog, Abraham, and Chaikoff, *J. Amer. Chem. Soc.*, 1953, **75**, 3473; Weygand and Leising, *Chem. Ber.*, 1954, **87**, 248; Weygand and Reiher, *Chem. Ber.*, 1955, **88**, 26; Schallenberg and Calvin, *J. Amer. Chem. Soc.*, 1955, **77**, 2779.
[4] Lardon and Reichstein, *Helv. Chim. Acta*, 1954, **37**, 388.
[5] Reed, *J. Amer. Chem. Soc.*, 1956, **78**, 801.
[6] Wiggins, *J.*, 1946, 388.

Treatment of the acetate (V) with methyl iodide and silver oxide gave an *O*-acetyl *O*-methyl ether (VII), m. p. 92°, which was obtained similarly from the acetate trifluoroacetate (IV). It has been found before [1] that trifluoroacetyl groups are replaced by methyl in reactions involving the Purdie reagents. The ether acetate (VII) was deacetylated to a 1 : 3-2 : 4-di-*O*-ethylidene-*O*-methyl-D-glucitol (VIII), m. p. 88—89°. The structures of these two methyl ethers (VII and VIII) were established by independent syntheses of both the 5- and the 6-*O*-methyl derivative of 1 : 3-2 : 4-di-*O*-ethylidene-D-glucitol. The 5-*O*-methyl derivative was made from the known 6-*O*-benzoyl-1 : 3-2 : 4-di-*O*-ethylidene-D-glucitol [7,8] (IX) by methylation with methyl iodide–silver oxide, followed by debenzoylation. Benzoyl migration is very unlikely during this methylation since it is known [8] that in this series benzoyl groups migrate from $C_{(5)}$ to $C_{(6)}$. The 6-benzoate (IX) was unchanged after treatment with silver oxide in refluxing acetone. The 5-methyl ether produced in this way had m. p. 87—88°, undepressed in admixture with compound (VIII), and afforded a 6-acetate, m. p. 93°, undepressed in admixture with compound (VII). 1 : 3-2 : 4-Di-*O*-ethylidene-6-*O*-methyl-D-glucitol (XI) was prepared by the method of Vargha and Puskas,[9] by reaction of the corresponding 5 : 6-anhydro-derivative (XII) with sodium methoxide. The product, which is that expected from the general mode of scission of anhydro-rings,[10] had m. p. 70°, depressed on admixture with either compound (VIII) or the sample of the 5-*O*-methyl ether prepared from the 6-benzoate (IX). Acetylation of the 6-*O*-methyl derivative (XI) gave its 5-acetate (XIII), m. p. 95—96°, depressed on admixture with either sample of compound (VII) described above. Thus, the ether (VIII) must have been 1 : 3-2 : 4-di-*O*-ethylidene-5-*O*-methyl-D-glucitol, and compound (VII) the corresponding 6-*O*-acetyl ester.

The acetylation of the monotrifluoroacetate (III) was next studied, with acetic acid–trifluoroacetic anhydride.[11] There was obtained an acetate trifluoroacetate whose crystalline form differed from that of compound (IV) and whose melting point was somewhat lower than that of (IV) (though with no depression on admixture). However, this new sample and compound (IV) gave the same acetate (V), acetate toluene-*p*-sulphonate (VI), acetate methyl ether (VII), and methyl ether (VIII). Further, the specimens of this acetate trifluoroacetate (IV) had identical infrared spectra (in Nujol; 1900—600 cm.$^{-1}$). Thus, the two different methods of acetylation gave the same product, contrary to the results obtained [1] with methyl 4 : 6-*O*-benzylidene-α-D-glucoside. Benzene was used as a solvent in the acetylation with acetic acid–trifluoroacetic anhydride, and from later results [11b] on this acylation process the presence of a non-polar solvent may have given rise to some bistrifluoroacetate as well as acetate trifluoroacetate. The slight difference in properties of the second sample of the latter may have been due to contamination by a trace of the bistrifluoroacetate, but, from the analytical results, the amount present, if any, must have been very small.

The above observations on the acetate (V) were at first sight contradictory, since it had given rise to a 5-*O*-acetyl-6-*O*-tosyl derivative (VI), and to a 6-*O*-acetyl-5-*O*-methyl ether (VII). However, examples of acyl migrations during methylations with the Purdie reagents are quite common.[12,13] whereas, in general, toluene-*p*-sulphonylation in pyridine appears not to cause such wanderings of groups. After treatment with pyridine, the acetate (V) was recovered in good yield, whereas silver oxide in refluxing acetone gave a syrup. Though no definite new compound could be isolated from this, no starting material was recovered and no crystalline toluenesulphonate was obtained. Further, in general,[13]

[7] Sullivan, *J. Amer. Chem. Soc.*, 1945, **67**, 837.
[8] Heyns and Stein, *Annalen*, 1947, **558**, 194.
[9] Vargha and Puskas, *Ber.*, 1943, **76**, 859.
[10] Wiggins and Wood, *J.*, 1950, 1566; Wiggins, *Adv. Carbohydrate Chem.*, 1950, **5**, 191.
[11] (*a*) Bourne, Stacey, Tatlow, and Tedder, *J.*, 1949, 2976; Bourne, Stacey, Tatlow, and Worrall, *J.*, 1954, 2006; (*b*) *Idem*, *J.*, 1958, 3268.
[12] Haworth, Hirst, and Teece, *J.*, 1931, 2858.
[13] Sugihara, *Adv. Carbohydrate Chem.*, 1953, **8**, 1.

acetyl migration occurs towards a primary hydroxyl group; again, 5-*O*-benzoyl-1 : 3-2 : 4-di-*O*-ethylidene-D-glucitol [8] (XIV) afforded the 6-ester (IX) when treated with alkali but migration in the reverse direction was not observed. Thus, all the evidence indicates that the monoacetate (V) is 5-*O*-acetyl-1 : 3-2 : 4-di-*O*-ethylidene-D-glucitol, and that acetyl migration to $C_{(6)}$ occurred during the methylation with methyl iodide–silver oxide. Attempts to convert the 5-acetate (V) into the 6-acetate by mild alkali gave syrups from which neither starting material nor the 6-*O*-acetate could be isolated. The allocation of the 5-acetate structure to compound (V) means that its precursors (III) and (IV) are probably both 6-*O*-trifluoroacetyl esters. This would be expected, since the foregoing discussion suggests that in the bistrifluoroacetate (II), the 6-*O*-trifluoroacetyl group is the more stable and the trifluoroacetyl carried on the secondary 5-alcoholic group should be removed preferentially during alcoholysis.

Experimental

Unless otherwise stated, anhydrous conditions were used.

1 : 3-2 : 4-*Di*-O-*ethylidene*-D-*glucitol*.—Syrupy tri-*O*-ethylidene-D-glucitol [14] was hydrolysed by Appel's procedure [15] to 1 : 3-2 : 4-di-*O*-ethylidene-D-glucitol (15%), m. p. 210—212°, $[\alpha]_D^{17}$ −11·6° (*c* 4·33 in H_2O). Cited values [14] were m. p. 212—213°, $[\alpha]_D^{15}$ −10·9° (*c* 5·5 in H_2O).

1 : 3-2 : 4-*Di*-O-*ethylidene*-5 : 6-*bis*-O-*trifluoroacetyl*-D-*glucitol*.—1 : 3-2 : 4-Di-*O*-ethylidene-D-glucitol (4·00 g.) was treated with trifluoroacetic anhydride (18·2 g.) and sodium trifluoroacetate (1·00 g.) at 60° for 20 min.; complete solution was achieved. The mixture was then distilled under slightly diminished pressure with several portions of carbon tetrachloride and the residue was extracted with boiling carbon tetrachloride (3 × 25 c.c.). The combined extracts were filtered and evaporated. Recrystallisation of the residue from light petroleum (b. p. 60—80°) afforded 1 : 3-2 : 4-*di*-O-*ethylidene*-5 : 6-*bis*-O-*trifluoroacetyl*-D-*glucitol* (6·31 g.), m. p. 104—105°, $[\alpha]_D^{18}$ +6·7° (*c* 2·39 in $CHCl_3$) (Found: C, 39·5; H, 3·9; F, 26·3; CF_3·CO, 45·4. $C_{14}H_{16}O_8F_6$ requires C, 39·4; H, 3·8; F, 26·7; CF_3·CO, 45·5%).

Partial Alcoholysis of 1 : 3-2 : 4-*Di*-O-*ethylidene*-5 : 6-*bis*-O-*trifluoroacetyl*-D-*glucitol*.—(*a*) A solution of the bistrifluoroacetate (5·00 g.) in *iso*pentyl alcohol (250 c.c.; dried over $MgSO_4$) was kept at 25° for 42 hr. Light petroleum (b. p. 100—120°) (200 c.c.) was then added and the solution was evaporated under reduced pressure. The last traces of alcohol were removed by co-distillation with light petroleum (b. p. 100—120°), leaving a solid residue which was dissolved in acetone (20 c.c.). The precipitate (0·20 g.) (mainly diethylideneglucitol) formed on addition of light petroleum (b. p. 40—60°) (200 c.c.) to the acetone solution was removed and the clear filtrate was evaporated. The residue was recrystallised twice from light petroleum (b. p. 60—80°), giving 1 : 3-2 : 4-*di*-O-*ethylidene*-6-O-*trifluoroacetyl*-D-*glucitol* (2·01 g.), m. p. 110—112°, depressed on admixture with the diester, $[\alpha]_D^{18}$ +6·4° (*c* 2·49 in $CHCl_3$) (Found: C, 43·5; H, 5·1; F, 17·4; CF_3·CO, 29·3. $C_{12}H_{17}O_7F_3$ requires C, 43·6; H, 5·2; F, 17·3; CF_3·CO, 29·4%). With *n*-pentyl alcohol, lower yields (*ca.* 30%) of the same monoester were obtained.

(*b*) 1 : 3-2 : 4-Di-*O*-ethylidene-D-glucitol (5·00 g.) was warmed with trifluoroacetic anhydride (15·2 g.) and sodium trifluoroacetate (0·85 g.) at 60° for 20 min. and the crude bistrifluoroacetate was isolated as described previously. Without being recrystallised, this was dissolved in *iso*-pentyl alcohol (400 c.c.) and after 40 hr. at 25° the solution was worked up as above, to give 1 : 3-2 : 4-di-*O*-ethylidene-6-*O*-trifluoroacetyl-D-glucitol (3·43 g.), m. p. and mixed m. p. 110—112°, $[\alpha]_D^{18}$ +6·5° (*c* 2·48 in $CHCl_3$).

Acetylation of 1 : 3-2 : 4-*Di*-O-*ethylidene*-6-O-*trifluoroacetyl*-D-*glucitol*.—Acetic anhydride (1·08 g.) was added to a solution of the 6-trifluoroacetate (1·71 g.) in pyridine (3 c.c.). After 44 hr. at 25°, the mixture was distilled under diminished pressure with several portions of carbon tetrachloride. The residue, recrystallised twice from light petroleum (b. p. 60—80°), gave 5-O-*acetyl*-1 : 3-2 : 4-*di*-O-*ethylidene*-6-O-*trifluoroacetyl*-D-*glucitol* (1·35 g.), needles, m. p. 94—98°, $[\alpha]_D^{21}$ +5·7° (*c* 2·46 in $CHCl_3$) (Found: C, 44·9; H, 4·9; F, 15·5%; N-alkali uptake, 5·39 c.c./g. $C_{14}H_{19}O_8F_3$ requires C, 45·2; H, 5·1; F, 15·3%; N-alkali uptake, 5·37 c.c./g.).

5-O-*Acetyl*-1 : 3-2 : 4-*di*-O-*ethylidene*-D-*glucitol*.—The foregoing diester (0·504 g.) in methyl alcohol (10 c.c.) was kept at 20° for 30 min. before the alcohol was removed under reduced

[14] Bourne and Wiggins, *J.*, 1948, 1933.
[15] Appel, *J.*, 1935, 425.

pressure. Recrystallised from light petroleum (b. p. 80—100°), the product, 5-O-*acetyl*-1 : 3-2 : 4-*di*-O-*ethylidene*-D-*glucitol* (0·187 g.), had m. p. 134—135°, $[\alpha]_D^{20}$ +1·1° (*c* 3·05 in $CHCl_3$) (Found: C, 52·5; H, 7·2; Ac, 15·7. $C_{12}H_{20}O_7$ requires C, 52·2; H, 7·3; Ac, 15·6%).

Difficulty was experienced at first in obtaining consistent yields of the monoester from this alcoholysis. One sample of methyl alcohol gave syrups, from another the starting material was recovered. Methyl alcohol, which had been dried with magnesium and iodine [16] and purified by distillation through a 1 foot column packed with glass helices, gave reproducible yields of 5-*O*-acetyl-1 : 3-2 : 4-di-*O*-ethylidene-D-glucitol.

5-O-*Acetyl*-1 : 3-2 : 4-*di*-O-*ethylidene*-6-O-*tosyl*-D-*glucitol*.—Toluene-*p*-sulphonyl chloride (0·071 g.) was added to 5-*O*-acetyl-1 : 3-2 : 4-di-*O*-ethylidene-D-glucitol (0·082 g.) in pyridine (0·2 c.c.), and the solution kept at 25° for 20 hr. before being poured into water–chloroform. The chloroform layer was separated and the aqueous layer was extracted once more with chloroform. The combined extracts were dried ($MgSO_4$), filtered, and evaporated. The residue, recrystallised from light petroleum (b. p. 80—100°), gave 5-*O*-acetyl-1 : 3-2 : 4-di-*O*-ethylidene-6-*O*-tosyl-D-glucitol (0·088 g.), m. p. 138° (alone and on admixture with an authentic specimen prepared by Wiggins's method [6]), $[\alpha]_D^{18}$ +5·0° (*c* 2·12 in $CHCl_3$). Wiggins [6] gave m. p. 140°, $[\alpha]_D^{17}$ +6·0° (*c* 1·664 in $CHCl_3$).

Treatment of 5-O-*Acetyl*-1 : 3-2 : 4-*di*-O-*ethylidene*-D-*glucitol with Pyridine*.—The specific rotation of a solution of 5-*O*-acetyl-1 : 3-2 : 4-di-*O*-ethylidene-D-glucitol (0·028 g.) in pyridine (1·00 c.c.) remained constant for 18 hr. at room temperature. The pyridine was removed by distillation under reduced pressure with several portions of light petroleum (b. p. 80—100°), and the residue, recrystallised from light petroleum (b. p. 80—100°), afforded the original 5-*O*-acetyl-1 : 3-2 : 4-di-*O*-ethylidene-D-glucitol (0·020 g.), m. p. and mixed m. p. 133—134°, $[\alpha]_D^{14}$ +0·9° (*c* 1·07 in $CHCl_3$).

6-O-*Acetyl*-1 : 3-2 : 4-*di*-O-*ethylidene*-5-O-*methyl*-D-*glucitol*.—(*a*) Silver oxide (1·50 g.) was added to a solution of 5-*O*-acetyl-1 : 3-2 : 4-di-*O*-ethylidene-D-glucitol (0·565 g.) in methyl iodide (10 c.c.), and the mixture was refluxed for 15 hr. The methyl iodide was removed by distillation, and the residue extracted exhaustively with boiling chloroform. Distillation of the filtered extracts left a solid, which, when recrystallised from light petroleum (b. p. 60—80°), afforded 6-O-*acetyl*-1 : 3-2 : 4-*di*-O-*ethylidene*-5-O-*methyl*-D-*glucitol* (0·397 g.), m. p. 92° [not depressed on admixture with a specimen (m. p. 93°) synthesised by another route (see below) but depressed on admixture with 5-*O*-acetyl-1 : 3-2 : 4-di-*O*-ethylidene-6-*O*-methyl-D-glucitol (m. p. 95—96°)], $[\alpha]_D^{17}$ −0·3° (*c* 3·98 in $CHCl_3$) (Found: C, 54·1; H, 8·0; Ac, 15·3; OMe, 10·7. $C_{13}H_{22}O_7$ requires C, 53·8; H, 7·6; Ac, 14·8; OMe, 10·7%).

(*b*) A solution of 5-*O*-acetyl-1 : 3-2 : 4-di-*O*-ethylidene-6-*O*-trifluoroacetyl-D-glucitol (1·95 g.) in methyl iodide (10 c.c.) was refluxed for 18 hr. with silver oxide (4·00 g.). The product was isolated as above, and recrystallised from light petroleum (b. p. 60—80°), giving 6-*O*-acetyl-1 : 3-2 : 4-di-*O*-ethylidene-5-*O*-methyl-D-glucitol (0·781 g.), m. p. 91—92° (alone and in admixture with the specimen prepared as above), $[\alpha]_D^{21}$ ±0·0° (*c* 10·78 in $CHCl_3$).

1 : 3-2 : 4-*Di*-O-*ethylidene*-5-O-*methyl*-D-*glucitol from* 6-O-*Acetyl*-1 : 3-2 : 4-*di*-O-*ethylidene*-5-O-*methyl*-D-*glucitol*.—A small piece of sodium was added to 6-*O*-acetyl-1 : 3-2 : 4-di-*O*-ethylidene-5-*O*-methyl-D-glucitol (0·507 g.) in magnesium-dried methanol (10 c.c.) and the solution was kept at room temperature for 16 hr. Solid carbon dioxide was then added, the solution evaporated to dryness and the residue was extracted exhaustively with boiling chloroform. Distillation of the filtered extracts and recrystallisation from light petroleum (b. p. 60—80°) gave 1 : 3-2 : 4-*di*-O-*ethylidene*-5-O-*methyl*-D-*glucitol* (0·253 g.), m. p. 88—89° [not depressed on admixture with an authentic specimen (m. p. 87—88°) (see below), but depressed on admixture with 1 : 3-2 : 4-di-*O*-ethylidene-6-*O*-methyl-D-glucitol (m. p. 70°)], $[\alpha]_D^{19}$ −5·0° (*c* 2·39 in $CHCl_3$) (Found: C, 53·1; H, 8·2; OMe, 12·2. $C_{11}H_{20}O_6$ requires C, 53·2; H, 8·1; OMe, 12·5%).

The same product (yield 27%) was isolated from the mother-liquors of the acetyl determination on the 5-methyl ether 6-acetate.

Treatment of 5-O-*Acetyl*-1 : 3-2 : 4-*di*-O-*ethylidene*-D-*glucitol in Acetone with Silver Oxide*.—Silver oxide (1·0 g.) was heated with 5-*O*-acetyl-1 : 3-2 : 4-di-*O*-ethylidene-D-glucitol (0·080 g.) in acetone (10 c.c.) for 18 hr. The acetone was distilled off and the residue extracted exhaustively with boiling chloroform. Distillation of the filtered extracts left a syrup (0·060 g.).

Acetylation of 1 : 3-2 : 4-*Di*-O-*ethylidene*-6-O-*trifluoroacetyl*-D-*glucitol*.—(a) *Isolation of the*

[16] Vogel, " A Text Book of Organic Chemistry," Longmans, Green and Co., London, 1948, p. 168.

product. A mixture of acetic acid (0·20 g.) and trifluoroacetic anhydride (0·75 g.) was added to 1 : 3-2 : 4-di-*O*-ethylidene-6-*O*-trifluoroacetyl-D-glucitol (0·967 g.) in benzene (12 c.c.). After 20 min. at 60°, carbon tetrachloride (20 c.c.) was added and the solution was evaporated under reduced pressure. The residue was re-acetylated as before for 15 min., and the mixture was distilled under reduced pressure with carbon tetrachloride (4 × 25 c.c.). The solute, recrystallised twice from light petroleum (b. p. 40—60°), afforded 5-*O*-acetyl-1 : 3-2 : 4-di-*O*-ethylidene-6-*O*-trifluoroacetyl-D-glucitol (0·696 g.), plates, m. p. 88—89°, $[\alpha]_D^{18}$ +7·7° (*c* 2·63 in $CHCl_3$) (Found: C, 45·0; H, 5·1; F, 15·3%; N-alkali uptake, 5·36 c.c./g.).

(b) *Properties.* This sample (plates, m. p. 88—89°) did not depress the m. p. of the material (needles, m. p. 94—98°) obtained by acetylation of 1 : 3-2 : 4-di-*O*-ethylidene-6-*O*-trifluoroacetyl-D-glucitol with acetic anhydride and pyridine. The infrared spectra of the two samples in Nujol were identical over the frequency range 1900—600 $cm.^{-1}$. The difference in m. p. may be attributed to their different crystalline forms, or to a trace of impurity, *e.g.*, the bistrifluoroacetate. Methylation afforded the 6-*O*-acetate 5-*O*-methyl ether (51%), m. p. and mixed m. p. 92—93°, deacetylated by sodium methoxide in methanol to the 5-*O*-methyl ether (59%), m. p. and mixed m. p. 88—89°.

Methanolysis of this sample of the acetate trifluoroacetate gave the 5-acetate (51%), m. p. and mixed m. p. 134—135°, which by tosylation was converted into the 5-*O*-acetate 6-*O*-toluene-*p*-sulphonate (64%), m. p. and mixed m. p. 138°. These four derivatives had correct specific rotations.

1 : 3-2 : 4-*Di*-O-*ethylidene*-6-O-*methyl*-D-*glucitol*.—Prepared [9] by the action of excess of methanolic sodium methoxide on 5 : 6-anhydro-1 : 3-2 : 4-di-*O*-ethylidene-D-glucitol, 1 : 3-2 : 4-di-*O*-ethylidine-6-*O*-methyl-D-glucitol had m. p. 70°, $[\alpha]_D^{19}$ +4·6° (*c* 2·17 in $CHCl_3$). Cited values [9] were m. p. 70°, $[\alpha]_D^{20}$ +4·5° (*c* 2·65 in $CHCl_3$). The m. p. of this compound was depressed on admixture with all samples of 1 : 3-2 : 4-di-*O*-ethylidene-5-*O*-methyl-D-glucitol (m. p. 88—89°).

5-O-*Acetyl*-1 : 3-2 : 4-*di*-O-*ethylidene*-6-O-*methyl*-D-*glucitol*.—Acetic anhydride (1·08 g.) was added to 1 : 3-2 : 4-di-*O*-ethylidene-6-*O*-methyl-D-glucitol (0·319 g.) in pyridine (1·0 c.c.) and the solution was kept at 25° for 18 hr. before being poured into water and extracted with chloroform. The extracts were washed with dilute hydrochloric acid, aqueous sodium hydrogen carbonate, and with water, and after being dried ($MgSO_4$) were evaporated. The residue, recrystallised from light petroleum (b. p. 60—80°), afforded 5-O-*acetyl*-1 : 3-2 : 4-*di*-O-*ethylidene*-6-O-*methyl*-D-*glucitol* (0·286 g.), m. p. 95—96°, $[\alpha]_D^{18}$ +0·9° (*c* 2·15 in $CHCl_3$) (Found: C, 54·0; H, 7·3. $C_{13}H_{22}O_7$ requires C, 53·8; H, 7·6%). This compound depressed the m. p. of all samples of 6-*O*-acetyl-1 : 3-2 : 4-di-*O*-ethylidene-5-*O*-methyl-D-glucitol (m. p. 92°).

6-O-*Benzoyl*-1 : 3-2 : 4-*di*-O-*ethylidene*-5-O-*methyl*-D-*glucitol*.—Silver oxide (8·0 g.) was refluxed with 6-*O*-benzoyl-1 : 3-2 : 4-di-*O*-ethylidene-D-glucitol [7] (2·92 g.) in methyl iodide (30 c.c.) for 18 hr. The methyl iodide was removed and the residue was exhaustively extracted with boiling chloroform. The filtered extracts were evaporated and the residual syrup was re-methylated with silver oxide (3·0 g.) and methyl iodide (15 c.c.), and then the product isolated as before. Recrystallisation of the residue from light petroleum (b. p. 60—80°) afforded 6-O-*benzoyl*-1 : 3-2 : 4-*di*-O-*ethylidene*-5-O-*methyl*-D-*glucitol* (1·84 g.), m. p. 95—96°, $[\alpha]_D^{23}$ −0·2° (*c* 8·56 in $CHCl_3$) (Found: C, 61·7; H, 7·0; OMe, 8·8. $C_{18}H_{24}O_7$ requires C, 61·4; H, 6·9; OMe, 8·8%).

A solution of 6-*O*-benzoyl-1 : 3-2 : 4-di-*O*-ethylidene-D-glucitol (0·215 g.) in acetone (20 c.c.) was refluxed with silver oxide (1·0 g.) for 18 hr. before the solute was isolated as above. Recrystallisation from light petroleum (b. p. 80—100°) afforded the original 6-*O*-benzoyl-1 : 3-2 : 4-di-*O*-ethylidene-D-glucitol (0·155 g.), m. p. and mixed m. p. 164—166°, $[\alpha]_D^{19}$ +3·9° (*c* 1·54 in $CHCl_3$).

1 : 3-2 : 4-*Di*-O-*ethylidene*-5-O-*methyl*-D-*glucitol and its* 6-*Acetate from* 6-O-*Benzoyl*-1 : 3-2 : 4-*di*-O-*ethylidene*-5-O-*methyl*-D-*glucitol*.—6-*O*-Benzoyl-1 : 3-2 : 4-di-*O*-ethylidene-5-*O*-methyl-D-glucitol (1·18 g.) was heated under reflux for 1 hr. with 0·4N-methanolic sodium hydroxide (25 c.c.). Solid carbon dioxide was then added and the solution was concentrated to *ca.* 3 c.c. and poured into water. The aqueous phase was extracted with chloroform and the combined extracts were washed with water, dried ($MgSO_4$), and evaporated. Recrystallised from light petroleum (b. p. 60—80°), the residue, 1 : 3-2 : 4-di-*O*-ethylidene-5-*O*-methyl-D-glucitol (0·600 g.), had m. p. 87—88°, $[\alpha]_D^{20}$ −4·8° (*c* 1·66 in $CHCl_3$). The m. p. of this compound was not depressed on admixture with the 1 : 3-2 : 4-di-*O*-ethylidene-5-*O*-methyl-D-glucitol (m. p.

88—89°) obtained from 5-*O*-acetyl-1 : 3-2 : 4-di-*O*-ethylidene-D-glucitol, but it was depressed on admixture with 1 : 3-2 : 4-di-*O*-ethylidene-6-*O*-methyl-D-glucitol (m. p. 70°).

Acetic anhydride (0·50 g.) was added to a solution of 1 : 3-2 : 4-di-*O*-ethylidene-5-*O*-methyl-D-glucitol (0·198 g.) in pyridine (0·5 c.c.) and the solution was kept at 25° for 18 hr., before being poured into water and extracted with chloroform. After isolation as usual the residue, recrystallised from light petroleum (b. p. 60—80°), afforded 6-*O*-acetyl-1 : 3-2 : 4-di-*O*-ethylidene-5-*O*-methyl-D-glucitol (0·164 g.), m. p. 93°, $[\alpha]_D^{19}$ +0·0° (*c* 2·05 in $CHCl_3$). This compound did not depress the m. p. of the samples described earlier (m. p. 92°), but with 5-*O*-acetyl-1 : 3-2 : 4-di-*O*-ethylidene-6-*O*-methyl-D-glucitol (m. p. 95—96°) considerable depressions of m. p. were given.

The authors thank Professor M. Stacey, F.R.S., for his interest in this work.

CHEMISTRY DEPARTMENT, THE UNIVERSITY,
EDGBASTON, BIRMINGHAM, 15.

[*Received, May 2nd,* 1958.]