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The preparation and phosphorylation of 2,5- and 1D-2,6-di-*O*-benzyl-*myo*-inositol*,†

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ABSTRACT

1,3,4,6-Tetra-*O*-allyl-*myo*-inositol was converted into the 2,5-di-*O*-benzyl- and 2,5-di-*O*-*p*-methoxybenzyl ethers, and the products were deallylated to give the 2,5-di-*O*-benzyl (and *p*-methoxybenzyl) ethers of *myo*-inositol, which were converted into the mono-*O*-isopropylidene derivatives. Both the 2,5-di-*O*-benzyl ether and its mono-*O*-isopropylidene derivative were converted into the crystalline octa(2-cyanoethyl) ester of 2,5-di-*O*-benzyl-*myo*-inositol 1,3,4,6-tetrakisphosphate. (±)-1,3,4,5-Tetra-*O*-allyl-*myo*-inositol was converted into (±)-2,4-di-*O*-benzyl-*myo*-inositol which gave a separable mixture of the 1,6- and 5,6-*O*-isopropylidene derivatives. The 1,6-*O*-isopropylidene derivative was resolved *via* (−)- and (+)-ω-camphanates and was also converted into (±)-2,6-di-*O*-benzyl-1,5-di-*O*-*p*-methoxybenzyl-*myo*-inositol, which was resolved *via* the (−)-ω-camphanates. The 5,6-*O*-isopropylidene derivative and 1,3-di-*O*-allyl-*myo*-inositol were converted into (±)-1,3-di-*O*-allyl-2,6-di-*O*-benzyl-*myo*-inositol, which was resolved as the (−)-ω-camphanates. 1D-1,3,4,5-Tetra-*O*-allyl-*myo*-inositol and the above described, relevant diaste reoisomers were converted into 1D-2,6-di-*O*-benzyl-*myo*-inositol which gave the syrupy octabenzyl ester of 1D-2,6-di-*O*-benzyl-*myo*-inositol 1,3,4,5-tetrakisphosphate.

INTRODUCTION

The intense biological interest in the *myo*-inositol phosphates and phosphatidylinositol phosphates of the phosphatidylinositol cycle (for reviews, see refs. 1 and 4) has stimulated efforts for the synthesis of these compounds, especially the chiral derivatives, by improved methods. We describe herein the conversion of the 1,3,4,5- and 1,3,4,6-tetra-*O*-allyl-*myo*-inositol, readily available[1] by dibutyltin-mediated allylation of *myo*-inositol, into the title compounds and the phosphorylation of these using phosphitylating reagents to give intermediates for the synthesis of *myo*-inositol tetrakisphosphates of the phosphatidylinositol cycle. Several of the chiral intermediates described will also be suitable for the synthesis of other components of the phosphatidylinositol cycle (for a preliminary communication, see ref. 5).

* Dedicated to Professor Serge David on the occasion of his 70th birthday.
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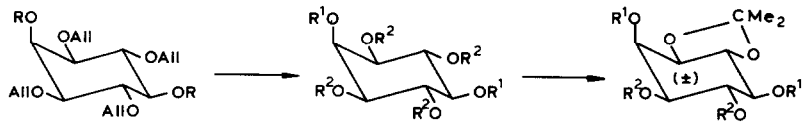
RESULTS AND DISCUSSION

1,3,4,6-Tetra-*O*-allyl-*myo*-inositol[1] (**1**) was converted into the di-*O*-benzyl and di-*O*-*p*-methoxybenzyl ethers **3** and **4**. Deallylation of **3** and **4** with palladium-on-charcoal[6] in aqueous ethanol gave the corresponding tetraols **5** and **9** in high yield, and these highly crystalline compounds separated from the medium during the reaction. The low solubility of **5** in organic solvents suggested that this might cause problems in the subsequent phosphorylation reaction and, therefore, the mono-*O*-isopropylidene derivative **11** was prepared. Similarly, **9** gave the mono-*O*-isopropylidene derivative **15**, the latter being required as an intermediate for a later synthesis of *myo*-inositol 2,4,5-trisphosphate[5]. The two di-*O*-isopropylidene derivatives **19** and **20** were characterised as byproducts in the synthesis of **11** and **15**.

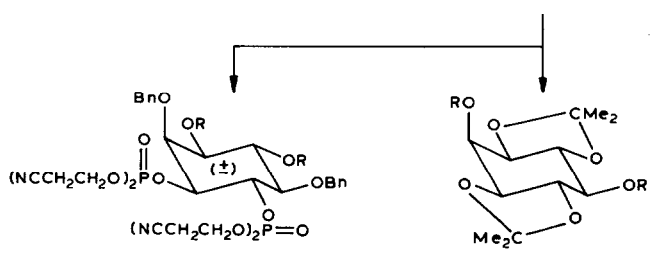
Phosphorylation of **11** using the reagent, bis(2-cyanoethoxy)-*N,N*-diisopropylaminophosphine[7] (**23**), gave **14**, the isopropylidene group of which was removed to give **17**, and further phosphorylation of this using the reagent **23** gave the crystalline



1 R = H*
2 R = Ac
3 R = Bn
4 R = *p*MB

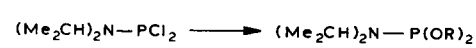
5 R^1 = Bn; R^2 = H
6 R^1 = Bn; R^2 = Ac
7 R^1 = Bn; R^2 = $P(OCH_2CH_2CN)_2$
8 R^1 = Bn; R^2 = $PO(OCH_2CH_2CN)_2$
9 R^1 = *p*MB; R^2 = H
10 R^1 = *p*MB; R^2 = Ac

11 R^1 = Bn; R^2 = H
12 R^1 = Bn; R^2 = Ac
13 R^1 = Bn; R^2 = $P(OCH_2CH_2CN)_2$
14 R^1 = Bn; R^2 = $PO(OCH_2CH_2CN)_2$
15 R^1 = *p*MB; R^2 = H
16 R^1 = *p*MB; R^2 = Ac



17 R = H
18 R = $P(OCH_2CH_2CN)_2$

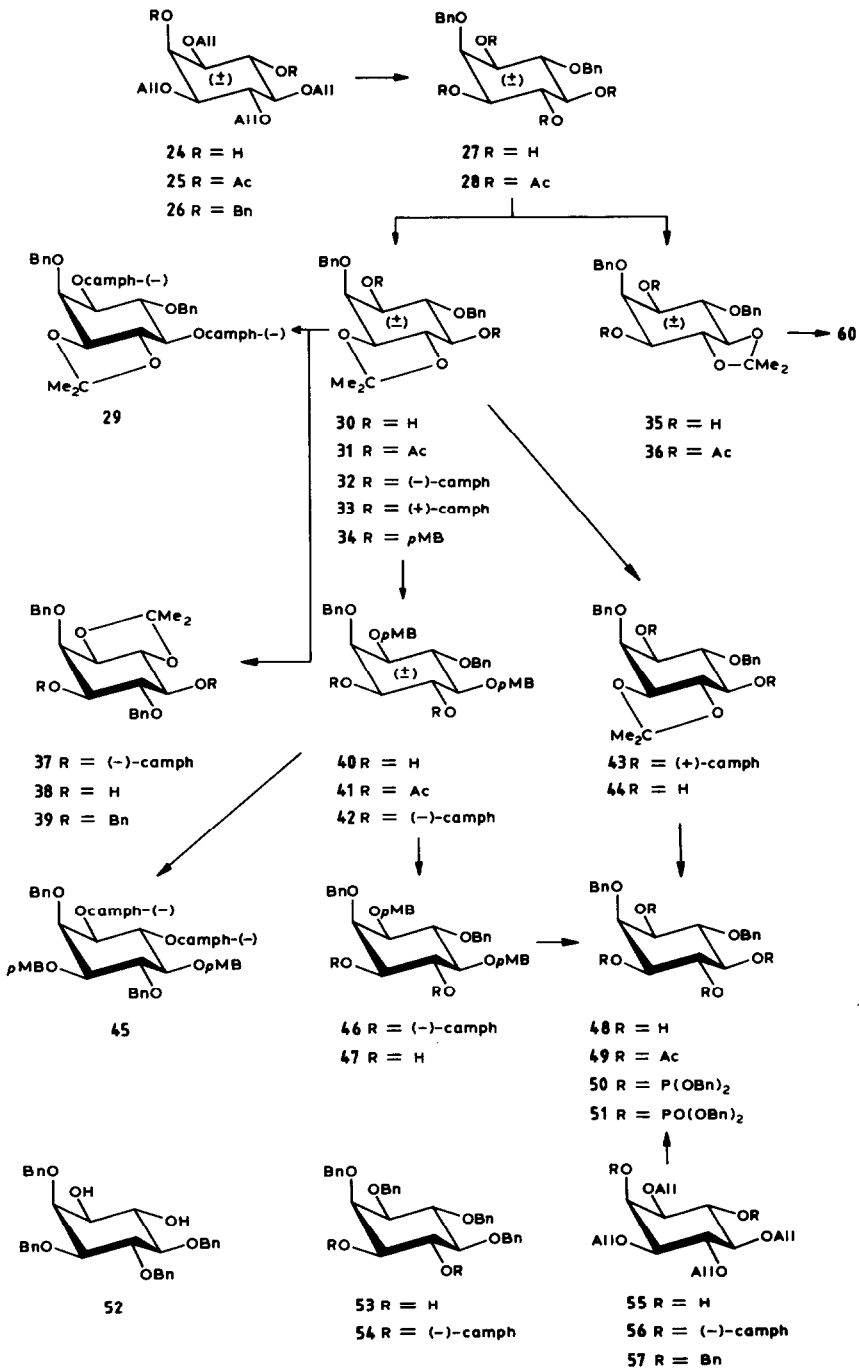
19 R = Bn
20 R = *p*MB



21

22 R = Bn
23 R = CH_2CH_2CN

* In the formulae, racemic inositol derivatives are indicated with (±) in the ring; chiral inositol derivatives, represented in their correct absolute configurations, are shown with thickened lines in the ring, and *meso*-compounds are shown with neither of these modifications.


24 R = H
25 R = Ac
26 R = Bn
27 R = H
28 R = Ac
29
30 R = H
31 R = Ac
32 R = (−)-camph
33 R = (+)-camph
34 R = pMB
35 R = H
36 R = Ac
37 R = (−)-camph
38 R = H
39 R = Bn
40 R = H
41 R = Ac
42 R = (−)-camph
43 R = (+)-camph
44 R = H
45
46 R = (−)-camph
47 R = H
48 R = H
49 R = Ac
50 R = P(OBn)2
51 R = PO(OBn)2
52
53 R = H
54 R = (−)-camph
55 R = H
56 R = (−)-camph
57 R = Bn

protected tetrakisphosphate **8**. The tetraol **5** was also successfully phosphorylated with **23** to give **8** directly. The inositol 1,3,4,6-tetrakisphosphate derived from **8** by deprotection has been shown to mobilise calcium ions in both *Xenopus* oocytes[8] and in permeabilised SH-SY5Y human neuroblastoma cells[9].

Benzylation of (±)-1,3,4,5-tetra-*O*-allyl-*myo*-inositol[1] (**24**) gave **26** and this gave racemic 2,4-di-*O*-benzyl-*myo*-inositol (**27**) on deallylation with palladium-on-charcoal. The yields in this reaction have been variable (50–70%) owing to debenzylation since, unlike **5** and **9**, the di-*O*-benzyl ether **27** does not crystallise from the reaction medium. The best yields have been obtained by slow distillation of the reaction medium to remove the propionaldehyde formed from the allyl ethers in this reaction. Attempted conversion of the allyl groups of **26** into prop-1-enyl groups using potassium *tert*-butoxide in methyl sulphoxide led to some decomposition reminiscent of the reaction[10] of 1,2-di-*O*-allyl-3-*O*-benzylglycerol under these conditions. The mechanism of this decomposition has not been established.

Reaction of **27** with 2,2-dimethoxypropane and an acid catalyst gave a mixture of the *O*-isopropylidene derivatives **30** and **35**, which were readily separated by chromatography. They were characterised by benzylation and subsequent deacetonation when **30** gave racemic 1,2,5,6-tetra-*O*-benzyl-*myo*-inositol[11], and **35** gave racemic 1,2,3,4-tetra-*O*-benzyl-*myo*-inositol[12].

Racemic 2,4-di-*O*-benzyl-1,6-*O*-isopropylidene-*myo*-inositol (**30**) was converted into the bis-(−)-ω-camphanates **32**, and the diastereoisomers showed separation on t.l.c. Crystallisation of **32** from ether gave the pure, slow-moving on t.l.c. isomer. The absolute configuration of this was established to be **37** by saponification to **38**, and subsequent benzylation to give **39**. Deisopropylidenation of **39** gave 1D-2,3,4,5-tetra-*O*-benzyl-*myo*-inositol (**52**) as established by comparison with the enantiomer[13] **53**. Thus, this easy resolution gave the wrong diastereoisomer for the preparation of the required compound **48**. A portion of the required, fast-moving on t.l.c. diastereoisomer **29** was obtained by chromatography of the contents of the mother liquors, after removal of **37** by crystallisation in order to compare the chemical shifts of the CMe groups of the camphanate portion in the ^{1}H-n.m.r. spectrum.

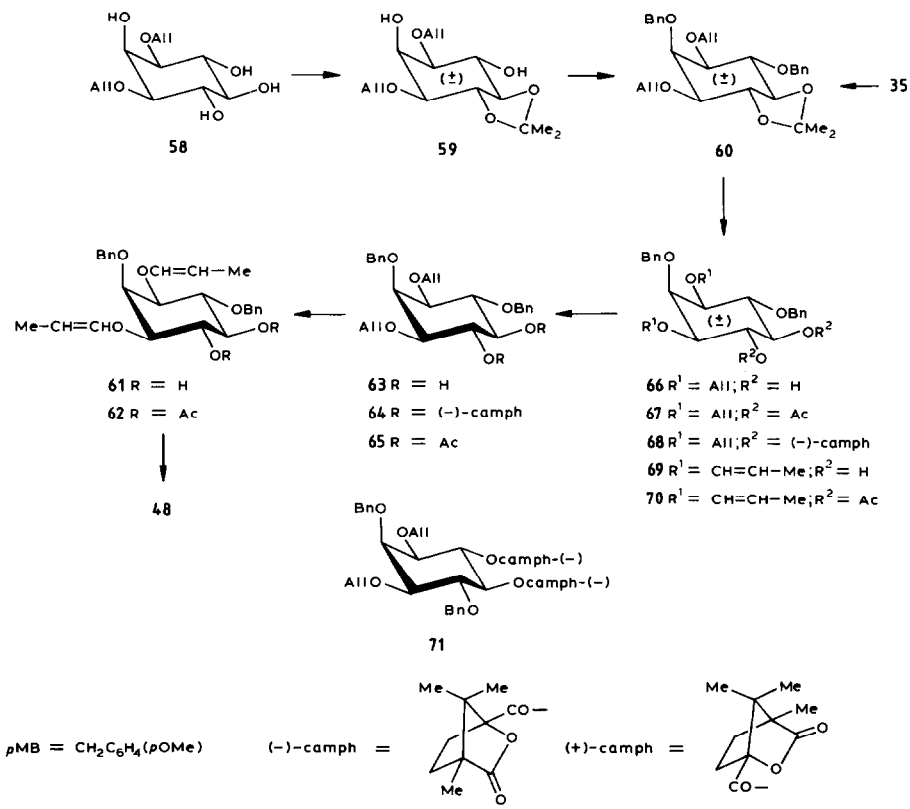
1D-1,3,4,5-Tetra-*O*-allyl-*myo*-inositol (**55**), obtained from the (−)-ω-camphanate[1] **56**, was converted into the benzyl ether **57** and this, on deallylation with palladium-on-charcoal gave the required 1D-2,6-di-*O*-benzyl-*myo*-inositol (**48**). As neither of the above-described camphanates **29** and **56** (required for the preparation of **48**) was readily available by crystallisation of the mixed diastereoisomers, other intermediates were investigated for the resolution in order to avoid the separation of diastereoisomers by column chromatography (see below).

Recently, however, (+)-ω-camphanic acid became available commercially (Fluka) and the resolution of **30** was reinvestigated. The product remaining in the mother liquors after the crystallisation of the (−)-ω-camphanate **37** was saponified, and the crude diol **30** (enriched in the required enantiomer) was converted into the (+)-ω-camphanates **33**. Crystallisation of this mixture of diastereosomers gave the pure (+)-ω-camphanate **43**, which is the enantiomer of the (−)-ω-camphanate **37**. Sapon-

ification of **43** gave the crystalline *O*-isopropylidene derivative **44** and this, on deacetonation, gave 1D-2,6-di-*O*-benzyl-*myo*-inositol (**48**).

Before the (+)-ω-camphanic acid became available, two other routes were investigated for the resolution of **27**. It was found[13] that crystallisation of the bis-(−)-ω-camphanates of racemic 1,2,5,6-tetra-*O*-benzyl-*myo*-inositol gave the pure bis-(−)-ω-camphanate **54** of 1D-1,2,5,6-tetra-*O*-benzyl-*myo*-inositol (**53**). It was decided to investigate the crystallisation behaviour of the bis-(−)-ω-camphanates of analogues of racemic 1,2,5,6-tetra-*O*-benzyl-*myo*-inositol containing *p*-methoxybenzyl groups in place of benzyl groups to see if they crystallised similarly. Thus, the racemic bis-*p*-methoxybenzyl ether **40** (prepared from the diol **30**) was converted into the (−)-ω-camphanates **42**. As before, a pure diastereoisomer crystallised preferentially from the mixture, and this was shown to be the required diastereoisomer **46** since, on saponification to the diol **47** and subsequent de-*p*-methoxybenzylation, it gave 1D-2,6-di-*O*-benzyl-*myo*-inositol (**48**).

In a further route to **48**, the *O*-isopropylidene derivative **35**, which was also required as an intermediate for the synthesis of *myo*-inositol 1,3-bisphosphate, was converted by allylation into racemic 1,3-di-*O*-allyl-2,6-di-*O*-benzyl-4,5-*O*-isopropyli-



dene-*myo*-inositol (**60**). The latter was also prepared by the benzylation of 1,3-di-*O*-allyl-4,5-*O*-isopropylidene-*myo*-inositol[1] (**59**) which was obtained by isopropylidenation[1] of **58**. Deisopropylidenation of **60** gave the diol **66**, which was converted into the diastereoisomeric bis-(−)-ω-camphanates **68**. Crystallisation of the latter gave readily a pure diastereoisomer in high yield, which was shown to be **64** as follows. Saponification of **64** gave the diol **63** which was treated with potassium *tert*-butoxide in methyl sulphoxide to give the prop-1-enyl ether **61**, and this on acidic hydrolysis gave 1D-2,6-di-*O*-benzyl-*myo*-inositol (**48**).

Thus, three practical routes involving crystallisation of ω-camphanates were found for the resolution of 2,4-di-*O*-benzyl-*myo*-inositol (**27**) to give the required enantiomer **48** and, at the same time, several chiral intermediates, valuable for other syntheses in this field[5], were made available. Other methods for the preparation of **48** have been described[14–16]. Phosphorylation of **48** with bisbenzyloxy(*N,N*-diisopropylamino)phosphine[7] (**22**) gave the syrupy protected chiral tetrakisphosphate **51** which has been described previously[14,15].

EXPERIMENTAL

General methods. — The general methods were as described earlier[13]. ^{31}P-N.m.r. spectra were recorded for solutions in $CDCl_3$ with an external phosphoric acid reference (in a capillary tube inside the n.m.r. tube) by use of a Jeol FX90Q F.t. spectrometer.

*2,5-Di-*O*-benzyl*-myo-*inositol* (**5**). — 1,3,4,6-Tetra-*O*-allyl-*myo*-inositol (**1**) (regenerated from the crystalline acetate[1] **2**) was treated with benzyl bromide and NaH in *N,N*-dimethylformamide at 20°, and the product was isolated in the usual way[13] and was separated from benzylation byproducts by column chromatography on silica gel (1:6 ether–light petroleum) to give pure 1,3,4,6-tetra-*O*-allyl-2,5-di-*O*-benzyl-*myo*-inositol (**3**) as a syrup; ^{1}H-n.m.r.: δ 3.17 (dd, *J* 2.44 and 9.76 Hz, H-1,3), 3.3 (t, *J* 8.54 Hz, H-5), 3.83 (t, *J* 9.16 Hz, H-4,6), 3.96 (t, *J* 2.44 Hz, H-2), and 4.81 (s, 2 CH_2Ph).

A mixture of the allyl ether **3** (10.4 g), Pd–C (1.6 g, 10% Fluka), and toluene-*p*-sulphonic acid (86 mg) in 19:1 ethanol–water (150 mL) was heated under reflux with stirring for 36 h after which time t.l.c. (15:1 chloroform–methanol) showed only traces of partially deallylated derivatives of **3** (R_F 0.4–1.0), which were observed during the course of the reaction, but no major product was visible. Triethylamine (2 mL) was added, the mixture was filtered through Celite, and the solid residue was washed with the same solvent mixture. Evaporation of the filtrate gave partially deallylated derivatives of **3** (1 g). The solid residue on the filter was extracted with hot *N,N*-dimethylformamide and the filtrate was diluted with water. The tetraol **5** (5.7 g, 80%) which separated was filtered, m.p. 270–272° (from *N,N*-dimethylformamide–ethanol) (Found: C, 67.40; H, 6.88. $C_{20}H_{24}O_6$ calc.: C, 66.65; H, 6.71%) which gave a tetraacetate **6**, m.p. 177–179° (from 1:2 ethyl acetate–light petroleum); ^{1}H-n.m.r.: δ 1.93, 1.97 (2 s, 4 Ac), 3.62 (t, *J* 9.1 Hz, H-5), 4.05 (t, *J* 2.44 Hz, H-2), 4.59, 4.69 (2 s, 2 CH_2Ph), 4.88 (dd, *J* 2.44 and 10.38 Hz, H-1,3), and 5.67 (t, *J* 9.16 Hz, H-4,6) (Found: C, 63.74; H, 6.32. $C_{28}H_{32}O_{10}$ calc.: C, 63.63; H, 6.10%).

2,5-Di-O-p-*methoxybenzyl*-myo-*inositol* (**9**). — In the same way as described above, but using *p*-methoxybenzyl chloride, diol **1** was converted into the di-*O*-*p*-methoxybenzyl ether **4** which was obtained as a syrup; ^{1}H-n.m.r.: δ 3.08–3.28 (m, H-1,3,5), 3.79 (s, 2 OMe), 3.69–3.96 (m, H-2,4,6), 4.05–4.33 (m, 4 OCH_2–CH =), 4.74 (s, 2 CH_2Ph), 5.08–5.37 (m, 4 CH_2 =), 5.71–6.15 (m, 4 CH =), and 6.80–7.37 (m, arom.). Compound **4** was deallylated and the product isolated as described above to give the tetraol **9**, m.p. 229–231° (Found: C, 62.67; H, 6.87. $C_{22}H_{28}O_8$ calc.: C, 62.84; H, 6.71) which gave a tetraacetate **10**, m.p. 138–140°; ^{1}H-n.m.r.: δ 1.96, 1.97 (2 s, 4 Ac), 3.59 (t, *J* 9.16 Hz, H-5), 3.78 (s, 2 OMe), 4.03 (t, *J* 2.4 Hz, H-2); 4.52, 4.61 (2 s, 2 CH_2Ph), 4.86 (dd, *J* 2.4 and 10.4 Hz, H-1,3), 5.64 (t, *J* 10.3 Hz, H-4,6), and 6.77–7.29 (m, aromatic) (Found: C, 61.22; H, 6.35. $C_{30}H_{36}O_{12}$ calc.: C, 61.21; H, 6.17%).

(±)-2,5-Di-O-*benzyl-1,6*-O-*isopropylidene*-myo-*inositol* (**11**) *and 2,5-di*-O-*benzyl-1,6:3,4-di*-O-*isopropylidene*-myo-*inositol* (**19**). — A mixture of the di-*O*-benzyl ether **5** (1 g, 2.77 mmol), toluene-*p*-sulphonic acid (200 mg), 2,2-dimethoxypropane (500 mg, 4.8 mmol), and *N,N*-dimethylformamide (20 mL) was stirred at 20° for 3 h, after which time most of **5** had dissolved and t.l.c. (1:1 dichloromethane–ether) showed the presence of major (R_F 0.5) and minor (R_F 0.98) products. Triethylamine (1 mL) was added, the solution was diluted with water (100 mL), and the precipitated products (840 mg) were filtered off. Column chromatography on silica gel (2:1 dichloromethane–ether) gave the di-*O*-isopropylidene derivative **19** (114 mg, R_F 0.98), m.p. 173–174°; ^{1}H-n.m.r.: δ 1.46 (s, 4 CMe), 3.59 (dd, *J* 1.83 and 9.15 Hz, H-1,3), 3.79 (t, *J* 8.8 Hz, H-5), 4.20 (t, *J* 9.15 Hz, H-4,6), 4.35 (t, *J* 1.83 Hz, H-2), 4.83, 4.85 (2 s, 2 CH_2Ph), and 7.29–7.40 (m, arom.) (Found: C, 70.97; H, 7.36. $C_{26}H_{32}O_6$ calc.: C, 70.89; H, 7.32%) and the mono-*O*-isopropylidene derivative **11** (530 mg, R_F 0.5), m.p. 184–186° (from 1:1 dichloromethane–ether) (Found: C, 69.13; H, 6.98. $C_{23}H_{28}O_6$ calc.: C, 68.98; H, 7.05%) which gave a diacetate **12**, m.p. 125–126° (from light petroleum); ^{1}H-n.m.r.: δ 1.48 (s, 2 CMe), 1.97 (s, 2 Ac), 3.51 (dd, *J* 1.83 and 9.77 Hz, H-1), 3.61 (t, *J* 9.77 Hz, H-5), 4.20–4.42 (m, H-2,6), 4.53–4.95 (m, 5 H, H-3 and 2 CH_2Ph), 5.50 (dd, *J* 9.16 and 10.37 Hz, H-4), 7.29, and 7.32 (2 s, arom.) (Found: C, 67.11; H, 6.70. $C_{27}H_{32}O_8$ calc.: C, 66.93; H, 6.66%).

(±)-1,6-O-*Isopropylidene-2,5-di*-O-p-*methoxybenzyl*-myo-*inositol* (**15**) *and 1,6:3,4-di*-O-*isopropylidene-2,5-di*-O-p-*methoxybenzyl*-myo-*inositol* (**20**). — In the same way as described above for the preparation of **11**, the di-*O*-*p*-methoxybenzyl ether **9** was converted into the di-*O*-isopropylidene derivative **20**, m.p. 143–144°; ^{1}H-n.m.r.: δ 1.45 (s, 4 CMe), 3.57 (dd, *J* 1.83 and 9.15 Hz, H-1,3), 3.79 (s, 2 OMe), 4.16 (t, *J* 9.16 Hz, H-4,6), 4.32 (t, *J* 1.83 Hz, H-2), 4.75, 4.77 (2 s, 2 CH_2Ph), and 6.81–7.38 (m, arom.) (Found: C, 67.28; H, 7.48. $C_{28}H_{36}O_8$ calc.: C, 67.18; H, 7.25%) and the mono-*O*-isopropylidene derivative **15**, m.p. 141–143° (Found: C, 65.19; H, 7.20. $C_{25}H_{32}O_8$ calc.: C, 65.20; H, 7.00%) which gave a diacetate **16**, m.p. 121–122°; ^{1}H-n.m.r.: δ 1.48 (s, 2 CMe), 1.96 (s, 2 Ac), 3.43–3.68 (m, H-1,5), 3.79 (s, 2 OMe), 4.04–4.28 (m, H-2,6), 4.47–4.86 (m, 5 H, H-3 and 2 CH_2Ph), 5.43 (t, *J* 9.8 Hz, H-4), and 6.80–7.31 (m, arom.) (Found: C, 64.04; H, 6.66. $C_{29}H_{36}O_{10}$ calc.: C, 63.96; H, 6.66%).

Preparation of the phosphitylating reagents **22** *and* **23**. — Dichloro(*N,N*-diisopropylamino)phosphine **21** was prepared by the reaction of *N,N*-diisopropylamine with

PCl_3 as described[17]. The distilled product crystallised on cooling and sometimes in the condenser (m.p. ~ 20°). The dichlorophosphine **21** was allowed to react with benzyl alcohol or 2-cyanoethanol, in ether containing triethylamine, and the products were purified on silica gel in the presence of triethylamine as described earlier[7]. The cyanoethyl ester **23** was eluted from the column with 2:1 ether–light petroleum and the benzyl ester **22** was eluted with 1:5 ether–light petroleum.

*Octa(2-cyanoethyl) ester of 2,5-di-*O*-benzyl-*myo*-inositol 1,3,4,6-tetrakisphosphate* (**8**). — (*a*). A solution of 1*H*-tetrazole (1.1 g, 15.7 mmol) in dry acetonitrile (31 mL) was added to a mixture of the diol **11** (1.16 g, 2.9 mmol) and the reagent **23** (3.14 g, 11.6 mmol) in dry dichloromethane (31 mL). After 1 h at 20°, t.l.c. (1:1 dichloromethane–ether) showed complete conversion of **11** (R_F 0.5) into the phosphite **13** (R_F 0.85). The mixture was cooled to 0° and a solution of *m*-chloroperbenzoic acid (3.8 g, 22 mmol) in dry dichloromethane (31 mL) was added dropwise during 5 min, and the temperature was then allowed to rise to 20° during 1 h. T.l.c. (ethyl acetate) then showed complete conversion of the phosphite **13** (R_F 1.0) into the phosphate **14** (R_F 0.5). The solution was concentrated to remove the acetonitrile and dichloromethane (50 mL) was added to the residue. The mixture was washed with 10% aq. $Na_2S_2O_5$ and 10% aq. Na_2CO_3, and dried ($MgSO_4$). The crude product was chromatographed on silica gel (ethyl acetate followed by 8:1 ethyl acetate–methanol) to give **14** (2.1 g, 94%) as a syrup; ^{1}H-n.m.r.: δ 1.21 and 1.29 (2 s, 2 CMe).

A solution of **14** (2.1 g) in acetone (20 mL), methanol (40 mL), and M HCl (7 mL) was kept at 20° for 2 h when t.l.c. (8:1 ethyl acetate–methanol) showed conversion of **14** (R_F 0.9) into the diol **17** (R_F 0.7). Sodium acetate (1 g) was added, the solvents were evaporated, and the residue was extracted with dichloromethane. Evaporation of the dried ($MgSO_4$) extract gave **17** as a syrup (1.8 g).

A solution of 1*H*-tetrazole (626 mg, 8.9 mmol) in dry acetonitrile (18 mL) was added to a solution of the diol **17** (1.21 g, 1.65 mmol) and the reagent **23** (1.8 g, 6.6 mmol) in dry dichloromethane (18 mL), and the solution was kept at 20° for 1 h when t.l.c. (as described above) showed complete conversion of **17** into the phosphite **18** (R_F 0.95). The solution was cooled to 0° and a solution of *m*-chloroperbenzoic acid (2.24 g, 13 mmol) in dichloromethane (18 mL) was added dropwise during 5 min, and the solution was then stirred at 20° for 1 h when t.l.c. (as described above) showed complete conversion of the phosphite **18** into the phosphate **8** (R_F 0.35). The solution was treated as described above, and the product was chromatographed on silica gel (8:1 ethyl acetate–methanol) to give the phosphate **8** (906 mg, 50%), m.p. 109–110° (from 15:1 ethyl acetate–light petroleum); ^{1}H-n.m.r.: δ 2.0–2.3 (m, 4 H), 2.6–2.87 (m, 12 H), 3.6–4.7 (m, 20 H), 4.7–5.0 (m, 6 H), and 7.35–7.38 (m, 10 H arom.); ^{31}P-n.m.r.: δ −3.23, −2.49 (Found: C, 47.64; H, 4.51; N, 10.01; P, 10.52. $C_{44}H_{52}N_8O_{18}P_4$ calc.: C, 47.83; H, 4.74. N, 10.15; P, 11.21%).

(*b*). A solution of 1*H*-tetrazole (210 mg, 3 mmol) in dry acetonitrile (6 mL) was added to a mixture of the tetraol **5** (200 mg, 0.55 mmol) and the reagent **23** (600 mg, 2.2 mmol) in dry dichloromethane (6 mL), and the mixture was stirred at 20° for 3 h when t.l.c. (8:1 ethyl acetate–methanol) showed the presence of the phosphite **7** (R_F 1.0). A solution of *m*-chloroperbenzoic acid (750 mg, 4.3 mmol) in dichloromethane (6 mL) was

added dropwise to the cooled solution and, after 1 h at 20°, t.l.c. (as described above) showed the phosphate **8** (R_F 0.35). The solution was treated as described in (*a*) to give **8** (360 mg, 59%), m.p. 108.5–110°, identical with the material described in (*a*).

(±)-*2,4-Di*-O-*benzyl*-myo-*inositol* (**27**). — 1,3,4,5-Tetra-*O*-allyl-*myo*-inositol[1] (**24**) (regenerated from the crystalline acetate[1] **25**) was treated with benzyl bromide and NaH in *N,N*-dimethylformamide at 20°, and the product isolated in the usual way[13] and chromatographed on silica gel (1:4 ether–light petroleum) to give (±)-1,3,4,5-tetra-*O*-allyl-2,6-di-*O*-benzyl-*myo*-inositol (**26**) as a syrup. A mixture of **26** (18 g, 34.5 mmol), toluene-*p*-sulphonic acid (1.25 g), and Pd–C (2.5 g, 10%; Fluka) in 19:1 ethanol–water (100 mL) was heated with stirring in an oil bath at 95° so that the solvent distilled slowly. The volume was kept constant by the addition of the same solvent mixture from a dropping funnel. After 24 h, t.l.c. (15:1 chloroform–methanol) showed almost complete disappearance of the partially deallylated derivatives of **26** (R_F 0.35–1.0), which were observed during the course of the reaction, and the presence of a major product (R_F 0.3). Triethylamine (5 mL) and $NaHCO_3$ (3 g) were added to the cooled solution, which was then filtered through Celite, and the residue was washed with the same solvent mixture. The filtrate was concentrated and toluene was evaporated from the residue which was chromatographed on silica gel (15:1 ethyl acetate–methanol) to give the major product **27** (R_F 0.3; 8 g, 64%), m.p. 125–126° (from ethyl acetate–light petroleum) (lit.[18] m.p. 119–120.5°; lit.[19], lit.[20] no data) (Found: C, 66.58; H, 6.78. $C_{20}H_{24}O_6$ calc.: C, 66.65; H, 6.71%) which gave a tetraacetate **28**, m.p. 163–165° (from 3:5 ethyl acetate–light petroleum); ^{1}H-n.m.r.: δ 1.92, 1.99 (2 s, 4 Ac), 4.01–4.23 (m, H-2,6), 4.64 (s, 2 CH_2Ph), 4.86–5.03 (m, H-1,3), 5.14 (t, *J* 9.77 Hz, H-5), 5.55 (t, *J* 9.76 Hz, H-4), and 7.26, 7.28, 7.34 (3 s, arom.) (Found: C, 63.74; H, 6.29. $C_{28}H_{32}O_{10}$ calc.: C, 63.63; H, 6.10%).

Extraction of the material on the filter with hot water and subsequent concentration and acetylation of the residue gave *myo*-inositol hexaacetate and pentaacetates of mono-*O*-benzyl-*myo*-inositols as observed by n.m.r. spectroscopy and t.l.c..

(±)-*2,4-Di*-O-*benzyl-1,6*-O-*isopropylidene*-myo-*inositol* (**30**) *and* (±)-*2,4-di*-O-*benzyl-5,6*-O-*isopropylidene*-myo-*inositol* (**35**). — A solution of the racemic benzyl ether **27** (3.5 g) and toluene-*p*-sulphonic acid (720 mg) in 2,2-dimethoxypropane (70 mL) and acetone (185 mL) was kept at 20° for 6 h. T.l.c. (3:1 ether–light petroleum) then showed almost complete conversion of the tetraol **27** (R_F 0) into two products (R_F 0.5 and 0.6). Triethylamine (1 mL) was added, the solvents were evaporated, and the products were chromatographed on silica gel (3:1 ether–light petroleum) to give the major (R_F 0.6, 1.52 g) and the minor (R_F 0.5, 900 mg) products. The residual starting material (R_F 0, 750 mg) was eluted with ethyl acetate. The product **30** (R_F 0.6) had m.p. 94–96° (from light petroleum containing a little triethylamine); ^{1}H-n.m.r.: δ 1.46, 1.48 (2 s, 2 CMe), 2.45–2.58 (m, 2 OH), 3.41–3.80 (m, 4 H), 4.01–4.20 (m, 2 H), 4.57–5.10 (2 ABq, 2 CH_2Ph), and 7.36 (s, arom.) (Found: C, 68.95; H, 7.10. $C_{23}H_{28}O_6$ calc.: C, 68.98; H, 7.05%). It gave a crystalline diacetate **31**, m.p. 117–118°; ^{1}H-n.m.r.: δ 1.44 (s, 2 CMe), 1.95, 1.98 (2 s, 2 Ac), and 5.24 (t, *J* 9.1 Hz, H-5) (Found: C, 66.85; H, 6.74. $C_{27}H_{32}O_8$ calc.: C, 66.93; H, 6.66%).

Benzylation of **30**, followed by acidic hydrolysis of the *O*-isopropylidene group gave racemic 1,2,5,6-tetra-*O*-benzyl-*myo*-inositol (m.p. 170–171°) which gave a diacetate (m.p. 106–108°) identical with the materials described previously[11].

The product **35** (R_F 0.5), m.p. 110–112° (from light petroleum containing a little triethylamine) (Found: C, 68.90; H, 7.32. $C_{23}H_{28}O_6$ calc.: C, 68.98; H, 7.05%) gave a syrupy diacetate **36**; ^{1}H-n.m.r.: δ 1.45, 1.48 (2 s, 2 CMe), 1.96, 2.04 (2 s, 2 Ac), and 4.22 (t, *J* 2.44 Hz, H-2).

Benzylation of **35** followed by acidic hydrolysis of the *O*-isopropylidene group gave racemic 1,2,3,4-tetra-*O*-benzyl-*myo*-inositol (m.p. 84–86°) which gave a diacetate (m.p. 127–129°) identical with the materials described previously[12].

*1D-2,6-Di-*O*-benzyl*-myo-*inositol* (**48**) *from 1D-1,3,4,5-tetra-*O*-allyl*-myo-*inositol* (**55**). — Compound **55** [regenerated from the crystalline (−)-ω-camphanate[1] **56**] was converted into the benzyl ether **57**, and the allyl groups were removed by the action of Pd–C as described above for the preparation and deallylation of the racemate **26**. The product **48**, m.p. 147–148° (from chloroform), $[\alpha]_D^{25}$ −28° (*c* 1, chloroform), $[\alpha]_D^{25}$ −28.5° (*c* 1, ethanol) (Found: C, 66.27; H, 6.58. $C_{20}H_{24}O_6$ calc.: C, 66.65; H, 6.71%) {lit.[14] m.p. 145–146°, $[\alpha]_D^{25}$ −29.2° (*c* 1, ethanol); lit.[15] m.p. 120–121.5°; $[\alpha]_D^{20}$ −22.9° (chloroform); lit.[16] m.p. 146–147°; $[\alpha]$ −29.2° (*c* 0.65, ethanol)} gave a tetraacetate **49**, m.p. 117–118° (from 2:1 ether–light petroleum), $[\alpha]_D^{26}$ +13.5° (*c* 1, chloroform) with a ^{1}H-n.m.r. spectrum identical with that described above for the racemate **28** (Found: C, 63.63; H, 6.02. $C_{28}H_{32}O_{10}$ calc.: C, 63.63; H, 6.10%).

*3,5-Bis-(−)-ω-camphanate of 1D-2,4-di-*O*-benzyl-1,6-*O*-isopropylidene-*myo*-inositol* (**37**). — A solution of **30** (1 g, 2.5 mmol) and (−)-ω-camphanic chloride (1.7 g, 7.8 mmol) in dry pyridine (10 mL) was kept at 20° for 14 h when t.l.c. (2:1 toluene–acetone) showed complete conversion of **30** (R_F 0.75) into the products **29** and **37** (R_F 0.85). T.l.c. (2:1 ether–light petroleum) showed separation of the products (R_F 0.55 and 0.6), but in this solvent system compound **30** also had R_F 0.55. Water (1 mL) was added, and the solution was kept at 20° for 1 h and then diluted with water (100 mL), and the products were extracted with 1:3 dichloromethane–ether. The extract was washed successively with M HCl, sat. aq. KCl, and sat. aq. $NaHCO_3$, dried ($MgSO_4$), and concentrated to give the mixed diastereoisomers **29** and **37** (1.9 g); ^{1}H-n.m.r.: δ 0.81 (3 H), 0.88 (6 H), 0.95 (3 H), 0.98 (9 H), 1.02 (6 H), 1.08 (6 H), and 1.1 (3 H), (7 s, 12 CMe of the camphanates). Crystallisation from ether gave the pure diastereoisomer **37** (R_F 0.55, 736 mg, 77%), m.p. 221–223°, $[\alpha]_D^{25}$ +36.5° (*c* 1, chloroform); ^{1}H-n.m.r.: δ 0.88 (6 H), 0.99 (6 H), 1.02 (3 H), and 1.08 (3 H) (4s, 6 CMe of the camphanates) (Found: C, 68.13; H, 7.03. $C_{43}H_{52}O_{12}$ calc.: C, 67.88; H, 6.89%).

A small portion of the diastereoisomer **29** (R_F 0.6) was obtained by chromatography of the mother liquors on silica gel (2:1 ether–light petroleum); ^{1}H-n.m.r.: δ 0.81, 0.95, 0.97, 1.02, 1.07, and 1.10 (6 s, 6 CMe of the camphanate), showing that the purity of **37** and **29** could be assessed by inspection of the CMe resonances of the camphanate portion at δ 0.88 and 0.81, respectively.

Saponification of the camphanate **37** with NaOH in methanol gave the diol **38** and this was benzylated in the usual way to give *1D-2,3,4,5-tetra-*O*-benzyl-1,6-*O*-

isopropylidene-myo-*inositol* (**39**), m.p. 108–109°, $[\alpha]_D^{25}$ +11.5° (*c* 1, chloroform); ^{1}H-n.m.r.: δ 1.44, 1.47 (2 s, 2 CMe), 3.30–4.40 (m, 6 H, ring protons), 4.58–4.99 (m, 8 H, 4 CH_2Ph), and 7.28–7.37 (m, arom.) (Found: C, 76.48; H, 6.82. $C_{37}H_{40}O_6$ calc.: C, 76.52; H, 6.94%). Acidic hydrolysis of **39** gave 1D-2,3,4,5-tetra-*O*-benzyl-*myo*-inositol (**52**), m.p. 153–154°, $[\alpha]_D^{25}$ +14° (*c* 1, chloroform) with a ^{1}H-n.m.r. spectrum identical with that of its enantiomer[13].

Acidic hydrolysis of the diol **38** gave the enantiomer of compound **48**, m.p. 146–148°, $[\alpha]_D^{25}$ +28° (*c* 1, chloroform).

*1,5-Bis-(+)-ω-camphanate of 1D-2,6-di-*O*-benzyl-3,4-*O*-isopropylidene*-myo-*inositol* (**43**). — The products from the mother liquor after the crystallisation of the (−)-ω-camphanate **37**, described in the previous section, were saponified with NaOH in methanol, and the diol obtained was converted into the crude (+)-ω-camphanates **33** (highly enriched in one diastereoisomer) as described above. Crystallisation of the mixture **33** from ether gave the pure diastereoisomer **43** (750 mg, 79%), m.p. 216–217°, $[\alpha]_D^{25}$ −36° (*c* 1, chloroform) which had an identical ^{1}H-n.m.r. spectrum with that of its enantiomer **37** described above (Found: C, 67.55; H, 6.99. $C_{43}H_{52}O_{12}$ calc.: C, 67.88; H, 6.89%).

*1D-2,6-Di-*O*-benzyl-3,4-*O*-isopropylidene*-myo-*inositol* (**44**). — Saponification of the (+)-ω-camphanate **43** with NaOH in methanol gave the diol **44**, m.p. 131–132.5° (from light petroleum containing a little triethylamine), $[\alpha]_D^{25}$ −19° (*c* 1, chloroform) with a ^{1}H-n.m.r. spectrum identical with that of the racemate **30** described above (Found: C, 68.54; H, 7.27. $C_{23}H_{28}O_6$ calc.: C, 68.98; H, 7.05%).

Acidic hydrolysis of **44** gave **48** which gave the tetraacetate **49** identical with the compounds described above.

*(±)-2,6-Di-*O*-benzyl-3,4-*O*-isopropylidene-1,5-di-*O*-p-methoxybenzyl*-myo-*inositol* (**34**). — The racemic diol **30** was treated with *p*-methoxybenzyl chloride and NaH in *N,N*-dimethylformamide and the product isolated in the usual way. Column chromatography on silica gel (2:1 ether–light petroleum) gave **34**, m.p. 112–114° (from light petroleum containing a little triethylamine); ^{1}H-n.m.r.: δ 1.43, 1.46 (2 s, 2 CMe), 3.78 (s, 2 OMe), and 6.74–7.36 (m, arom.) (Found: C, 73.14; H, 7.24. $C_{39}H_{44}O_8$ calc.: C, 73.10; H, 6.92%).

*(±)-2,6-Di-*O*-benzyl-1,5-di-*O*-p-methoxybenzyl*-myo-*inositol* (**40**). — A solution of the *O*-isopropylidene derivative **34** (1 g) in 1:3:7 M HCl–acetone–methanol (25 mL) was kept at 25° for 1 h. An excess of $NaHCO_3$ was added, the solvents were evaporated, and the residue was extracted with ethyl acetate to give the diol **40**, m.p. 175–176° (from ether–light petroleum); ^{1}H-n.m.r.: δ 3.77, 3.79 (2 s, 2 OMe), and 6.78–7.32 (m, arom.) (Found: C, 72.43; H, 6.77. $C_{36}H_{40}O_8$ calc.: C, 71.98; H, 6.71%). This gave a syrupy diacetate **41**; ^{1}H-n.m.r.: δ 1.92, 1.95 (2 s, 2 Ac), 3.36–3.57 (m, H-1,5), 3.77, 3.08 (2 s, 2 OMe), 4.00–4.21 (m, H-2,6), 4.47–4.90 (m, H-3 and 4 CH_2Ph), 5.60 (t, *J* 10 Hz, H-4), and 6.76–7.30 (m, arom.).

*Resolution of (±)-2,6-di-*O*-benzyl-1,5-di-*O*-p-methoxybenzyl*-myo-*inositol* (**40**) via *the (−)-ω-camphanates.* — The racemic diol **40** (2.5 g) was converted into the diastereoisomeric bis-(−)-ω-camphanates **42** (4.1 g) as described above. T.l.c. (3:1

ether–light petroleum) showed both diastereoisomers at R_F 0.5; ^{1}H-n.m.r.: δ 0.81 (3 H), 0.86 (3 H), 0.91 (6 H), 0.94 (6 H), 0.98 (6 H), 1.04 (3 H), and 1.07 (9 H) (7 s, 12 CMe of the camphanates). Crystallisation from ethyl acetate–light petroleum gave the pure diastereoisomer **46** (1.5 g), m.p. 196–198°, $[\alpha]_D^{25}$ 0° (*c* 1, chloroform); ^{1}H-n.m.r.: δ 0.8, 0.91, 0.94, 0.99, 1.04, and 1.07 (6 s, 6 CMe of the camphanate) (Found: C, 69.82; H, 6.87. $C_{56}H_{64}O_{14}$ calc.: C, 69.98; H, 6.71%).

Crystallisation of the contents of the mother liquor from methanol gave the pure diastereoisomer **45** (1.6 g), m.p. 160–163° $[\alpha]_D^{25}$ − 10° (*c* 1, chloroform); ^{1}H-n.m.r.: δ 0.86 (3 H), 0.91 (3 H), 0.94 (3 H), 0.98 (3 H), and 1.06 (6 H) (5 s, 6 CMe of the camphanate) (Found: C, 69.92; H, 6.89%).

*1D-2,6-Di-*O*-benzyl-1,5-di-*O*-*p*-methoxybenzyl*-myo-*inositol* (**47**). — The camphanate **46** was saponified with NaOH in methanol to give the diol **47**, m.p. 166–167° (from ethanol), $[\alpha]_D^{25}$ − 10° (*c* 1, chloroform) (Found: C, 72.02; H, 6.86. $C_{36}H_{40}O_8$ calc.: C, 71.98; H, 6.71%).

A mixture of the diol **47** (200 mg, 0.33 mmol), dichloromethane (10 mL), water (0.5 mL), and 2,3-dichloro-5,6-dicyano-1,4-benzoquinone[21] (189 mg, 0.83 mmol) was stirred at 5° for 5 h when t.l.c. (15:1 chloroform–methanol) showed complete conversion of **47** (R_F 0.7) into a product (R_F 0.4). The mixture was dried ($MgSO_4$) and concentrated, and the product was chromatographed on silica gel (ethyl acetate) to give **48** (90 mg), m.p. 147–148°, $[\alpha]_D^{25}$ − 28° (*c* 1, chloroform), identical with the material described above, thus establishing the absolute configurations of compounds **46** and **47**.

*(±)-1,3-Di-*O*-allyl-2,6-di-*O*-benzyl-4,5-*O*-isopropylidene*-myo-*inositol* (**60**). — (*a*). A solution of 1,3-di-*O*-allyl-*myo*-inositol[1] (**58**, 1 g) and toluene-*p*-sulphonic acid (100 mg) in acetone (10 mL) and 2,2-dimethoxypropane (30 mL) was kept at 20° for 3 h when t.l.c. (8:1 ethyl acetate–methanol) showed almost complete conversion of **58** (R_F 0.5) into the product **59** (R_F 0.85). Triethylamine (1 mL) and $NaHCO_3$ (1 g) were added, the solvents were evaporated, and the products extracted from the residue with ethyl acetate. Column chromatography on silica gel (ether) gave first a minor product (50 mg, R_F 0.8 in ether), the ^{1}H-n.m.r. spectrum of which indicated a dimethylmethoxymethyl ether of **59**, and then the product **59** (900 mg, R_F 0.6 in ether) as a syrup which crystallised slowly, m.p. 57–58°.

Compound **59** was treated with benzyl bromide and NaH in *N,N*-dimethylformamide in the usual way, and column chromatography of the product on silica gel (1:3 ether–light petroleum) gave **60**, m.p. 106–108° (from light petroleum); ^{1}H-n.m.r.: δ 1.44 (s, 2 CMe), 3.25–3.56 (m, H-1,3,5), 3.91–4.20 (m, 2 OCH_2–CH = and H-2,4,6), 4.82 (ABq, CH_2Ph), 4.84 (s, CH_2Ph), 5.1–5.37 (m, 2 $=CH_2$), 5.9 (m, 2 CH =), and 7.25–7.41 (m, arom.) (Found: C, 72.61; H, 7.64. $C_{29}H_{36}O_6$ calc.: C, 72.47; H, 7.55%).

(*b*). 2,4-Di-*O*-benzyl-5,6-*O*-isopropylidene-*myo*-inositol (**35**) was treated with allyl bromide and NaH in *N,N*-dimethylformamide, and the product isolated in the usual way and processed as in (*a*) to give **60** identical with that described in (*a*).

*(±)-4,5-Di-*O*-acetyl-1,3-di-*O*-allyl-2,6-di-*O*-benzyl*-myo-*inositol* (**67**). — The *O*-isopropylidene derivative **60** was heated under reflux with 1:9 M HCl–acetone for 30 min. An excess of $NaHCO_3$ was added and the solvents were evaporated. The product

was extracted from the residue with ethyl acetate to give **66** as a syrup which gave a crystalline diacetate **67**, m.p. 128–129° (from light petroleum); ^{1}H-n.m.r.: δ 1.91, 2.02 (2 s, 2 Ac), 3.32 (dd, *J* 1.8 and 9.8 Hz, H-1,3), 3.92–4.11 (m, 6 H, 2 OCH_2–CH = and H-2,6), 4.73 (ABq, CH_2Ph), 4.87 (s, CH_2Ph), 4.90–5.60 (m, 6 H, 2 =CH_2 and H-5,6), and 7.27–7.40 (m, arom.) (Found: C, 68.58; H, 7.21. $C_{30}H_{36}O_8$ calc.: C, 68.68; H, 6.92%).

(±)-*4,5-Di*-O-*acetyl-2,6-di*-O-*benzyl-1,3-di*-O-*(prop-1-enyl)*-myo-*inositol* (**70**). — A solution of the diol **66** (130 mg, 0.3 mmol, regenerated from the crystalline acetate **67**) and potassium *tert*-butoxide (500 mg, 4.1 mmol) in dry dimethyl sulphoxide (15 mL) was kept at 50° for 5 h when t.l.c. (2:1 ether–light petroleum) showed conversion of **66** (R_F 0.6) into a product (R_F 0.75). Semisaturated aq. KCl (50 mL) was added and the product was extracted with ether (2 × 50 mL). The extract was dried (K_2CO_3) and evaporated to give the product **69** as a syrup (120 mg) which gave the diacetate **70**, m.p. 136–138°; ^{1}H-n.m.r.: δ 1.52–1.72 (m, 2 =CH-CH_3), 1.91, 1.99 (2 s, 2 Ac), 3.56–3.71 (m, H-1,3), 3.98–4.20 (m, H-2,6), 4.34–4.54 (m, 2 =C*H*-Me), 4.67 (ABq, CH_2Ph), 4.84 (s, CH_2Ph), 5.04 (t, *J* 9.76 Hz, H-5), 5.58 (t, *J* 9.9 Hz, H-4), 5.90–6.11 (m, 2 OCH =), and 7.27–7.43 (m, arom.) (Found: C, 68.84; H, 7.09. $C_{30}H_{36}O_8$ calc.: C, 68.68; H, 6.92%).

4,5-Bis-(−)-*ω-camphanate of* 1D-*1,3-di*-O-*allyl-2,6-di*-O-*benzyl*-myo-*inositol* (**64**). — A solution of the racemic diol **66** (2.7 g, 6.13 mmol, regenerated from the crystalline acetate **67**) and (−)-*ω*-camphanic chloride (5 g, 23 mmol) in dry pyridine (30 mL) was kept at 20° for 10 h when t.l.c. (5:1 toluene–acetone) showed complete conversion of **66** (R_F 0.25) into the mixed camphanates **68** (R_F 0.6). The solution was processed as described above and the product [4.8 g; ^{1}H-n.m.r.: δ 0.74 (3 H), 0.82 (3 H), 0.96 (12 H), 1.04 (12 H), and 1.08 (6 H) (5 s, 12 CMe of the camphanates)] crystallised from 1:5 ethyl acetate–light petroleum to give camphanate **64** (1.6 g, 68%) as small hard prisms, m.p. 163–165°, $[\alpha]_D^{25}$ + 17.5° (*c* 1, chloroform); ^{1}H-n.m.r.: δ 0.74 (3 H), 0.95 (6 H), 1.03 (6 H), and 1.09 (3 H) (4 s, 6 CMe) (Found: C, 68.80; H, 7.26. $C_{46}H_{56}O_{12}$ calc.: C, 68.98; H, 7.05%).

A further portion of **64** (100 mg) was obtained when the contents of the mother liquors were kept in methanol (30 mL). The crystalline camphanate **64** has a low solubility in hot methanol. The ^{1}H-n.m.r. spectrum of the contents of the mother liquors, now enriched in the diastereoisomer **71**, showed predominant CMe resonances at δ 0.82 (3 H), 0.97 (6 H), 1.04 (6 H), and 1.08 (3 H) (4 s, 6 CMe), showing that the two resonances at δ 0.74 and 0.82 observed in the mixed diastereoisomers **68** were diagnostic for **64** and **71**, respectively.

1D-*4,5-Di*-O-*acetyl-1,3-di*-O-*allyl-2,6-di*-O-*benzyl*-myo-*inositol* (**65**). — The camphanate **64** was saponified with NaOH in methanol and the diol **63** was obtained as a syrup which gave a crystalline diacetate **65**, m.p. 123–124° (from light petroleum), $[\alpha]_D^{25}$ + 39° (*c* 1, chloroform) with a ^{1}H-n.m.r. spectrum identical with that described for the racemate **67** (Found: C, 68.70; H, 7.06. $C_{30}H_{36}O_8$ calc.: C, 68.68; H, 6.92%).

1D-*4,5-Di*-O-*acetyl-2,6-di*-O-*benzyl-1,3-di*-O-*(prop-1-enyl)*-myo-*inositol* (**62**). — The diol **63** (regenerated from the diacetate **65**) was treated with potassium *tert*-butoxide in methyl sulphoxide and the product isolated, as described above for the preparation of the racemate **69**, to give the diol **61** as a syrup which crystallised slowly.

This gave the diacetate **62**, m.p. 133–135°, $[\alpha]_D^{25}$ + 35° (*c* 1, chloroform), with a ^{1}H-n.m.r. spectrum identical with that described for the racemate **70** (Found: C, 68.55; H, 6.83. $C_{30}H_{36}O_8$ calc.: C, 68.68; H, 6.92%).

The diol **61** was heated under reflux in 1:10 M HCl–methanol for 15 min. An excess of $NaHCO_3$ was added and the solvents were evaporated. The product **48** was extracted from the residue with hot chloroform, m.p. 147–149° (from chloroform), $[\alpha]_D^{25}$ − 27° (*c* 1, chloroform) and was identical with the material described above, thus establishing the absolute configuration of the camphanate **64**.

Octabenzyl ester of 1D-*2,6-di*-O-*benzyl*-myo-*inositol 1,3,4,5-tetrakisphosphate* (**51**). — A solution of 1*H*-tetrazole (211 mg, 3 mmol) in dry acetonitrile (5 mL) was added to a solution of the tetraol **48** (198 mg, 0.55 mmol) and the phosphitylating agent **22** (1 g, 2.9 mmol) in dry dichloromethane (5 mL), and the mixture was stirred for 1 h at 20° when t.l.c. (15:1 chloroform–methanol) showed complete conversion of **48** (R_F 0.5) into a product (R_F 1.0) assumed to be the phosphite **50**. The mixture was cooled to 0° and a solution of *m*-chloroperbenzoic acid (742 mg, 4.3 mmol) in dry dichloromethane (5 mL) was added dropwise during 5 min, and the mixture was then kept at 20° for 2 h when t.l.c. (ether) showed a major product (R_F 0.5) and some less polar, minor products. The solvents were evaporated and dichloromethane (50 mL) was added to the residue. The mixture was washed with aqueous $Na_2S_2O_5$ (10%) and aqueous Na_2CO_3 (10%), and the solution dried ($MgSO_4$) and concentrated. The residue was chromatographed on silica gel (ether followed by ethyl acetate) to give the phosphate **51** (658 mg, 85%) as a syrup, $[\alpha]_D^{25}$ − 4.0° (*c* 1, chloroform); ^{1}H-n.m.r. as described[14,18]; ^{31}P-n.m.r.: δ − 1.88, − 1.61, − 1.41, and − 1.21 (Found: C, 65.81; H, 5.54; P, 9.07. $C_{62}H_{63}O_{15}P_3$ calc.: C, 65.14; H, 5.47; P, 8.84%); lit.[14,15] n.m.r. data only; lit.[22] no data.

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