Carbohydrate Research, 234 (1992) 1–21
Elsevier Science Publishers B.V., Amsterdam

The preparation of intermediates for the synthesis of 1D-*myo*-inositol 1,4,5-trisphosphate, a second messenger for signal transduction in cells *,**

Trupti Desai, Jill Gigg, Roy Gigg, Sheila Payne and Soledad Penades [1]

Laboratory of Lipid and General Chemistry, National Institute for Medical Research, Mill Hill, London NW7 1AA (United Kingdom)

(Received October 23rd, 1991; accepted December 6th, 1991)

ABSTRACT

Racemic 1,2,4-tri-*O*-benzyl-5,6-*O*-isopropylidene-*myo*-inositol was prepared by a new route involving crotyl (but-2-enyl) ethers and converted into the (−)-ω-camphanates to give the pure crystalline 1L-diastereoisomer and the chirally impure, syrupy 1D-diastereoisomer. The latter was converted via the 1-*O*-allyl or 1-*O*-*p*-methoxybenzyl ethers into chirally pure 1D-2,3,6-tri-*O*-benzyl-*myo*-inositol [required as an intermediate for the synthesis of 1D-*myo*-inositol 1,4,5-trisphosphate (1,4,5-IP_3)], which was also prepared by de-*p*-methoxybenzylation of 1D-2,3,6-tri-*O*-benzyl-1,5-di-*O*-*p*-methoxybenzyl-*myo*-inositol. Racemic 2,4-di-*O*-benzyl-5,6-*O*-isopropylidene-1-*O*-*p*-methoxybenzyl-*myo*-inositol was prepared in a similar way to the analogous tribenzyl ether (using crotyl ethers) and the ω-camphanate esters behaved similarly, allowing efficient resolution by crystallisation of the (−)- and (+)-ω-camphanates. Racemic 1,2,4-tri-*O*-allyl-3-*O*-(but-2-enyl)-*myo*-inositol was resolved via the (−)-ω-camphanates and was also converted into 1,2,4-tri-*O*-(*cis*-prop-1-enyl)-*myo*-inositol, an alternative intermediate for the synthesis of 1,4,5-IP_3.

INTRODUCTION

The interaction of many agonists with their receptors on the cell surface stimulates a membrane-bound phosphodiesterase to cause the hydrolysis of the membrane lipid phosphatidylinositol 4,5-bisphosphate (**1**). This reaction produces

Correspondence to: Dr. R. Gigg, Laboratory of Lipid and General Chemistry, National Institute for Medical Research, Mill Hill, London NW7 1AA, UK.

* The Allyl Group for Protection in Carbohydrate Chemistry. Part 26. Presented in part at the XVth International Carbohydrate Symposium, Yokohama, Japan, August 12–17, 1990; at the 200th National Meeting of the American Chemical Society, Washington, DC, USA, August 26–31, 1990; and at the 2nd Jornados de Carbohidratos, Medina del Campo, Spain, June 12–14, 1991. For Part 25, see ref. 1. For a preliminary communication, see ref. 2. This work forms part of Theses (ref. 3) and a Patent Application (ref. 4).

** Dedicated to Professor Laurens Anderson.

[1] Visiting scientist from the Instituto de Quimica Organica General, C.S.I.C., Madrid, Spain.

1D-*myo*-inositol 1,4,5-trisphosphate (**3**), which is liberated into the cytosol and interacts with receptors on the endoplasmic reticulum, resulting in the release of calcium ions which activate the cell.

The ubiquitous nature of this signal transduction system for many different types of agonist-receptor interactions has stimulated much biological interest (for reviews, see refs. 5 and 6) and consequently much chemical synthetic work (for reviews, see refs. 5 and 7) on the second messenger **3**.

We now describe the preparation of chiral derivatives of *myo*-inositol suitable for phosphorylation to give **3**.

RESULTS AND DISCUSSION

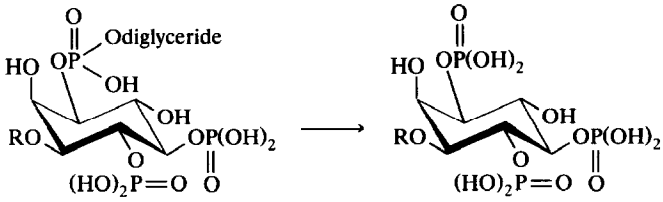
We have described[8,9] the synthesis of racemic 1,2,4-tri-*O*-benzyl-5,6-*O*-isopropylidene-*myo*-inositol (**15**) by way[8] of the allyl ethers (**7**, **11**, and **12**) and we now describe a modification of the synthesis using the crotyl (but-2-enyl) ethers (**8**, **13**, and **14**). The removal[10,11] of the crotyl group from **14** is a single stage reaction, whereas the removal of the allyl group from **12** requires[8] two stages, one of which involves the use[10] of mercury salts.

One-pot, tin-mediated[5] crotylation of racemic 1,4-di-*O*-benzyl-*myo*-inositol[12] (**6**) with 1 equiv of dibutyltin oxide gave crystalline **8** as a major product together with small proportions of two dicrotylated derivatives (**18** and **20**) and a product presumed to be **10**, which were separated by column chromatography.

Because, with an excess of reagents in the tin-mediated reaction, **6** should give **18** and **20** in high yield, and as they were readily separated and may be useful intermediates for future work, they were characterised. This aim was achieved by conversion of **18** through **19** and **22** (and **20** through **21** and **25**) into known[5] 2,5-(**23**) and racemic 2,4-di-*O*-methyl-*myo*-inositol (**26**) and their respective tetraacetates (**24** and **27**).

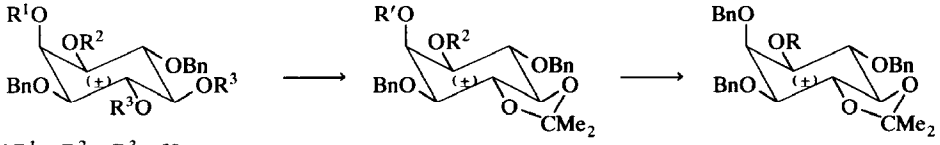
Compound **8** was converted into the *O*-isopropylidene derivative **13** which gave the crystalline tribenzyl ether **14**. Removal of the crotyl ether from **14** by the action[10,11] of potassium *tert*-butoxide in methyl sulphoxide gave known **15** (refs. 8 and 9), which was resolved as described[1,13] via (−)- and (+)-ω-camphanates (**16** and **17**) to give **33** and **28**, respectively. Deprotection[1] of **28** gave 1D-2,3,6-tri-*O*-benzyl-*myo*-inositol[1] (**37**) required as an intermediate for the synthesis of 1D-*myo*-inositol 1,4,5-trisphosphate (**3**).

Before (+)-ω-camphanic acid became available to allow the ready preparation[1] of the crystalline (+)-ω-camphanate (**28**) (and hence **37**), other routes were investigated for the conversion of the crude, syrupy (−)-ω-camphanate (**29**) (remaining in the mother liquors after the crystallisation of **33** and still containing some **33**) into an enantiomerically pure derivative of **37**.



1 * R = H
2 R = $P(OH)_2$ (=O)

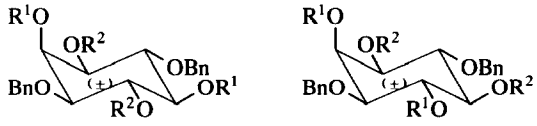
3 R = H
4 R = $P(OH)_2$ (=O)
5 R = $P(OH)_2$ (=S)



6 $R^1 = R^2 = R^3 = H$
7 $R^1 = R^3 = H$, R^2 = Allyl
8 $R^1 = R^3 = H$, R^2 = Crotyl
9 $R^1 = R^3$ = Ac, R^2 = Crotyl
10 R^1 = Crotyl, $R^2 = R^3 = H$

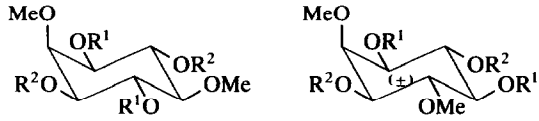
11 $R^1 = H$, R^2 = Allyl
12 R^1 = Bn, R^2 = Allyl
13 $R^1 = H$, R^2 = Crotyl
14 R^1 = Bn, R^2 = Crotyl

15 R = H
16 R = (−)-camphanoyl
17 R = (+)-camphanoyl



18 $R^1 = H$, R^2 = Crotyl
19 R^1 = Me, R^2 = Crotyl

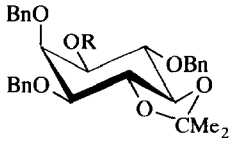
20 $R^1 = H$, R^2 = Crotyl
21 R^1 = Me, R^2 = Crotyl



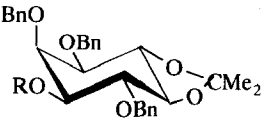
22 $R^1 = H$, R^2 = Bn
23 $R^1 = R^2 = H$
24 $R^1 = R^2$ = Ac

25 $R^1 = H$, R^2 = Bn
26 $R^1 = R^2 = H$
27 $R^1 = R^2$ = Ac

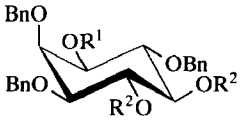
* In the formulae, racemic inositol derivatives are indicated with (±) in the ring; chiral inositol derivatives, represented in their correct absolute configurations, are shown with thickened lines in the ring, and *meso*-compounds are shown with neither of these modifications.



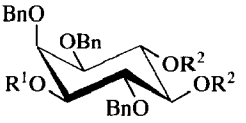
17 → **28** R = (+)-camphanoyl
29 R = (−)-camphanoyl
30 R = H
31 R = Allyl
32 R = pMeOBn



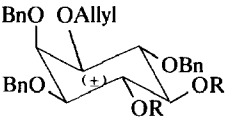
16 → **33** R = (−)-camphanoyl
34 R = H
35 R = pMeOBn
36 R = Allyl



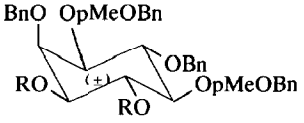
37 $R^1 = R^2 = H$
38 R^1 = Allyl, $R^2 = H$
39 R^1 = Allyl, R^2 = Ac
40 R^1 = Propenyl, $R^2 = H$
41 R^1 = Propenyl, R^2 = Ac
42 R^1 = pMeOBn, $R^2 = H$
43 R^1 = pMeOBn, R^2 = (−)-camphanoyl
44 R^1 = pMeOBn, R^2 = Ac



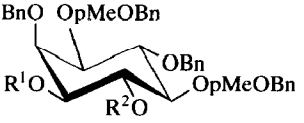
45 $R^1 = R^2 = H$
46 R^1 = Allyl, $R^2 = H$
47 R^1 = Allyl, R^2 = Ac
48 R^1 = pMeOBn, $R^2 = H$
49 R^1 = pMeOBn, R^2 = Ac
50 R^1 = pMeOBn, R^2 = (−)-camphanoyl



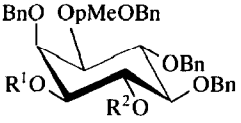
51 R = H
52 R = Ac



53 R = H
54 R = (−)-camphanoyl



55 $R^1 = R^2$ = (−)camphanoyl
56 $R^1 = R^2 = H$
57 R^1 = Bn, $R^2 = H$
58 R^1 = Bn, R^2 = Ac
59 R^1 = H, R^2 = Bn



60 $R^1 = R^2 = H$
61 R^1 = Bn, $R^2 = H$

For this purpose, crude **29** was converted through the alcohol **30** into the crude allyl ether **31** which was hydrolysed with dilute acid to give the crude diol **38**. We have shown[13] that the chiral allyl ether **46** (the enantiomer of **38**) is readily crystalline, whereas the racemate **51** was obtained as a syrup. Therefore, recrystallisation of crude **38** gave the enantiomerically pure diol **38** since the racemate remained in the mother liquors as a syrup. The enantiomeric purity was established by comparison of the optical rotations of **38** and its diacetate **39** with those[13] of the enantiomer **46** and its diacetate **47**, and also by ^{1}H NMR spectroscopic studies (at 200 MHz) of the chiral (**39** and **47**) and racemic (**52**) diacetates in the presence of the chiral shift reagent tris[3-(heptafluoropropylhydroxymethylene)-(+)-camphorato]europium(III) [Eu(hfc)$_3$, Aldrich] at different concentrations.

The pure chiral allyl ether **38** was converted into the crystalline *cis*-prop-1-enyl ether **40** by the action[14] of potassium *tert*-butoxide in methyl sulphoxide, and acid hydrolysis of **40** gave 1D-2,3,6-tri-*O*-benzyl-*myo*-inositol (**37**) identical with the compound described[1].

The crude (−)-ω-camphanate **29** was also converted via the alcohol **30** into the crude *O*-*p*-methoxybenzyl derivative **32** which was hydrolysed to give the crude diol **42**. The crude mixture of diastereoisomeric bis-(−)-ω-camphanates **43**, obtained from **42**, was recrystallised to give the pure diastereoisomer **43**, as established by conversion into the diol **42** and its diacetate **44** and comparison of these with the enantiomers **48** and **49** prepared via the alcohol[13] **34**. De-*p*-methoxybenzylation[15] of **42** gave the enantiomerically pure triol **37** identical with the material described above.

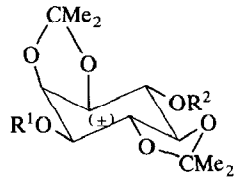
Again, before (+)-ω-camphanic acid became available, we investigated a further route for the preparation of **37**. We have shown[6] that crystallisation of the mixed diastereoisomeric bis-(−)-ω-camphanates **54** of the racemic diol **53** gave the pure diastereoisomer **55** in good yield and saponification of this isomer gave[6] the chiral diol **56**. We have also shown[1] that tin-mediated benzylation of the chiral diol **60** (an analogue of **56**) gave **61** in high yield. Therefore, the tin-mediated benzylation of **56** was investigated and this produced **57** in good yield together with a small proportion of the regioisomer **59**. De-*p*-methoxybenzylation of **57** gave the chiral triol **37** identical with the material described above.

Because of the success achieved[1] in the resolution of the alcohol **15** by crystallisation of the (−)- and (+)-ω-camphanates (**16** and **17**), we investigated similar resolutions of analogues (**68**–**70**) of **15** in which one of the *O*-benzyl groups was replaced by an *O*-*p*-methoxybenzyl group since, if successful, the pure chiral products would be useful for the synthesis of other inositol phosphates of the phosphatidylinositol cycle.

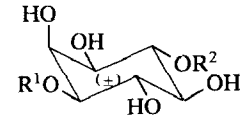
For this purpose, the *p*-methoxybenzyl ether[9] **64** was prepared from **62** (refs. 9 and 16) and converted into **66**. Tin-mediated crotylation of **66** gave the crotyl ether **76**, which was converted via **71** into **68** as described for the preparation of **15**. Likewise, **65** (ref. 16) was converted via **67**, **77**, and **72** into **69**, and **13** was converted via **75** into **70**.

The ω-camphanates of the alcohol **68** behaved as did those of **15**, and thus the (+)-ω-camphanate **79** and the (−)-ω-camphanate **81** were obtained readily by crystallisation in the same way[1] as for the preparation of **28** and **33**.

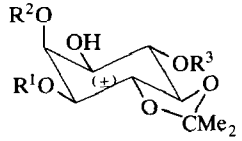
We have not been able to separate the diastereoisomeric camphanates of the alcohols **69** and **70** by crystallisation. However the mixed, syrupy diastereoisomeric (−)-ω-camphanates (**94**) of **69** were converted through the diols **93** into the diacetates **95**, and crystallisation of the mixed diastereoisomeric diacetates **95** gave



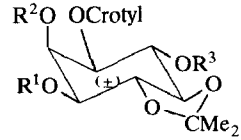
62 R^1 = pMeOBn, R^2 = H
63 R^1 = H, R^2 = pMeOBn
64 R^1 = pMeOBn, R^2 = Bn
65 R^1 = Bn, R^2 = pMeOBn



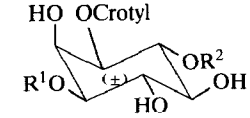
66 R^1 = pMeOBn, R^2 = Bn
67 R^1 = Bn, R^2 = pMeOBn



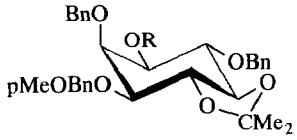
68 R^1 = pMeOBn, R^2 = R^3 = Bn
69 R^1 = R^2 = Bn, R^3 = pMeOBn
70 R^1 = R^3 = Bn, R^2 = pMeOBn



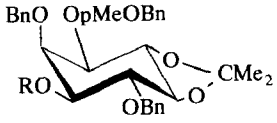
71 R^1 = pMeOBn, R^2 = R^3 = Bn
72 R^1 = R^2 = Bn, R^3 = pMeOBn
73 R^1 = pMeOBn, R^2 = H, R^3 = Bn
74 R^1 = Bn, R^2 = H, R^3 = pMeOBn
75 R^1 = R^3 = Bn, R^2 = pMeOBn



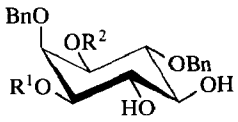
76 R^1 = pMeOBn, R^2 = Bn
77 R^1 = Bn, R^2 = pMeOBn



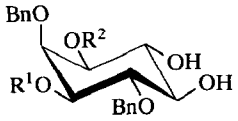
78 R = (−)-camphanoyl
79 R = (+)-camphanoyl
80 R = H



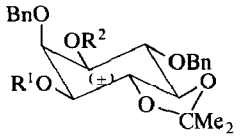
81 R = (−)-camphanoyl
82 R = H
83 R = Allyl



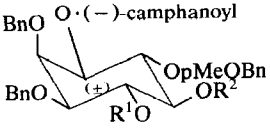
84 R^1 = pMeOBn, R^2 = H
85 R^1 = R^2 = H



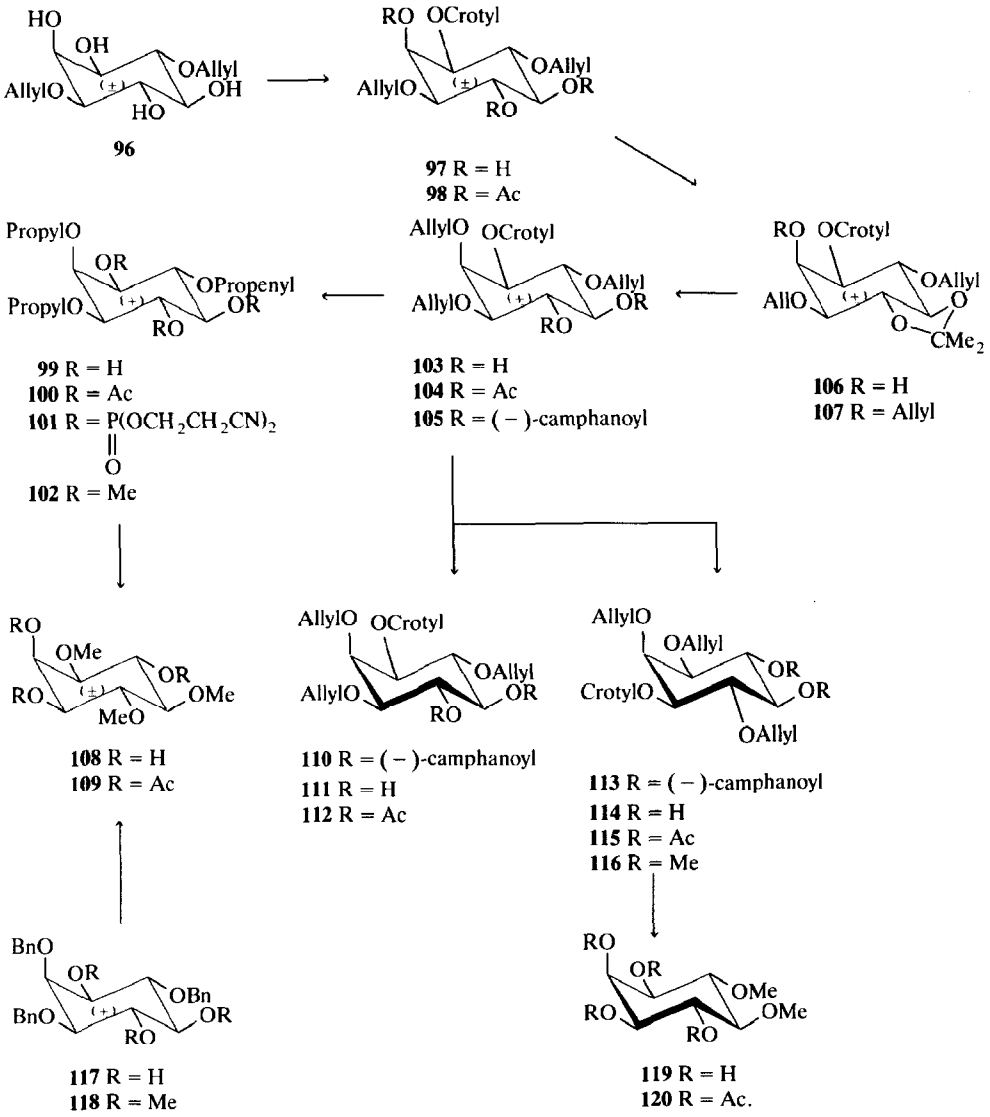
86 R^1 = H, R^2 = pMeOBn
87 R^1 = R^2 = H
88 R^1 = Allyl, R^2 = pMeOBn
89 R^1 = Allyl, R^2 = H



90 R^1 = R^2 = H
91 R^1 = R^2 = pMeOBn
92 R^1 = H, R^2 = pMeOBn



93 R^1 = R^2 = H
94 R^1, R^2 = CMe_2
95 R^1 = R^2 = Ac.



a pure diastereoisomer (as observed from the ^{1}H NMR spectrum) whose absolute configuration was not established.

Saponification of the (−)-ω-camphanate **81** gave the alcohol **82** which, on acid hydrolysis, gave the triol **86** and this on de-*p*-methoxybenzylation gave the known[6] 1D-2,4-di-*O*-benzyl-*myo*-inositol (**87**), thus establishing the absolute configuration of **81** (and **79**).

Similar reactions with **79** will give the enantiomers **84** and **85**, which are suitable intermediates for the synthesis of 1D-*myo*-inositol 1,4,5-tris- (**3**) and 1,3,4,5-tetrakis-phosphate (**4**), respectively. The triol **84** is also required as an intermediate for the synthesis of a 3-phosphorothioate analogue (**5**) of D-*myo*-inositol 1,3,4,5-tetrakisphosphate and possibly also of a 3-^{3}H-analogue of D-*myo*-inositol 1,4,5-trisphosphate (**3**).

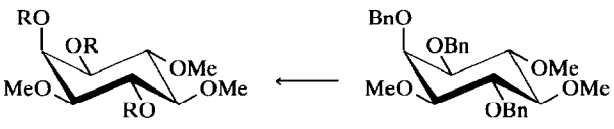
Because the chiral alcohols **80** and **82** are therefore readily available by the resolution of **68** and as they are potentially valuable intermediates for the synthesis of other inositol phosphates of the phosphatidylinositol cycle, a more direct route for the synthesis of **68** was investigated. The racemic diol **90** is readily available[6] from racemic 2,4-di-*O*-benzyl-*myo*-inositol. Partial *p*-methoxybenzylation of **90** gave **68** in moderate yield and this was readily separable from the other products **91** and **92** by column chromatography.

Allylation of the chiral alcohols **82** gave **83** which gave **88** on acid hydrolysis, and de-*p*-methoxybenzylation of **88** gave 1L-1-*O*-allyl-2,6-di-*O*-benzyl-*myo*-inositol (**89**). Compound **89** is being used as a model for the investigation of the synthesis of phosphatidylinositol 3,4,5-trisphosphate (**2**) which is of considerable biological interest[17].

As an alternative intermediate for the synthesis of D-*myo*-inositol 1,4,5-trisphosphate (**3**), we considered a compound such as **101** where the hydroxyl groups are protected as prop-1-enyl ethers and the phosphate groups are protected as 2-cyanoethyl esters. With **101**, a mild hydrolysis with alkali (to remove the 2-cyanoethyl esters) followed by a mild hydrolysis with acid (to remove the prop-1-enyl ethers) would afford a simple method of deprotection. We therefore investigated the synthesis of the racemic intermediate **99** and the resolution of **103** to see if this was a practical route.

Racemic 1,4-di-*O*-allyl-*myo*-inositol[5,8] (**96**) was converted by tin-mediated crotylation into crystalline **97** which gave a crystalline triacetate **98**. The triol **97** was converted into the *O*-isopropylidene derivative **106** and this gave the triallyl ether **107** which, on acid hydrolysis, gave the diol **103** that gave a crystalline diacetate **104**. Treatment of **103** with potassium *tert*-butoxide in methyl sulphoxide removed[10,11] the crotyl ether and isomerised[14] the allyl ethers to give racemic 1,2,4-tri-*O*-(*cis*-prop-1-enyl)-*myo*-inositol (**99**) (which gave a crystalline triacetate **100**), thus establishing the practicality of the route.

In order to confirm the structure of **99**, it was converted into the trimethyl ether **102** which, on acid hydrolysis, gave racemic 1,4,5-tri-*O*-methyl-*myo*-inositol (**108**) identical with the compound prepared by the methylation and subsequent hydrogenolysis of known[9,18] racemic 1,2,4-tri-*O*-benzyl-*myo*-inositol (**117**). The chiral 1L-1,4,5-tri-*O*-methyl-*myo*-inositol (**121**) was also prepared from the known[13] 1D-1,2,4-tri-*O*-benzyl-*myo*-inositol (**45**) via **123**.



121 R = H
122 R = Ac

123

The diol **103** was converted into the mixture of diastereoisomeric bis-(−)-ω-camphanates **105**, which were resolved by TLC and separated by column chromatography to give the crystalline diastereoisomers **110** and **113**. Alkaline hydrolysis of **110** and **113** gave the diols **111** and **114**, which gave crystalline diacetates **112** and **115**, respectively.

The absolute configuration of **114** was established by conversion into the dimethyl ether **116** and subsequent deallylation–decrotylation, using[19] Pd/C, to give the known[1] 1D-5,6-di-*O*-methyl-*myo*-inositol (**119**), thus establishing the practicality of the route for the preparation of chiral materials.

EXPERIMENTAL

General.—The general methods were as described[1,5]

*(±)-1,4-Di-*O*-benzyl-3-*O*-(but-2-enyl)-* (**8**), *(±)-1,4-di-*O*-benzyl-3,6-di-*O*-(but-2-enyl)-* (**18**), *and (±)-1,4-di-*O*-benzyl-3,5-di-*O*-(but-2-enyl)-*myo*-inositol* (**20**).—A mixture of racemic 1,4-di-*O*-benzyl-*myo*-inositol[12] (**6**; 12 g, 33.3 mmol), dibutyltin oxide (8.3 g, 33.3 mmol), tetrabutylammonium bromide (10.8 g, 33.5 mmol), and acetonitrile (300 mL) was stirred and heated under reflux with a Soxhlet apparatus containing molecular sieve 3A (20 g) for 8 h. Crotyl bromide (5.5 mL, 53 mmol) was added, and boiling under reflux was continued for 10 h; TLC (ether) of the clear solution then showed complete conversion of **6** (R_F 0) into major (R_F 0.25) and minor (R_F 0.3, 0.75, and 0.85) products. The solution was cooled, the solvent evaporated, and the residue distributed between ether (100 mL) and water (100 mL). The layers were separated and the aqueous layer was extracted with ether (2 × 100 mL) to obtain more of the product R_F 0.25. The combined ether layers were stirred with satd aq $NaHCO_3$ (50 mL) containing solid $NaHCO_3$ (10 g) for 1 h and the mixture was filtered through Celite. The ether layer was separated, dried (K_2CO_3), and concentrated to give a crystalline product (11.6 g). Recrystallisation from EtOAc–light petroleum (2:1) gave **8** (6.1 g, R_F 0.25). Column chromatography of the contents of the mother liquors separated the minor products (see below) and gave more (2.25 g) **8**. The product **8** (8.3 g, 60%) had mp 109–111°. ^{1}H NMR data: δ 1.70 (d, *J* 4.9 Hz, =CH*Me*), 3.17, 3.20, 3.23, 3.27, 3.30, 3.33, 3.37, 3.47, 3.65, 3.75, 3.86, 3.96, 4.04, 4.10, 4.18, 4.21, 4.24 (m, 6 ring H and $-OCH_2CH=$), 4.71 (s, CH_2Ph), 4.83 (ABq, CH_2Ph), 5.56–5.68 (m, 2 H, –CH=CH–), 7.34 (s, aromatic) (Found: C, 69.25; H, 7.43. $C_{24}H_{30}O_6$. Calcd C, 69.54; H, 7.30%).

Compound **8** gave the 2,5,6-triacetate **9**, mp 103–105° (from light petroleum–EtOAc, 8:1). ^{1}H NMR data: δ 1.70 (d, *J* 4.9 Hz, =CH*Me*), 1.91, 1.98, 2.18 (3 s, 3 Ac), 3.33–3.52 (m, H-1,3), 3.82 (t, *J* 9.5 Hz, H-4), 3.96–4.33 (m, $-OCH_2CH=$), 4.63 (2ABq, $2CH_2Ph$), 5.01 (t, *J* 9.7 Hz, H-5), 5.32 (t, *J* 9.9 Hz, H-6), 5.58–5.72 (m, –CH=CH–), 5.75 (t, *J* 2.7 Hz, H-2), 7.28 (s, aromatic) (Found: C, 66.19; H, 6.79. $C_{30}H_{36}O_9$. Calcd C, 66.65; H, 6.71%).

The minor product **18** (1 g, R_F 0.85) formed in the crotylation reaction had mp

82–84° (from light petroleum–EtOAc, 10:1) (Found: C, 71.45; H, 7.91. $C_{28}H_{36}O_6$. Calcd C, 71.77; H, 7.74%).

Compound **18** was treated with MeI and NaH in *N,N*-dimethylformamide in the usual way, and the product **19** was decrotylated with 10% Pd/C, as described[5] for related compounds, to give the diol **22**, mp 131–134° (from light petroleum–EtOAc, 3:1) (Found: C, 67.83; H, 7.28. $C_{22}H_{28}O_6$. Calcd C, 68.02; H, 7.27%).

Hydrogenolysis of the diol **22** gave 2,5-di-*O*-methyl-*myo*-inositol (**23**), mp 271–272° (from EtOH), identical with that described[5], which gave the 1,3,4,6-tetra-acetate **24**, mp 151–152°, with a ^{1}H NMR spectrum identical with that described[5], thus establishing the structure of **18** (R_F 0.85).

The syrupy minor product **20** (1.2 g, R_F 0.75) was methylated and the product **21** was decrotylated (as described above for the product R_F 0.85) to give the diol **25**, mp 153–155° (from light petroleum–EtOAc, 5:2) (Found: C, 67.70; H, 7.29. $C_{22}H_{28}O_6$. Calcd C, 68.02; H, 7.27%).

Hydrogenolysis of **25** gave racemic 2,4-di-*O*-methyl-*myo*-inositol (**26**), mp 193–194° (from EtOH), identical with that described[5]; **26** gave the 1,3,5,6-tetra-acetate **27**, mp 176–178°, identical with that described[5], which had a ^{1}H NMR spectrum identical with that of the known[16] chiral derivative, thus establishing the structure of **20** (R_F 0.75).

The minor product (R_F 0.3, 0.5 g) was not further investigated, but was assumed to be the crotyl ether **10**.

(±)-1,2,4-Tri-O-*benzyl-3*-O-*(but-2-enyl)-5,6*-O-*isopropylidene*-myo-*inositol* (**14**). —A solution of **8** (23 g) in acetone (200 mL) and 2,2-dimethoxypropane (100 mL) containing toluene-*p*-sulphonic acid (500 mg) was kept at 20° for 2 h. TLC (ether) then showed almost complete conversion of **8** (R_F 0.25) into the *O*-isopropylidene derivative **13** (R_F 0.9). Triethylamine (1 mL) and $NaHCO_3$ (1 g) were added and the solvents were evaporated. The product was extracted from the residue with ether and subjected to column chromatography (ether–light petroleum, 2:1) to give **13** (21 g) as a syrup. ^{1}H NMR data: δ 1.46 (s, CMe_2), 1.69 (d, J 4.9 Hz, =CH*Me*), 2.62 (s, OH), 4.79, 4.82 (2 ABq, 2 CH_2Ph), 5.64 (m, –CH=CH–), 7.36 (s, aromatic). This syrup was treated conventionally with benzyl bromide and NaH in *N,N*-dimethylformamide, and TLC (ether–light petroleum, 1:2) showed conversion of **13** (R_F 0.25) into **14** (R_F 0.7). The product was isolated in the usual way and column chromatography (light petroleum–ether, 4:1 then 3:1) gave **14** (23.5 g), mp 59–60° (from light petroleum). ^{1}H NMR data: δ 1.45 (s, CMe_2), 1.69 (d, J 4.88 Hz, =CH*Me*), 4.72 (ABq, CH_2Ph), 4.83 (s, 2 CH_2Ph), 7.23–7.33 (m, aromatic) (Found: C, 74.74; H, 7.59. $C_{34}H_{40}O_6$. Calcd C, 74.97; H, 7.40%).

(±)-1,2,4-Tri-O-*benzyl-5,6*-O-*isopropylidene*-myo-*inositol*[8,9] (**15**).—A solution of **14** (22 g) and potassium *tert*-butoxide (8 g) in dry Me_2SO (200 mL) was kept at 20° with exclusion of moisture and CO_2 for 4 h. TLC (ether–light petroleum, 1:2) then showed complete conversion of **14** (R_F 0.7) into the alcohol **15** (R_F 0.3). The solution was poured into ice-cold, semi-satd aq KCl and the product was extracted with ether. The ether solution was dried (K_2CO_3), the solvent was evaporated, and

column chromatography (ether–light petroleum, 1:1) of the residue gave the alcohol **15** (17 g), mp 76–77°, identical with the material described previously[9]. ^{1}H NMR data: δ 1.46 (s, CMe_2), 2.41 (d, J 6.1 Hz, OH), 4.57, 4.60, 4.71, 4.73, 4.81, 4.86, 4.93, 4.95, 4.99 (m, 3 CH_2Ph), 7.30 (s, aromatic).

1D-1-O-Allyl-2,3,6-tri-O-benzyl-myo-*inositol* (**38**) *and the 4,5-diacetate* (**39**).—The crude (−)-ω-camphanate (**29**) left in the mother liquors after the removal[1,13] of the crystalline (−)-ω-camphanate **33** (and still containing some **33**) was saponified (as described[13] for **33**) to give the crude alcohol **30**, which was converted into the crude allyl ether **31** in the usual way. Deacetonation of **31** (as described[13] for **36**) gave the crude diol **38**, recrystallisation of which from light petroleum–EtOAc (25:1) gave **38**, mp 95–97°, $[\alpha]_D^{25}$ +19.5° (*c* 1, $CHCl_3$). ^{1}H NMR data: δ 3.13–3.50 (m, 3 ring protons), 3.77–4.13 (m, 3 ring protons and $-OCH_2CH=$), 4.58 (s, CH_2Ph), 4.81, 4.87 (2 ABq, 2 CH_2Ph), 5.12–5.41 (m, $=CH_2$), 5.72–6.08 (m, $-CH_2CH=$), 7.31–7.47 (m, aromatic) (Found: C, 72.40; H, 6.97. $C_{30}H_{34}O_6 \cdot 0.5H_2O$. Calcd C, 72.12; H, 7.06%) {lit.[13], mp 96–98°, $[\alpha]_D^{25}$ −20.5° (*c* 1, $CHCl_3$) for the enantiomer **46**}.

The diacetate (**39**) of **38** had mp 132–133°, $[\alpha]_D^{27}$ +41° (*c* 1, $CHCl_3$). ^{1}H NMR data: δ 1.89, 1.98 (2 s, 2 Ac), 3.23–3.46 (m, H-1,3), 3.93–4.13 (m, H-2,4 and $-OCH_2CH=$), 4.50 (s, CH_2Ph), 4.72 (ABq, CH_2Ph), 4.85 (s, CH_2Ph), 4.99 (t, J 9.8 Hz, H-5), 5.10–5.35 (m, $=CH_2$), 5.53 (t, J 9.8 Hz, H-6), 5.78–5.98 (m, $-OCH_2CH=$), 7.25–7.39 (m, aromatic) (Found: C, 71.19; H, 6.69. $C_{34}H_{38}O_8$. Calcd C, 71.06; H, 6.67%).

*1D-2,3,6-Tri-O-benzyl-1-O-(*cis*-prop-1-enyl)*-myo-*inositol* (**40**) *and the 4,5-diacetate* (**41**).—A solution of the allyl ether **38** (2 g) and potassium *tert*-butoxide (3.5 g) in dry Me_2SO (30 mL) was kept at 50° for 4 h. A portion of the solution was diluted with semi-satd aq KCl and the precipitated product was extracted with ether and treated with acetone–M HCl (10:1) at reflux for 20 min. TLC (ether–CH_2Cl_2, 9:1) then showed complete conversion of **38** (R_F 0.7) into a product (R_F 0.6, co-chromatographing with **37**), indicating that the isomerisation of the allyl group into the prop-1-enyl group was complete. The reaction mixture was poured into ice–water and the crystalline product (2 g) was filtered off, washed with water, and dried to give **40**, mp 114–115° (from light petroleum containing a little triethylamine), $[\alpha]_D^{25}$ +33° (*c* 1, $CHCl_3$). ^{1}H NMR data: δ 1.67 (dd, J 1.2 and 6.7 Hz, $=CHMe$), 4.55, 4.77 (2 ABq, 2 CH_2Ph), 4.84 (s, CH_2Ph), 6.07 (dd, J 1.8 and 6.1 Hz, $-OCH=$), 7.31–7.74 (m, aromatic) (Found: C, 73.41; H, 7.05. $C_{30}H_{34}O_6$. Calcd C, 73.44; H, 6.99%).

The diacetate (**41**) of **40** had mp 154–155° (from light petroleum–EtOAc, 10:1, containing a little pyridine), $[\alpha]_D^{25}$ +49° (*c* 1, $CHCl_3$). ^{1}H NMR data: δ 1.68 (dd, J 1.83 and 6.71 Hz, $=CHMe$), 1.91, 1.98 (2 s, 2 Ac), 3.43, 3.59 (2 dd, J 2.44 and 9.8 Hz, H-1,3), 4.07 (t, J 2.44 Hz, H-2), 4.09 (t, J 9.8 Hz, H-6), 4.49, 4.66 (2 ABq, 2 CH_2Ph), 4.86 (s, CH_2Ph), 5.01 (t, J 9.8 Hz, H-5), 5.54 (t, J 9.8 Hz, H-4), 6.06 (dd, J 1.83 and 6.10 Hz, $-OCH=$), 7.27–7.45 (m, aromatic) (Found: C, 70.96; H, 6.69. $C_{34}H_{38}O_8$. Calcd C, 71.06; H, 6.67%).

1D-5,6-Di-O-acetyl-3-O-allyl-1,2,4-tri-O-benzyl-myo-*inositol* (**47**).—The chiral diol[13] (**46**) gave the diacetate **47**, mp 133–134° (from light petroleum–EtOAc, 10:1), $[\alpha]_D^{25}$ −42° (*c* 1, $CHCl_3$), with ^1H NMR data identical to those described above for the enantiomer **39** (Found: C, 70.96; H, 6.79. $C_{34}H_{38}O_8$. Calcd C, 71.06; H, 6.67%).

200-MHz ^1H NMR spectra of the diacetates **39**, **47**, *and* **52** *in the presence of Eu(hfc)$_3$*.—The racemic diacetate[13] **52** had a 90-MHz ^1H NMR spectrum identical to that described above for the chiral derivative **39**. In the 200-MHz ^1H NMR spectrum of **52** in the presence of $Eu(hfc)_3$ at a ratio of 20:1 [(w/w) **52**: $Eu(hfc)_3$], the ABq system centred at 4.72 ppm showed signs of splitting and the triplet originally centred at 4.99 ppm had moved downfield to 5.12 ppm (where it partially overlapped the $=CH_2$ signals) and showed splitting of ~4 Hz. With a ratio of 8:1, the ABq system originally centred at 4.72 ppm had moved downfield to 4.80 ppm and showed splitting of ~4 Hz, and the triplet originally centred at 4.99 ppm overlapped the $=CH_2$ signals around 5.2 ppm and was therefore not of diagnostic value. With the chiral diacetates **39** and **47**, single signals were observed at these positions [those downfield in the ABq system (4.80 ppm) were due to 1D-4,5-di-*O*-acetyl-1-*O*-allyl-2,3,6-tri-*O*-benzyl-*myo*-inositol (**39**)], thus indicating the chiral purity of these compounds.

1D-1,2,4-Tri-O-benzyl-3-O-p-methoxybenzyl-myo-*inositol* (**48**).—The alcohol[13] **34** was converted into the *p*-methoxybenzyl ether **35** in the usual way, and the product was treated with acetone–MeOH–M HCl (5:5:1) at 20° for 2 h when TLC (ether) showed complete conversion of **35** (R_F 1.0) into the diol **48** (R_F 0.7). An excess of $NaHCO_3$ was added and the solvents were evaporated. Extraction of the residue with CH_2Cl_2 gave **48**, mp 106–107° (from light petroleum–EtOAc, 6:1), $[\alpha]_D^{25}$ −15.3° (*c* 1, $CHCl_3$). ^1H NMR data: δ 3.09–3.51 (m, 3 H), 3.79 (s, OMe), 3.89–4.13 (m, 3 H), 4.54 (s, 2 CH_2Ph), 4.81 (s, CH_2Ph), 4.85 (ABq, CH_2Ph), 6.79–7.30 (m, aromatic) (Found: C, 71.29; H, 6.54. $C_{35}H_{38}O_7 \cdot H_2O$. Calcd C, 71.41; H, 6.85%).

The 5,6-diacetate (**49**) of **48** had mp 125–126° (from light petroleum–EtOAc, 4:1), $[\alpha]_D^{25}$ −36° (*c* 1, $CHCl_3$). ^1H NMR data: δ 1.89, 1.97 (2 s, 2 Ac), 3.36 (dd, *J* 1.8 and 9.7 Hz, H-1,3), 3.81 (s, OMe), 3.96–4.17 (m, H-2,4), 4.48 (ABq, CH_2Ph), 4.52 (s, CH_2Ph), 4.73 (ABq, CH_2Ph), 4.84 (s, CH_2Ph), 4.99 (t, *J* 9.5 Hz, H-5), 5.53 (t, *J* 10 Hz, H-6), 6.78–7.47 (m, aromatic) (Found: C, 71.59; H, 6.42. $C_{39}H_{42}O_9$. Calcd C, 71.54; H, 6.47%).

1D-1,2,4-Tri-O-benzyl-5,6-di-O-[(−)-ω-camphanoyl]-3-O-p-methoxybenzyl-myo-*inositol* (**50**).—A solution of the diol **48** in toluene was concentrated in order to remove water, and the product was converted in the usual way into the bis-(−)-ω-camphanate **50**, mp 172–175°, $[\alpha]_D^{25}$ −19.3° (*c* 1, $CHCl_3$). ^1H NMR data: δ 0.80 (6 H), 0.96 (6 H), 1.04 (6 H) (3 s, 6 CMe of the camphanates), 3.79 (s, OMe), 4.47 (s, 2 CH_2Ph), 4.80 (ABq, CH_2Ph), 4.83 (s, CH_2Ph), 5.28 (t, *J* 9.15 Hz, H-5), 5.68 (t, *J* 9.16 Hz, H-6), 6.75–7.34 (m, aromatic) (Found: C, 71.07; H, 6.81. $C_{55}H_{62}O_{13}$. Calcd C, 70.95; H, 6.71%).

1D-2,3,6-Tri-O-benzyl-4,5-di-O-[(−)-ω-camphanoyl]-1-O-p-methoxybenzyl-myo-inositol (**43**).—The crude syrupy (−)-ω-camphanate **29** (containing some **33**) was saponified to give the crude alcohol **30**, which was converted into the crude *p*-methoxybenzyl ether **32** in the usual way. Deacetonation of **32** (as described above for the preparation of **48**) gave the crude diol **42** (containing some **48**) and this was converted into the crude bis-(−)-ω-camphanate **43**. The ^{1}H NMR spectrum showed peaks in the CMe region of the camphanate portion mainly due to **43** (see below) together with small peaks due to **50** (see above). Crystallisation from MeOH gave **43**, mp 111–112°, $[\alpha]_D^{25}$ +13.1° (*c* 1, $CHCl_3$). ^{1}H NMR data: δ 0.74 (3 H), 0.76 (3 H), 0.90 (3 H), 0.93 (3 H), 1.02 (6 H) (5 s, 6 CMe of the camphanates), 3.79 (s, OMe), 4.48 (s, 2 CH_2Ph), 4.82 (ABq, CH_2Ph), 4.84 (s, CH_2Ph), 5.33 (t, *J* 9.2 Hz, H-5), 5.75 (t, *J* 9.6 Hz, H-6), 6.75–7.42 (m, aromatic) (Found: C, 70.70; H, 6.75. $C_{55}H_{62}O_{13}$. Calcd C, 70.95; H, 6.71%).

1D-2,3,6-Tri-O-benzyl-1-O-p-methoxybenzyl-myo-inositol (**42**).—Saponification of the pure camphanate **43** gave the diol **42**, mp 105–106° (from light petroleum–EtOA, 10:1), $[\alpha]_D^{25}$ +15.5° (*c* 1, $CHCl_3$), with a ^{1}H NMR spectrum identical with that of the enantiomer **48** (Found: C, 73.56; H, 6.55. $C_{35}H_{38}O_7$. Calcd C, 73.66; H, 6.71%).

The 4,5-diacetate (**44**) of **42** had mp 125–126° (from light petroleum–EtOAc, 10:1), $[\alpha]_D^{25}$ +34.7° (*c* 1, $CHCl_3$), with a ^{1}H NMR spectrum identical with that of the enantiomer **49** (Found: C, 71.60; H, 6.54. $C_{39}H_{42}O_9$. Calcd C, 71.54; H, 6.47%).

1D-2,3,6-Tri-O-benzyl-1,5-di-O-p-methoxybenzyl-myo-inositol (**57**).—A mixture of the chiral diol[6] **56** (700 mg), dibutyltin oxide (434 mg), tetrabutylammonium bromide (562 mg), and benzyl bromide (0.5 mL) in acetonitrile (50 mL) was heated under reflux for 24 h with molecular sieve 3A present in a Soxhlet thimble. TLC (ether–light petroleum, 1:1) then showed conversion of **56** (R_F 0) into a product (R_F 0.5). The product was isolated in the usual way[1] and crystallisation from EtOH gave **57** (750 mg), mp 78–79°, $[\alpha]_D^{25}$ +10.7° (*c* 1, $CHCl_3$). ^{1}H NMR data: δ 2.45 (d, *J* 1.8 Hz, OH), 2.83–3.43 (m, 3 H), 3.77–3.80 (2 s, 2 OMe), 3.84–4.27 (m, 3 H), 4.56 (s, 2 CH_2Ph), 4.56–4.87 (m, 3 CH_2Ph), 6.78–7.30 (m, aromatic) (Found: C, 74.87; H, 6.76. $C_{43}H_{46}O_8$. Calcd. C, 74.76; H, 6.71%).

Compound **57** gave the 4-acetate **58**, mp 129–130° (from light petroleum–EtOAc, 10:1), $[\alpha]_D^{25}$ +7.4° (*c* 1, $CHCl_3$). ^{1}H NMR data: δ 1.94 (s, Ac), 3.18–3.38 (2 dd, H-1,3), 3.41 (t, *J* 9.2 Hz, H-5), 3.77, 3.81 (2 s, 2 OMe), 3.98 (H-2), 4.01 (t, *J* 9.8 Hz, H-4), 4.47 (ABq, CH_2Ph), 4.54 (s, CH_2Ph), 4.65 (ABq, CH_2Ph), 4.84–4.86 (m, 2 CH_2Ph), 5.62 (t, *J* 9.7 Hz, H-6), 6.76–7.30 (m, aromatic) (Found: C, 73.64; H, 6.56. $C_{45}H_{48}O_9$. Calcd C, 73.75; H, 6.60%).

1D-2,3,6-Tri-O-benzyl-myo-inositol[1] (**37**).—(*a*) A solution of the prop-1-enyl ether **40** (1 g) in M HCl–acetone (1:10, 40 mL) was kept at 50° for 1 h. Sodium hydrogen carbonate (1 g) was added, the solution concentrated, and the residue extracted with CH_2Cl_2. The solution was dried (K_2CO_3) and evaporated to give **37**

(920 mg), mp 122–123°, $[\alpha]_D^{25}$ +10° (*c* 1, $CHCl_3$), with a ^1H NMR spectrum identical with that described[1].

(*b*) The *O*-*p*-methoxybenzyl derivative **42** was treated with dichlorodicyanobenzoquinone in CH_2Cl_2–water (10:1) in the usual way[6]. TLC (EtOAc–light petroleum 1:1) showed conversion of **42** (R_F 0.4) into a product (R_F 0.3) which was isolated in the usual way. Crystallisation from ether gave **37** identical with the material described in (*a*).

(*c*) A mixture of the di-*O*-*p*-methoxybenzyl ether **57** (480 mg) and dichlorodicyanobenzoquinone (402 mg) was stirred in CH_2Cl_2–water (20:1, 20 mL) for 6 h, when TLC ($CHCl_3$–MeOH, 15:1) showed conversion of **57** (R_F 1.0) into major (R_F 0.7) and minor products (R_F 0.45 and 0.3, which co-chromatographed with 1,4-di-*O*-benzyl-[12] and 2,4-di-*O*-benzyl-*myo*-inositol[6], respectively), indicating partial debenzylation. The products were isolated in the usual way and column chromatography (ether) gave **37** identical with the material described in (*a*).

*(±)-3-*O-p-*Methoxybenzyl-1,2 : 4,5-di-*O-*isopropylidene-*myo-*inositol*[9] **(62).**—Compound **62** was prepared as described[9] and had ^1H NMR data: δ 1.34, 1.46, 1.48, 1.53 (4 s, 2 CMe_2), 2.77 (d, *J* 2.44 Hz, OH), 3.81 (s, OMe), 4.78 (ABq, CH_2Ph). In this preparation, **62** is separated from the regioisomer **63** by crystallisation; **62** and **63** are not resolved by TLC, but their acetates are resolved[16]. The regioisomer[16] **63** had ^1H NMR data: δ 1.36, 1.39, 1.45, 1.46 (4 s, 2 CMe_2), 2.46 (d, *J* 7.9 Hz, OH), 3.79 (s, OMe), 4.74 (s, CH_2Ph). Thus, the singlet at 1.53 and the doublet at 2.77 ppm in the spectrum of **62** and the singlet at 1.39 and doublet at 2.46 ppm in the spectrum of **63** are diagnostic for these compounds in a mixture.

*(±)-6-*O-*Benzyl-1,2 : 4,5-di-*O-*isopropylidene-3-*O-p-*methoxybenzyl-*myo-*inositol*[9] **(64).**—The alcohol **62** was treated with NaH and benzyl bromide in *N*,*N*-dimethylformamide, and the product was isolated in the usual way to give **64**, mp 131–133° (this is a correction of the previous[9] value of 111–113°). ^1H NMR data: δ 1.31, 1.38, 1.46, 1.47 (4 s, 2 CMe_2), 3.20–4.31 (m, 6 ring protons), 3.80 (s, OMe), 4.77 (ABq, CH_2Ph), 4.80 (s, CH_2Ph), 6.82–7.38 (m, aromatic) (Found: C, 68.85; H, 7.25. $C_{27}H_{34}O_7$. Calcd C, 68.91; H, 7.28%).

*(±)-4-*O-*Benzyl-1-*O-p-*methoxybenzyl-*myo-*inositol* **(66).**—A solution of **64** (4.8 g) in MeOH (150 mL) and M HCl (15 mL) was kept at 20° for 10 h. Triethylamine (5 mL) was added, the solution was concentrated, the residue was diluted with water, and the product **66** (3.9 g) was collected by filtration; mp 186–188° (from EtOH) (Found: C, 64.71; H, 6.87. $C_{21}H_{26}O_7$. Calcd C, 64.60; H, 6.71%).

*(±)-4-*O-*Benzyl-3-*O-*(but-2-enyl)-1-*O-p-*methoxybenzyl-*myo-*inositol* **(76).**—The tetraol **66** (3.5 g) was subjected to tin-mediated crotylation, as described for the preparation of **8**, to give **76** (2.57 g, 64%), mp 130–132° (from EtOAc–light petroleum, 8:5). ^1H NMR data: δ 1.7 (d, *J* 4.9 Hz, =CH*Me*), 2.45, 2.59, 2.61 (3 s, 3 OH), 3.17–4.27 (m, 6 ring H and $-OCH_2CH=$), 3.80 (s, OMe), 4.64–5.01 (m, 2 CH_2Ph), 5.61–5.69 (m, –CH=CH–), 6.84–7.34 (m, aromatic) (Found: C, 67.49; H, 7.34. $C_{25}H_{32}O_7$. Calcd C, 67.55; H, 7.26%).

*(±)-2,4-Di-*O*-benzyl-3-*O*-(but-2-enyl)-5,6-*O*-isopropylidene-1-*O*-p-methoxybenzyl-*myo*-inositol* (**71**).—The triol **76** was treated with 2,2-dimethoxypropane and toluene-*p*-sulphonic acid in acetone and the products were isolated in the usual way[1]. TLC (ether–light petroleum, 1:1) showed almost complete conversion of **76** (R_F 0) into major (R_F 0.4) and minor (R_F 0.9) products. Column chromatography (ether–light petroleum, 1:1) gave **73** as a syrup (90%). ^{1}H NMR data: δ 1.45 (s, CMe_2), 1.70 (d, *J* 4.8 Hz, =CH*Me*), 2.58 (s, OH), 3.80 (s, OMe), 4.68, 4.73, 4.79, 4.82 (m, 2 CH_2Ph), 6.81–7.34 (m, aromatic). This syrup was benzylated and the product was isolated in the usual way. Column chromatography (ether–light petroleum, 1:2) gave **71** (94%), mp 69–71° (from light petroleum). ^{1}H NMR data: δ 1.44 (s, CMe_2), 1.70 (d, *J* 4.8 Hz, =CH*Me*), 3.80 (s, OMe), 4.60, 4.68, 4.81, 4.84 (m, 3 CH_2Ph), 6.90–7.36 (m, aromatic) (Found: C, 73.25; H, 7.52. $C_{35}H_{42}O_7$. Calcd C, 73.14; H, 7.37%).

*(±)-2,4-Di-*O*-benzyl-5,6-*O*-isopropylidene-1-*O*-p-methoxybenzyl-*myo*-inositol* (**68**).—(*a*) The crotyl ether **71** (2.2 g) was treated with potassium *tert*-butoxide (1 g) in dry Me_2SO (30 mL) at 50° for 1 h, when TLC (ether–light petroleum, 1:1) showed conversion of **71** (R_F 0.8) into a product (R_F 0.45). The solution was diluted with semi-satd aq KCl (30 mL) and extracted with ether, and the extract was dried (K_2CO_3) and concentrated. Column chromatography (ether–light petroleum, 1:1) of the residue gave **68** (1.79 g, 90%) as a syrup. ^{1}H NMR data: δ 1.46 (s, CMe_2), 2.41 (d, *J* 6.7 Hz, OH), 3.80 (s, OMe), 4.51, 4.58, 4.64, 4.74, 4.86, 4.91, 4.99, 5.04 (m, 3 CH_2Ph), 6.81–7.32 (m, aromatic) (Found: C, 71.48; H, 7.01. $C_{31}H_{36}O_7$. Calcd C, 71.52; H, 6.97%).

(*b*) A mixture of racemic 2,4-di-*O*-benzyl-5,6-*O*-isopropylidene-*myo*-inositol[6] (**90**; 4.28 g, 10.7 mmol) and NaH (720 mg, 30 mmol) in dry *N*,*N*-dimethylformamide (35 mL) was cooled in ice–water with the exclusion of moisture and CO_2. *p*-Methoxybenzyl chloride (1.88 g, 12 mmol) was added and the mixture was stirred for 2 h. TLC (ether–light petroleum, 1:1) then showed partial conversion of **90** (R_F 0) into major (R_F 0.6 and 0.45) and minor (R_F 0.15) products. The products were isolated in the usual way and column chromatography (ether–light petroleum, 1:1) gave presumed **91** (R_F 0.6, 1.28 g), and the product **68** (R_F 0.45, 1.16 g, 21%) identical with the material described in (*a*). Further elution with ether gave presumed **92** (R_F 0.15) and recovered **90**.

*1D-2,4-Di-*O*-benzyl-3-*O*-[(−)-ω-camphanoyl]-5,6-*O*-isopropylidene-1-*O*-p-methoxybenzyl-*myo*-inositol* (**81**).—The racemic alcohol **68** was converted into the mixture of diastereoisomeric (−)-ω-camphanates (**78** and **81**) as described[1] for the preparation of **16**. ^{1}H NMR data: δ 0.79 (3 H), 0.83 (3 H), 0.86 (3 H), 0.94 (3 H), 1.05 (6 H) (5 s, 6 CMe of the camphanates), 1.46 (s, 2 CMe_2), 3.81 (s, 2 OMe) (cf. the ^{1}H NMR data[1] for **16**). The mixture was crystallised from ether to give the (−)-ω-camphanate **81** (80% of this diastereoisomer), mp 151–153°, $[\alpha]_D^{25}$ +49° (*c* 1, $CHCl_3$) ^{1}H NMR data: δ 0.79, 0.94, 1.05 (3 s, 3 CMe of the camphanate), 1.47 (s, CMe_2), 3.81 (s, OMe) (cf. the ^{1}H NMR data[1] for **33**) (Found: C, 70.07; H, 6.98. $C_{41}H_{48}O_{10}$. Calcd C, 70.27; H, 6.90%).

1D-2,6-Di-O-benzyl-1-O-[(+)-ω-camphanoyl]-4,5-O-isopropylidene-3-O-p-methoxybenzyl-myo-*inositol* (**79**).—The contents of the mother liquors after the crystallisation of **81** were saponified and the product was converted into the (+)-ω-camphanates as described[1] for the preparation of **28**. Crystallisation of the product from ether gave **79** (85% of this diastereoisomer), mp 150–152°, $[\alpha]_D^{25}$ −53° (*c* 1, $CHCl_3$), with a ^1H NMR spectrum identical with that of its enantiomer **81** (Found: C, 70.42; H, 6.94. $C_{41}H_{48}O_{10}$. Calcd C, 70.27; H, 6.90%).

1D-2,4-Di-O-benzyl-1-O-p-methoxybenzyl-myo-*inositol* (**86**).—Saponification of the (−)-ω-camphanate **81** gave the alcohol **82**, and acid hydrolysis of the *O*-isopropylidene group, as described for the preparation of **66**, gave **86**, mp 120–122° (from EtOH), $[\alpha]_D^{25}$ −10.4° (*c* 1, $CHCl_3$). ^1H NMR data: δ 2.35 (d, *J* 6.1 Hz, OH), 2.74 (m, 2 OH), 3.24 (dd, *J* 2.4 and 9.8 Hz), 3.79 (s, OMe), 4.55, 4.81 (2 ABq, 2 CH_2Ph), 4.84 (s, CH_2Ph), 6.81–7.33 (m, aromatic) (cf. the ^1H NMR data[1] for **37**) (Found: C, 70.04; H, 6.80. $C_{28}H_{32}O_7$. Calcd C, 69.98; H, 6.71%).

Removal of the *O-p*-methoxybenzyl group from **86**, in the usual way, gave 1D-2,4-di-*O*-benzyl-*myo*-inositol (**87**), mp 146–147°, $[\alpha]_D^{25}$ +28° (*c* 1, EtOH), identical with the material prepared previously[6] {lit.[6] mp 146–148°, $[\alpha]_D^{25}$ +28° (*c* 1, EtOH)}, thus establishing the absolute configuration of **81** (and **79**).

1D-3-O-Allyl-2,4-di-O-benzyl-1-O-p-methoxybenzyl-myo-*inositol* (**88**).—Allylation of **82** (prepared by saponification of the camphanate **81**) in the usual way gave **83** as a syrup. ^1H NMR data: δ 1.45 (s, 2 CMe), 3.79 (s, OMe), 4.65 (ABq, CH_2Ph), 4.81 (s, CH_2Ph), 4.82 (ABq, CH_2Ph), 6.81–7.36 (m, aromatic). Acid hydrolysis of the *O*-isopropylidene group in **83** (as described for the preparation of **66**) gave **88**, mp 121–122° (from light petroleum–EtOAc), $[\alpha]_D^{25}$ −22° (*c* 1, $CHCl_3$). ^1H NMR data: δ 2.57–2.62 (m, 2 OH), 3.79 (s, OMe), 4.50, 4.83, 4.85 (3 ABq, 3 CH_2Ph), 6.81–7.33 (m, aromatic) (Found: C, 71.63; H, 7.01. $C_{31}H_{36}O_7$. Calcd C, 71.51; H, 6.97%).

1D-3-O-Allyl-2,4-di-O-benzyl-myo-*inositol* (**89**).—Compound **88** was treated with dichlorodicyanobenzoquinone in the usual way and TLC (EtOAc) showed conversion of **88** (R_F 0.8) into a product (R_F 0.5). Column chromatography (EtOAc) gave **89**, mp 108–110° (from ether–light petroleum), $[\alpha]_D^{25}$ −3.6° (*c* 1, $CHCl_3$) (Found: C, 69.13; H, 6.87. $C_{23}H_{28}O_6$. Calcd. C, 68.98; H, 7.05%).

(±)-1-O-Benzyl-4-O-p-methoxybenzyl-myo-*inositol* (**67**).—Compound **65** (ref. 16) was hydrolysed, as described above for the preparation of **66**, to give **67**, mp 182–184° (from EtOH) (Found: C, 64.57; H, 6.92. $C_{21}H_{26}O_7$. Calcd C, 64.60; H, 6.71%).

(±)-1-O-Benzyl-3-O-(but-2-enyl)-4-O-p-methoxybenzyl-myo-*inositol* (**77**).—Tin-mediated crotylation of **67**, as described for the preparation of **8**, gave **77**, mp 124–125° (from EtOAc–light petroleum). ^1H NMR data: δ 1.71 (d, *J* 4.9 Hz, =CH*Me*), 2.49 (s, OH), 2.63. 2.65, 2.68, 2.70 (m, 2 OH), 3.79 (s, OMe), 4.71 (s, CH_2Ph), 4.76 (ABq, CH_2Ph), 6.82–7.35 (m, aromatic) (Found: C, 67.49; H, 7.47. $C_{25}H_{32}O_7$. Calcd C, 67.55; H, 7.26%).

The 2,5,6-triacetate of **77** had mp 125–127° (from light petroleum). ^1H NMR

data: δ 1.93, 1.98, 2.17 (3 s, 3 Ac), 3.79 (s, OMe) (Found: C, 65.58; H, 6.94. $C_{31}H_{38}O_{10}$. Calcd C, 65.25; H, 6.71%).

*(±)-1,2-Di-O-benzyl-3-O-(but-2-enyl)-5,6-O-isopropylidene-4-O-p-methoxybenzyl-*myo*-inositol* (**72**).—The triol **77** was converted into the syrupy *O*-isopropylidene derivative **74**, as described for the preparation of **13**. ^{1}H NMR data: δ 1.46 (s, CMe_2), 1.69 (d, *J* 4.9 Hz, =CH*Me*), 3.79 (s, OMe), 4.75, 4.76 (2 ABq, 2 CH_2Ph), 6.81–7.36 (m, aromatic). Compound **74** was benzylated in the usual way to give the readily crystalline derivative **72**, mp 111–113° (from light petroleum–EtOAc). ^{1}H NMR data: δ 1.44 (s, CMe_2), 1.69 (d, *J* 4.9 Hz, =CH*Me*), 3.79 (s, OMe), 4.52–4.89 (m, 3 CH_2Ph), 6.81–7.37 (m, aromatic) (Found: C, 73.20; H, 7.57. $C_{35}H_{42}O_7$. Calcd C, 73.14; H, 7.37%).

(−)-ω-Camphanate (**95**) *of 1*D- *or 1*L-*4,5-di-O-acetyl-2,3-di-O-benzyl-6-O-p-methoxybenzyl-*myo*-inositol*.—The crotyl group was removed from **72**, as described for the preparation of **68**, to give the alcohol **69** as a syrup; ^{1}H NMR data: δ 1.46 (s, CMe_2), 3.79 (s, OMe). This syrup was converted into the syrupy mixture of diastereoisomeric (−)-ω-camphanates (**94**), in the usual way. ^{1}H NMR data: δ 0.81 (3 H), 0.87 (3 H), 0.88 (3 H), 0.97 (3 H), 1.06 (6 H) (5 s, 6 CMe of the camphanate), 1.47 (s, 2 CMe_2), 3.79 (s, 2 OMe). Hydrolysis of the *O*-isopropylidene group in **94**, as described above in the preparation of **66**, gave the mixed diastereoisomeric diols **93** which were acetylated with acetic anhydride–pyridine to give the mixed diastereoisomeric diacetates **95**. ^{1}H NMR data: δ 0.89 (3 H), 0.91 (3 H), 0.99 (3 H), 1.02 (3 H), 1.10 (6 H) (5 s, 6 CMe of the camphanate), 1.92, 1.98 (2 s, 4 Ac), 3.77 (s, 2 OMe). Crystallisation from ether gave one diastereoisomer, mp 152–154°, $[\alpha]_D^{25}$ −15.6° (*c* 1, $CHCl_3$). ^{1}H NMR data: δ 0.91, 1.02, 1.10 (3 s, 3 CMe of the camphanate), 1.92, 1.98 (2 s, 2 Ac), 3.77 (s, OMe) (Found: C, 67.80; H, 6.58. $C_{42}H_{48}O_{12}$. Calcd C, 67.73; H, 6.50%). This compound was not further investigated.

*(±)-1,4-Di-O-benzyl-5,6-O-isopropylidene-2-O-p-methoxybenzyl-*myo*-inositol* (**70**).—The crotyl ether **13** was converted, in the usual way, into the syrupy *p*-methoxybenzyl ether **75**. ^{1}H NMR data: δ 1.44 (s, CMe_2), 1.69 (d, *J* 4.9 Hz, =CH*Me*), 3.76 (s, OMe), 4.51–4.88 (m, 3 CH_2Ph), 5.58 (m, −CH=CH−), 6.77–7.32 (m, aromatic). The product **75** was decrotylated as described for the preparation of **15**, to give **70** as a syrup which slowly crystallised; mp 83–85° (from light petroleum). ^{1}H NMR data: δ 1.45 (s, CMe_2), 2.55 (s, OH), 3.75 (s, OMe), 4.54, 4.59, 4.67, 4.72, 4.78, 4.84, 4.92, 4.97 (m, 3 CH_2Ph), 6.78–7.32 (m, aromatic) (Found: C, 71.62; H, 7.09. $C_{31}H_{36}O_7$. Calcd C, 71.52; H, 6.97%).

Hydrolysis of the *O*-isopropylidene group in **70**, as described for the preparation of **66**, gave racemic 1,4-di-*O*-benzyl-2-*O*-*p*-methoxybenzyl-*myo*-inositol, mp 139–140° (from light petroleum–EtOAc, 1 : 1). ^{1}H NMR data: δ 2.34 (d, *J* 6.1 Hz, OH), 2.68 (m, 2 OH), 3.26 (dd, *J* 2.4 and 9.8 Hz), 3.79 (s, OMe), 4.61, 4.74 (2 ABq, 2 CH_2Ph), 4.84 (s, CH_2Ph), 6.81–7.34 (m, aromatic) (Found: C, 69.54; H, 6.79. $C_{28}H_{32}O_7$. Calcd C, 69.98; H, 6.71%).

The crystalline mixed diastereoisomeric (−)-ω-camphanates were prepared

from **70** in the usual way. ^{1}H NMR data: δ 0.81 (3 H), 0.84 (3 H), 0.87 (3 H), 0.95 (3 H), 1.06 (6 H) (5 s, 6 CMe of the camphanate), 1.46 (2 CMe_2), 3.79 (s, 2 OMe). Recrystallisation from ether–light petroleum or MeOH gave a mixture of diastereoisomers, as observed by ^{1}H NMR spectroscopy, which were not further investigated.

*(±)-1,4-Di-*O*-allyl-3-*O*-(but-2-enyl)*-myo*-*inositol* (**97**).—Racemic 1,4-di-*O*-allyl-*myo*-inositol[5,8] (**96**, 5 g) was subjected to tin-mediated crotylation as described for the preparation of **8**. TLC (EtOAc) showed major (R_F 0.5) and minor (R_F 0.6, 0.85, and 0.9) products. The solvent was evaporated, ether (300 mL) was added to the residue, the mixture was stirred, and the crystalline precipitate of tetrabutylammonium bromide was discarded. The ether solution was washed with water (3 × 100 mL) to extract the products (R_F 0.5 and 0.6) and the aqueous solution was concentrated. Column chromatography (EtOAc) of the residue (5.6 g) gave **97** (4 g, 66%), mp 91–93° (from light petroleum) (Found: C, 61.16; H, 8.59. $C_{16}H_{26}O_6$. Calcd. C, 61.13; H, 8.34%).

The 2,5,6-triacetate (**98**) of **97** had mp 128–129° (from light petroleum or 50% aq EtOH). ^{1}H NMR data: δ 1.64–1.74 (m, =CH*Me*), 2.03, 2.05, 2.15 (3 s, 3 Ac), 3.30–3.49 (m, H-1,3), 3.69 (t, *J* 9.5 Hz, H-4), 3.96–4.22 (m, 3 $-OCH_2CH=$), 4.88–5.52 (m, 2 $=CH_2$ and H-5), 5.58–5.96 (m, $-CH=CH-$, 2 $-CH_2CH=$, and H-2,6) (cf. the ^{1}H NMR data[5] for 2,5,6-tri-*O*-acetyl-1,3,4-tri-*O*-allyl-*myo*-inositol) (Found: C, 60.35; H, 7.41. $C_{22}H_{32}O_9$. Calcd C, 59.99; H, 7.32%).

*(±)-5,6-Di-*O*-acetyl-1,2,4-tri-*O*-allyl-3-*O*-(but-2-enyl)*-myo*-*inositol* (**104**).—A solution of the triol **97** (1 g) in acetone (20 mL) and 2,2-dimethoxypropane (5 mL) containing toluene-*p*-sulphonic acid (25 mg) was kept at 20° for 3 h. TLC (ether–light petroleum, 1:1) then showed almost complete conversion of **97** (R_F 0) into the *O*-isopropylidene derivative **106** (R_F 0.8). Triethylamine (1 mL) and $NaHCO_3$ (50 mg) were added and the solvents were evaporated. Column chromatography (ether–light petroleum, 1:1, followed by ether) of the residue gave **106** (1.07 g, 95%) as a syrup that was treated with allyl bromide and NaH in *N*,*N*-dimethylformamide, in the usual way, to give the triallyl ether **107** as a syrup. A solution of **107** in MeOH (22.5 mL) and M HCl (2.5 mL) was heated under reflux for 30 min, $NaHCO_3$ (500 mg) was added, and the solvents were evaporated. The syrupy product **103** was extracted from the residue with CH_2Cl_2 and acetylated with acetic anhydride–pyridine to give the diacetate **104**, mp 117–119°. ^{1}H NMR data: δ 1.65–1.74 (m, =CH*Me*), 2.01, 2.03 (2 s, 2 Ac), 3.22 (dd, *J* 2.44 and 9.8 Hz, H-1 or H-3), 3.29 (dd, *J* 2.44 and 9.8 Hz, H-1 or H-3), 3.81 (t, *J* 9.8 Hz, H-4), 3.93–4.32 (m, 4 $-OCH_2CH=$ and H-2), 4.93 (t, *J* 9.8 Hz, H-5) (cf. data[5] for 5,6-di-*O*-acetyl-1,2,3,4-tetra-*O*-allyl-*myo*-inositol) (Found: C, 63.32; H, 8.16. $C_{23}H_{34}O_8$. Calcd C, 62.99; H, 7.82%).

*(±)-1,4,5-Tri-*O*-acetyl-2,3,6-tri-*O*-(*cis*-prop-1-enyl)*-myo*-*inositol* (**100**).—A solution of the diol **103** (regenerated from the crystalline diacetate **104**) (630 mg) and potassium *tert*-butoxide (6 g) in dry Me_2SO (40 mL) was kept at 50° for 6 h with exclusion of moisture and CO_2. TLC (EtOAc) then showed conversion of **103** (R_F

0.75) into a product (R_F 0.9). Saturated aq KCl (40 mL) was added to the cooled solution which was then extracted with ether (4 × 100 mL). The extract was dried (K_2CO_3) and concentrated, and the residue was acetylated with acetic anhydride–pyridine at 50° for 3 h. Column chromatography (light petroleum–ether, 2:1) of the product gave **100** (500 mg, 66%), mp 105–106°. ^{1}H NMR data: δ 1.41–1.72 (3 dd, 3 =CH*Me*), 2.00, 2.03, 2.06 (3 s, 3 Ac), 3.76 (dd, *J* 2.5 and 9.4 Hz, H-3), 4.14 (t, *J* 9.5 Hz, H-6), 4.19–4.61 (m, 3 OCH=C*H*Me), 4.25 (t, *J* 2.5 Hz, H-2), 4.91 (dd, *J* 2.5 and 9.4 Hz, H-1), 5.17 (t, *J* 9.5 Hz, H-5), 5.54 (t, *J* 9.5 Hz, H-4), 5.88–6.04 (m, 3 OCH=) (Found: C, 59.29; H, 7.27. $C_{21}H_{30}O_9$. Calcd C, 59.14; H, 7.09%). The ^{1}H NMR data for the related compound 2,4,5-tri-*O*-acetyl-1,3,6-tri-*O*-(*cis*-prop-1-enyl)-*myo*-inositol[5] (omitted from ref. 5) were: δ 1.41–1.54 (m, 9 H, 3 =CH*Me*), 2.03 (6 H), 2.18 (3 H) (2 s, 3 Ac), 3.70 (dd, *J* 2.7 and 9.4 Hz, H-1,3), 4.00 (t, *J* 9.5 Hz, H-6), 4.20–4.70 (m, 3 OCH=C*H*Me), 5.14 (t, *J* 9.5 Hz, H-5), 5.44 (t, *J* 9.8 Hz, H-4), 5.72 (t, *J* 2.7 Hz, H-2), 5.88–6.04 (m, 3 OCH=).

(±)-1,2,4-Tri-O-*benzyl-3,5,6-tri*-O-*methyl*-myo-*inositol* (**118**).—Racemic 1,2,4-tri-*O*-benzyl-*myo*-inositol[9,13,18] (**117**) was treated with MeI and NaH in *N*,*N*-dimethylformamide in the usual way. TLC (ether–light petroleum, 1:1) of the product showed conversion of **117** (R_F 0) into **118** (R_F 0.75), mp 115–116° (from light petroleum). ^{1}H NMR data: δ 3.39 (3 H), 3.64 (6 H) (2 s, 3 OMe), 4.65, 4.80 (2 ABq, 2 CH_2Ph), 4.84 (s, CH_2Ph) (Found: C, 73.41; H, 7.53. $C_{30}H_{36}O_6$. Calcd C, 73.14; H, 7.37%).

(±)-1,4,5-Tri-O-*methyl*-myo-*inositol* (**108**).—(*a*) A solution of **118** in EtOH was treated with H_2 over 10% Pd/C at atmospheric pressure for 12 h. TLC ($CHCl_3$–MeOH, 8:1) then showed conversion of **118** (R_F 1.0) into **108** (R_F 0.3), mp 130–132° (from CH_2Cl_2) (Found: C, 48.84; H, 8.16. $C_9H_{18}O_6$. Calcd C, 48.64; H, 8.16%).

The 2,3,6-triacetate (**109**) of **108** had mp 101–103° (from light petroleum–EtOAc, 9:1). ^{1}H NMR data: δ 2.06, 2.11, 2.14 (3 s, 3 Ac), 3.05–3.69 (m, H-1,4,5), 3.31 (3 H), 3.55 (6 H) (2 s, 3 OMe), 4.78 (dd, *J* 2.5 and 9.7 Hz, H-3), 5.23 (t, *J* 9.7 Hz, H-6), 5.64 (t, *J* 2.5 Hz, H-2) (Found: C, 51.72; H, 7.04. $C_{15}H_{24}O_9$. Calcd C, 51.72; H, 6.95%).

(*b*) The racemic triol **99** (regenerated from the crystalline acetate **100**) was treated with MeI and NaH in *N*,*N*-dimethylformamide in the usual way. TLC (ether–light petroleum, 1:1) of the product showed conversion of **99** (R_F 0) into **102** (R_F 0.8). A solution of the crude product **102** in acetone–M HCl (9:1) was heated under reflux for 20 min, when TLC ($CHCl_3$–MeOH, 8:1) showed conversion of **102** (R_F 0.95) into **108** (R_F 0.3). An excess of $NaHCO_3$ was added and the solvents were evaporated. Extraction of the residue with hot $CHCl_3$ gave **108**, identical with the material described in (*a*), which gave a triacetate identical with **109** described in (*a*).

1D-1,2,4-Tri-O-*benzyl-3,5,6-tri*-O-*methyl*-myo-*inositol* (**123**).—The chiral triol **45** was methylated, as described above for the preparation of the racemate **118**, to give **123**, mp 84–85° (from light petroleum), $[\alpha]_D^{25}$ −1.7° (*c* 1, $CHCl_3$) with a ^{1}H

NMR spectrum as described for the racemate **118** (Found: C, 73.17; H, 7.46. $C_{30}H_{36}O_6$. Calcd C, 73.14; H, 7.37%).

1D-3,5,6-Tri-O-methyl-myo-inositol (**121**).—Compound **123** was hydrogenolysed, as described above for the racemate **118**, to give **121**, mp 153–155° (from EtOAc), $[\alpha]_D^{25}$ +2.9° (*c* 1, $CHCl_3$), +12.6° (*c* 1, MeOH) (Found: C, 48.82; H, 8.15. $C_9H_{18}O_6$. Calcd C, 48.64; H, 8.16%).

The 1,2,4-triacetate (**122**) of **121** had mp 110–112° (from light petroleum), $[\alpha]_D^{25}$ +6.0° (*c* 1, $CHCl_3$), with a ^1H NMR spectrum identical with that of the racemate **109** (Found: C, 51.75; H, 7.10. $C_{15}H_{24}O_9$. Calcd C, 51.72; H, 6.95%).

Bis-(−)-ω-camphanates (**110** *and* **113**) *of 1,2,4-tri-O-allyl-3-O-(but-2-enyl)-myo-inositol* (**103**).—The racemic diol **103** was converted into the mixture of diastereoisomeric bis-(−)-ω-camphanates **105** in the usual way[1]. TLC (ether–light petroleum, 2:1) showed conversion of **103** (R_F 0.25) into a mixture of two products (R_F 0.5 and 0.45). ^1H NMR data: δ 0.95 (12 H), 1.01 (3 H), 1.05 (9 H), 1.09 (12 H) (4 s, 12 CMe of the camphanate). Column chromatography (ether–light petroleum, 2:1) of the mixture **105** (2 g) gave the diastereoisomer **113** (R_F 0.5, 590 mg), mp 110–111° (from light petroleum–ether), $[\alpha]_D^{25}$ −22° (*c* 1, $CHCl_3$). ^1H NMR data: δ 0.95, 1.05, 1.09 (3 s, 6 CMe of the camphanate) (Found: C, 65.77; H, 7.43. $C_{39}H_{54}O_{12}$. Calcd. C, 65.53; H, 7.62%).

Further elution gave a mixture (426 mg) and then the diastereoisomer **110** (R_F 0.45, 491 mg), mp 118–120° (from light petroleum–ether), $[\alpha]_D^{25}$ +2.9° (*c* 1, $CHCl_3$); ^1H NMR data: δ 0.95 (6 H), 1.01 (3 H), 1.04 (3 H), 1.09 (6 H) (4 s, 6 CMe of the camphanate) (Found: C, 65.32; H, 8.0%).

1D-4,5-Di-O-acetyl-2,3,6-tri-O-allyl-1-O-(but-2-enyl)-myo-inositol (**112**) *and 1D-5,6-di-O-acetyl-1,2,4-tri-O-allyl-3-O-(but-2-enyl)-myo-inositol* (**115**).—Saponification of **110** (R_F 0.45) gave the diol **111** as a syrup, $[\alpha]_D^{25}$ +19.7° (*c* 1, $CHCl_3$), which gave a crystalline diacetate **112**, mp 125–126° (from light petroleum), $[\alpha]_D^{25}$ +28.6° (*c* 1, $CHCl_3$), with a ^1H NMR spectrum identical with that of the racemate **104** (Found: C, 63.03; H, 8.01. $C_{23}H_{34}O_8$. Calcd C, 62.99; H, 7.82%).

Saponification of **113** (R_F 0.5) gave the diol **114** as a syrup, $[\alpha]_D^{25}$ −19.3° (*c* 1, $CHCl_3$), which gave a crystalline diacetate **115**, mp 126–127°, $[\alpha]_D^{25}$ −28.3° (*c* 1, $CHCl_3$), with a ^1H NMR spectrum identical with that of the racemate **104** (Found: C, 62.70; H, 7.74%).

Treatment of the diol **114** (regenerated from the crystalline diacetate **115**) with NaH and MeI in *N,N*-dimethylformamide, in the usual way, gave **116**. Compound **116** was deallylated–decrotylated with 10% Pd/C in aq EtOH containing toluene-*p*-sulphonic acid, in the usual way, to give 1D-5,6-di-*O*-methyl-*myo*-inositol (**119**), mp 197–200° (from EtOH–EtOAc), $[\alpha]_D^{25}$ −7° (*c* 1, MeOH), which gave the 1,2,3,4-tetra-acetate **120** identical with the material described previously[1], thus establishing the absolute configuration of the bis-(−)-ω-camphanate **113** (and **110**).

ACKNOWLEDGMENTS

We thank the Royal Society for a European Exchange Fellowship (to S. Penades), Perstorp Pharma, Perstorp, Sweden for support (to J.G.), Miss Sheila Lathwell for determination of optical rotations, and Andrew Birchall for the 200-MHz ^{1}H NMR spectra.

REFERENCES

1 T. Desai, J. Gigg, R. Gigg, and S. Payne, *Carbohydr. Res.*, 225 (1992) 209–228.
2 T. Desai, A. Fernandez-Mayoralas, J. Gigg, R. Gigg, C. Jaramillo, S. Payne, S. Penades, and N. Schnetz, *ACS Symp. Ser.*, 463 (1991) 86–102.
3 T. Desai, *The Chemistry of Inositol Compounds of Biological Interest*, M.Phil. Thesis, C.N.A.A., 1989; Ph.D. Thesis, C.N.A.A., 1991.
4 R.H. Gigg, Internat. Pat. Appl. No. WO 89/00156 (1989); *Chem. Abstr.*, 111 (1989) 174590t.
5 T. Desai, J. Gigg, R. Gigg, S. Payne, S. Penades, and H.J. Rogers, *Carbohydr. Res.*, 216 (1991) 197–209.
6 T. Desai, J. Gigg, R. Gigg, and S. Payne, *Carbohydr. Res.*, 228 (1992) 65–79.
7 A.B. Reitz (Ed.), *ACS Symp. Ser.*, 463 (1991).
8 J. Gigg, R. Gigg, S. Payne, and R. Conant, *J. Chem. Soc., Perkin Trans. 1*, (1987) 2411–2414; (1988) 981.
9 J. Gigg, R. Gigg, S. Payne, and R. Conant, *J. Chem. Soc., Perkin Trans. 1*, (1987) 423–429.
10 R. Gigg and C.D. Warren, *J. Chem. Soc., C*, (1968) 1903–1911.
11 P.A. Gent, R. Gigg, and R. Conant, *J. Chem. Soc., Perkin Trans. 1*, (1972) 1535–1542; R. Gigg, *ACS Symp. Ser.*, 39 (1977) 253–278.
12 J. Gigg, R. Gigg, S. Payne, and R. Conant, *Carbohydr. Res.*, 142 (1985) 132–134.
13 J. Gigg, R. Gigg, S. Payne, and R. Conant, *J. Chem. Soc., Perkin Trans. 1*, (1987) 1757–1762.
14 J. Cunningham, R. Gigg, and C.D. Warren, *Tetrahedron Lett.*, (1964) 1191–1196; J. Gigg and R. Gigg, *J. Chem. Soc., C*, (1966) 82–86.
15 Y. Oikawa, T. Yoshioka, and O. Yonemitsu, *Tetrahedron Lett.*, 23 (1982) 885–888.
16 T. Desai, A. Fernandez-Mayoralas, J. Gigg, R. Gigg, and S. Payne, *Carbohydr. Res.*, 205 (1990) 105–123.
17 M. Whitman and L. Cantley, *Biochim. Biophys. Acta*, 948 (1988) 327–344; C.L. Carpenter and L. Cantley, *Biochemistry*, 29 (1990) 11147–11156; T.W. Cunningham and P.W. Majerus, *Biochem. Biophys. Res. Commun.*, 175 (1991) 568–576; L.R. Stephens, K.T. Hughes, and R.F. Irvine, *Nature (London)*, 351 (1991) 33–39.
18 J. Gigg, R. Gigg, S. Payne, and R. Conant, *Carbohydr. Res.*, 140 (1985) c1–c3.
19 R. Boss and R. Scheffold, *Angew. Chem. Int. Ed. Engl.*, 15 (1976) 558–559.