Pergamon

Tetrahedron, Vol. 52, No. 36, pp. 11739-11752, 1996

0040-4020/96 $15.00 + 0.00

PII: S0040-4020(96)00682-5

An Aza-Payne Rearrangement-Epoxide Ring Opening Reaction of 2-Aziridinemethanols in a One-pot Manner: A Regio- and Stereoselective Synthetic Route to Diastereomerically Pure *N*-Protected 1,2-Amino Alcohols

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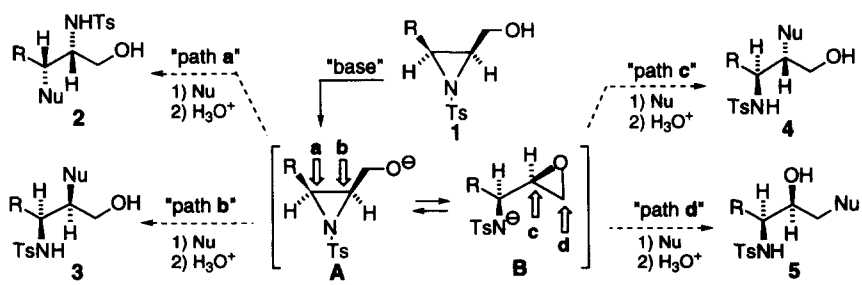
Abstract: A regio- and stereoselective synthetic route to diastereomerically pure 1,2-amino alcohols via *a one-pot* aza-Payne rearrangement - epoxide ring opening reaction of 2-aziridinemethanols is reported.

Due to the important role played by 1,2-amino alcohols as chiral auxiliaries and chiral building blocks in the preparation of biologically active compounds, the development of versatile and new methodology for the synthesis of 1,2-amino alcohols in optically active form has emerged as an important and challenging synthetic endeavor for organic chemists.[1)]

Acyclic chiral 1,2-amino alcohols can be prepared by the following fundamental routes: i) reduction of chiral amino acids;[2)] ii) epoxide-opening reaction of chiral oxiranes by the use of nitrogen nucleophiles such as amines and azides;[3)] iii) selective ring opening reaction of 1,2-cyclic sulfates with a wide variety of amines and azides;[4)] iv) stereoselective addition reaction of nucleophiles to chiral amino carbonyl compounds,[5)] and osmium-catalyzed asymmetric aminohydroxylation of olefins in the presence of chiral ligands.[6)] Recently, activated aziridine derivatives have been employed in the formation of *N*-protected 1,3-amino alcohols as intermediates in a number of important synthetic transformations.[7)] One very important aspect of aziridine ring-opening reactions is that they are usually stereospecific, producing synthetically useful amino alcohols with inversion of configuration at the site of the ring opening via an S_N2 mechanism.[8)] However, except for a few cases,[9)] there have been no systematic investigations toward a simple and effective method for synthesizing chiral *N*-protected 1,2-amino alcohols of type **5** (Scheme 1) from readily available chiral 2-aziridinemethanols.



Scheme 1 R = H, alkyl, phenyl, or benzyloxymethyl, etc

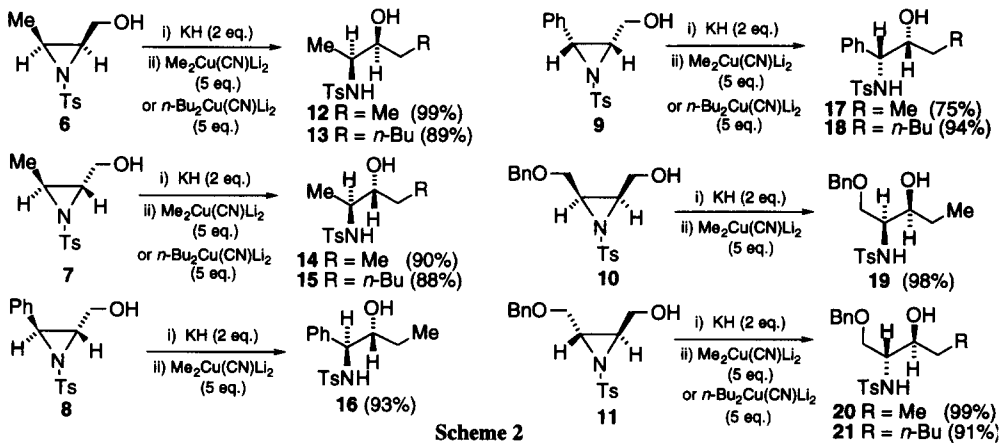
We have been interested in synthetically useful ring-opening reactions of aziridine-ring bearing compounds with various nucleophilic reagents in connection with synthetic studies on bioactive compounds of stereochemically well defined structure.[10)] It was our expectation to be able to synthesize stereochemically pure *N*-protected 1,2-amino alcohols in a stereo- and regioselective manner in a one-pot sequence starting from 2-aziridinemethanols by successive treatment with base and various nucleophilic reagents as shown in Scheme

1. In principle, reaction of 2-aziridinemethanol **1** with bases such as potassium hydride (KH), followed by nucleophilic reagents in a one-pot manner, could afford one or a mixture of three primary alcohols **2**, **3**, and **4** and a secondary alcohol **5** *via* the anionic intermediates **A** and **B**. Thus, it is not an easy matter to predict whether **a**, **b**, **c**, or **d** would be the major reaction pathway.

Recently, we reported that the aza-anionic energy minimum of type **B** was predicted to be 18.6 kcal mol^{-1} lower than the oxa-anionic minimum of type **A** at the RHF/3-21+G* level.[10c] In actuality, *N*-alkylsulfonyl- or arylsulfonyl-2-aziridinemethanols did yield *N*-protected epoxyamines in good isolated yields upon exposure to KH followed by quenching at low temperature. Taking advantage of these results, we decided to investigate simple transformation reactions of various 2-aziridinemethanols into *N*-protected 1,2-amino alcohols of type **5** (Scheme 1) in a one-pot manner. The rearrangement-epoxide ring opening reaction scenario does in fact lead to the stereochemically pure 1,2-amino alcohols *via* the path **d** in Scheme 1. We now detail how this approach is a viable and potentially useful route to stereodefined functionalized 1,2-amino alcohols from readily available chiral 2-aziridinemethanols.

Results and Discussion

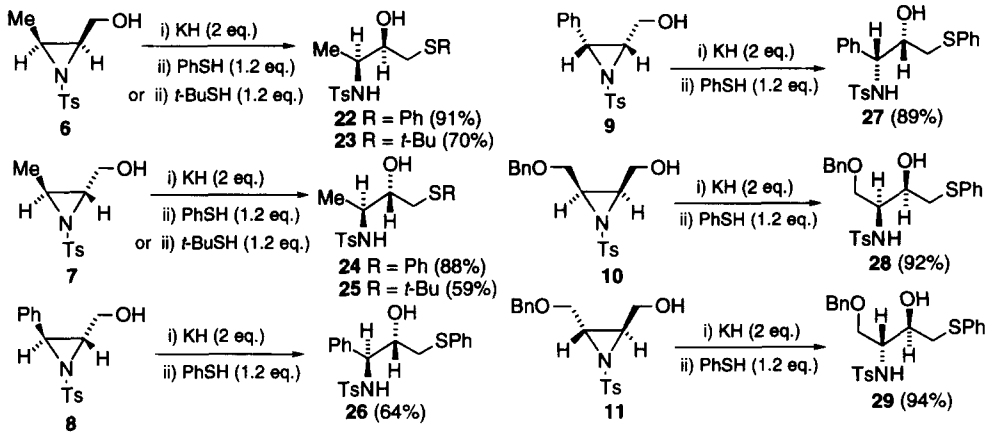
The requisite 2-aziridinemethanols **6**, **7**, **8**, **9**, **10**, and **11** for the present study were readily prepared in acceptable yields by our published methods[10c] from (2*S*,3*R*)-threonine, (2*R*,3*R*)-allo-threonine, (2*R*,3*R*)-3-phenyl-2,3-epoxy alcohol,[11] commercially available (1*S*,2*S*)-(+)-2-amino-1-phenyl-1,3-propanediol, (2*S*,3*R*)-3-benzyloxymethyl-2,3-epoxy alcohol,[12] and (2*S*,3*S*)-3-benzyloxymethyl-2,3-epoxy alcohol,[13] respectively.



Scheme 2

Initial experiments with aziridinemethanol **6** revealed that KH was superior to sodium hydride or lithium diisopropylamide as a base, and it was therefore used for all experiments reported herein. Reaction of **6** and **7** with KH (2 equiv.) in THF at 0 °C for 1 h, was followed by the addition of $Me_2Cu(CN)Li_2{\cdot}2LiBr$ (5 equiv.)[14] by syringe in a one-pot manner, and the entire mixture was then stirred for 1 h at the same temperature to yield the single *N*-protected 1,2-amino alcohols **12** and **14**, respectively (Scheme 2). These transformations could be achieved by successive treatment with KH (2 equiv.) and the lower order cyanocuprate MeCu(CN)Li·LiBr (5 equiv.) in comparable yields. Although conversion of **6** and **7** to **12** and **14** can be carried out in one pot by exposing to KH (1 equiv.) and organocopper reagents (1 equiv.), the overall yields of products in this method are considerably lower. The presence of an excess of KH does not exert any influence on the organocopper reactions of intermediate epoxy aza-anions of type B in Scheme 1. This contrasted with our previous work [10a,e] where the direct reaction of either **6** and **7** with MeCu(CN)Li·LiBr gave a 4:6 mixture of 1,2-amino alcohols **12** and **14**. As stated above, in a series of bases, KH gave the best results in combination with 5 equivalents of organocopper reagent. It should be clearly noted that the use of MeLi·LiBr or MeMgBr instead of MeCu(CN)Li·LiBr or $Me_2Cu(CN)Li_2{\cdot}2LiBr$ did not result in clean transformations. In a similar manner, reaction of the anionic equilibrium mixture, derived from **6** or **7** by exposure to KH, with $Bu_2Cu(CN)Li_2$ afforded the single product **13** or **15** in 89 or 88% isolated yields, respectively. We were unable to detect any

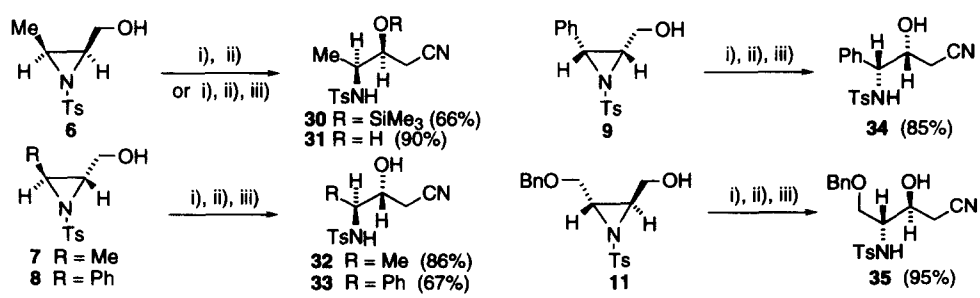
regio- or stereoisomeric compounds in these reactions. Structural and stereochemical assignments for the amino alcohols **12**, **13**, **14**, and **15** were made by comparison of spectral data (^{1}H NMR, IR, and $[\alpha]_D$) with those of authentic samples.[10e] Other 2-aziridinemethanols **8-11** have been converted into the corresponding *N*-protected amino alcohols **16-21** in stereo- and regioselctive manners in good yields by reaction with organocopper reagents.



Scheme 3

The usefulness of this one-pot regio- and stereoselective method would be enhanced if it could be successfully extended to other nucleophiles. Alkylthio and arylthio functionalities play an important role in chemical transformations.[15] As shown in Scheme 3, the reactions of **6** and **7** with KH followed by PhSH in a one-pot manner gave the diastereomerically pure phenylthio amino alcohols **22** and **24** in 91 and 88% yields, respectively. Similar treatment of **6** and **7** with KH and *t*-BuSH yielded only *t*-butylthio amino alcohols **23** and **25**.[16] Other 2-aziridinemethanols **8-11** could easily be converted into the corresponding phenylthio amino alcohols **26** -**29** in good yields.

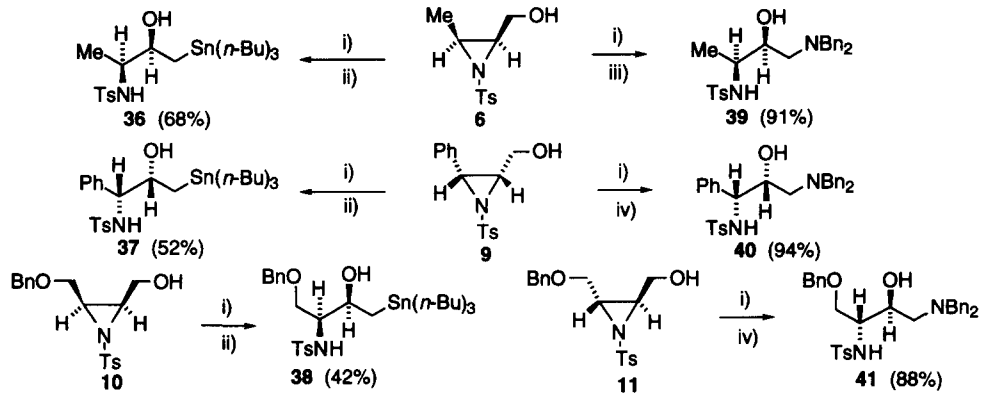
Protected 1,2-amino alcohols bearing a nitrile group could also be prepared in a one-pot manner as shown in Scheme 4. The reaction of **6** with KH followed by the sequential addition of Me_3SiCN (3 equiv.) and $Yb(CN)_3$ (0.2 equiv.)[17] yielded the nitrile **30** in 66% yield after flash chromatographic purification. The low yield of **30** could be attributed to the instability of the siloxy group in **30**. In light of this, sequential treatment of **6** with KH, Me_3SiCN in the presence of $Yb(CN)_3$ and Bu_4NF (1.5 equiv.) yielded the cyano amino alcohol **31** in 90% isolated yield as the sole product. Results obtained for the four other 2-aziridinemethanols **7**, **8**, **9**, and **11** are summarized in Scheme 4. All aziridines afforded the corresponding cyano amino alcohols **32**, **33**, **34** and **35** in high isolated yields by successive exposure to KH, Me_3SiCN-$Yb(CN)_3$, and Bu_4NF. Thus, the reaction appears to be quite general, giving yields which are good to excellent.



Reagents: i) KH (2 eq.); ii) Me_3SiCN (3 eq.), $Yb(CN)_3$ (0.2 eq.); iii) *n*-Bu_4NF (1.5 eq.)

Scheme 4

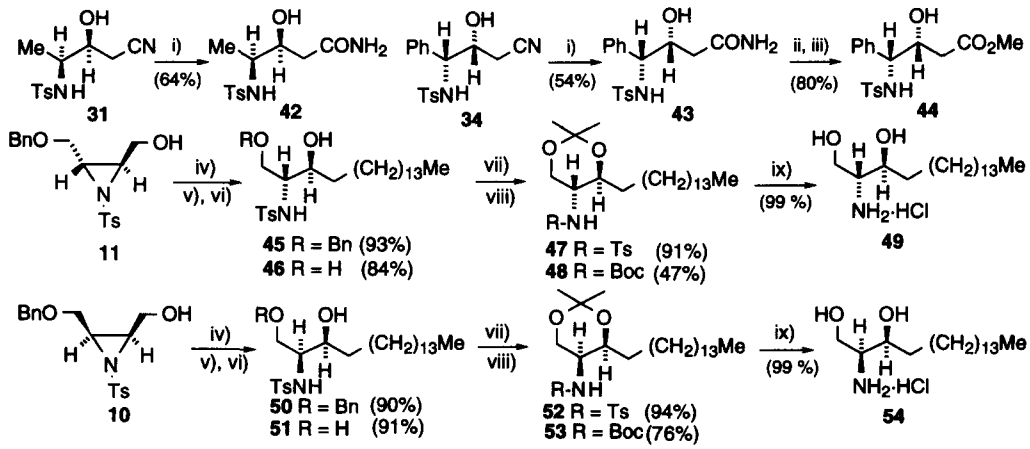
Since the useful reaction conditions for the synthesis of functionalized 1,2-amino alcohols from 2-aziridinemethanols were established, the use of hetero-organocopper reagents was briefly investigated next. As can be seen from Scheme 5, some protected 1,2-amino alcohols bearing a tributylstannyl group (**36**, **37**, and **38**) were obtained in moderate yields via the treatment of 2-azridinemethanols **6**, **9**, and **10** with KH followed by $(Bu_3Sn)_2Cu(CN)Li_2$.[18] All attempts to enhance the isolated yields were fruitless.



Reagents: i) KH (2 eq.); ii) $(n\text{-}Bu_3Sn)_2Cu(CN)Li_2$ (5 eq.); iii) $(Bn_2N)_2Cu(CN)Li_2$ (5 eq.); iv) $(Bn_2N)_2Cu(CN)Li_2$ (3 eq.)

Scheme 5

Synthesis of diamino alcohols from aziridines was also investigated. Attempts to use either dibenzylamine or lithium dibenzylamide to effect the epoxide ring opening of an anionic intermedate derived from 2-aziridinemethanol **6** were unsuccessful, and the desired diamino alcohol **39** was obtained in only 1-15% yield under otherwise identical reaction conditions. Fortunately, use of the higher order amide cuprate, $(Bn_2N)_2Cu(CN)Li_2$,[19] overcame the problem and yielded diastereomerically pure diamino alcohols **39**, **40**, and **41** from aziridines **6**, **9**, and **11** in high yields as shown in Scheme 5.[20] In all reactions listed in Scheme 5, no evidence for unreacted starting material was detected by TLC analysis of the crude reaction product(s).



Reagents: i) 30% H_2O_2 -MeOH, K_2CO_3; ii) KOH-MeOH-H_2O; iii) CH_2N_2-Et_2O; iv) KH (2 eq.); v) $[(Me(CH_2)_{13}]_2Cu(CN)(MgCl)_2$ (5 eq.); vi) H_2/PtO_2 in 1*N*-HCl-MeOH; vii) 2,2-dimethoxypropane - acetone, BF_3-Et_2O; viii) Na/NH_3, Boc_2O; ix) 3*N*-HCl

Scheme 6

In view of the synthetic utility of the above described reactions, it was of interest to examine whether these transformation products could be useful as synthetic intermediates. As shown in Scheme 6, the hydroxy amino

nitriles **31** and **34** were treated with an alkaline hydrogen peroxide to yield amides **42** and **43**, respectively, in moderate yields. Upon successive treatment of the amide **43** with 2N-KOH in MeOH, 5% hydrochloric acid, and ethereal diazomethane, the amino acid methyl ester **44** was obtained in 80% yield. (2*R*,3*S*)- and (2*S*,3*S*)-C18-dihydrosphingosines **49** and **54** also can be readily synthesized in good yields from 2-aziridinemethanols **11** and **10**, respectively, as shown in Scheme 6 via a sequence of reactions.[21]

In conclusion, although yields were not necessarily optimized, an attractive one-pot regio- and stereoselective synthetic route to 1,2-amino alcohols from readily available 2-aziridinemethanols has been developed. Isolation or purification of intermediates resulting from the aza-Payne rearrangement is not necessary. This methodology leads to a series of useful diastereomerically pure amino alcohols which can be utilized in the synthesis of more complex molecules such as unusual amino acids.

Experimental Section

General Methods. All reactions were carried out under a positive pressure of argon, and glassware and syringes were dried in an electric oven at 100 °C prior to use. Ethereal MeLi (as complex with LiBr) and *n*-BuLi were purchased from Aldrich and Nacalai Tesque, respectively. CuCN was obtained from Mitsuwa Chemicals and dried in an Abderhalden under vacuum at rt. Melting points are uncorrected. Nominal (LR-MS) and exact mass (HR-MS) spectra were recorded on a JEOL JMS-01SG-2 or JMS-HX/HX 110A mass spectrometer. ^{1}H NMR spectra (270 or 300 NHz) were recorded in $CDCl_3$ unless otherwise specified. Chemical shifts are reported in parts per million downfield from internal Me_4Si (s = singlet, d = doublet, dd = double doublet, ddd = doublet of double doublet, t = triplet, m = multiplet). Optical rotations were measured in $CHCl_3$ with a JASCO DIP-360 digital polarimeter. For flash chromatography, silica gel 60 H (silica gel for thin-layer chromatography, Merck) or silica gel 60 (finer than 230 mesh, Merck) was employed. For HPLC, Cosmosil-5SL (10 x 250 mm, Nacalai Tesque) was employed.

(2*S*,3*S*)-2-(4-Methylphenyl)sulfonylamino-3-pentanol (12). To a stirred suspension of 40 mg (1 mmol) of KH in 2 mL of THF at - 78 °C under argon wa-s added 120.7 mg (0.5 mmol) of alcohol **6** in 2 mL of THF, and the mixture was allowed to warm to 0 °C and the strring was continued for 1 h. To the mixture was added by syringe 6 mL of a 0.42 M solution of $Me_2Cu(CN)Li_2{\cdot}2LiBr$ (2.5 mmol, 5 equiv.) in THF-Et_2O (1:1), prepared from CuCN (224 mg, 2.5 mmol) and 3.3 mL of a 1.5 M solution of MeLi·LiBr (5 mmol) in Et_2O, at - 78 °C and the mixture was stirred at - 78 °C for 0.5 h. The reaction was quenched with 4 mL of a saturated NH_4Cl-28% NH_4OH (1:1) solution with vigorous stirring at - 78 °C. The mixture was extracted with Et_2O-CH_2Cl_2 (4:1) and the usual workup followed by flash chromatography over silica gel with *n*-hexane-EtOAc (2:1) gave 128 mg (99% yield) of the title compound **12** as a crystalline mass. Colorless crystals from *n*-hexane-Et_2O (1:3). mp 90 °C; $[\alpha]^{32}_D$ - 3.3 (c 0.546, $CHCl_3$); IR ($CHCl_3$) 3550, 3400, 1598 cm^{-1}; ^{1}H NMR (300 MHz, $CDCl_3$) δ 0.88 (t, *J* = 7.4 Hz, 3 H), 1.02 (d, *J* = 6.6 Hz, 3 H), 1.44 (m, 2 H), 1.80 (broad s, 1 H), 2.43 (s, 3 H), 3.21-3.37 (m, 2 H), 4.78 (m, 1 H), 7.29-7.31 (m, 2 H), 7.75-7.79 (m, 2 H). Anal. Calcd for $C_{12}H_{19}NO_3S$: C, 56.01; H, 7.44; N, 5.44. Found: C, 55.74; H, 7.50; N, 5.33.

(2*S*,3*S*)-2-(4-Methylphenyl)sulfonylamino-3-octanol (13). To a stirred suspension of 40 mg (1 mmol) of KH in 2 mL of THF at - 78 °C under argon was added 120.7 mg (0.5 mmol) of alcohol **6** in 2 mL of THF, and the mixture was allowed to warm to 0 °C and the stirring was continued for 1 h. To the mixture was added by syringe 6 mL of a 0.42 M solution of $Bu_2Cu(CN)Li_2$ (2.5 mmol, 5 equiv.) in *n*-hexane-THF (1:1), prepared from 224 mg of CuCN (2.5 mmol) and 3 mL of a 1.69 M solution of *n*-BuLi (5 mmol) in *n*-hexane, at - 78 °C and the mixture was allowed to warm to 0 °C and the stirring was continued for 2 h. The reaction was quenched with 4 mL of a saturated NH_4Cl-28% NH_4OH (1:1) solution with vigorous stirring at - 78 °C. The mixture was extracted with Et_2O-CH_2Cl_2 (4:1) and the usual workup followed by flash chromatography over silica gel with *n*-hexane-EtOAc (2:1) gave 133 mg (89% yield) of the title compound **13** as a crystalline mass. Colorless crystals from Et_2O; mp 79 °C; $[\alpha]^{32}_D$ - 8.0 (c 0.67, $CHCl_3$); ^{1}H NMR (270 MHz, $CDCl_3$) δ 0.86 (tripletoid m, 3 H), 1.05 (d, *J* = 6.5 Hz, 3 H), 1.10-1.40 (m, 8 H), 1.76 (d, *J* = 4.6 Hz, 1 H), 2.43 (s, 3 H), 3.24 (dddd, *J* = 17.2, 10.6, 6.8, 3.8 Hz, 1 H), 3.39 (m, 1 H), 4.70 (d, *J* = 8.4 Hz, 1 H), 7.29-7.32 (m, 2 H), 7.75-7.78 (m, 2 H). Anal. Calcd for $C_{15}H_{25}NO_3S$: C, 60.17; H, 8.42; N, 4.68. Found: C, 60.02; H, 8.52; N, 4.74.

(2*S*,3*R*)-2-(4-Methylphenyl)sulfonylamino-3-pentanol (14). By a procedure identical with that described for the preparation of **12** from alcohol **6**, 60.3 mg (0.25 mmol) of alcohol **7** was converted into 58 mg (90% yield) of the title compound **14**. Colorless needles from Et_2O; mp 108 °C; $[\alpha]^{27}_D$ - 27.3 (c 0.81, $CHCl_3$); IR ($CHCl_3$) 3550, 3400, 3290, 1600 cm^{-1}; ^1H NMR (300 MHz, $CDCl_3$) δ 0.91 (t, *J* = 7.3 Hz, 3 H), 0.95 (d, *J* = 6.8 Hz, 3 H), 1.31-1.45 (m, 2 H), 2.43 (s, 3 H), 3.34 (m, 1 H), 3.48 (m, 1 H), 4.73 (d, *J* = 8.2 Hz, 1 H), 7.29-7.32 (m, 2 H), 7.75-7.78 (m, 2 H). Anal. Calcd for $C_{12}H_{19}NO_3S$: C, 56.01; H, 7.44; N, 5.44. Found: C, 55.75; H, 7.53; N, 5.30.

(2*S*,3*R*)-2-(4-Methylphenyl)sulfonylamino-3-octanol (15). By a procedure identical with that described for the synthesis of **13** from alcohol **6**, 60.3 mg (0.25 mmol) of **7** was converted into 66 mg (88% yield) of the title compound **15**. Colorless crystals from Et_2O. mp 120 °C; $[\alpha]^{20}_D$ - 21.5 (c 0.80, $CHCl_3$); ^1H NMR (300 MHz, $CDCl_3$) δ 0.87 (tripletoid m, 3 H), 0.96 (d, *J* = 6.8 Hz, 3 H), 1.21-1.45 (m, 8 H), 1.89 (m, 1 H), 2.43 (s, 3 H), 3.33 (dddd, *J* = 16.7, 9.9, 6.8, 3.0 Hz, 1 H), 3.54 (m, 1 H), 4.90 (d, *J* = 7.9 Hz, 1 H), 7.28-7.33 (m, 2 H), 7.75-7.79 (m, 2 H). Anal. Calcd for $C_{15}H_{25}NO_3S$: C, 60.17; H, 8.42; N, 4.68. Found: C, 60.03; H, 8.31; N, 4.60.

(1*S*,2*R*)-1-(4-Methylphenyl)sulfonylamino-1-phenyl-2-butanol (16). By a procedure identical with that described for the preparation of **12** from alcohol **6**, 91 mg (0.3 mmol) of alcohol **8** was converted into 89.5 mg (93% yield) of the title compound **16**. Colorless crystals from *n*-hexane-Et_2O (1:3). mp 133 °C; $[\alpha]^{33}_D$ + 34.6 (c 0.69, $CHCl_3$); ^1H NMR (300 MHz, $CDCl_3$) δ 0.90 (t, *J* = 7.3 Hz, 3 H), 1.11 (m, 1 H), 1.34 (m, 1 H), 1.81 (d, *J* = 6.7 Hz, 1 H), 2.32 (s, 3 H), 3.79 (dddd, *J* = 12.8, 6.7, 3.9, 3.9 Hz, 1 H), 4.33 (dd, *J* = 8.4, 3.9 Hz, 1 H), 5.67 (d, *J* = 8.4 Hz, 1 H), 7.03-7.16 (m, 7 H), 7.49-7.52 (m, 2 H). Anal. Calcd for $C_{17}H_{21}NO_3S$: C, 63.92; H, 6.63; N, 4.39. Found: C, 63.72; H, 6.74; N, 4.34.

(1*R*,2*R*)-1-(4-Methylphenyl)sulfonylamino-1-phenyl-2-butanol (17). By a procedure identical with that described for the preparation of **12** from alcohol **6**, 121.4 mg (0.4 mmol) of alcohol **9** was converted into 96 mg (75% yield) of the title compound **17**. Colorless crystals from Et_2O; mp 133 °C; $[\alpha]^{32}_D$ - 60.4 (c 0.91, $CHCl_3$); ^1H NMR (300 MHz, $CDCl_3$) δ 0.89 (t, *J* = 7.4 Hz, 3 H), 1.34-1.47 (m, 2 H), 2.04 (d, *J* = 4.4 Hz, 1 H), 2.33 (s, 3 H), 3.62 (m, 1 H), 4.25 (dd, *J* = 7.4, 5.2 Hz, 1 H), 5.55 (d, *J* = 7.4 Hz, 1 H), 7.01-7.18 (m, 7 H), 7.49-7.53 (m, 2 H). Anal. Calcd for $C_{17}H_{21}NO_3S$: C, 63.92; H, 6.63; N, 4.39. Found: C, 63.75; H, 6.65; N, 4.25.

(1*R*,2*R*)-1-(4-Methylphenyl)sulfonylamino-1-phenyl-2-heptanol (18). By a procedure identical with that described for the synthesis of **13** from alcohol **6**, 121.4 mg (0.4 mmol) of alcohol **9** was converted into 136 mg (94% yield) of the title compound **18**. Colorless crystals from Et_2O. mp 105 °C; $[\alpha]^{20}_D$ - 48.9 (c 0.65, $CHCl_3$); ^1H NMR (300 MHz, $CDCl_3$) δ 0.84 (tripletoid m, 3 H), 1.09-1.42 (m, 8 H), 1.88 (d, *J* = 4.1 Hz, 1 H), 2.34 (s, 3 H), 3.69 (m, 1 H), 4.24 (dd, *J* = 7.2, 4.8 Hz, 1 H), 5.46 (d, *J* = 7.2 Hz, 1 H), 7.03-7.18 (m, 7 H), 7.50-7.54 (m, 2 H). Anal. Calcd for $C_{20}H_{27}NO_3S$: C, 66.45; H, 7.53; N, 3.87. Found: C, 66.22; H, 7.53; N, 3.75.

(2*S*,3*S*)-1-Benzyloxy-2-(4-methylphenyl)sulfonylamino-3-pentanol (19). By a procedure identical with that described for the preparation of **12** from alcohol **6**, 69.5 mg (0.2 mmol) of alcohol **10** was converted into 71 mg (98% yield) of the title compound **19** as a colorless oil. $[\alpha]^{20}_D$ + 36.6 (c 0.93, $CHCl_3$); ^1H NMR (270 MHz, $CDCl_3$) δ 0.76 (t, *J* = 7.4 Hz, 3 H), 1.18-1.42 (m, 2 H), 2.41 (s, 3 H), 2.75 (d, *J* = 2.4 Hz, 1 H), 3.31 (m, 1 H), 3.52 (d, *J* = 3.5 Hz, 2 H), 3.71 (m, 1 H), 4.37 (d, *J* = 12.6 Hz, 1 H), 4.41 (d, *J* = 12.6 Hz, 1 H), 5.20 (d, *J* = 8.4 Hz, 1 H), 7.21-7.38 (m, 7 H), 7.71-7.74 (m, 2 H). Anal. Calcd for $C_{19}H_{25}NO_4S$: C, 62.79; H, 6.93; N, 3.85. Found: C, 62.78; H, 7.13; N, 3.88.

(2*R*,3*S*)-1-Benzyloxy-2-(4-methylphenyl)sulfonylamino-3-pentanol (20). By a procedure identical with that described for the preparation of **12** from alcohol **6**, 69.5 mg (0.2 mmol) of alcohol **11** was converted into 72 mg (99% yield) of the title compound **20** as colorless crystals from *n*-hexane-Et_2O (1:3). mp 112 °C; $[\alpha]^{20}_D$ - 21.1 (c 0.828, $CHCl_3$); ^1H NMR (270 MHz, $CDCl_3$) δ 0.89 (t, *J* = 7.5 Hz, 3 H), 1.34-1.50 (m, 2 H), 2.41 (s, 3 H), 2.45 (d, *J* = 8.6 Hz, 1 H), 3.28 (ddd, *J* = 7.5, 7.5, 3.8 Hz, 1 H), 3.35-3.45 (m, 2 H), 3.68 (dd, *J* = 10.0, 3.8

Hz, 1 H), 4.35 (s, 2 H), 5.36 (d, J = 8.1 Hz, 1 H), 7.19-7.38 (m, 7 H), 7.71-7.74 (m, 2 H). Anal. Calcd for $C_{19}H_{25}NO_4S$: C, 62.79; H, 6.93; N, 3.85. Found: C, 62.52; H, 7.04; N, 3.84.

(2*R*,3*S*)-1-Benzyloxy-2-(4-methylphenyl)sulfonylamino-3-octanol (21). By a procedure identical with that described for the synthesis of **13** from alcohol **6**, 104.2 mg (0.3 mmol) of alcohol **11** was converted into 111 mg (91% yield) of the title compound **21** as colorless crystals from *n*-hexane-Et_2O (1:3). mp 62 °C; $[\alpha]^{20}_D$ - 17.3 (c 0.765, $CHCl_3$); ^1H NMR (270 MHz, $CDCl_3$) δ 0.86 (tripletoid m, 3 H), 1.19-1.43 (m, 6 H), 2.41 (s, 3 H), 2.44 (d, J = 8.4 Hz, 1 H), 3.25 (ddd, J = 7.8, 7.8, 3.5 Hz, 1 H), 3.41-3.50 (m, 2 H), 3.69 (dd, J = 10.0, 3.8 Hz, 1 H), 4.34 (d, J = 11.8 Hz, 1 H), 4.39 (d, J = 11.8 Hz, 1 H), 5.35 (d, J = 7.8 Hz, 1 H), 7.19-7.38 (m, 7 H), 7.71-7.74 (m, 2 H). Anal. Calcd for $C_{22}H_{31}NO_4S$: C, 65.16; H, 7.70; N, 3.45. Found: C, 65.02; H, 7.62; N, 3.29.

(2*R*,3*S*)-3-(4-Methylphenyl)sulfonylamino-1-phenylthio-2-butanol (22). To a stirred suspension of 40 mg (1 mmol) of KH in 2 mL of THF at - 78 °C under argon was added 120.7 mg (0.5 mmol) of alcohol **6** in 2 mL of THF, and the mixture was allowed to warm to 0 °C and to stir at this temperature for 1 h. To the mixture was added 0.062 mL (0.6 mmol, 1.2 equiv.) of PhSH at 0 °C, and the mixture was allowed to warm to room temperature then stirred at this temperature for 2 h. The reaction was quenched with 2 mL of a saturated NH_4Cl solution with vigorous stirring at - 78 °C. The mixture was extracted with EtOAc and the usual workup followed by flash chromatography over silica gel with *n*-hexane-EtOAc (2:1) gave 160 mg (91% yield) of the title compound **22** as a crystalline mass. Colorless crystals from *n*-hexane-Et_2O (1:5); mp 82 °C; $[\alpha]^{33}_D$ - 44.9 (c 0.616, $CHCl_3$); ^1H NMR (300 MHz, $CDCl_3$) δ 1.04 (d, J = 6.7 Hz, 3 H), 2.42 (s, 3 H), 2.64 (dd, J = 3.0, 0.7 Hz, 1 H), 2.91 (dd, J = 13.9, 9.0 Hz, 1 H), 3.02 (dd, J = 13.9, 3.8 Hz, 1 H), 3.37-3.49 (m, 2 H), 4.82 (d, J = 9.0 Hz, 1 H), 7.22-7.35 (m, 7 H), 7.74-7.77 (m, 2 H). LR-MS (FAB), *m/z*, 352 (MH^+), 334, 224, 198 (base peak), 155, 123, 91. HR-MS (FAB), *m/z*, Calcd for $C_{17}H_{22}NO_3S_2$ (MH^+): 352.1041. Found: 352.1045.

(2*R*,3*S*)-1-*tert*-Butylthio-3-(4-methylphenyl)sulfonylamino-2-butanol (23). To a stirred suspension of 40 mg (1 mmol) of KH in 2 mL of THF at - 78 °C under argon was added 120.7 mg (0.5 mmol) of alcohol **6** in 2 mL of THF, and the mixture was allowed to warm to 0 °C and the stirring was continued at this temperature for 1 h. To the mixture was added 0.068 mL (0.6 mmol, 1.2 equiv.) of *tert*-BuSH at 0 °C, and the mixture was allowed to warm to room temperature and the stirring was continued for 2 h. The reaction was quenched with 2 mL of a saturated NH_4Cl solution with vigorous stirring at - 78 °C. The mixture was extracted with EtOAc and the usual workup followed by flash chromatography over silica gel with *n*-hexane-EtOAc (2:1) gave 116 mg (70% yield) of the title compound **23** as a crystalline mass. Colorless crystals from *n*-hexane-Et_2O (1:1); mp 106 °C; $[\alpha]^{33}_D$ - 50.8 (c 1.00, $CHCl_3$); ^1H NMR (300 MHz, $CDCl_3$) δ 1.11 (d, J = 6.7 Hz, 3 H), 1.28 (s, 9 H), 2.42 (s, 3 H), 2.51 (dd, J = 13.1, 9.4 Hz, 1 H), 2.61 (dd, J = 13.1, 3.8 Hz, 1 H), 2.70 (dd, J = 2.7, 0.6 Hz, 1 H), 3.37 (m, 1 H), 3.48 (m, 1 H), 4.84 (d, J = 8.7 Hz, 1 H), 7.29-7.32 (m, 2 H), 7.75-7.79 (m, 2 H). Anal. Calcd for $C_{15}H_{25}NO_3S_2$: C, 54.35; H, 7.60; N, 4.23. Found: C, 54.28; H, 7.69; N, 4.16.

(2*S*,3*S*)-3-(4-Methylphenyl)sulfonylamino-1-phenylthio-2-butanol (24). By a procedure identical with that described for the preparation of **22** from alcohol **6**, 60.3 mg (0.25 mmol) of alcohol **7** was converted into 78 mg (88% yield) of the title compound **24** by treatment with KH (20 mg, 0.5 mmol) at 0 °C for 1 h followed by 0.031 mL (0.3 mmol, 1.2 equiv.) of PhSH at room temperature for 1 h. Colorless crystals from *n*-hexane-Et_2O (1:4); mp 116 °C; $[\alpha]^{33}_D$ - 10.8 (c 0.723, $CHCl_3$); ^1H NMR (270 MHz, $CDCl_3$) δ 1.01 (d, J = 6.8 Hz, 3 H), 2.41 (s, 3 H), 2.59 (d, J = 3.6 Hz, 1 H), 2.79 (dd, J = 13.8, 9.1 Hz, 1 H), 3.07 (dd, J = 13.8, 3.9 Hz, 1 H), 3.45 (m, 1 H), 3.56 (ddd, J = 9.1, 7.8, 3.9 Hz, 1 H), 4.83 (d, J = 8.5 Hz, 1 H), 7.22-7.33 (m, 7 H), 7.70-7.74 (m, 2 H). Anal. Calcd for $C_{17}H_{21}NO_3S_2$: C, 58.09; H, 6.02; N, 3.99. Found: C, 57.80; H, 6.09; N, 3.99.

(2*S*,3*S*)-1-*tert*-Butylthio-3-(4-methylphenyl)sulfonylamino-2-butanol (25). By a procedure identical with that described for the preparation of **23** from alcohol **6**, 72.4 mg (0.3 mmol) of alcohol **7** was converted into 59 mg (59% yield) of the title compound **25**. Colorless crystals from *n*-hexane-Et_2O (1:1). mp 70 °C; $[\alpha]^{30}_D$ - 16.4 (c 0.761, $CHCl_3$); ^1H NMR (270 MHz, $CDCl_3$) δ 1.03 (d, J = 6.8 Hz, 3 H), 1.27 (s, 9 H), 2.42 (s, 3 H), 2.46 (dd, J = 12.8, 8.8 Hz, 1 H), 2.66 (dd, J = 12.8, 4.3 Hz, 1 H), 2.69 (m, 1 H), 3.41 (m, 1 H), 3.55 (m, 1 H), 4.99 (d, J = 8.8 Hz, 1 H), 7.29-7.32 (m, 2 H), 7.75-7.80 (m, 2 H). LR-MS (FAB), *m/z*, 332 (MH^+), 276,

258, 198, 155, 87 (base peak). HR-MS (FAB), *m/z*, Calcd for $C_{15}H_{26}NO_3S_2$ (MH^+): 332.1354. Found: 332.1337.

(2*S*,3*S*)-3-(4-Methylphenyl)sulfonylamino-3-phenyl-1-phenylthio-2-propanol (26). By a procedure identical with that described for the preparation of **22** from alcohol **6**, 91 mg (0.3 mmol) of alcohol **8** was converted into 80 mg (64% yield) of the title compound **26** by treatment with KH (24 mg, 0.6 mmol) at 0 °C for 1 h followed by 0.037 mL (0.36 mmol, 1.2 equiv.) of PhSH at room temperature for 1 h. **26**: colorless crystals from Et_2O; mp 146 °C; $[\alpha]^{30}_D$ + 5.2 (c 0.643, $CHCl_3$); ^1H NMR (300 MHz, $CDCl_3$) δ 2.32 (s, 3 H), 2.52 (d, *J* = 4.2 Hz, 1 H), 2.55 (dd, *J* = 13.9, 8.8 Hz, 1 H), 2.88 (dd, *J* = 13.9, 4.5 Hz, 1 H), 3.94 (ddd, *J* = 8.8, 8.8, 4.5 Hz, 1 H), 4.48 (dd, *J* = 8.3, 4.2 Hz, 1 H), 5.56 (d, *J* = 8.3 Hz, 1 H), 7.02-7.28 (m, 12 H), 7.46-7.50 (m, 2 H). Anal. Calcd for $C_{22}H_{23}NO_3S_2$: C, 63.90; H, 5.61; N, 3.39. Found: C, 63.61; H, 5.52; N, 3.46.

(2*S*,3*R*)-3-(4-Methylphenyl)sulfonylamino-3-phenyl-1-phenylthio-2-propanol (27). By a procedure identical with that described for the preparation of **22** from alcohol **6**, 151.7 mg (0.5 mmol) of alcohol **9** was converted into 184 mg (89% yield) of the title compound **27**. Colorless crystals from Et_2O. mp 144 °C; $[\alpha]^{25}_D$ - 13.9 (c 0.776, $CHCl_3$); ^1H NMR (300 MHz, $CDCl_3$) δ 2.32 (s, 3 H), 2.68 (d, *J* = 3.5 Hz, 1 H), 2.91 (dd, *J* = 14.0, 8.2 Hz, 1 H), 3.03 (dd, *J* = 14.0, 4.2 Hz, 1 H), 3.75 (ddd, *J* = 8.2, 8.2, 4.2 Hz, 1 H), 4.41 (dd, *J* = 7.1, 4.6 Hz, 1 H), 5.56 (d, *J* = 7.1 Hz, 1 H), 7.00-7.26 (m, 12 H), 7.48-7.51 (m, 2 H). Anal. Calcd for $C_{22}H_{23}NO_3S_2$: C, 63.90; H, 5.61; N, 3.39. Found: C, 63.95; H, 5.50; N, 3.26.

(2*R*,3*S*)-4-Benzyloxy-3-(4-methylphenyl)sulfonylamino-1-phenylthio-2-butanol (28). By a procedure identical with that described for the preparation of **22** from alcohol **6**, 104.2 mg (0.3 mmol) of alcohol **10** was converted into 126.5 mg (92% yield) of the title compound **28** as colorless crystals from Et_2O. mp 117 °C; $[\alpha]^{20}_D$ + 21.1 (c 0.804, $CHCl_3$); ^1H NMR (300 MHz, $CDCl_3$) δ 2.39 (s, 3 H), 2.75 (dd, *J* = 13.8, 5.9 Hz, 1 H), 2.86 (dd, *J* = 13.8, 7.5 Hz, 1 H), 2.95 (d, *J* = 2.4 Hz, 1 H), 3.48-3.54 (m, 2 H), 3.60 (dddd, *J* = 9.0, 4.5, 4.5, 1.9 Hz, 1 H), 3.88 (m, 1 H), 4.37 (s, 2 H), 5.17 (d, *J* = 9.0 Hz, 1 H), 7.16-7.32 (m, 12 H), 7.72-7.75 (m, 2 H). Anal. Calcd for $C_{24}H_{27}NO_4S_2$: C, 62.99; H, 5.95; N, 3.06. Found: C, 63.15; H, 6.02; N, 2.99.

(2*R*,3*R*)-4-Benzyloxy-3-(4-methylphenyl)sulfonylamino-1-phenylthio-2-butanol (29). By a procedure identical with that described for the preparation of **22** from alcohol **6**, 104.2 mg (0.3 mmol) of alcohol **11** was converted into 128.9 mg (94% yield) of the title compound **29** as colorless crystals from Et_2O. mp 115 °C; $[\alpha]^{20}_D$ - 23.0 (c 0.60, $CHCl_3$); ^1H NMR (300 MHz, $CDCl_3$) δ 2.39 (s, 3 H), 2.90 (d, *J* = 6.2 Hz, 1 H), 2.93 (dd, *J* = 14.0, 8.1 Hz, 1 H), 3.17 (dd, *J* = 14.0, 5.2 Hz, 1 H), 3.28 (dd, *J* = 9.7, 3.6 Hz, 1 H), 3.46 (m, 1 H), 3.61 (m, 1 H), 3.68 (dd, *J* = 9.7, 2.9 Hz, 1 H), 4.34 (d, *J* = 11.8 Hz, 1 H), 4.38 (d, *J* = 11.8 Hz, 1 H), 5.21 (d, *J* = 8.8 Hz, 1 H), 7.17-7.34 (m, 12 H), 7.64-7.67 (m, 2 H). Anal. Calcd for $C_{24}H_{27}NO_4S_2$: C, 62.99; H, 5.95; N, 3.06. Found: C, 63.08; H, 5.94; N, 3.02.

(3*S*,4*S*)-4-(4-Methylphenyl)sulfonylamino-3-trimethylsilyloxypentanenitrile (30). To a stirred suspension of 40 mg (1 mmol) of KH in 2 mL of THF at - 78 °C under argon was added 120.7 mg (0.5 mmol) of alcohol **6** in 2 mL of THF, and the mixture was allowed to warm to 0 °C then stirred at this temperature for 1 h. To the mixture were added 0.2 mL of Me_3SiCN (1.5 mmol, 3 equiv.) and 2 mL of a 0.05 M solution of $Yb(CN)_3$ (0.1 mmol, 0.2 equiv.) in a 9:1 mixture of THF and *n*-hexane at 0 °C and the mixture was allowed to warm to room temperature then stirred at this temperature for 3 h. The reaction was quenched with 2 mL of a saturated NH_4Cl solution with vigorous stirring at 0 °C. The mixture was extracted with CH_2Cl_2 and the usual workup followed by flash chromatography over silica gel with *n*-hexane-EtOAc (3:1) gave 112 mg (66% yield) of the title compound **30** as a colorless oil. $[\alpha]^{30}_D$ - 17.0 (c 0.406, $CHCl_3$); ^1H NMR (270 MHz, $CDCl_3$) δ 0.17 (s, 9 H), 0.98 (d, *J* = 7.0 Hz, 3 H), 2.44 (s, 3 H), 2.46 (m, 2 H), 3.39 (m, 1 H), 3.87 (ddd, *J* = 6.5, 6.5, 1.9 Hz, 1 H), 4.69 (d, *J* = 9.5 Hz, 1 H), 7.31-7.34 (m, 2 H), 7.75-7.78 (m, 2 H). LR-MS (FAB), *m/z*, 341 (MH^+, base peak), 325, 198, 155, 91, 73. HR-MS (FAB), *m/z*, Calcd for $C_{15}H_{25}N_2O_3SSi$ (MH^+): 341.1355. Found: 341.1348.

(3*S*,4*S*)-3-Hydroxy-4-(4-methylphenyl)sulfonylaminopentanenitrile (31). To a stirred suspension of 40 mg (1 mmol) of KH in 2 mL of THF at - 78 °C under argon was added 120.7 mg (0.5 mmol) of alcohol **6** in 2

mL of THF, and then the mixture was allowed to warm to 0 °C and the stirring was continued for 1 h. To the mixture were added 0.2 mL of Me_3SiCN (1.5 mmol, 3 equiv.) and 2 mL of a 0.05 M solution of $Yb(CN)_3$ (0.1 mmol, 0.2 equiv.) in a 9:1 mixture of THF and *n*-hexane at 0 °C and the mixture was allowed to warm to room temperature then stirred at this temperature for 2 h. To the mixture was added 0.75 mL of a 1.0 M solution of nBu_4NF (0.75 mmol, 1.5 equiv.) in THF at 0 °C, and the mixture was allowed to warm to room temperature then stirred for 15 min. The reaction was quenched with 3 mL of a saturated NH_4Cl solution with vigorous stirring at - 78 °C. The mixture was extracted with EtOAc and the extract was washed successively with 5% citric acid, saturated brine, 5% $NaHCO_3$, and water, and dried over $MgSO_4$. Concentration under reduced pressure gave an oily residue which was purified by flash chromatography over silica gel with *n*-hexane-EtOAc (1:1) to yield 121 mg (90% yield) of the title compound **31** as a crystalline mass. Colorless crystals from Et_2O-MeOH (1:1); mp 178 °C; $[\alpha]^{29}_D$ - 66.5 (c 0.49, MeOH); ^1H NMR (300 MHz, DMSO-*d6*) δ 0.76 (d, *J* = 6.9 Hz, 3 H), 2.38 (s, 3 H), 2.42-2.58 (m, 2 H), 3.13 (ddd, *J* = 13.7, 6.8, 3.2 Hz, 1 H), 3.32 (m, 1 H), 3.67 (ddd, *J* = 8.1, 4.4, 3.2 Hz, 1 H), 7.37-7.40 (m, 2 H), 7.68-7.72 (m, 2 H). Anal. Calcd for $C_{12}H_{16}N_2O_3S$: C, 53.71; H, 6.01; N, 10.44. Found: C, 53.73; H, 5.97; N, 10.35.

(3*R*,4*S*)-3-Hydroxy-4-(4-methylphenyl)sulfonylaminopentanenitrile (32). By a procedure identical with that described for the preparation of **31** from alcohol **6**, 120.7 mg (0.5 mmol) of alcohol **7** was converted into 115 mg (86% yield) of the title compound **32** as a colorless oil. $[\alpha]^{20}_D$ - 39.1 (c 0.42, $CHCl_3$); ^1H NMR (270 MHz, $CDCl_3$) δ 0.98 (d, *J* = 6.8 Hz, 3 H), 2.44 (s, 3 H), 2.50-2.67 (m, 2 H), 3.29-3.39 (m, 2 H), 3.96 (m, 1 H), 5.21 (d, *J* = 8.1 Hz, 1 H), 7.28-7.35 (m, 2 H), 7.76-7.79 (m, 2 H). LR-MS (FAB), *m/z*, 269 (MH^+), 198, 155, 139, 91 (base peak), 79. HR-MS (FAB), *m/z*, Calcd for $C_{12}H_{17}N_2O_3S$ (MH^+): 269.0960. Found: 269.0956.

(3*R*,4*S*)-3-Hydroxy-4-(4-methylphenyl)sulfonylamino-4-phenylbutanenitrile (33). By a procedure identical with that described for the preparation of **31** from alcohol **6**, 121.4 mg (0.4 mmol) of alcohol **8** was converted into 89 mg (67% yield) of hydroxy nitrile **33** as colorless crystals from *n*-hexane-Et_2O (1:5). mp 157 °C; $[\alpha]^{20}_D$ + 35.3 (c 0.43, $CHCl_3$); ^1H NMR (270 MHz, $CDCl_3$) δ 2.34 (s, 3 H), 2.44 (m, 2 H), 2.90 (d, *J* = 4.9 Hz, 1 H), 4.32 (m, 2 H), 5.69 (d, *J* = 8.1 Hz, 1 H), 7.02-7.30 (m, 7 H), 7.45-7.55 (m, 2 H). Anal. Calcd for $C_{17}H_{18}N_2O_3S$: C, 61.80; H, 5.49; N, 8.48. Found: C, 61.76; H, 5.62; N, 8.22.

(3*R*,4*R*)-3-Hydroxy-4-(4-methylphenyl)sulfonylamino-4-phenylbutanenitrile (34). By a procedure identical with that described for the preparation of **31** from alcohol **6**, 151.7 mg (0.5 mmol) of alcohol **9** was converted into 140 mg (85% yield) of hydroxy nitrile **34** as colorless crystals from MeOH-Et_2O (1:1). mp 162 °C; $[\alpha]^{20}_D$ - 5.9 (c 1.02, MeOH); ^1H NMR (300 MHz, CD_3OD) δ 2.29 (s, 3 H), 2.49 (dd, *J* = 16.8, 7.7 Hz, 1 H), 2.60 (dd, *J* = 16.8, 4.6 Hz, 1 H), 3.31 (m, 2 H), 3.98 (ddd, *J* = 8.9, 4.6, 4.6 Hz, 1 H), 4.34 (d, *J* = 4.3 Hz, 1 H), 7.06-7.13 (m, 7 H), 7.45-7.49 (m, 2 H). Anal. Calcd for $C_{17}H_{18}N_2O_3S$: C, 61.80; H, 5.49; N, 8.48. Found: C, 61.99; H, 5.52; N, 8.70.

(3*S*,4*R*)-5-Benzyloxy-3-hydroxy-4-(4-methylphenyl)sulfonylaminopentanenitrile (35). By a procedure identical with that described for the preparation of **31** from alcohol **6**, 139 mg (0.4 mmol) of alcohol **11** was converted into 142 mg (95% yield) of nitrile **35** as colorless crystals from Et_2O. mp 136 °C; $[\alpha]^{20}_D$ - 32.3 (c 0.736, $CHCl_3$); ^1H NMR (270 MHz, $CDCl_3$) δ 2.42 (s, 3 H), 2.56 (dd, *J* = 17.0, 7.8 Hz, 1 H), 2.77 (dd, *J* = 17.0, 4.3 Hz, 1 H), 3.00 (d, *J* = 6.9 Hz, 1 H), 3.08 (dd, *J* = 9.6, 3.8 Hz, 1 H), 3.27 (m, 1 H), 3.60 (dd, *J* = 9.6, 2.8 Hz, 1 H), 3.95 (ddd, *J* = 14.9, 6.9, 4.3 Hz, 1 H), 4.31 (d, *J* = 11.8 Hz, 1 H), 4.40 (d, *J* = 11.8 Hz, 1 H), 7.17-7.40 (m, 7 H), 7.64-7.68 (m, 2 H). Anal. Calcd for $C_{19}H_{22}N_2O_4S$: C, 60.94; H, 5.92; N, 7.48. Found: C, 60.79; H, 5.90; N, 7.32.

(2*R*,3*S*)-3-(4-Methylphenyl)sulfonylamino-1-tributylstannyl-2-butanol (36). To a stirred suspension of 24 mg (0.6 mmol) of KH in 2 mL of THF at - 78 °C under argon was added 72.4 mg (0.3 mmol) of alcohol **6** in 2 mL of THF, and the mixture was allowed to warm to 0 °C and the stirring was continued at this temperature for 1 h. To the mixture was added by syringe 6.6 mL of a 0.23 M solution of $(Bu_3Sn)_2Cu(CN)Li_2$ (1.5 mmol, 5 equiv.) in *n*-hexane-THF(2:3), prepared from 134 mg (1.5mmol) of CuCN , 1.8 mL of a 1.64 M *n*-hexane solution of *n*-BuLi (3 mmol), and 1.8 mL of bis(tributyltin) (3.6 mmol), at - 78 °C and the mixture was allowed to warm to - 40 °C for 1 h. The reaction was quenched with 4 mL of a saturated NH_4Cl-28%

NH_4OH (1:1) solution with vigorous stirring at - 78 °C. The mixture was extracted with Et_2O and the usual workup followed by flash chromatography over silica gel with *n*-hexane-EtOAc-Et_3N (15:4:1) gave 108 mg (68% yield) of the title compound **36** as a colorless oil. $[\alpha]^{20}_D$ - 44.6 (c 1.4, $CHCl_3$); ^{1}H-NMR (270 MHz, $CDCl_3$) δ 0.70-0.95 (m, 17 H), 1.00 (d, *J* = 7.0 Hz, 3 H), 1.21-1.59 (m, 12 H), 1.86 (d, *J* = 4.8 Hz, 1 H), 2.43 (s, 3 H), 3.11 (m, 1 H), 3.59 (ddd, *J* = 10.0, 10.0, 4.8 Hz, 1 H), 4.60 (d, *J* = 8.1 Hz, 1 H), 7.29-7.32 (m, 2 H), 7.75-7.78 (m, 2 H). Anal. Calcd for $C_{23}H_{43}NO_3SSn$: C, 51.89; H, 8.14; N, 2.63. Found: C, 52.13; H, 8.42; N, 2.64.

(2*S*,3*R*)-3-(4-Methylphenyl)sulfonylamino-3-phenyl-1-tributylstannyl-2-propanol (37). By a procedure identical with that described for the synthesis of **36** from alcohol **6**, 91 mg (0.3 mmol) of alcohol **9** was converted into 93 mg (52% yield) of the title compound **37** as a colorless oil. $[\alpha]^{20}_D$ - 2.1 (c 1.0, $CHCl_3$); ^{1}H-NMR (270 MHz, $CDCl_3$) δ 0.68-0.97 (m, 17 H), 1.22-1.50 (m, 12 H), 1.89 (m, 1 H), 2.34 (s, 3 H), 3.91 (m, 1 H), 4.13 (dd, *J* = 7.1, 4.9 Hz, 1 H), 5.30 (d, *J* = 7.1 Hz, 1 H), 6.99-7.18 (m, 7 H), 7.51-7.54 (m, 2 H). Anal. Calcd for $C_{28}H_{45}NO_3SSn$: C, 56.58; H, 7.63; N, 2.36. Found: C, 56.68; H, 7.90; N, 2.32.

(2*S*,3*R*)-5-Benzyloxy-3-(4-methylphenyl)sulfonylamino-1-tributylstannyl-2-butanol (38). By a procedure identical with that described for the synthesis of **36** from alcohol **6**, 104.2 mg (0.3 mmol) of alcohol **10** was converted into 80 mg (42% yield) of the title compound **38**. **38**: a colorless oil; $[\alpha]^{20}_D$ - 15.1 (c 0.74, $CHCl_3$); ^{1}H-NMR (270 MHz, $CDCl_3$) δ 0.58-0.91 (m, 17 H), 1.20-1.54 (m, 12 H), 2.41 (s, 3 H), 2.71 (m, 1 H), 3.18 (m, 1 H), 3.43 (dd, *J* = 9.6, 4.1 Hz, 1 H), 3.54 (dd, *J* = 9.6, 2.7 Hz, 1 H), 3.96 (m, 1 H), 4.36 (d, *J* = 11.9 Hz, 1 H), 4.41 (d, *J* = 11.9 Hz, 1 H), 5.17 (d, *J* = 8.6 Hz, 1 H), 7.20-7.38 (m, 7 H), 7.71-7.74 (m, 2 H). Anal. Calcd for $C_{30}H_{49}NO_4SSn$: C, 56.44; H, 7.74; N, 2.19. Found: C, 56.34; H, 7.98; N, 2.03.

(2*S*,3*S*)-1-(*N*,*N*-Dibenzyl)amino-3-(4-methylphenyl)sulfonylamino-2-butanol (39). To a stirred suspension of 40 mg (1 mmol) of KH in 2 mL of THF at - 78 °C under argon was added 120.7 mg (0.5 mmol) of alcohol **6** in 2 mL of THF, and the mixture was allowed to warm to 0 °C and the stirring was continued for 1 h. To the mixture was added by syringe 8 mL of a 0.31 M solution of $(Bn_2N)_2Cu(CN)Li_2$ (2.5 mmol, 5 equiv.) in *n*-hexane-THF (2:3), prepared from 224 mg of CuCN (2.5 mmol) and 8 mL of a 0.62 M solution of Bn_2NLi in a 5:3 mixed solvent of THF and *n*-hexane, at - 78 °C and the mixture was allowed to warm to 0 °C then stirred at this temperature for 1.5 h. The reaction was quenched with 4 mL of a saturated NH_4Cl-28%NH_4OH (1:1) solution with vigorous stirring at - 78 °C. The mixture was extracted with Et_2O-CH_2Cl_2 (4:1) and the usual workup followed by flash chromatography over silica gel with *n*-hexane-EtOAc (3:1) gave 199 mg (91% yield) of the title compound **39** as a crystalline mass. **39**: colorless crystals from Et_2O; mp 136 °C; $[\alpha]^{20}_D$ - 56.0 (c 1.01, $CHCl_3$); ^{1}H-NMR (300 MHz, $CDCl_3$) δ 1.03 (d, *J* = 6.8 Hz, 3 H), 2.31 (dd, *J* = 13.7, 3.6 Hz, 1 H), 2.41 (s, 3 H), 2.58 (dd, *J* = 12.9, 10.4 Hz, 1 H), 3.17 (m, 1 H), 3.35 (s, 1 H), 3.39 (s, 1 H), 3.41 (m, 1 H), 3.48 (ddd, *J* = 10.4, 3.5, 2.5 Hz, 1 H), 3.73 (s, 1 H), 3.77 (s, 1 H), 7.21-7.35 (m, 12 H), 7.63-7.66 (m, 2 H). Anal. Calcd for $C_{25}H_{30}N_2O_3S$: C, 68.46; H, 6.89; N, 6.39. Found: C, 68.34; H, 7.01; N, 6.31. LR-MS (FAB), *m/z*, 439 (MH^+), 437, 210, 91 (base peak). HR-MS (FAB), *m/z*, Calcd for $C_{25}H_{31}N_2O_3S$ (MH^+): 439.2055. found: 439.2057.

(2*R*,3*R*)-1-(*N*,*N*-Dibenzyl)amino-3-(4-methylphenyl)sulfonylamino-1-phenyl-2-propanol (40). By a procedure identical with that described for the synthesis of **39** from alcohol **6**, 91 mg (0.3 mmol) of alcohol **9** was converted into 142 mg (94% yield) of the title compound **40** as a colorless oil. $[\alpha]^{20}_D$ + 2.5 (c 0.72, $CHCl_3$); ^{1}H NMR (270 MHz, $CDCl_3$) δ 2.32 (s, 3 H), 2.38 (dd, *J* = 13.0, 3.6 Hz, 1 H), 2.64 (dd, *J* = 13.0, 10.0 Hz, 1 H), 3.37 (s, 1 H), 3.42 (s, 1 H), 3.48 (m, 1 H), 3.68 (s, 1 H), 3.73 (s, 1 H), 3.76 (m, 1 H), 4.12 (dd, *J* = 6.5, 3.6 Hz, 1 H), 5.49 (d, *J* = 6.5 Hz, 1 H), 6.97-7.41 (m, 19 H). LR-MS (FAB), *m/z*, 501 (MH^+), 499, 210, 120, 91 (base peak). HR-MS (FAB), *m/z*, Calcd for $C_{30}H_{33}N_2O_3S$ (MH^+): 501.2212. Found: 501.2215.

(2*R*,3*S*)-1-Benzyloxy-4-(*N*,*N*-dibenzyl)amino-2-(4-methylphenyl)sulfonylamino-3-butanol (41). By a procedure identical with that described for the synthesis of **39** from alcohol **6**, 104.2 mg (0.3 mmol) of alcohol **11** was converted into 144 mg (88% yield) of the title compound **41** as a colorless oil; $[\alpha]^{20}_D$ - 41.3 (c 1.05, $CHCl_3$); ^{1}H NMR (270 MHz, $CDCl_3$) δ 2.35 (s, 3 H), 2.45 (m, 1 H), 2.65 (dd, *J* = 13.0, 5.8 Hz, 1 H), 3.03 (dd,

J = 9.6, 3.8 Hz, 1 H), 3.21 (m, 1 H), 3.35 (dd, *J* = 9.6, 2.7 Hz, 1 H), 3.40 (s, 1 H), 3.45 (s, 1 H), 3.51 (s, 1 H), 3.56 (s, 1 H), 3.64 (ddd, *J* = 8.4, 8.4, 5.8 Hz, 1 H), 4.12 (d, *J* = 11.4 Hz, 1 H), 4.20 (d, *J* = 11.4 Hz, 1 H), 5.23 (d, *J* = 8.4 Hz, 1 H), 7.11-7.35 (m, 17 H), 7.61-7.65 (m, 2 H). Anal. Calcd for $C_{32}H_{36}N_2O_4S$: C, 70.56; H, 6.66; N, 5.14. Found: C, 70.27; H, 6.61; N, 5.26.

(3*S*,4*S*)-3-Hydroxy-4-(4-methylphenyl)sulfonylaminopentanamide (42). To a stirred solution of hydroxy nitrile **31** (188 mg, 0.7 mmol) in 10 mL of 30%H_2O_2-MeOH (1:1) at room temperature was added 103 mg of K_2CO_3, and the mixture was heated under reflux for 6 h. The whole was concentrated under reduced pressure to a semisolid, which was extracted with EtOAc-$CHCl_3$ (3:1). The extract was washed with brine and dried over $MgSO_4$. The usual workup and flash chromatography over silica gel with EtOAc gave 129 mg (64 % yield) of the title compound **42** as a crystalline mass. Colorless crystals from MeOH-Et_2O (1:1); mp 205 °C; $[\alpha]^{20}_D$ - 67.8 (c 0.51, MeOH); ^{1}H NMR (270 MHz, DMSO-*d6*) δ 0.73 (d, *J* = 6.8 Hz, 3 H), 2.13 (m, 2 H), 2.38 (s, 3 H), 2.51 (m, 1 H), 3.13 (m, 1 H), 3.79 (m, 1 H), 4.86 (d, *J* = 4.9 Hz, 1 H), 6.79 (s, 1 H), 7.24 (s, 1 H), 7.36-7.39 (m, 2 H), 7.68-7.71 (m, 2 H). Anal. Calcd for $C_{12}H_{18}N_2O_4S$: C, 50.34; H, 6.34; N, 9.78. Found: C, 50.51; H, 6.49; N, 9.16. LR-MS (CI), *m/z*, 287 (MH^+), 270 (base peak), 269, 198, 157, 88. HR-MS (CI), *m/z*, Calcd for $C_{12}H_{19}N_2O_4S$ (MH^+): 287.1065. Found: 287.1066.

(3*R*,4*R*)-3-Hydroxy-4-(4-methylphenyl)sulfonylamino-4-phenylbutanamide (43). By a procedure identical with that described for the preparation of **42** from hydroxy nitrile **31**, 660 mg (2 mmol) of hydroxy nitrile **34** was converted into 376 mg (54% yield) of the title compound **43**. Colorless crystals from MeOH-Et_2O (3:1); mp 199 °C; $[\alpha]^{20}_D$ - 17.1 (c 0.53, MeOH); ^{1}H NMR (270 MHz, CD_3OD) δ 2.24-2.39 (m, 3 H), 2.29 (s, 3 H), 3.31 (m, 1 H), 4.10 (m, 1 H), 4.32 (d, *J* = 4.6 Hz, 1 H), 7.06-7.14 (m, 7 H), 7.45-7.48 (m, 2 H). Anal. Calcd for $C_{17}H_{20}N_2O_4S$: C, 58.60; H, 5.79; N, 8.04. Found: C, 58.09; H, 5.76; N, 7.81.

Methyl (3*R*,4*R*)-3-Hydroxy-4-(4-methylphenyl)sulfonylamino-4-phenylbutanoate (44). To a stirred solution of **43** (86 mg, 0.247 mmol) in 2 mL of MeOH was added 1.24 mL (2.47 mmol) of 2*N* KOH at room temperature, and the mixture was heated under reflux for 8 h. After the mixture was acidified with 3 mL of 2 *N*-HCl at 0 °C, 5 mL of ethereal CH_2N_2 was added to the mixture at - 30 °C, and stirring was continued for 30 min at 0 °C. The mixture was extracted with EtOAc and the extract was washed with brine, 5% $NaHCO_3$, and brine and dried over $MgSO_4$. The usual workup and flash chromatography over silica gel with *n*-hexane-EtOAc (1:1) gave 72 mg (80% yield) of the title compound **44** as a crystalline mass. Colorless crystals from *n*-hexane-Et_2O (1:4); mp 106 °C; $[\alpha]^{20}_D$ - 33.0 (c 1.06, $CHCl_3$); ^{1}H NMR (270 MHz, $CDCl_3$) δ 2.33 (s, 3 H), 2.40 (dd, *J* = 16.7, 3.6 Hz, 1 H), 2.54 (dd, *J* = 16.7, 8.6 Hz, 1 H), 3.25 (d, *J* = 3.6 Hz, 1 H), 3.66 (s, 3 H), 4.14 (m, 1 H), 4.28 (dd, *J* = 5.9, 5.9 Hz, 1 H), 5.62 (d, *J* = 6.8 Hz, 1 H), 7.04-7.20 (m, 7 H), 7.46-7.49 (m, 2 H). Anal. Calcd for $C_{18}H_{21}NO_5S$: C, 59.49; H, 5.82; N, 3.85. Found: C, 59.79; H, 5.90; N, 3.80.

(2*R*,3*S*)-1-Benzyloxy-2-(4-methylphenyl)sulfonylamino-3-octadecanol (45). To a stirred suspension of 80 mg (2 mmol) of KH in 5 mL of THF at - 78 °C under argon was added 347 mg (1 mmol) of alcohol **11** in 5 mL of THF, and the mixture was allowed to warm to 0 °C then stirred at this temperature for 1 h. To the mixture was added by syringe 20 mL of a 0.25 M solution of $[CH_3(CH_2)_{13}]_2Cu(CN)(MgCl)_2$ (5 mmol, 5 equiv.) in THF, prepared from 448 mg of CuCN (5 mmol) and 10 mL of a 1.0 M solution of $[CH_3(CH_2)_{13}]MgCl$ (10 mmol) in THF, at - 78 °C and the mixture was stirred at - 78 °C for 2 h. The reaction was quenched with 10 mL of a saturated NH_4Cl-28% NH_4OH (1:1) solution with vigorous stirring at - 78 °C. The mixture was extracted with EtOAc and the usual workup followed by flash chromatography over silica gel with *n*-hexane-EtOAc (3:1) gave 505 mg (93% yield) of the title compound **45** as a crystalline mass. Colorless crystals from *n*-hexane-Et_2O (1:3); mp 85 °C; $[\alpha]^{20}_D$ - 12.0 (c 1.0, $CHCl_3$); ^{1}H NMR (270 MHz, $CDCl_3$) δ 0.88 (m, 3 H), 1.18-1.39 (m, 28 H), 2.40-2.43 (m, 1 H), 2.41 (s, 3 H), 3.26 (m, 1 H), 3.43 (dd, *J* = 9.6, 3.2 Hz, 1 H), 3.48 (m, 1 H), 3.69 (dd, *J* = 9.6, 3.5 Hz, 1 H), 4.34 (d, *J* = 11.9 Hz, 1 H), 4.39 (d, *J* = 11.9 Hz, 1 H), 5.32 (d, *J* = 8.1 Hz, 1 H), 7.19-7.38 (m, 7 H), 7.71-7.74 (m, 2 H). Anal. Calcd for $C_{32}H_{51}NO_4S$: C, 70.42; H, 9.42; N, 2.57. Found: C, 70.25; H, 9.64; N, 2.46.

(2*R*,3*S*)-2-(4-Methylphenyl)sulfonylaminooctadecane-1,3-diol (46). Benzyl ether **45** (150 mg, 0.275 mmol) in a mixed solvent of 5%-HCl (0.2 mL) and MeOH (4 mL) was subjected to catalytic hydrogenolysis

over PtO_2 (30 mg) at atmospheric pressure for 2 h. The catalyst was removed by filtration, and the filtrate was concentrated under reduced pressure to leave an oily residue, which was purified by flash chromatography over silica gel with *n*-hexane-EtOAc (1:2) to yield 105 mg (84% yield) of the title compound **46** as a crystalline mass. Colorless crystals from Et_2O; mp 97 °C; $[\alpha]^{20}_D$ + 5.3 (c 0.19, $CHCl_3$); ^1H NMR (270 MHz, $CDCl_3$) δ 0.88 (m, 3 H), 1.14-1.47 (m, 28 H), 2.35 (m, 2 H), 2.43 (s, 3 H), 3.14 (m, 1 H), 3.52 (m, 1 H), 3.63 (m, 1 H), 3.89 (m, 1 H), 5.50 (d, *J* = 7.8 Hz, 1 H), 7.30-7.33 (m, 2 H), 7.76-7.79 (m, 2 H). LR-MS (FAB), *m/z*, 456 (MH^+), 438, 302, 214, 172, 155, 136, 91 (base peak). HR-MS (FAB), *m/z*, Calcd for $C_{25}H_{46}NO_4S$ (MH^+): 456.3147. Found: 456.3142.

(4*S*,5*R*)-2,2-Dimethyl-4-pentadecyl-5-(4-methylphenyl)sulfonylamino-1,3-dioxane (47). To a stirred solution of **46** (100 mg, 0.22 mmol) in a mixture of CH_2Cl_2 (3 mL), 2,2-dimethoxypropane (0.54 mL, 4.4 mmol), and acetone (0.16 mL, 2.2 mmol) at 0 °C was added boron trifluoride etherate (0.1 mL), and the whole was stirred for 18 h with warming to room temperature. The mixture was poured into a stirred cold saturated $NaHCO_3$ solution (5 mL) and the stirring was continued for 1 h with warming to room temperature. The mixture was extracted with Et_2O and the extract was washed with water and dried over $MgSO_4$. The usual workup and flash chromatography over silica gel with *n*-hexane-EtOAc (4:1) gave 99 mg (91% yield) of the title compound **47** as a crystalline mass. Colorless crystals from *n*-hexane-Et_2O (3:1); mp 69 °C; $[\alpha]^{20}_D$ - 22.7 (c 0.299, $CHCl_3$); ^1H NMR (270 MHz, $CDCl_3$) δ 0.88 (m, 3 H), 1.10-1.58 (m, 28 H), 1.31 (s, 3 H), 1.36 (s, 3 H), 2.43 (s, 3 H), 3.12 (m, 1 H), 3.39 (m, 2 H), 3.71 (dd, *J* = 11.9, 5.1 Hz, 1 H), 4.52 (m, 1 H), 7.29-7.32 (m, 2 H), 7.74-7.77 (m, 2 H). LR-MS (FAB), *m/z*, 496 (MH^+), 438, 214, 172, 155 (base peak), 139, 91. HR-MS (FAB), *m/z*, Calcd for $C_{28}H_{50}NO_4S$ (MH^+): 496.3460. Found: 496.3448.

(4*S*,5*R*)-2,2-Dimethyl-4-pentadecyl-5-(*tert*-butoxycarbonylamino)-1,3-dioxane (48). To a stirred solution of 95 mg (0.192 mmol) of **47** in a mixture of 20 mL of liquid ammonia and 5 mL of Et_2O at - 78 °C was added sodium (300 mg) in small portions at - 78 °C until a blue coloration persisted. The mixture was allowed to warm to - 35 °C, and the stirring was continued at this temperature for 4 h. The reaction was quenched with 1 mL of *t*-BuOH at - 78 °C, and the mixture was allowed to warm to 0 °C. The mixture was concentrated under reduced pressure to leave a semisolid. To the above residue were added 3 mL of H_2O, 5 mL of Et_2O, and 670 mg (3.07 mmol) of $(Boc)_2O$ at 0 °C, and the mixture was stirred for 5 h at room temperature. The mixture was extracted with Et_2O and the extract was washed with water and dried over $MgSO_4$. The usual workup and flash chromatography over silica gel with *n*-hexane-EtOAc (5:1) gave 40 mg (47% yield) of the title compound **48** as a crystalline mass. Colorless crystals from *n*-hexane-Et_2O (5:1); mp 65 °C; $[\alpha]^{20}_D$ - 27.7 (c 0.26, $CHCl_3$); ^1H NMR (270 MHz, $CDCl_3$) δ 0.88 (m, 3 H), 1.18-1.62 (m, 28 H), 1.38 (s, 3 H), 1.41 (s, 3 H), 1.44 (s, 9 H), 3.50 (m, 3 H), 3.90 (m, 1 H), 4.36 (m, 1 H). LR-MS (FAB), *m/z*, 442 (MH^+), 386, 370, 328 (base peak), 284, 282, 95. HR-MS (FAB), *m/z*, Calcd for $C_{26}H_{52}NO_4$ (MH^+): 442.3896. Found: 442.3900.

(2*R*,3*S*)-2-Aminooctadecane-1,3-diol hydrochloride (49). To a stirred solution of **48** (19 mg, 0.043 mmol) in 2 mL of THF was added 0.5 mL of 3 *N*-HCl at 0 °C, and the mixture was stirred for 2 h with warming to room temperature. Concentration under reduced pressure gave a colorless semisolid. Recrystallization from a mixed solvent of MeOH-Et_2O (1:1) gave 14.3 mg (99% yield) of the title compound **49** as colorless crystals from MeOH-Et_2O (1:1). mp 90-92 °C; $[\alpha]^{20}_D$ - 8.6 (c 0.21, MeOH); ^1H NMR (270 MHz, CD_3OD) δ 0.90 (m, 3 H), 1.10-1.41 (m, 28 H), 3.19 (m, 1 H), 3.69 (dd, *J* = 11.6, 8.6 Hz, 1 H), 3.79 (m, 1 H), 3.83 (dd, *J* = 11.6, 4.3 Hz, 1 H). LR-MS (FAB), *m/z*, 302 (MH^+, base peak), 300, 284, 154, 136, 60. HR-MS (FAB), *m/z*, Calcd for $C_{18}H_{40}NO_2$ (MH^+): 302.3059. Found: 302.3053.

(2*S*,3*S*)-1-Benzyloxy-2-(4-methylphenyl)sulfonylamino-3-octadecanol (50). By a procedure identical with that described for the synthesis of **45** from alcohol **11**, 347 mg (1 mmol) of alcohol **10** was converted into 488 mg (90% yield) of the title compound **50**. Colorless crystals from *n*-hexane-Et_2O (5:1); mp 66 °C; $[\alpha]^{20}_D$ + 22.1 (c 0.57, $CHCl_3$); ^1H NMR (270 MHz, $CDCl_3$) δ 0.88 (m, 3 H), 0.98-1.33 (m, 28 H), 2.41 (s, 3 H), 2.71 (d, *J* = 2.4 Hz, 1 H), 3.26 (m, 1 H), 3.56 (d, *J* = 3.5 Hz, 2 H), 3.77 (m, 1 H), 4.39 (d, *J* = 11.9 Hz, 1 H), 4.44 (d, *J* = 11.9 Hz, 1 H), 5.19 (d, *J* = 8.4 Hz, 1 H), 7.22-7.38 (m, 7 H), 7.72-7.75 (m, 2 H). Anal. Calcd for $C_{32}H_{51}NO_4S$: C, 70.42; H, 9.42; N, 2.57. Found: C, 70.24; H, 9.29; N, 2.59.

(2*S*,3*S*)-2-(4-Methylphenyl)sulfonylaminooctadecane-1,3-diol (51). By a procedure identical with that described for the preparation of **46** from **45**, 320 mg (0.587 mmol) of **50** was converted into 244 mg (91% yield) of **51** as colorless crystals from *n*-hexane-Et_2O (1:4). mp 81 °C; $[\alpha]^{20}_D$ + 12.3 (c 0.51, $CHCl_3$); ^1H NMR (270 MHz, $CDCl_3$) δ 0.88 (m, 3 H), 0.97-1.36 (m, 28 H), 2.42 (s, 3 H), 2.62 (m, 2 H), 3.15 (m, 1 H), 3.71 (m, 2 H), 3.80 (m, 1 H), 5.46 (d, *J* = 8.1 Hz, 1 H), 7.29-7.32 (m, 2 H), 7.76-7.80 (m, 2 H). LR-MS (FAB), *m/z*, 456 (MH^+), 302, 214, 172, 155, 136, 91 (base peak). HR-MS (FAB), *m/z*, Calcd for $C_{25}H_{46}NO_4S$ (MH^+): 456.3147. Found: 456.3141.

(4*S*,5*S*)-2,2-Dimethyl-4-pentadecyl-5-(4-methylphenyl)sulfonylamino-1,3-dioxane (52). By a procedure identical with that described for the preparation of **47** from diol **46**, 216 mg (0.475 mmol) of diol **51** was converted into 222 mg (94% yield) of acetonide **52** as a colorless oil. $[\alpha]^{20}_D$ + 14.3 (c 0.67, $CHCl_3$); ^1H NMR (270 MHz, $CDCl_3$) δ 0.88 (m, 3 H), 1.04-1.43 (m, 28 H), 1.36 (s, 3 H), 1.38 (s, 3 H), 2.41 (s, 3 H), 3.11 (m, 1 H), 3.46 (dd, *J* = 12.0, 1.7 Hz, 1 H), 3.78 (m, 1 H), 3.85 (dd, *J* = 12.0, 1.7 Hz, 1 H), 5.22 (d, *J* = 10.3 Hz, 1 H), 7.27-7.30 (m, 2 H), 7.75-7.78 (m, 2 H). LR-MS (FAB), *m/z*, 496 (MH^+), 438, 214, 184, 155 (base peak), 139, 91. HR-MS (FAB), *m/z*, Calcd for $C_{28}H_{50}NO_4S$ (MH^+): 496.3460. Found: 496.3449.

(4*S*,5*S*)-2,2-Dimethyl-4-pentadecyl-5-(*tert*-butoxycarbonylamino)-1,3-dioxane (53). By a procedure identical with that described for the preparation of **48** from **47**, 200 mg (0.404 mmol) of **52** was converted into 135 mg (76% yield) of **53** as a colorless oil. $[\alpha]^{20}_D$ + 11.5 (c 0.47, $CHCl_3$); ^1H NMR (270 MHz, $CDCl_3$) δ 0.88 (m, 3 H), 1.19-1.40 (m, 28 H), 1.40 (s, 3 H), 1.45 (s, 12 H), 3.50 (m, 1 H), 3.75 (dd, *J* = 11.9, 1.9 Hz, 1 H), 3.90 (ddd, *J* = 6.2, 6.2, 1.9 Hz, 1 H), 4.05 (dd, *J* = 11.9, 1.9 Hz, 1 H), 5.29 (d, *J* = 10.0 Hz, 1 H). LR-MS (FAB), *m/z*, 442 (MH^+), 386, 370, 328 (base peak), 284, 282, 95. HR-MS (FAB), *m/z*, Calcd for $C_{26}H_{52}NO_4$ (MH^+): 442.3896. Found: 442.3903.

(2*S*,3*S*)-2-Aminooctadecane-1,3-diol hydrochloride (54). By a procedure identical with that described for the preparation of **49** from **48**, 41 mg (0.093 mmol) of **53** was converted into 31 mg (99% yield) of **54** as colorless crystals from $CHCl_3$. mp 75-77 °C; $[\alpha]^{20}_D$ - 10.4 (c 0.79, MeOH); ^1H NMR (270 MHz, $CDCl_3$) δ 0.88 (m, 3 H), 1.10-1.40 (m, 28 H), 1.82 (m, 2 H), 3.37-4.05 (m, 3 H), 4.98 (m, 1 H), 7.75 (m, 2 H). LR-MS (FAB), *m/z*, 302 (MH^+, base peak), 300, 284, 154, 136, 60. HR-MS (FAB), *m/z*, Calcd for $C_{18}H_{40}NO_2$ (MH^+): 302.3059. Found: 302.3061.

ACKNOWLEDGEMENT

This work was supported in part by Grant-in-Aid for Scientific Researches (B) and (C) from the Ministry of Education, Science and Culture of Japan, to which the authors' thanks are due. We thank Dr. Terrence R. Burke, Jr., NCI, NIH, Bethesda, for reading the manuscript and providing useful comments.

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(*Received in Japan* 27 *June* 1996; *accepted* 19 *July* 1996)