

Approaches to the total synthesis of chaetochalasin A

Eric J. Thomas and Mark Willis

Full experimental data

Experimental

General experimental details

¹H and ¹³C NMR spectra were recorded on Varian Unity 500, Varian Unity Inova 400 and Varian Unity Inova 300 spectrometers with residual non-deuterated solvent as the internal standard. Coupling constants are rounded to the nearest 0.5 Hz. Only distinguishable peaks are reported for minor isomers in isomeric mixtures. IR spectra were recorded on an ATI Mattson Genesis FTIR as thin films produced by evaporation of a dichloromethane solution on sodium chloride plates unless otherwise stated. Mass spectra were recorded on Fison VG Trio 2000 and Kratos Concept spectrometers. Chemical ionisation (CI) was performed using ammonia. Chromatography refers to flash column chromatography using Merck silica gel 60H (230-300 mesh). Tetrahydrofuran (THF) was dried and distilled from sodium metal using benzophenone as an indicator under an atmosphere of nitrogen. Dichloromethane was dried and distilled from calcium hydride under an atmosphere of nitrogen. Ether refers to diethyl ether, which was dried and distilled from sodium metal using benzophenone as an indicator under an atmosphere of nitrogen. Light petroleum refers to the fraction of petroleum ether distilled between 40-60 °C. Benzene and hexane were dried over sodium metal. Butyllithium (1.6 M in hexanes) was titrated against a solution of propan-2-ol in xylene with 2,2'-bipyridine as an indicator. Triethylamine and di-isopropylamine were dried over potassium hydroxide pellets. Brine refers to saturated aqueous sodium chloride.

(2R,4E)-N-[(1S,2S)-1-Hydroxy-1-phenylpropan-2-yl]-N-methyl-6-tert-butylidimethylsilyloxy-2,4-dimethylhex-4-enamide (12).

Lithium di-*isopropylamide* (1.8 M in THF/heptane/ethylbenzene, 1.72 g, 16.1 mmol, 8.94 mL) was added to LiCl (1.95 g, 46.4 mmol) in THF (11 mL) and the solution cooled to -78 °C. The amide (+)-**11** (1.70 g, 7.74 mmol) in THF (20 mL) cooled to 0 °C, was added dropwise with stirring at -78 °C for 1 h before being allowed to warm to r.t.. The mixture was cooled 0 °C before the dropwise addition of the bromide **10** (3.24 g, 11.6 mmol) in THF (11 mL) with stirring at 0 °C for 40 min. Saturated aqueous ammonium chloride (360 mL) was added and the aqueous layer was extracted with ethyl acetate (144 mL × 6). The organic extracts were dried (MgSO₄) and concentrated under reduced pressure. Chromatography of the residue using ethyl acetate : light petroleum (1 : 2) as eluent gave the *title compound 12* as a light yellow oil (2.89 g, 89%), *R*_f = 0.17 (2 : 1, ether : petrol), as a 3 : 1 mixture of rotamers (¹H and ¹³C NMR), [*α*]_D¹⁹ +37 (*c* 0.4, CHCl₃) (Found: M⁺ + Na, 442.2750. C₂₄H₄₁O₃NNaSi requires *M*, 442.2748); *v*_{max}/cm⁻¹ 3371(br), 2929, 2856, 2361, 1620, 1462, 1407, 1378, 1253, 1196, 1074, 1053, 1005, 939, 833, 774, 700, 667 and 614; *δ*_H (400 MHz, CDCl₃) major rotamer 0.04 (6 H, s, 2 × SiCH₃), 0.88 [9 H, s, SiC(CH₃)₃], 1.07 (6 H, m, 2-CH₃ and 2'-CH₃), 1.59 (3 H, s, 4-CH₃), 2.00 (1 H, dd, *J* 14.0, 7.5, 3-H), 2.30 (1 H, dd, *J* 14.0, 7.0, 3-H'), 2.81 (1 H, m, 2-H), 2.89 (3 H, s, N-CH₃), 4.17 (2 H, m, 6-H₂), 4.34 (1 H, br. s, OH), 4.45 (1 H, m, 2'-H), 4.61 (1 H, m, 1'-H), 5.30 (1 H, tq, *J* 7.5, 1.0, 5-H) and 7.35 (5 H, m, Ar); minor rotamer 0.06 (6 H, s, 2 × SiCH₃), 0.89 [9 H, s, Si(CH₃)₃], 0.99 (3 H, d, *J* 7.0, 2'-CH₃), 1.68 (3 H, s, 4-CH₃), 2.08 (1 H, dd, *J* 13.5, 8.0, 3-H), 2.52 (1 H, dd, *J* 13.5, 6.5, 3-H'), 2.74 (1 H, br. s, OH), 2.90 (3 H, s, N-CH₃), 3.06 (1 H, m, 2-H), 4.08 (1 H, m, 2'-H), 4.54 (1 H, m, 1'-H), 5.42 (1 H, m, 5-H) and 7.27 (5 H, m, Ar); *δ*_C (100 MHz, CDCl₃) major rotamer -5.3, 14.3, 16.5, 16.8, 18.2, 25.8, 25.9, 33.6, 34.6, 43.1, 60.0, 76.1, 126.2, 126.3, 127.4, 128.1, 134.2, 142.4, and 178.3; minor rotamer -5.2, 15.5, 16.5, 17.2, 18.3, 27.0, 32.4, 43.1, 58.0, 75.1, 126.7, 128.0, 128.5, 135.0, 141.4 and 177.3; *m/z* (ES⁺) 442 (M⁺ + 23, 100%).

(4E,2R)-6-tert-Butyldimethylsilyloxy-2,4-dimethylhex-4-en-1-ol (13). The borane-ammonia complex (90%, 0.328 g, 9.52 mmol) in THF (3 mL) was added to lithium di-*isopropylamide* (1.8 M in THF/heptane/ethylbenzene; 1.02 g, 9.52 mmol, 5.29 mL) at 0 °C with stirring at 0 °C for 15 min and then at r.t. for 15 min. The solution was then cooled to 0 °C before the addition of the amide **12** (1.00 g, 2.38 mmol) in THF (7 mL) with subsequent stirring at r.t. for 1.5 h. Aqueous hydrogen chloride (1.0 M, 50 mL) was added and the aqueous layer was extracted with ethyl acetate (50 mL × 4). The organic extracts were extracted with saturated aqueous sodium hydrogen carbonate (50 mL), dried (Na₂SO₄) and concentrated under reduced pressure. Chromatography of the residue using ether : light petroleum (1 : 1) gave the *title compound 13* as a clear liquid (0.49 g, 80%), *R*_f = 0.47 (1 : 1, ether : light petroleum), [*α*]_D²⁰ +4.6 (*c* 1.1, CHCl₃) (Found: M⁺ + Na, 281.1914. C₁₄H₃₀O₂SiNa requires *M*, 281.1907); *v*_{max}/cm⁻¹ 3350(br), 2954, 2928, 2857, 2364, 1668, 1462, 1382, 1361, 1253, 1081, 1040, 1005, 938, 833, 813, 773 and 665; *δ*_H (400 MHz, CDCl₃) 0.07 (6 H, s, 2 × SiCH₃), 0.89 (3 H, d, *J* 6.5, 2-CH₃), 0.90 [9 H, s, SiC(CH₃)₃], 1.54 (1 H, br. s, OH), 1.64 (3 H, m, 4-CH₃), 1.79-1.92 (2 H, m, 3-H₂), 2.12 (1 H, m, 2-H), 3.43 and 3.50 (each 1 H, dd, *J* 10.5, 5.5, 1-H), 4.19 (2 H, m, 6-H₂) and 5.35 (1 H, tq, *J* 6.5, 1.0, 5-H); *δ*_C (100 MHz, CDCl₃) -5.1, 16.2, 16.6, 18.4, 26.0, 33.7, 44.1, 60.1, 68.4, 126.2 and 135.7; *m/z* (ES⁺) 281 (M⁺ + 23, 100%).

(2R,4E)-6-tert-Butyldimethylsilyloxy-2,4-dimethylhex-4-en-1-yl (2R)-3,3,3-trifluoro-2-methoxy-2-phenylpropanoate (14a). Following the above procedure, alcohol **13** (21 mg, 0.081 mmol) in dichloromethane (2 mL), Et₃N (0.016 g, 0.16 mmol, 0.022 mL), (*S*)-(+)-Mosher's acid chloride (31 mg, 0.12 mmol, 0.022 mL) and DMAP (30 mg, 0.24 mmol), after chromatography using ether : light petroleum (1 : 10) as eluent gave the *title compound 14a* as a clear liquid (29 mg, 74%), *R*_f = 0.36 (10 : 1, light petroleum : ether), [*α*]_D²² +22 (*c* 1.4, CHCl₃) (Found: M⁺ + Na, 497.2314. C₂₄H₃₇O₄F₃NaSi requires *M*, 497.2305); *v*_{max}/cm⁻¹ 2955, 2927, 2856, 2360, 2341, 1749, 1464, 1387, 1252, 1169, 1122, 1081, 1023, 842, 813, 776, 719, 696 and 668; *δ*_H (400 MHz, CDCl₃) 0.07 (6 H, s, 2 × SiCH₃), 0.89 (3 H, d, *J* 6.5, 2-CH₃), 0.91 [9 H, s, SiC(CH₃)₃], 1.60 (3 H, m, 4-CH₃), 1.85 (1 H, m, 3-H), 2.06 (2 H, m, 2-H and 3-H'), 3.56 (3 H, q, *J* 1.0, OCH₃), 4.05 (1 H, dd, *J*

10.5, 6.0, 1-H), 4.19 (2 H, m, 6-H₂), 4.26 (1 H, dd, *J* 10.5, 5.0, 1-H'), 5.31 (1 H, tq, *J* 6.5, 1.0, 5-H), 7.42 (3 H, m, Ar) and 7.53 (2 H, m, Ar); δ_{C} (100 MHz, CDCl₃) -5.1, 16.1, 16.6, 16.6, 18.4, 26.0, 30.4, 43.4, 55.4, 60.1, 70.8, 127.1, 127.2, 127.3, 128.4, 129.6, 132.3, 134.0 and 166.6; *m/z* (ES⁺) 497 (M^+ + 23, 100%).

(2*R*,4*E*)-6-*tert*-Butyldimethylsilyloxy-2,4-dimethylhex-4-en-1-yl (2*S*)-3,3,3-trifluoro-2-methoxy-2-phenylpropanoate (14b). Triethylamine (0.012 g, 0.12 mmol, 0.017 mL), followed by (*R*)-(-)-Mosher's acid chloride (22 mg, 0.087 mmol, 0.016 mL) and DMAP (0.021 g, 0.17 mmol) were added to the alcohol **13** (15 mg, 0.058 mmol) in dichloromethane (2 mL) and the mixture stirred at r.t. for 15 min. Dichloromethane (10 mL) and saturated aqueous sodium hydrogen carbonate (10 mL) were added and the aqueous layer extracted with dichloromethane (10 mL \times 3). The organic extracts were dried (MgSO₄) and concentrated under reduced pressure. Chromatography of the residue using ether : light petroleum (1 : 10) as eluent gave the *title compound* **14b** as a clear liquid (20 mg, 71%), R_f = 0.38 (10 : 1, light petroleum : ether), $[\alpha]_{\text{D}}^{21}$ -33 (*c* 0.3, CHCl₃) (Found: M^+ + Na, 497.2293. C₂₄H₃₇O₄F₃NaSi requires *M*, 497.2305); $\nu_{\text{max}}/\text{cm}^{-1}$ 2954, 2856, 2360, 2341, 1749, 1464, 1387, 1251, 1168, 1122, 1081, 1023, 835, 775, 719, 696 and 668; δ_{H} (400 MHz, CDCl₃) 0.07 (6 H, s, 2 \times SiCH₃), 0.89 (3 H, d, *J* 6.5, 2-CH₃), 0.91 [9 H, s, SiC(CH₃)₃], 1.58 (3 H, m, 4-CH₃), 1.83 (1 H, m, 3-H), 2.06 (2 H, m, 2-H and 3-H'), 3.56 (3 H, q, *J* 1.0, OCH₃), 4.14 (1 H, dd, *J* 10.5, 5.5, 1-H), 4.16 (1 H, dd, *J* 10.5, 6.0, 1-H'), 4.18 (2 H, m, 6-H₂), 5.29 (1 H, tq, *J* 6.5, 1.0, 5-H), 7.42 (3 H, m, Ar) and 7.53 (2 H, m, Ar); δ_{C} (100 MHz, CDCl₃) -5.1, 16.1, 16.6, 16.6, 18.4, 26.0, 30.4, 43.4, 55.4, 60.1, 70.8, 127.1, 127.2, 127.3, 128.4, 129.6, 132.3, 134.0 and 166.6; *m/z* (ES⁺) 497 (M^+ + 23, 100%).

(2*R*,4*E*)-6-*tert*-Butyldimethylsilyloxy-1-iodo-2,4-dimethylhex-4-ene (15). Triphenylphosphine (0.51 g, 1.94 mmol) and imidazole (0.132 g, 1.94 mmol) were added to the alcohol **13** (0.32 g, 1.25 mmol) in dichloromethane (13 mL) with stirring for 10 min. Iodine (0.434 g, 1.71 mmol) was added and the reaction mixture was stirred for 1.5 h at r.t. Saturated aqueous sodium bisulfite (14 mL) was added and the aqueous layer was extracted with dichloromethane (40 mL \times 4). The organic extracts were dried (MgSO₄) and concentrated under reduced pressure. Chromatography of the residue using light petroleum then light petroleum : ether (99 : 1) as eluent gave the *title compound* **15** as a clear liquid (0.38 g, 83%), R_f = 0.44 (20 : 1, hexane : ether), $[\alpha]_{\text{D}}^{20}$ -8.8 (*c* 1.6, CHCl₃) (Found: M^+ - C₄H₉, 311.0313. C₁₀H₂₀OISi requires *M*, 311.0323); $\nu_{\text{max}}/\text{cm}^{-1}$ 2955, 2927, 2885, 2856, 1670, 1638, 1472, 1461, 1380, 1360, 1314, 1253, 1221, 1194, 1151, 1101, 1055, 1005, 938, 833, 813, 773 and 665; δ_{H} (400 MHz, CDCl₃) 0.08 (6 H, s, 2 \times SiCH₃), 0.91 [9 H, s, SiC(CH₃)₃], 0.97 (3 H, d, *J* 6.5, 2-CH₃), 1.61 (3 H, m, 4-CH₃), 1.68 (1 H, m, 2-H), 1.88 and 2.10 (each 1 H, dd, *J* 13.5, 7.0, 3-H), 3.10 (1 H, dd, *J* 9.5, 6.0, 1-H), 3.24 (1 H, dd, *J* 9.0, 4.5, 1-H'), 4.20 (2 H, m, 6-H₂) and 5.37 (1 H, tq, *J* 6.5, 1.0, 5-H); δ_{C} (100 MHz, CDCl₃) -5.1, 16.2, 17.2, 18.4, 20.6, 26.0, 32.7, 46.5, 60.1, 127.1, and 134.2; *m/z* (EI/CI) 311 (M^+ - 57, 4%).

(2*R*,4*S*,6*E*)-*N*-[(1*S*,2*S*)-1-Hydroxy-1-phenylpropan-2-yl]-*N*-methyl-8-*tert*-butyldimethylsilyloxy-2,4,6-trimethyloct-6-enamide (16). Lithium di-isopropylamide (1.8 M in THF/heptane/ethylbenzene; 0.92 g, 8.6 mmol, 4.78 mL) was added to LiCl (1.15 g, 27.3 mmol) in THF (4 mL) and the solution cooled to -78 °C. The amide (+)-**11** (1.00 g, 4.52 mmol) in THF (13 mL) cooled to -78 °C was added dropwise and the mixture stirred at -78 °C for 1 h, 0 °C for 15 min and at r.t. for 10 min. The iodide **15** (0.79 g, 2.15 mmol) in THF (8 mL) was then added and the mixture stirred at r.t. for 19 h. Saturated aqueous ammonium chloride (280 mL) was added and the aqueous layer extracted with ethyl acetate (240 mL \times 5). The organic extracts were dried (MgSO₄) and concentrated under reduced pressure. Chromatography of the residue using ethyl acetate : light petroleum (1 : 2) as eluent gave the *title compound* **16** as a clear oil (0.85 g, 86%) as a 5 : 1 mixture of rotamers, R_f = 0.24 (2 : 1, light petroleum : ethyl acetate), $[\alpha]_{\text{D}}^{19}$ +41 (*c* 1.6, CHCl₃) (Found: M^+ + Na, 484.3230. C₂₇H₄₇O₃NNaSi requires *M*, 484.3217); $\nu_{\text{max}}/\text{cm}^{-1}$ 3378 (br), 2955, 2928, 2856, 1620, 1462, 1408, 1378, 1360, 1300, 1253, 1197, 1083, 1051, 1005, 938, 843, 813, 774, 700 and 665; δ_{H} (400 MHz, CDCl₃) major rotamer 0.06 (6 H, s, 2 \times SiCH₃), 0.71 (3 H, d, *J* 6.5, 4-CH₃), 0.90 [9 H, s, SiC(CH₃)₃], 1.02 (1 H, m, 3-H), 1.04 (3 H, d, *J* 7.0, 2-CH₃), 1.14 (3 H, d, *J* 7.0, 2'-CH₃), 1.56 (1 H, m, 4-H), 1.60 (3 H, s, 6-CH₃), 1.67 (1 H, m, 3-H'), 1.73 (1 H, dd, *J* 13.0, 8.5, 5-H), 1.97 (1 H, dd, *J* 13.0, 6.0, 5-H'), 2.69 (1 H, m, 2-H), 2.83 (3 H, s, NCH₃), 4.19 (2 H, m, 8-H₂), 4.37 (1 H, m, 2'-H), 4.61 (1 H, t, *J* 7.0, 1'-H), 5.27 (1 H, tq, *J* 6.0, 1.0, 7-H) and 7.33 (5 H, m, ArH); minor rotamer 0.86 (3 H, d, *J* 6.5, 4-CH₃), 1.60 (3 H, s, 6-CH₃), 1.73 (1 H, m, 5-H), 1.88 (1 H, m, 3-H'), 2.06 (1 H, dd, *J* 13.0, 5.5, 5-H'), 2.88 (3 H, s, NCH₃), 3.01 (1 H, m, 2-H), 4.08 (1 H, m, 2'-H), 4.55 (1 H, m, 1'-H) and 5.30 (1 H, m, 7-H); δ_{C} (100 MHz, CDCl₃) major rotamer -5.1, 14.3, 16.0, 16.0, 17.9, 18.3, 18.3, 19.4, 25.9, 28.1, 33.9, 41.1, 47.8, 60.2, 76.3, 126.1, 126.1, 127.4, 128.2, 135.4, 142.6 and 178.8; minor rotamer -5.4, 15.4, 18.7, 19.7, 26.9, 28.3, 33.1, 41.3, 57.9, 60.2, 75.1, 125.9, 126.9, 128.3, 128.6, 135.8, 141.3 and 177.5; *m/z* (ES⁺) 484 (M^+ + 23, 100%).

(2*R*,4*S*,6*E*)-8-*tert*-Butyldimethylsilyloxy-2,4,6-trimethyloct-6-en-1-ol (9). Borane-ammonia complex (1.52 g, 44.2 mmol) was added at 0 °C to LDA (1.8 M in THF/heptane/ethylbenzene; 4.73 g, 44.2 mmol, 24.5 mL) in THF (13 mL) with stirring at 0 °C for 15 min and at r.t. for 15 min. The solution was cooled to 0 °C before the amide **16** (5.10 g, 11.0 mmol) was added in THF (37 mL) and the solution stirred at r.t. for 2 h. Aqueous hydrogen chloride (1.0 M; 10 mL) was added and the aqueous layer extracted with ethyl acetate (4 \times 10 mL). The organic extracts were extracted with saturated aqueous sodium hydrogen carbonate (10 mL), dried (Na₂SO₄) and concentrated under reduced pressure. Chromatography of the residue using ethyl acetate : light petroleum (1 : 10) as eluent gave the *title compound* **9** as a clear liquid (2.79 g, 84%), R_f = 0.18 (1 : 3, ether : light petroleum), $[\alpha]_{\text{D}}^{22}$ +7.5 (*c* 2.4, CHCl₃) (Found: M^+ + Na, 323.2365. C₁₇H₃₆O₂NaSi requires *M*, 323.2377); $\nu_{\text{max}}/\text{cm}^{-1}$ 3348(br), 2953, 2927, 2856, 2360, 1668, 1462, 1379, 1361, 1253, 1092, 1042, 1005, 938, 833, 813, 773, 734 and 665; δ_{H} (400 MHz, CDCl₃) 0.07 (6 H, s, 2 \times SiCH₃), 0.84 (3 H, d, *J* 6.0, 4-CH₃), 0.90 [9 H, s, SiC(CH₃)₃], 0.93 (3 H, d, *J* 6.0, 2-CH₃), 0.94 and 1.33 (each 1 H, m, 3-H), 1.53 (1 H, br. s, OH), 1.59 (3 H, m, 6-CH₃), 1.65-1.78 (3 H, m, 2-H, 4-H and 5-H), 2.02 (1 H, m, 5-H'), 3.38 (1 H, dd, *J* 10.5, 6.5, 1-H), 3.50 (1 H, dd, *J* 10.5, 5.5, 1-H'), 4.19 (2 H, m, 8-H₂) and 5.30 (1 H, tq, *J* 6.5, 1.0, 7-H); δ_{C} (100 MHz, CDCl₃) -5.1, 16.2, 17.4, 18.4, 20.4, 26.0, 28.0, 33.2, 40.9, 47.5, 60.2, 68.2, 125.9 and 135.8; *m/z* (ES⁺) 323 (M^+ + 23, 100%).

(2*S*,4*S*,6*E*)-*N*-[(1*R*,2*R*)-1-Hydroxy-1-phenylpropan-2-yl]-*N*-methyl-8-*tert*-butyldimethylsilyloxy-2,4,6-trimethyloct-6-enamide (17). Following the procedure outlined for the synthesis of amide **16**, LiCl (0.421 g, 10.0 mmol) in THF (1 mL), LDA (1.8 M in

THF/heptane/ethylbenzene; 0.338 g, 3.16 mmol, 1.76 mL), the amide (–)(**11**) (0.367 g, 1.66 mmol) in THF (7 mL) and the iodide **15** (0.29 g, 0.79 mmol) in THF (2 mL) after chromatography using ethyl acetate : light petroleum (1 : 2) as eluent gave the *title compound 17* as a light orange oil (0.302 g, 83%) as a 5 : 1 mixture of rotamers, $R_f = 0.29$ (2 : 1, light petroleum : ethyl acetate), $[\alpha]_D^{18} -50$ (c 1.7, CHCl₃) (Found: $M^+ + Na$, 484.3234. C₂₇H₄₇O₃NNaSi requires M , 484.3217); ν_{max}/cm^{-1} 3380 (br), 2955, 2928, 2856, 1619, 1462, 1408, 1377, 1253, 1198, 1083, 1051, 1005, 834, 813, 774, 732, 700 and 665; δ_H (500 MHz, CDCl₃) major rotamer 0.01 (6 H, s, 2 × SiCH₃), 0.72 (3 H, d, J 6.5, 4-CH₃), 0.84 [9 H, s, SiC(CH₃)₃], 0.98 (3 H, d, J 6.5, 2-CH₃), 1.05 (3 H, d, J 6.5, 2'-CH₃), 1.17-1.30 (2 H, m, 3-H₂), 1.48 (3 H, s, 6-CH₃), 1.53 (1 H, m, 4-H), 1.70 (1 H, dd, J 13.5, 8.5, 5-H), 1.89 (1 H, dd, J 13.5, 6.0, 5-H'), 2.64 (1 H, m, 2-H), 2.79 (3 H, s, NCH₃), 4.12 (2 H, d, J 6.5, 8-H₂), 4.40 (1 H, m, 2'-H), 4.53 (1 H, d, J 7.5, 1'-H), 5.22 (1 H, t, J 6.5, 7-H), and 7.28 (5 H, m, ArH); minor rotamer 0.00 (6 H, s, 2 × SiCH₃), 0.78 (3 H, d, J 6.5, 4-CH₃), 0.83 [9 H, s, SiC(CH₃)₃], 0.93 (3 H, d, J 6.5, 2'-CH₃), 0.99 (3 H, m, 2-CH₃), 1.53 (4 H, m, 6-CH₃ and 4-H), 1.72 (1 H, m, 5-H), 2.05 (1 H, dd, J 13.5, 5.5, 5-H'), 2.83 (3 H, s, NCH₃), 2.90 (1 H, m, 2-H), 4.01 (1 H, m, 2'-H), 4.50 (1 H, d, J 9.0, 1'-H) and 5.24 (1 H, m, 7-H); δ_C (125 MHz, CDCl₃) major rotamer -5.2, 14.4, 16.0, 16.1, 16.9, 18.3, 18.4, 19.3, 25.9, 28.3, 34.1, 40.9, 47.8, 60.1, 76.4, 126.3, 126.3, 127.5, 128.2, 135.2, 142.5, and 179.2; minor rotamer 15.4, 16.1, 17.5, 19.3, 28.2, 33.1, 40.8, 58.0, 60.2, 75.2, 125.9, 126.8, 128.6, 135.6, 141.3 and 177.9; m/z (ES+) 484 ($M^+ + 23$, 100%).

(2S,4S,6E)-8-tert-butyltrimethylsilyloxy-2,4,6-trimethyloct-6-en-1-ol (18). Following the procedure outlined for the synthesis of alcohol **9**, LDA (1.8 M in THF/heptane/ethylbenzene; 0.158 g, 1.48 mmol, 0.82 mL) in THF (0.5 mL), NH₃.BH₃ (90%; 0.051 g, 1.5 mmol) and the amide **17** (0.17 g, 0.37 mmol) in THF (1.5 mL), after chromatography using ethyl acetate : light petroleum (1 : 10) as eluent gave the *title compound 18* as a clear liquid (82 mg, 75%), $R_f = 0.36$ (1 : 5, ethyl acetate : light petroleum), $[\alpha]_D^{20} -12$ (c 1, CHCl₃) (Found: $M^+ + Na$, 323.2381. C₁₇H₃₆O₂NaSi requires M , 323.2377); ν_{max}/cm^{-1} 3342(br), 2955, 2927, 2857, 1462, 1380, 1361, 1253, 1094, 1042, 1005, 939, 909, 833, 813, 774, 733 and 665; δ_H (400 MHz, CDCl₃) 0.07 (6 H, s, 2 × SiCH₃), 0.82 (3 H, d, J 6.5, 4-CH₃), 0.88 (3 H, d, J 6.5, 2-CH₃), 0.90 [9 H, s, SiC(CH₃)₃], 1.02-1.14 (2 H, m, 3-H₂), 1.48 (1 H, br. s, OH), 1.59 (3 H, m, 6-CH₃), 1.65-1.78 (2 H, m, 2-H and 4-H), 1.85 (1 H, dd, J 13.5, 7.5, 5-H), 1.95 (1 H, dd, J 13.5, 7.0, 5-H'), 3.39 (1 H, dd, J 10.5, 6.5, 1-H), 3.47 (1 H, dd, J 10.5, 6.0, 1-H'), 4.20 (2 H, m, 8-H₂) and 5.29 (1 H, tq, J 6.5, 1.5, 7-H); δ_C (100 MHz, CDCl₃) -5.1, 16.1, 16.2, 18.4, 19.3, 26.0, 27.7, 33.2, 40.2, 48.4, 60.2, 69.0, 126.1 and 135.6; m/z (ES+) 323 ($M^+ + 23$, 100%).

(2R,4S,6E)-8-tert-Butyltrimethylsilyloxy-1-triisopropylsilyloxy-2,4,6-trimethyloct-6-ene (19). Triethylamine (0.248 g, 2.46 mmol, 0.34 mL) and tri-isopropyl triflate (0.603 g, 1.97 mmol, 0.53 mL) were added to the alcohol **9** (0.493 g, 1.64 mmol) in dichloromethane (10 mL) at -78 °C and the mixture stirred at -78 °C for 20 min and then r.t. for 30 min. Saturated aqueous ammonium chloride (40 mL) was added and the aqueous layer was extracted with ether (40 mL × 4). The organic extracts were dried (Na₂SO₄) and concentrated under reduced pressure. Chromatography of the residue using light petroleum as eluent gave the *title compound 19* as a clear liquid (0.689 g, 92%), $R_f = 0.52$ (1 : 50, ether : light petroleum), $[\alpha]_D^{20} +2.4$ (c 0.5, CHCl₃) (Found: M^+ , 456.3802. C₂₆H₅₆O₂Si₂ requires M , 456.3813); ν_{max}/cm^{-1} 2928, 2866, 1667, 1463, 1382, 1254, 1096, 1064, 1007, 939, 919, 882, 835, 774, 680 and 659; δ_H (500 MHz, CDCl₃) 0.08 (6 H, s, 2 × SiCH₃), 0.82 (3 H, d, J 6.0, 4-CH₃), 0.90 (1 H, m, 3-H), 0.91 [9 H, s, SiC(CH₃)₃], 0.92 (3 H, m, 2-CH₃), 1.08 [21 H, m, 3 × SiCH(CH₃)₂], 1.35 (1 H, m, 3-H'), 1.59 (3 H, s, 6-CH₃), 1.66-1.76 (3 H, m, 5-H, 4-H and 2-H), 2.05 (1 H, m, 5-H'), 3.44 (1 H, dd, J 9.5, 6.5, 1-H), 3.54 (1 H, dd, J 9.5, 5.0, 1-H'), 4.20 (2 H, d, J 6.5, 8-H₂) and 5.29 (1 H, t, J 6.5, 7-H); δ_C (125 MHz, CDCl₃) -5.1, 12.0, 16.1, 17.8, 18.1, 18.4, 20.1, 26.0, 28.2, 33.4, 41.2, 47.6, 60.3, 68.4, 125.9 and 135.9; m/z (EI/CI) 456 (M^+ , 2%).

(5S,7R,2E)-8-Triisopropylsilyloxy-3,5,7-trimethyloct-2-en-1-ol (20). Pyridinium toluene 4-sulfonate (38 mg, 0.15 mmol) was added to the bis-silyl ether **19** (0.69 g, 1.51 mmol) in dichloromethane (6 mL) and methanol (6 mL) and the mixture stirred at r.t. for 4 h. Saturated aqueous sodium hydrogen carbonate (50 mL) was added and the mixture extracted with ether (4 × 100 mL). The organic extracts were dried (Na₂SO₄) and concentrated under reduced pressure. Chromatography of the residue using ether : light petroleum (1 : 5) as eluent gave the *title compound 20* as a clear liquid (0.443 g, 86%), $R_f = 0.15$ (1 : 3, ether : light petroleum), $[\alpha]_D^{20} +2.7$ (c 0.6, CHCl₃) (Found: $M^+ + Na$, 365.2847. C₂₀H₄₂O₂NaSi requires M , 365.2847); ν_{max}/cm^{-1} 3313(br), 2944, 2866, 1667, 1462, 1382, 1246, 1098, 1063, 995, 919, 882, 786, 680 and 658; δ_H (400 MHz, CDCl₃) 0.83 (3 H, d, J 6.0, 5-CH₃), 0.90 (1 H, m, 6-H), 0.92 (3 H, d, J 6.5, 7-CH₃), 1.08 [21 H, m, 3 × SiCH(CH₃)₂], 1.21 (1 H, br. s, OH), 1.37 (1 H, m, 6-H'), 1.64 (3 H, s, 3-CH₃), 1.67-1.76 (3 H, m, 7-H, 5-H and 4-H), 2.07 (1 H, m, 4-H'), 3.45 (1 H, dd, J 9.5, 6.5, 8-H), 3.53 (1 H, dd, J 9.5, 5.5, 8-H'), 4.16 (2 H, d, J 7.0, 1-H₂) and 5.40 (1 H, t, J 7.0, 2-H); δ_C (100 MHz, CDCl₃) 12.0, 16.1, 17.7, 18.0, 20.1, 28.1, 33.4, 41.1, 47.6, 59.4, 68.4, 124.8 and 138.9; m/z (ES+) 365 ($M^+ + 23$, 100%).

(5S,7R,2E)-8-Triisopropylsilyloxy-3,5,7-trimethyloct-2-enal (21). The Dess Martin periodinane (0.50 g, 1.18 mmol) was added to the alcohol **20** (0.202 g, 0.589 mmol) in dichloromethane (5 mL) and the solution stirred at r.t. for 1 h. Ether (30 mL) and saturated aqueous sodium hydrogen carbonate and sodium bisulfite (30 mL) were added and the aqueous layer was extracted with ether (4 × 10 mL). The organic extracts were extracted with brine (30 mL), dried (Na₂SO₄) and concentrated under reduced pressure. Chromatography of the residue using ether : light petroleum (1 : 10) as eluent gave the *title compound 21* as a clear liquid (0.185 g, 92%), $R_f = 0.53$ (1 : 3, ether : light petroleum), $[\alpha]_D^{20} +11.6$ (c 0.9, benzene) (Found: $M^+ + Na$, 363.2698. C₂₀H₄₀O₂NaSi requires M , 363.2690); ν_{max}/cm^{-1} 2943, 2866, 1675, 1631, 1610, 1462, 1382, 1247, 1196, 1100, 1067, 1013, 996, 919, 882, 785, 680 and 659; δ_H (400 MHz, CDCl₃) 0.87 (3 H, d, J 6.5, 5-CH₃), 0.92 (3 H, d, J 6.5, 7-CH₃), 0.98 (1 H, m, 6-H), 1.07 [21 H, m, 3 × SiCH(CH₃)₂], 1.42 (1 H, m, 6-H'), 1.72 (1 H, m, 7-H), 1.83-1.96 (2 H, m, 5-H, 4-H), 2.15 (3 H, d, J 1.0, 3-CH₃), 2.27 (1 H, m, 4-H'), 3.49 (1 H, dd, J 9.5, 6.0, 8-H), 3.52 (1 H, dd, J 9.5, 5.5, 8-H'), 5.87 (1 H, d, J 8.0, 2-H) and 9.99 (1 H, d, J 8.0, 1-H); δ_C (100 MHz, CDCl₃) 12.0, 17.4, 17.7, 18.0, 20.1, 28.7, 33.3, 41.1, 48.6, 68.2, 128.8, 163.4 and 191.2; m/z (ES+) 363 ($M^+ + 23$, 100%).

(2R,4S,6E,8E,10E)-2,4,6,10-Tetramethyl-1-triisopropylsilyloxydodeca-6,8,10-triene (22). Lithium hexamethyldisilazide (1.0 M in THF; 0.029 g, 0.18 mmol, 0.18 mL) was added to the aldehyde **21** (0.04 g, 0.12 mmol) and the sulphone **23** (0.047 g, 0.18 mmol) in THF (2 mL)

at $-78\text{ }^{\circ}\text{C}$ and the mixture was stirred at $-78\text{ }^{\circ}\text{C}$ for 1 h and at r.t. for 2 h. Aqueous sodium hydroxide (1.0 M, 5 mL) and ether (8 mL) were added and the aqueous layer was extracted with ether ($4 \times 8\text{ mL}$). The organic extracts were extracted with brine (5 mL), dried (Na_2SO_4) and concentrated under reduced pressure. Chromatography of the residue using light petroleum as eluent gave the *title compound* **22** as a light yellow liquid (34 mg, 74%), as a mixture of geometrical isomers, (6*E*,8*E*,10*E*) : (6*E*,8*Z*,10*E*) : (6*E*,8*E*,10*Z*) = 91 : 5 : 4 ($^1\text{H NMR}$), R_f = 0.24 (light petroleum), $[\alpha]_D^{20} +7.5$ (c 0.8, benzene) (Found: M^+ , 392.3478. $\text{C}_{25}\text{H}_{48}\text{OSi}$ requires M , 392.3469); $\nu_{\text{max}}/\text{cm}^{-1}$ 2943, 2921, 2865, 1643, 1462, 1381, 1248, 1097, 1068, 1013, 996, 958, 882, 791, 680 and 659; δ_{H} (400 MHz, C_6D_6) (6*E*,8*E*,10*E*)-isomer **22** 0.92 (3 H, d, J 6.0, 4- CH_3), 0.99 (1 H, m, 3-H), 1.01 (3 H, d, J 6.5, 2- CH_3), 1.13 [21 H, m, $3 \times \text{SiCH}(\text{CH}_3)_2$], 1.50 (1 H, m, 3-H'), 1.60 (3 H, d, J 7.0, 12- H_3), 1.75 (6 H, m, 6- CH_3 and 10- CH_3), 1.82 (3 H, m), 2.18 (1 H, m), 3.48 (1 H, dd, J 9.5, 6.0, 1-H), 3.57 (1 H, dd, J 9.5, 5.0, 1-H'), 5.54 (1 H, q, J 7.0, 11-H), 6.07 (1 H, d, J 11.0, 7-H), 6.35 (1 H, d, J 15.5, 9-H) and 6.54 (1 H, dd, J 15.5, 11.0, 8-H); (6*E*,8*Z*,10*E*)-isomer 5.68 (1 H, q, J 7.0, 11-H), 5.93 (1 H, d, J 11.5, 7-H) and 6.26 (1 H, t, J 11.5, 8-H); (6*E*,8*E*,10*Z*)-isomer 5.36 (1 H, q, J 7.5, 11-H), 6.12 (1 H, d, J 11.5, 7-H), 6.64 (1 H, dd, J 15.0, 11.5, 8-H) and 6.75 (1 H, d, J 15.0, 9-H); δ_{C} (100 MHz, C_6D_6) (6*E*,8*E*,10*E*)-isomer **22** 12.6, 12.7, 14.4, 17.2, 18.5, 18.7, 20.9, 29.4, 34.3, 41.9, 48.9, 69.1, 123.3, 126.6, 128.2, 135.8, 136.6 and 136.8; m/z (AP+) 393 ($\text{M}^+ + 1$, 100%).

(2*E*)-2-(2-methylbut-2-en-1-yl)sulfonylbenzo[d]thiazole (23).

2-Mercaptobenzothiazole (0.606 g, 3.63 mmol) and triphenylphosphine (0.951 g, 3.63 mmol) were added sequentially to (*E*)-2-methylbut-2-en-1-ol (0.208 g, 2.42 mmol) in THF (8 mL) and the reaction mixture cooled down to $0\text{ }^{\circ}\text{C}$ before the addition of di-isopropyl azodicarboxylate (0.733 g, 3.63 mmol, 0.71 mL). The mixture was stirred at $0\text{ }^{\circ}\text{C}$ for 10 min and at r.t. for 3 h, and then concentrated under reduced pressure. Chromatography of the residue using ether : light petroleum (1 : 30) as eluent, gave (*E*)-2-(2-methylbut-2-en-1-yl)thiobenzo[d]thiazole as a light yellow liquid (0.442 g, 78%), R_f = 0.37 (20 : 1, light petroleum : ether) (Found: $\text{M}^+ + \text{Na}$, 258.0383. $\text{C}_{12}\text{H}_{13}\text{NNaS}_2$ requires M , 258.0382); $\nu_{\text{max}}/\text{cm}^{-1}$ 3059, 2978, 2913, 2856, 2289, 1939, 1901, 1822, 1782, 1667, 1558, 1455, 1425, 1380, 1308, 1274, 1237, 1205, 1158, 1125, 1076, 1018, 990, 933, 879, 850, 828, 780, 725, 704 and 666; δ_{H} (400 MHz, CDCl_3) 1.64 (3 H, dq, J 7.0, 1.0, 4- H_3), 1.79 (3 H, m, 2- CH_3), 4.01 (2 H, s, 1- H_2), 5.66 (1 H, qq, J 7.0, 1.5, 3-H), 7.30 (1 H, ddd, J 8.5, 7.5, 1.5, 6'-H), 7.42 (1 H, ddd, J 8.5, 7.5, 1.5, 5'-H), 7.76 (1 H, dd, J 8.5, 1.5, 7'-H) and 7.89 (1 H, dd, J 8.5, 1.5, 4'-H); δ_{C} (100 MHz, CDCl_3) 13.7, 15.0, 43.0, 120.9, 121.5, 124.1, 124.9, 125.9, 130.0, 135.2, 153.1 and 167.2; m/z (ES+) 258 ($\text{M}^+ + 23$, 100%).

Ammonium molybdate tetrahydrate (16.3 g, 13.2 mmol) in aqueous hydrogen peroxide (28%; 287.0 mL) was to a chilled solution of the benzothiazolyl sulphide (6.60 g, 28.1 mmol) in ethanol (200 mL) and the mixture stirred at $0\text{ }^{\circ}\text{C}$ for 15 min and at r.t. for 30 min. Ethyl acetate (2000 mL) was added, the mixture was cooled to $0\text{ }^{\circ}\text{C}$ and saturated aqueous sodium bisulfite (400 mL) and water (1000 mL) were added. The aqueous layer was washed with ethyl acetate ($4 \times 1000\text{ mL}$) and the organic extracts were dried (MgSO_4) and concentrated under reduced pressure. Chromatography of the residue using gradient elution, ether : light petroleum (1 : 10) to ether as eluent, gave the *title compound* **23** as a white solid (5.74 g, 77%), R_f = 0.11 (5 : 1, light petroleum : ether), m.p $90.1\text{-}91.4\text{ }^{\circ}\text{C}$; (Found: $\text{M}^+ + \text{Na}$, 290.0271. $\text{C}_{12}\text{H}_{13}\text{O}_2\text{NNaS}_2$ requires 290.0280; Found: C, 53.72; H, 4.97; N, 5.21; S, 23.53. $\text{C}_{12}\text{H}_{13}\text{O}_2\text{NS}_2$ requires C, 53.91; H, 4.90; N, 5.24; S, 23.99); $\nu_{\text{max}}/\text{cm}^{-1}$ 2927, 2855, 1667, 1553, 1466, 1403, 1311, 1235, 1197, 1143, 1124, 1084, 1022, 850, 771, 732, 692 and 641; δ_{H} (400 MHz, CDCl_3) 1.55 (3 H, dq, J 7.0, 1.0, 4- H_3), 1.83 (3 H, s, 2- CH_3), 4.15 (2 H, s, 1- H_2), 5.45 (1 H, qq, J 7.0, 1.0, 3-H), 7.59 (1 H, ddd, J 8.5, 7.5, 1.5, 6'-H), 7.64 (1 H, ddd, J 8.5, 7.5, 1.5, 5'-H), 8.01 (1 H, dd, J 8.5, 1.5, 7'-H) and 8.23 (1 H, dd, J 8.5, 1.5, 4'-H); δ_{C} (100 MHz, CDCl_3) 14.1, 16.6, 64.4, 122.2, 122.5, 125.4, 127.5, 127.9, 132.1, 136.9, 152.6 and 165.8; m/z (ES+) 557 (100%) and 290 ($\text{M}^+ + 23$, 56%).

(1*E*)-Tridec-1-en-1-yl(tributyl)stannane (25). Tributyltin hydride (0.81 g, 2.78 mmol, 0.75 mL) and AIBN (10 mg, 0.056 mmol) were added to 1-tridecyne **24** (0.50 g, 2.78 mmol) in benzene (6 mL) and the solution was heated under reflux for 4 h. Ether (60 mL) was added and the solution extracted with saturated aqueous ammonium chloride (20 mL) and brine (20 mL). The organic extract was dried (MgSO_4) and concentrated under reduced pressure. Chromatography of the residue using hexane with 1% Et_3N as eluent gave the *title compound* as a clear liquid (1.03 g, 79%), a 10 : 1 mixture of (*E*)- and (*Z*)-isomers, R_f = 0.89 (light petroleum); $\nu_{\text{max}}/\text{cm}^{-1}$ 2956, 2922, 2853, 2361, 1599, 1464, 1377, 1341, 1292, 1182, 1072, 988, 961, 874, 721, 691 and 666; δ_{H} (400 MHz, CDCl_3) (*E*)-isomer **25** 0.85-0.95 (18 H, m, $3 \times \text{SnCH}_2\text{CH}_2\text{CH}_2\text{CH}_3$ and 13- H_3), 1.25-1.45 (24 H, m, $3 \times \text{SnCH}_2\text{CH}_2\text{CH}_2\text{CH}_3$ and $9 \times \text{CH}_2$), 1.47-1.57 (6 H, m, $3 \times \text{SnCH}_2\text{CH}_2\text{CH}_2\text{CH}_3$), 2.15 (2 H, q, J 6.0, 3- H_2), 5.87 (1 H, d, J 19.0, 1-H) and 5.97 (1 H, dt, J 19.0, 6.0, 2-H); (*Z*)-isomer 2.03 (2 H, q, J 7.0, 3- H_2), 5.80 (1 H, dt, J 12.5, 1.0, 1-H) and 6.54 (1 H, dt, J 12.5, 7.0, 2-H); δ_{C} (100 MHz, CDCl_3) (*E*)-isomer 9.4, 10.2, 13.7, 14.1, 22.7, 27.3, 28.9, 29.1, 29.2, 29.4, 29.5, 29.7, 29.7, 31.9, 37.9, 126.9 and 149.9; (FTMS) 415 [$\text{M}^+ - 57$, 100%], 413 [$\text{M}^+ - 57$, 60] and 411 [$\text{M}^+ - 57$, 31].

Ethyl (2*Z*,4*E*)-hexadeca-2,4-dienoate (27). The iodide **26** (0.80 g, 3.53 mmol) in DMF (12 mL) was added to the vinyl stannane **25** (1.99 g, 4.23 mmol) in DMF (12 mL) followed by $\text{PdCl}_2(\text{MeCN})_2$ (18 mg, 0.071 mmol) and the mixture stirred at r.t. for 24 h. Aqueous ammonia (10%; 24 mL) was added and the mixture was extracted with ether ($3 \times 360\text{ mL}$). The organic extracts were extracted with water (120 mL) and brine (120 mL), then dried (MgSO_4) and concentrated under reduced pressure. Chromatography of the residue using ether : light petroleum (1 : 100) as eluent gave the *title compound* **27** as a dark orange liquid (0.79 g, 80%) as a 10 : 1 mixture of the (2*Z*,4*E*)- and (2*Z*,4*Z*)-isomers ($^1\text{H NMR}$), R_f = 0.54 (1 : 10, ether : light petroleum) (Found: $\text{M}^+ + \text{Na}$, 303.2285. $\text{C}_{18}\text{H}_{32}\text{O}_2\text{Na}$ requires M , 303.2295); $\nu_{\text{max}}/\text{cm}^{-1}$ 2923, 2853, 2360, 1715, 1637, 1601, 1465, 1421, 1388, 1367, 1301, 1274, 1177, 1096, 1062, 1031, 999, 962, 932, 819, 764, 722 and 615; δ_{H} (400 MHz, CDCl_3) (2*Z*,4*E*)-isomer **27** 0.88 (3 H, t, J 7.0, 16- H_3), 1.20-1.35 (16 H, m, $8 \times \text{CH}_2$), 1.30 (3 H, t, J 7.0, OCH_2CH_3), 1.40-1.47 (2 H, m, 7- H_2), 2.20 (2 H, q, J 7.0, 6- H_2), 4.18 (2 H, q, J 7.0, OCH_2), 5.56 (1 H, d, J 11.5, 2-H), 6.07 (1 H, dt, J 14.0, 7.0, 5-H), 6.55 (1 H, t, J 11.5, 3-H) and 7.37 (1 H, ddq, J 14.0, 11.5, 1.0, 4-H); (2*Z*,4*Z*)-isomer 2.26 (1 H, q, J 7.0, 6- H_2), 5.67 (1 H, d, J 11.5, 2-H), 5.91 (1 H, m, 5-H), 6.93 (1 H, dt, J 1.0, 11.5, 3-H) and 7.28 (1 H, m, 4-H); δ_{C} (100 MHz, CDCl_3) (2*Z*,4*E*)-isomer **27** 14.1, 14.3, 22.7, 28.8, 29.2, 29.3, 29.4, 29.5, 29.6, 29.6, 31.9, 33.0, 59.8, 115.4, 126.8, 145.4, 145.8 and 166.6; m/z (ES+) 303 ($\text{M}^+ + 23$, 100%).

(2*Z*,4*E*)-Hexadeca-2,4-dienoic acid (28). Sodium hydroxide (2.37 g, 59.2 mmol) in water (2.5 mL) was added to the ester **27** (0.79 g, 2.82 mmol) in ethanol (16 mL) at r.t. and the solution stirred at r.t. for 3 h. The mixture was acidified to pH 2 using aqueous hydrogen chloride

(1.0 M) and then extracted with ether (4 × 120 mL). The organic extracts were extracted with water (120 mL), dried (Na₂SO₄) and concentrated under reduced pressure to afford the *title compound 28* as a cream solid (0.70 g, 99%) as a 10 : 1 mixture of the (2*Z*,4*E*)- and (2*Z*,4*Z*)-isomers, $R_f = 0.33$ (1 : 3, ether : light petroleum), m.p 53-54 °C (Found: M⁺ – H, 251.2017. C₁₆H₂₇O₂ requires *M*, 251.2016); $\nu_{\max}/\text{cm}^{-1}$ 3044, 2953, 2913, 2848, 2754, 2586, 1789, 1693, 1674, 1635, 1602, 1473, 1465, 1444, 1379, 1315, 1300, 1292, 1248, 1234, 1226, 1145, 1124, 1085, 1076, 1048, 1011, 1002, 963, 870, 853, 824, 773, 748, 723, 700, 661, 645 and 617; δ_{H} (400 MHz, CDCl₃) (2*Z*,4*E*)-isomer **28** 0.89 (3 H, t, *J* 7.0, 16-H₃), 1.20-1.35 (16 H, m, 8 × CH₂), 1.41-1.46 (2 H, m, 7-H₂), 2.22 (2 H, q, *J* 7.0, 6-H₂), 5.59 (1 H, d, *J* 11.5, 2-H), 6.14 (1 H, dt, *J* 14.0, 7.0, 5-H), 6.67 (1 H, t, *J* 11.5, 3-H), 7.35 (1 H, ddq, *J* 14.0, 11.5, 1.0, 4-H) and 12.14 (1 H, br. s, OH); (2*Z*,4*Z*)-isomer 2.28 (1 H, q, *J* 7.0, 6-H₂), 5.70 (1 H, d, *J* 11.5, 2-H), 5.98 (1 H, m, 5-H), 7.06 (1 H, dt, *J* 11.5, 1.0, 3-H) and 7.28 (1 H, m, 4-H); δ_{C} (100 MHz, CDCl₃) (2*Z*,4*E*)-isomer **28** 14.1, 22.7, 28.8, 29.3, 29.4, 29.5, 29.6, 29.6, 29.6, 31.9, 33.1, 114.7, 127.0, 147.3, 147.8 and 172.5; *m/z* (ES⁻) 251 (M⁺ – 1, 100%).

(2*Z*,4*E*)-Hexadeca-2,4-dien-1-oyl imidazolide (29). 1,1'-Carbonyldi-imidazole (0.57 g, 3.53 mmol) was added to the acid **27** (0.70 g, 2.78 mmol) in THF (14 mL) at r.t. and the solution stirred at r.t. for 45 min. Ether (100 mL) was added and the ethereal solution extracted with water (20 mL) and brine (20 mL), then dried (Na₂SO₄) and concentrated under reduced pressure to afford the *title compound 29* as a cream solid (0.803g, 82%) as a 5 : 1 mixture of (2*Z*,4*E*)- and (2*E*,4*E*)-isomers (¹H NMR), $R_f = 0.20$ (6 : 1, ether : light petroleum), m.p 45-46 °C (Found: M⁺ + H, 303.2424. C₁₉H₃₁ON₂ requires *M*, 303.2431); $\nu_{\max}/\text{cm}^{-1}$ 3129, 3107, 2955, 2916, 2871, 2850, 2358, 1758, 1706, 1628, 1588, 1525, 1471, 1445, 1381, 1358, 1313, 1278, 1244, 1095, 1077, 1045, 1005, 981, 961, 922, 901, 872, 849, 830, 810, 796, 764, 717, 700, 662, 645 and 605; δ_{H} (400 MHz, CDCl₃) (2*Z*,4*E*)-isomer **29** 0.88 (3 H, t, *J* 7.0, 16-H₃), 1.20-1.35 (16 H, m, 8 × CH₂), 1.42-1.52 (2 H, m, 7-H₂), 2.27 (2 H, q, 7.0, 6-H₂), 6.18 (1 H, d, *J* 11.5, 2-H), 6.33 (1 H, dt, *J* 15.5, 7.0, 5-H), 6.89 (1 H, t, *J* 11.5, 3-H), 7.11 (1 H, m, 3'-H), 7.44 (1 H, ddq, *J* 15.5, 11.0, 1.5, 4-H), 7.53 (1 H, t, *J* 1.5, 5'-H) and 8.20 (1 H, s, 6'-H); (2*E*,4*E*)-isomer 6.44 (1 H, d, *J* 15.0, 2-H), 6.96 (1 H, m, 5-H) and 7.66 (1 H, dd, *J* 15.0, 10.0, 4-H); δ_{C} (100 MHz, CDCl₃) (2*Z*,4*E*)-isomer **29** 14.1, 22.6, 28.5, 29.2, 29.3, 29.4, 29.5, 29.5, 29.6, 31.8, 33.2, 111.9, 116.2, 127.1, 130.7, 136.1, 150.6, 150.9 and 161.3; *m/z* (ES⁺) 325 (M⁺ + 23, 100%).

(2*R*,4*S*,6*E*)-8-*tert*-Butyldimethylsilyloxy-2,4,6-trimethyloct-6-enal (30). Pyridine (3.28 g, 41.5 mmol, 3.35 mL) was added to the Dess Martin periodinane (2.93 g, 6.92 mmol) in dichloromethane (15 mL) at r.t. and the solution stirred at r.t. for 15 min. The alcohol **9** (1.04 g, 3.46 mmol) in dichloromethane (15 mL) was added and the mixture stirred at r.t. for 2 h. Ether (100 mL) and saturated sodium hydrogen carbonate/sodium bisulfite (100 mL) were added. The aqueous layer was extracted with ether (4 × 100 mL) and the organic extracts were washed with brine (100 mL), dried (Na₂SO₄) and concentrated under reduced pressure to afford the *title compound 30* as a light yellow liquid (1.00 g, 97%), $R_f = 0.38$ (1 : 10, ether : light petroleum), $[\alpha]_{\text{D}}^{18} -7.6$ (*c* 0.8, benzene) (Found: M⁺ + Na, 321.2217. C₁₇H₃₄O₂NaSi requires *M*, 321.2220); $\nu_{\max}/\text{cm}^{-1}$ 2955, 2928, 2855, 2706, 1727, 1461, 1380, 1360, 1252, 1198, 1087, 1057, 1005, 938, 833, 813, 773, 742 and 665; δ_{H} (500 MHz, CDCl₃) 0.07 (6 H, s, 2 × SiCH₃), 0.86 (3 H, d, *J* 6.5, 4-CH₃), 0.91 [9 H, s, SiC(CH₃)₃], 1.09 (3 H, d, *J* 7.0, 2-CH₃), 1.11 (1 H, m, 3-H), 1.58 (3 H, s, 6-CH₃), 1.64-1.75 (2 H, m, 4-H and 3-H'), 1.80 (1 H, dd, *J* 13.0, 8.0, 5-H), 2.00 (1 H, dd, *J* 13.0, 6.0, 5-H'), 2.46 (1 H, m, 2-H), 4.20 (2 H, d, *J* 6.5, 8-H₂), 5.30 (1 H, tq, *J* 6.5, 1.0, 7-H) and 9.57 (1 H, d, *J* 2.5, 1-H); δ_{C} (125 MHz, CDCl₃) –5.1, 14.3, 16.1, 18.4, 19.7, 26.0, 28.3, 38.0, 44.1, 47.5, 60.2, 126.6, 135.1 and 205.3; *m/z* (ES⁺) 321 (M⁺ + 23, 100%).

(3*R*,5*S*,7*E*)-9-*tert*-Butyldimethylsilyloxy-1,1-dibromo-3,5,7-trimethylnona-1,7-diene (31). Zinc (0.20 g, 3.14 mmol) was added to triphenylphosphine (0.82 g, 3.12 mmol) in dichloromethane (10 mL) and the mixture cooled to 0 °C before the addition of CBr₄ (1.04 g, 3.14 mmol). The reaction mixture was stirred at 0 °C for 15 min and then at r.t. for 20 min before the addition of the aldehyde **30** (0.47 g, 1.57 mmol) in dichloromethane (5 mL). The mixture was stirred at r.t. for 18 h. Pentane (100 mL) was added with vigorous stirring for 1 h and the mixture was filtered through celite that was washed with pentane (4 × 100 mL). The organic extracts were dried (Na₂SO₄) and concentrated under reduced pressure. Chromatography of the residue using light petroleum as eluent gave the *title compound 31* as a clear liquid (0.53 g, 74%), $R_f = 0.41$ (1 : 40, ether : light petroleum), $[\alpha]_{\text{D}}^{20} -1.7$ (*c* 0.7, benzene) (Found: M⁺ – C₄H₉, 395.0033. C₁₄H₂₅O⁷⁹Br₂Si requires *M*, 395.0036); $\nu_{\max}/\text{cm}^{-1}$ 2956, 2928, 2856, 2359, 1667, 1614, 1462, 1380, 1361, 1253, 1191, 1085, 1056, 1006, 968, 939, 833, 813, 773 and 665; δ_{H} (400 MHz, CDCl₃) 0.08 (6 H, s, 2 × SiCH₃), 0.87 (3 H, d, *J* 6.5, 5-CH₃), 0.91 [9 H, s, SiC(CH₃)₃], 0.99 (3 H, d, *J* 6.5, 3-CH₃), 1.05 (1 H, ddd, *J* 13.5, 9.5, 4.5, 4-H) 1.35 (1 H, ddd, *J* 13.5, 10.0, 4.0, 4-H'), 1.57 (1 H, m, 5-H), 1.59 (3 H, s, 7-CH₃), 1.83 (1 H, dd, *J* 13.5, 7.5, 6-H), 1.93 (1 H, dd, *J* 13.5, 7.0, 6-H'), 2.59 (1 H, m, 3-H), 4.21 (2 H, d, *J* 6.5, 9-H₂), 5.29 (1 H, tq, *J* 6.5, 1.0, 8-H) and 6.10 (1 H, d, *J* 9.5, 2-H); δ_{C} (100 MHz, CDCl₃) –5.0, 16.1, 18.4, 19.8, 19.9, 26.0, 28.6, 36.2, 43.3, 48.0, 60.2, 87.2, 126.3, 135.3 and 144.4; *m/z* (EI/CI) 399 (M⁺ – 57, 26%), 397 (M⁺ – 57, 49) and 395 (M⁺ – 57, 26).

(5*S*,7*R*,2*E*)-1-*tert*-Butyldimethylsilyloxy-3,5,7-trimethylnon-2-en-8-yne (32). *n*-Butyllithium (1.6 M in hexanes; 0.474 g, 7.41 mmol, 4.63 mL) was added to the dibromide **31** (1.12 g, 2.47 mmol) in THF (14 mL) and the mixture stirred at –78 °C for 1.5 h. Saturated sodium hydrogen carbonate (24 mL) was added and the mixture allowed to warm to r.t. The aqueous layer was extracted with ether (4 × 200 mL) and the organic extracts were dried (Na₂SO₄) and concentrated under reduced pressure. Chromatography of the residue using light petroleum as eluent gave the *title compound 32* as a clear liquid (0.58 g, 80%), $R_f = 0.53$ (1 : 20, ether : light petroleum), $[\alpha]_{\text{D}}^{20} -10.8$ (*c* 1.3, CHCl₃) (Found: M⁺ – CH₃, 279.2126. C₁₇H₃₁OSi requires *M*, 279.2139); $\nu_{\max}/\text{cm}^{-1}$ 3312, 2955, 2927, 2856, 1668, 1471, 1461, 1379, 1360, 1325, 1252, 1199, 1117, 1084, 1054, 1005, 938, 833, 812, 773, 663 and 627; δ_{H} (400 MHz, CDCl₃) 0.08 (6 H, s, 2 × SiCH₃), 0.85 (3 H, d, *J* 6.5, 5-CH₃), 0.91 [9 H, s, SiC(CH₃)₃], 1.04 (1 H, ddd, *J* 13.5, 9.5, 4.5, 6-H), 1.18 (3 H, d, *J* 7.0, 7-CH₃), 1.47 (1 H, ddd, *J* 13.5, 11.0, 3.0, 6-H'), 1.61 (3 H, s, 3-CH₃), 1.84-1.97 (3 H, m, 5-H, 4-H₂), 2.02 (1 H, d, *J* 2.5, 9-H), 2.53 (1 H, m, 7-H), 4.21 (2 H, d, *J* 6.5, 1-H₂) and 5.30 (1 H, tq, *J* 6.5, 1.0, 2-H); δ_{C} (100 MHz, CDCl₃) –5.1, 16.1, 18.4, 19.1, 21.7, 23.6, 26.0, 28.6, 43.6, 48.1, 60.2, 68.2, 88.8, 126.2 and 135.5; *m/z* (EI/CI) 294 (M⁺, 1%) and 279 (M⁺ – 15, 3).

(3R,5S,1E,7E)-9-tert-Butyldimethylsilyloxy-1-iodo-3,5,7-trimethylnona-1,7-diene (33). A solution of dried CrCl_2 (0.80 g, 6.50 mmol) in THF (4 mL) was stirred at r.t. for 15 min then cooled to 0 °C. The aldehyde **30** (0.195 g, 0.652 mmol) and iodoform (0.51 g, 1.30 mmol) in THF (6 mL) cooled to 0 °C were added and the mixture stirred at 0 °C for 3 h. Ether (100 mL) and added and the mixture filtered through celite that was then washed with ether (4 × 50 mL). The organic extracts were washed with saturated aqueous sodium bisulfite and brine (50 mL), dried (MgSO_4) and concentrated under reduced pressure. Chromatography of the residue using light petroleum as eluent gave the *title compound* **33** as a light yellow oil (0.21 g, 76%) as a 94 : 6 mixture of (1E)- and (1Z)-isomers, $R_f = 0.74$ (1 : 9, ether : light petroleum), $[\alpha]_D^{19} -14.8$ (c 0.7, CHCl_3) (Found: $M^+ + \text{Na}$, 445.1378 $\text{C}_{18}\text{H}_{35}\text{ONaSi}$ requires M , 445.1395); $\nu_{\text{max}}/\text{cm}^{-1}$ 2954, 2926, 2854, 1668, 1600, 1459, 1380, 1360, 1459, 1380, 1360, 1252, 1199, 1174, 1085, 1055, 1006, 944, 833, 811, 773 and 665; δ_{H} (400 MHz, CDCl_3) (1E,7E)-isomer **33** 0.08 (6 H, s, 2 × SiCH_3), 0.81 (3 H, d, J 6.5, 5- CH_3), 0.91 [9 H, s, $\text{SiC}(\text{CH}_3)_3$], 0.97 (1 H, m, 4-H), 0.99 (3 H, d, J 6.5, 3- CH_3), 1.29 (1 H, ddd, J 13.5, 10.0, 4.5, 4-H'), 1.58 (3 H, s, 7- CH_3), 1.61 (1 H, m, 5-H), 1.80 (1 H, dd, J 13.5, 7.5, 6-H), 1.92 (1 H, dd, J 13.5, 7.0, 6-H'), 2.30 (1 H, m, 3-H), 4.20 (2 H, d, J 6.5, 9- H_2), 5.28 (1 H, tq, J 6.5, 1.0, 8-H), 5.96 (1 H, dd, J 14.5, 1.0, 1-H) and 6.32 (1 H, dd, J 14.5, 8.5, 2-H); (1Z,7E)-isomer 5.86 (1 H, dd, J 9.0, 7.5, 2-H) and 6.12 (1 H, dd, J 7.5, 1.0, 1-H); δ_{C} (100 MHz, CDCl_3) (1E,7E)-isomer **33** -5.0, 16.1, 18.4, 19.4, 20.7, 26.0, 28.1, 38.6, 43.3, 48.0, 60.2, 73.2, 126.3, 135.4 and 152.0; m/z (ES+) 445 ($M^+ + 23$, 100%).

(5S,7R,2E,8E)-9-iodo-3,5,7-trimethylnona-2,8-dien-1-ol (34). Tetrabutylammonium fluoride (1.0 M in THF; 0.21 g, 0.798 mmol, 0.80 mL) was added to the iodide **33** (0.123 g, 0.266 mmol) in THF (2 mL) at 0 °C and the solution stirred at 0 °C for 30 min and at r.t. for 1 h. Saturated aqueous sodium hydrogen carbonate (4 mL) was added and the mixture extracted with dichloromethane (4 × 10 mL). The organic extracts were dried (Na_2SO_4) and concentrated under reduced pressure. Chromatography of the residue using ether : light petroleum (1 : 2) as eluent gave the *title compound* **34** as a clear liquid (0.068 g, 83%) as a 94 : 6 mixture of the (2E,8E)- and (2E,8Z)-isomers, $R_f = 0.37$ (1 : 1, ether : light petroleum), $[\alpha]_D^{18} -30.4$ (c 0.5, CHCl_3) (Found: $M^+ + \text{NH}_4$, 326.0975. $\text{C}_{12}\text{H}_{25}\text{ONI}$ requires M , 326.0975); $\nu_{\text{max}}/\text{cm}^{-1}$ 3307(br), 2956, 2912, 2868, 2840, 2242, 1710, 1666, 1603, 1455, 1377, 1352, 1326, 1280, 1241, 1202, 1174, 1112, 1070, 992, 947, 907, 812, 766, 731, 669 and 646; δ_{H} (400 MHz, CDCl_3) (2E,8E)-isomer **34** 0.81 (3 H, d, J 6.5, 5- CH_3), 0.99 (3 H, d, J 6.5, 7- CH_3), 1.00 (1 H, m, 6-H), 1.24-1.31 (2 H, m, 6-H' and OH), 1.62 (1 H, m, 5-H), 1.63 (3 H, s, 3- CH_3), 1.81 (1 H, dd, J 13.5, 8.0, 4-H), 1.95 (1 H, dd, J 13.5, 7.0, 4-H'), 2.30 (1 H, m, 7-H), 4.16 (2 H, d, J 7.0, 1- H_2), 5.38 (1 H, tq, J 7.0, 1.0, 2-H), 5.96 (1 H, dd, J 14.5, 1.0, 9-H) and 6.32 (1 H, dd, J 14.5, 8.5, 8-H); (2E,8Z)-isomer 5.86 (1 H, dd, J 9.0, 7.5, 8-H) and 6.12 (1 H, d, J 7.5, 9-H); δ_{C} (100 MHz, CDCl_3) (2E,8E)-isomer **34** 16.1, 19.3, 20.7, 28.0, 38.6, 43.3, 47.9, 59.4, 73.3, 125.2, 138.2 and 152.0; m/z (ASAP+) 326 ($M^+ + 18$, 100%).

(3R,5S,1E,7E)-9-Hydroxy-3,5,7-trimethylnona-1,7-dien-1-yl(tributyl)stannane (36). *t*-Butyllithium (1.7 M in THF; 0.319 g, 4.98 mmol, 2.93 mL) was added to tributyltin chloride (1.082 g, 3.32 mmol, 0.90 mL) and the iodide **33** (0.70 g, 1.66 mmol) in THF (16 mL) at -78 °C and the mixture stirred at -78 °C for 2 h. Saturated aqueous ammonium chloride in MeOH (60 mL) was added and the mixture allowed to warm to r.t. then extracted with ether (4 × 140 mL). The organic extracts were washed with brine (80 mL), dried (MgSO_4) and concentrated under reduced pressure. Chromatography of the residue using light petroleum with 1% Et_3N as eluent gave vinyl stannane **35** (0.817 g, 84%) as a clear liquid.

Tetrabutylammonium fluoride (1.0 M in THF; 0.476 g, 1.82 mmol, 1.82 mL) was added to the vinyl stannane **35** (0.36 g, 0.608 mmol) in THF (4 mL) at 0 °C and the mixture stirred at this temperature for 40 min and then at r.t. for 1 h. Saturated aqueous sodium hydrogen carbonate (8 mL) was added and the mixture extracted with dichloromethane (4 × 30 mL). The organic extracts were dried (Na_2SO_4) and concentrated under reduced pressure. Chromatography of the residue using ether : light petroleum (1 : 10 with 1% Et_3N) as eluent gave the *title compound* **36** as a clear liquid (0.235 g, 82%) as a 94 : 6 mixture of the (1E,7E)- and (1Z,7E)-isomers, $R_f = 0.63$ (1 : 1, ether : light petroleum), $[\alpha]_D^{20} -22$ (c 0.4, EtOH) (Found: $M^+ + \text{Na}$, 495.2726. $\text{C}_{24}\text{H}_{48}\text{ONa}^{120}\text{Sn}$ requires M , 495.2709); $\nu_{\text{max}}/\text{cm}^{-1}$ 3307(br), 2954, 2919, 2869, 2845, 2360, 2340, 1596, 1456, 1419, 1375, 1339, 1321, 1289, 1244, 1180, 1070, 988, 960, 873, 860, 771 and 667; δ_{H} (500 MHz, C_6D_6) (1E,7E)-isomer **36** 0.86 (3 H, d, J 6.5, 5- CH_3), 0.89 (1 H, br. s, OH), 0.95 (9 H, t, J 7.5, 3 × CH_2CH_3), 0.97-1.00 (6 H, m, 3 × CH_2CH_3), 1.04 (1 H, m, 4-H), 1.04 (3 H, d, J 6.5, 3- CH_3), 1.33-1.42 (7 H, m, 4-H' and 3 × SnCH_2CH_2), 1.54 (3 H, s, 7- CH_3), 1.59-1.69 (6 H, m, 3 × SnCH_2), 1.70-1.82 (2 H, m, 5-H and 6-H), 1.96 (1 H, dd, J 13.0, 6.5, 6-H'), 2.33 (1 H, m, 3-H), 4.01 (2 H, d, J 6.5, 9- H_2), 5.40 (1 H, t, J 6.5, 8-H), 5.90 (1 H, ddd, J 33.0, 19.0, 7.5, 2-H) and 6.07 (1 H, dd, J 39.5, 19.0, 1-H); (1Z,7E)-isomer 2.05 (1 H, dd, J 13.0, 6.0, 6-H), 2.20 (1 H, m, 3-H) and 6.36 (1 H, dd, J 12.5, 9.5, 2-H); δ_{C} (125 MHz, C_6D_6) (1E,7E)-isomer **36** 10.2, 14.3, 16.4, 19.9, 22.2, 28.0, 28.9, 30.0, 40.6, 44.6, 48.9, 59.7, 125.9, 127.0, 137.3 and 156.1; (ES+) 495 ($M^+ + 23$, 85%), 493 ($M^+ + 23$, 100) and 491 ($M^+ + 23$, 65).

(5S,7R,2E,8E)-9-Iodo-3,5,7-trimethylnona-2,8-dienal (37). Pyridine (0.16 g, 2.04 mmol, 0.16 mL) was added to the Dess Martin periodinane (0.144 g, 0.340 mmol) in dichloromethane (1 mL) at r.t. and the solution stirred at r.t. for 15 min. The alcohol **34** (0.05 g, 0.17 mmol) in dichloromethane (1 mL) was added and the mixture stirred at r.t. for 1 h. Ether (10 mL) and saturated sodium hydrogen carbonate / sodium bisulfite (10 mL) were added and the aqueous layer was extracted with ether (4 × 10 mL). The organic extracts were washed with brine (10 mL), dried (Na_2SO_4) and concentrated under reduced pressure. Chromatography of the residue using ether : light petroleum (1 : 10) as eluent gave the *title compound* **37** as a clear liquid (40 mg, 78%) as a 94 : 6 mixture of (2E,8E)- and (2E,8Z)-isomers, $R_f = 0.69$ (1 : 1, ether : light petroleum), $[\alpha]_D^{19} -18.4$ (c 0.5, dichloromethane) (Found: $M^+ + \text{Na}$, 329.0366. $\text{C}_{12}\text{H}_{19}\text{OINa}$ requires M , 329.0373); $\nu_{\text{max}}/\text{cm}^{-1}$ 2957, 2923, 2869, 2840, 2360, 1668, 1629, 1604, 1455, 1404, 1380, 1323, 1280, 1243, 1195, 1120, 1083, 1038, 948, 888, 863, 808, 766, 703, 669 and 618; δ_{H} (400 MHz, CDCl_3) (2E,8E)-isomer **37** 0.85 (3 H, d, J 6.5, 5- CH_3), 1.00 (3 H, d, J 6.5, 7- CH_3), 1.06 (1 H, ddd, J 13.5, 9.5, 5.0, 6-H), 1.27 (1 H, ddd, J 13.5, 10.0, 4.5, 6-H'), 1.74 (1 H, m, 5-H), 2.10 (1 H, dd, J 13.5, 8.0, 4-H), 2.13 (3 H, d, J 1.5, 3- CH_3), 2.16 (1 H, dd, J 13.5, 6.5, 4-H'), 2.30 (1 H, m, 7-H), 5.84 (1 H, dq, J 8.0, 1.0, 2-H), 6.00 (1 H, dd, J 14.5, 1.0, 9-H), 6.31 (1 H, dd, J 14.5, 9.0, 8-H) and 9.99 (1 H, d, J 8.0, 1-H); (2E,8Z)-isomer 6.16 (1 H, d, J 7.5, 9-H); δ_{C} (100 MHz, CDCl_3) (2E,8E)-isomer **37** 17.3, 19.2, 20.6, 28.5, 38.6, 43.3, 48.9, 73.7, 128.9, 151.4, 162.5 and 191.1; m/z (ES+) 329 ($M^+ + 23$, 100%).

(5S,7R,2E,8E)-3,5,7-Trimethyl-9-(tributylstannyl)nona-2,8-dienal (38). Activated manganese dioxide (2.21 g, 25.4 mmol) was added to the alcohol **36** (0.40 g, 0.845 mmol) in dichloromethane (30 mL). The mixture was stirred at r.t. for 1 h, filtered through celite and extracted with ether (4 × 30 mL). After concentration under reduced pressure, chromatography of the residue using ether : light petroleum (1 : 40 with 1% Et₃N) as eluent gave the *title compound 38* as a clear liquid (0.325 g, 82%) as a 94 : 6 mixture of the (2E,8E)- and (2E,8Z)-isomers, $R_f = 0.68$ (1 : 2, ether : light petroleum), $[\alpha]_D^{18} +7.2$ (*c* 0.5, benzene) (Found: $M^+ + Na$, 493.2450. C₂₄H₄₆ONa¹²⁰Sn requires *M*, 493.2463); ν_{max}/cm^{-1} 2952, 2920, 2868, 2844, 1675, 1629, 1596, 1454, 1376, 1291, 1194, 1116, 1080, 990, 959, 863, 809, 770, 745, 689, 656 and 618; δ_H (500 MHz, C₆D₆) (2E,8E)-isomer **38** 0.69 (3 H, d, *J* 6.0, 5-CH₃), 0.91-0.97 (19 H, m, 3 × CH₂CH₃, 7-CH₃ and 6-H), 1.15 (1 H, ddd, *J* 13.5, 10.0, 4, 6-H'), 1.32-1.40 (6 H, m, 3 × SnCH₂CH₂), 1.52-1.63 (8 H, m, 3 × SnCH₂, 5-H and 4-H), 1.66 (3 H, s, 3-CH₃), 1.80 (1 H, m, 4-H'), 2.19 (1 H, m, 7-H), 5.76 (1 H, ddd, *J* 32.0, 19.0, 7.5, 8-H), 5.81 (1 H, m, 2-H), 5.99 (1 H, dd, *J* 39.5, 19.0, 9-H) and 9.88 (1 H, d, *J* 8.0, 1-H); (2E,8Z)-isomer 2.08 (1 H, m, 7-H), 6.24 (1 H, dd, *J* 12.5, 9.5, 8-H) and 9.93 (1 H, d, *J* 8.0, 1-H); δ_C (125 MHz, C₆D₆) (2E,8E)-isomer **38** 10.1, 14.4, 17.2, 19.6, 22.0, 28.0, 29.1, 30.0, 40.5, 44.3, 49.3, 126.4, 129.6, 155.6, 160.8 and 189.8; (ES+) 471 ($M^+ + 1$, 100%) and 469 [$M^+ + 1$, 65].

(3R,5S,1E,7E,9E,11E)-3,5,7,11-Tetramethyltrideca-1,7,9,11-tetraen-1-yl(tributyl)stannane (39). Lithium hexamethyldisilazide (1.0 M in THF, 0.123 g, 0.74 mmol, 0.74 mL) was added to the aldehyde **38** (0.23 g, 0.49 mmol) and the sulphone **23** (0.196 g, 0.735 mmol) in THF (10 mL) at -78 °C and the solution stirred at -78 °C for 1 h and at r.t. for 2 h. Aqueous sodium hydroxide (1.0 M; 20 mL) and ether (40 mL) were added and the aqueous layer extracted with ether (4 × 40 mL). The organic extracts were washed with brine (20 mL), dried (Na₂SO₄) and concentrated under reduced pressure. Chromatography of the residue using light petroleum with 1% Et₃N as eluent gave the *title compound 39* as a clear liquid (0.192 g, 75%), a mixture of geometrical isomers, (1E,7E,9E,11E) : (1E,7E,9Z,11E) : (1E,7E,9E,11Z) = 88 : 7 : 5, $R_f = 0.54$ (100% light petroleum), $[\alpha]_D^{20} -9.0$ (*c* 0.4, EtOH) (Found: $M^+ - C_4H_9$, 465.2544. C₂₅H₄₅¹²⁰Sn requires *M*, 465.2538); ν_{max}/cm^{-1} 2952, 2918, 2868, 1595, 1454, 1375, 1323, 1180, 1070, 990, 956, 872, 794, 689 and 654; δ_H (500 MHz, C₆D₆) (1E,7E,9E,11E)-isomer **39** 0.90 (3 H, d, *J* 6.5, 5-CH₃), 0.92-1.04 (19 H, m, 3 × CH₂CH₃, 3-CH₃ and 4-H), 1.35-1.43 (7 H, m, 3 × SnCH₂CH₂ and 4-H'), 1.55-1.64 (9 H, m, 3 × SnCH₂ and 12-CH₃), 1.73 and 1.77 (each 3 H, s, 7-CH₃ or 11-CH₃), 1.81 (1 H, m, 5-H), 1.93 (1 H, dd, *J* 13.0, 8.0, 6-H), 2.06 (1 H, dd, *J* 13.0, 6.5, 6-H'), 2.33 (1 H, m, 3-H), 5.52 (1 H, q, *J* 7.0, 12-H), 5.85 (1 H, ddd, *J* 33.0, 19.0, 7.5, 2-H), 5.99-6.10 (2 H, m, 8-H and 1-H), 6.32 (1 H, d, *J*, 15.5, 10-H) and 6.50 (1 H, dd, *J* 15.5, 11.0, 9-H); (1E,7E,9Z,11E)-isomer 5.64 (1 H, q, *J* 7.0, 12-H) and 6.22 (1 H, t, *J* 11.5, 10-H); (1E,7E,9E,11Z)-isomer 5.34 (1 H, q, *J* 7.5, 12-H), 6.08 (1 H, d, *J* 11.5, 8-H), 6.60 (1 H, dd, *J* 15.5, 11.5, 9-H) and 6.71 (1 H, d, *J* 15.5, 10-H); δ_C (125 MHz, C₆D₆) (1E,7E,9E,11E)-isomer **39** 10.2, 12.6, 14.4, 14.4, 17.2, 20.1, 22.2, 28.1, 29.5, 30.0, 40.7, 44.6, 49.6, 123.2, 125.8, 126.5, 128.3, 135.8, 136.6, 136.7 and 156.2; *m/z* (EI/CI) 465 [$M^+ - 57$, 100%], 463 [$M^+ - 57$, 75] and 461 [$M^+ - 57$, 41].

Ethyl (4R,6S,2E,8E)-10-tert-butylidimethylsilyloxy-4,6,8-trimethyldeca-2,8-dienoate (41). (Ethoxycarbonylmethylene)-triphenylphosphorane (3.38 g, 9.70 mmol) was added to the aldehyde **30** (1.45 g, 4.85 mmol) in dichloromethane (60 mL) and the solution stirred at r.t. for 14 h. After concentration under reduced pressure, chromatography of the residue using ether : light petroleum (1 : 20) as eluent gave the *title compound 41* as a clear liquid (1.30 g, 73%), $R_f = 0.58$ (1 : 5, ether : light petroleum), $[\alpha]_D^{18} -8.5$ (*c* 0.8, benzene) (Found: $M^+ + Na$, 391.2625. C₂₁H₄₀O₃NaSi requires *M*, 391.2639); ν_{max}/cm^{-1} 2957, 2928, 2857, 1721, 1652, 1462, 1380, 1368, 1341, 1302, 1254, 1202, 1176, 1141, 1085, 1050, 1006, 986, 939, 833, 813, 774, 726 and 665; δ_H (400 MHz, C₆D₆) 0.08 (6 H, s, 3 × SiCH₃), 0.70 (3 H, d, *J* 6.5, 6-CH₃), 0.80 (3 H, d, *J* 6.5, 4-CH₃), 0.84 (1 H, ddd, *J* 13.5, 9.5, 5.0, 5-H), 0.98 [9 H, s, SiC(CH₃)₃], 1.00 (3 H, t, *J* 7.0, CH₂CH₃), 1.20 (1 H, ddd, *J* 13.5, 9.5, 4.5, 5-H'), 1.41 (3 H, s, 8-CH₃), 1.49 (1 H, m, 6-H), 1.65 (1 H, dd, *J* 13.0, 7.5, 7-H), 1.79 (1 H, dd, 13.0, 7.0, 7-H'), 2.15 (1 H, m, 4-H), 4.03 (2 H, q, *J* 7.0, CH₂CH₃), 4.18 (2 H, d, *J* 6.5, 10-H₂), 5.40 (1 H, tq, *J* 6.5, 1.0, 9-H), 5.84 (1 H, dd, *J* 15.5, 1.0, 2-H) and 6.91 (1 H, dd, *J* 15.5, 8.5, 3-H); δ_C (100 MHz, C₆D₆) -4.5, 14.7, 16.4, 18.9, 19.9, 20.9, 26.5, 28.8, 34.8, 43.8, 48.5, 60.3, 60.6, 120.9, 127.5, 135.6, 154.4 and 166.5; *m/z* (ES+) 391 ($M^+ + 23$, 100%).

Ethyl (4R,6S,2E,8E)-10-hydroxy-4,6,8-trimethyldeca-2,8-dienoate (42). Pyridinium toluene 4-sulfonate (0.083 g, 0.33 mmol) was added to the ester **41** (1.23 g, 3.33 mmol) in dichloromethane (12 mL) and ethanol (12 mL) and the mixture stirred at r.t. for 20 h. Saturated aqueous sodium hydrogen carbonate (50 mL) was added and the mixture extracted with ether (4 × 100 mL). The organic extracts were dried (Na₂SO₄) and concentrated under reduced pressure. Chromatography of the residue using ether : light petroleum (gradient elution 1 : 5 to 1 : 1) as eluent gave the *title compound 42* as a clear liquid (0.76 g, 90%), $R_f = 0.26$ (1 : 1, ether : light petroleum), $[\alpha]_D^{18} -14.7$ (*c* 0.3, benzene) (Found: $M^+ + Na$, 277.1784. C₁₅H₂₆O₃Na requires *M*, 277.1775); ν_{max}/cm^{-1} 3419(br), 2960, 2915, 2872, 2361, 1717, 1651, 1457, 1369, 1341, 1302, 1274, 1236, 1203, 1176, 1143, 1096, 1037, 986, 863, 775 and 726; δ_H (400 MHz, C₆D₆) 0.72 (3 H, d, *J* 6.5, 6-CH₃), 0.80 (3 H, d, *J* 6.5, 4-CH₃), 0.86 (1 H, ddd, *J* 13.5, 9.5, 5, 5-H), 1.00 (3 H, t, *J* 7.0, CH₂CH₃), 1.22 (1 H, ddd, *J* 13.5, 9.5, 4.5, 5-H') 1.44 (3 H, s, 8-CH₃), 1.50 (1 H, m, 6-H), 1.67 (1 H, dd, *J* 13.5, 8.0, 7-H), 1.82 (1 H, dd, *J* 13.5, 6.5, 7-H'), 2.16 (1 H, m, 4-H), 2.80 (1 H, br, s, OH), 4.02 (2 H, q, *J* 7.0, CH₂CH₃), 4.12 (2 H, d, *J* 6.5, 10-H₂), 5.44 (1 H, tq, *J* 6.5, 1.0, 9-H), 5.83 (1 H, dd, *J* 15.5, 1.0, 2-H) and 6.91 (1 H, dd, *J* 15.5, 8.5, 3-H); δ_C (100 MHz, C₆D₆) 14.7, 16.4, 19.9, 20.8, 28.8, 34.9, 43.8, 48.5, 59.5, 60.5, 120.8, 127.3, 136.6, 154.8 and 166.9; *m/z* (ES+) 277 ($M^+ + 23$, 100%).

Ethyl (4R,6S,2E,8E)-4,6,8-trimethyl-10-oxodeca-2,8-dienoate (43). Activated manganese dioxide (7.70 g, 88.5 mmol) was added to the alcohol **42** (0.75 g, 2.95 mmol) in dichloromethane (60 mL). The mixture was stirred at r.t. for 2 h then filtered through celite and extracted with ether (4 × 80 mL). After concentration under reduced pressure, chromatography of the residue using ether : light petroleum (1 : 4) as eluent gave the *title compound 43* as a clear liquid (0.63 g, 85%), $R_f = 0.42$ (1 : 1, ether : light petroleum), $[\alpha]_D^{20} +2.3$ (*c* 0.7, benzene) (Found: $M^+ + Na$, 275.1620. C₁₅H₂₄O₃Na requires *M*, 275.1618); ν_{max}/cm^{-1} 2961, 2927, 2872, 2361, 1715, 1670, 1631, 1458, 1382, 1368, 1341, 1303, 1274, 1236, 1197, 1177, 1142, 1095, 1037, 987, 931, 863, 809, 727 and 621; δ_H (400 MHz, C₆D₆) 0.55 (3 H, d, *J* 6.5, 6-CH₃), 0.75 (3 H, d, *J* 6.5, 4-CH₃), 0.77 and 1.00 (each 1 H, ddd, *J* 14.0, 9.0, 5.0, 5-H), 1.02 (3 H, t, *J* 7.0, CH₂CH₃), 1.39 (1 H, m, 6-H), 1.50 (1 H, dd, *J* 13.0, 8.5, 7-H), 1.55 (3 H, d, *J* 1.5, 8-CH₃), 1.70 (1 H, dd, *J* 13.0, 6.0, 7-H'), 2.07 (1 H, m, 4-H), 4.04 (2 H, q, *J* 7.0, CH₂CH₃), 5.73 (1

H, dq, J 8.0, 1.0, 9-H), 5.79 (1 H, dd, J 15.5, 1.0, 2-H), 6.81 (1 H, dd, J 15.5, 8.5, 3-H) and 9.84 (1 H, d, J 8.0, 10-H); δ_C (100 MHz, C_6D_6) 14.7, 17.0, 19.4, 20.7, 28.9, 34.6, 43.7, 48.9, 60.5, 121.1, 129.6, 154.0, 161.0, 166.5 and 190.2; m/z (ES⁺) 275 ($M^+ + 23$, 100%).

Ethyl (4R,6S,2E,8E,10E,12E)-4,6,8,12-tetramethyltetradeca-2,8,10,12-tetraenoate (44). Lithium hexamethyldisilazide (1.0 M in THF; 0.243 g, 1.46 mmol, 1.46 mL) was added to a solution of the aldehyde **43** (0.245 g, 0.972 mmol) and sulphone **23** (0.389 g, 1.46 mmol) in THF (10 mL) at $-78^\circ C$ and the solution stirred at $-78^\circ C$ for 1 h and at r.t. for 2 h. Saturated aqueous sodium hydrogen carbonate (20 mL) and ether (40 mL) were added and the aqueous layer was extracted with ether (4 \times 40 mL). The organic extracts were then washed with brine (20 mL), dried (Na_2SO_4) and concentrated under reduced pressure. Chromatography of the residue using ether : light petroleum (1 : 100) as eluent gave the *title compound* **44** as a light yellow liquid (0.215 g, 73%), a mixture of geometrical isomers, (2E,8E,10E,12E) : (2E,8E,10Z,12E) : (2E,8E,10E,12Z) = 87 : 6 : 7, R_f = 0.45 (1 : 8 ether : light petroleum), $[\alpha]_D^{20} +36.7$ (c 0.6, benzene) (Found: $M^+ + Na$, 327.2289 $C_{20}H_{32}O_2Na$ requires M , 327.2295); ν_{max}/cm^{-1} 2958, 2916, 2870, 2361, 1719, 1651, 1456, 1368, 1339, 1302, 1272, 1235, 1202, 1176, 1140, 1096, 1037, 986, 959, 861, 797, 725 and 620; δ_H (400 MHz, C_6D_6) (2E,8E,10E,12E)-isomer **44** 0.73 (3 H, d, J 6.5, 6-CH₃), 0.78 (3 H, d, J 7.0, 4-CH₃), 0.87 (1 H, ddd, J 13.5, 9.5, 5.0, 5-H), 1.00 (3 H, t, J 7.0, CH₂CH₃), 1.23 (1 H, ddd, J 13.5, 9.5, 4.5, 5-H'), 1.55-1.67 (7 H, m, 14-H₃, 8-CH₃ and 6-H), 1.72 (3 H, s, 12-CH₃), 1.76 (1 H, dd, J 13.5, 8.0, 7-H), 1.91 (1 H, dd, J 13.5, 7.0, 7-H'), 2.17 (1 H, m, 4-H), 4.04 (2 H, q, J 7.0, CH₂CH₃), 5.52 (1 H, q, J 7.0, 13-H), 5.86 (1 H, dd, J 15.5, 1.0, 2-H), 5.97 (1 H, d, J 11.0, 9-H), 6.31 (1 H, d, J 15.5, 11-H), 6.46 (1 H, dd, J 15.5, 11.0, 10-H) and 6.93 (1 H, dd, J 15.5, 8.5, 3-H); (2E,8E,10Z,12E)-isomer 5.63 (1 H, q, J 7.0, 13-H) and 6.17 (1 H, t, J 11.5, 10-H); (2E,8E,10E,12Z)-isomer 5.34 (1 H, q, J 7.5, 13-H), 6.01 (1 H, d, J 11.0, 9-H), 6.56 (1 H, dd, J 15.0, 11.0, 10-H) and 6.71 (1 H, d, J 15.0, 11-H); δ_C (100 MHz, C_6D_6) (2E,8E,10E,12E)-isomer **44** 12.5, 14.4, 14.7, 16.9, 19.9, 20.9, 29.2, 34.8, 43.9, 49.1, 60.4, 120.9, 123.1, 126.7, 128.3, 135.8, 136.4, 136.7, 154.4 and 166.6; m/z (ES⁺) 327 ($M^+ + 23$, 100%).

(4R,6S,2E,8E,10E,12E)-4,6,8,12-Tetramethyltetradeca-2,8,10,12-tetraen-1-ol (45). Di-*isobutyl*aluminium hydride (1.0 M in hexanes; 0.562 g, 3.96 mmol, 3.96 mL) was added dropwise to the ester **44** (0.40 g, 1.32 mmol) in THF (12 mL) at $-78^\circ C$ and the solution stirred at $-78^\circ C$ for 1 h. The reaction mixture was allowed to warm to r.t. before the addition of saturated aqueous ammonium chloride (16 mL) followed by the addition of dichloromethane (48 mL) and saturated aqueous Rochelle's salt (32 mL) with subsequent stirring at r.t. for 1.5 h. The aqueous layer was extracted with dichloromethane (4 \times 80 mL). The organic extracts were washed with brine (100 mL), dried (Na_2SO_4) and concentrated under reduced pressure. Chromatography of the residue using ether : light petroleum (1 : 6) as eluent gave the *title compound* **45** as a clear liquid (0.293 g, 85%), a mixture of geometrical isomers (2E,8E,10E,12E) : (2E,8E,10Z,12E) : (2E,8E,10E,12Z) = 82 : 6 : 12, R_f = 0.55 (1 : 1 ether : light petroleum), $[\alpha]_D^{18} +29.3$ (c 0.3, benzene) (Found: $M^+ + Na$, 285.2195. $C_{18}H_{30}ONa$ requires M , 285.2189); ν_{max}/cm^{-1} 3315(br), 2954, 2914, 2867, 2360, 1456, 1378, 1269, 1083, 1005, 959, 796 and 620; δ_H (400 MHz, C_6D_6) (2E,8E,10E,12E)-isomer **45** 0.86 (3 H, d, J 6.5, 6-CH₃), 0.94 (3 H, d, J 6.5, 4-CH₃), 0.98 (1 H, ddd, J 13.5, 9.0, 5.0, 5-H), 1.22 (1 H, br. s, OH), 1.29 (1 H, ddd, J 13.5, 9.5, 4.5, 5-H'), 1.60 (3 H, d, J 7.0, 14-H₃), 1.70 (3 H, s, 8-CH₃), 1.72 (1 H, m, 6 H), 1.73 (3 H, s, 12-CH₃), 1.87 (1 H, dd, J 13.5, 8.0, 7-H), 2.04 (1 H, dd, J 13.5, 7.0, 7-H'), 2.19 (1 H, m, 4-H), 3.89 (2 H, d, J 5.5, 1-H₂), 5.37 (1 H, ddt, J 15.5, 8.0, 1.0, 3-H), 5.50 (1 H, dt, J 15.5, 5.5, 2-H), 5.52 (1 H, m, 13-H), 6.05 (1 H, d, J 11.0, 9-H), 6.34 (1 H, d, J 15.5, 11-H) and 6.52 (1 H, dd, J 15.5, 11.0, 10-H); (2E,8E,10Z,12E)-isomer 5.67 (1 H, q, J 7.0, 13-H), 5.91 (1 H, d, J 11.5, 9-H) and 6.23 (1 H, t, J 11.5, 10-H); (2E,8E,10E,12Z)-isomer 6.09 (1 H, d, J 11.0, 9-H), 6.61 (1 H, dd, J 15.5, 11.0, 10-H) and 6.74 (1 H, d, J 15.5, 11-H); δ_C (100 MHz, C_6D_6) (2E,8E,10E,12E)-isomer **45** 12.6, 14.4, 17.1, 20.1, 22.2, 29.3, 34.8, 44.9, 49.3, 63.8, 123.2, 126.7, 128.2, 129.0, 135.8, 136.6, 136.7 and 137.9; m/z (ES⁺) 285 ($M^+ + 23$, 100%).

(4R,6S,2E,8E,10E,12E)-4,6,8,12-Tetramethyltetradeca-2,8,10,12-tetraenal (46). Activated manganese dioxide (2.65 g, 30.5 mmol) was added to the alcohol **45** (0.266 g, 1.02 mmol) in dichloromethane (20 mL) and the mixture stirred at r.t. for 4 h before being filtered through celite. The celite was washed with ether (4 \times 20 mL) and the ether extracts concentrated under reduced pressure. Chromatography of the residue using ether : light petroleum (1 : 15) as eluent gave the *title compound* **46** as a clear liquid (0.22 g, 84%), a mixture of geometrical isomers, (2E,8E,10E,12E) : (2E,8E,10Z,12E) : (2E,8E,10E,12Z) = 80 : 6 : 14, R_f = 0.46 (1 : 4, ether : light petroleum), $[\alpha]_D^{18} +92$ (c 0.2, benzene) (Found: $M^+ + H$, 261.2212. $C_{18}H_{29}O$ requires M , 261.2213); ν_{max}/cm^{-1} 2960, 2915, 1690, 1634, 1456, 1378, 1149, 1096, 1032, 977, 959, 795 and 621; δ_H (400 MHz, C_6D_6) (2E,8E,10E,12E)-isomer **46** 0.70 (3 H, d, J 6.5, 6-CH₃), 0.71 (3 H, d, J 6.5, 4-CH₃), 0.83 (1 H, ddd, J 13.5, 9.5, 5.5, 5-H), 1.14 (1 H, ddd, J 13.5, 9.5, 5.0, 5-H'), 1.43 (1 H, m, 6-H), 1.59-1.63 (6 H, m, 14-H₃ and 8-CH₃), 1.74 (3 H, s, 12-CH₃), 1.79 (1 H, dd, J 13.5, 6.0, 7-H), 1.90 (1 H, dd, J 13.5, 7.0, 7-H'), 2.09 (1 H, m, 4-H), 5.54 (1 H, q, J 7.0, 13-H), 5.93 (1 H, dd, J 15.5, 7.0, 2-H), 6.01 (1 H, d, J 10.0, 9-H), 6.02 (1 H, dd, J 15.5, 7.5, 3-H), 6.36 (1 H, d, J 15.5, 11-H), 6.52 (1 H, dd, J 15.5, 11.0, 10-H) and 9.36 (1 H, d, J 7.5, 1-H); (2E,8E,10Z,12E)-isomer 5.66 (1 H, m, 13-H) and 6.22 (1 H, t, J 11.5, 10-H); (2E,8E,10E,12Z)-isomer 5.36 (1 H, q, J 7.5, 13-H), 6.61 (1 H, dd, J 15.5, 11.0, 10-H) and 6.76 (1 H, d, J 15.5, 11-H); δ_C (100 MHz, C_6D_6) (2E,8E,10E,12E)-isomer **46** 12.6, 14.4, 17.0, 20.0, 20.5, 29.2, 35.0, 43.6, 49.0, 123.0, 127.0, 128.5, 132.4, 135.7, 136.1, 136.9, 162.5 and 193.1; m/z (ES⁺) 283 ($M^+ + 23$, 100%) and 261 ($M^+ + 1$, 44).

Methyl (6R,8S,2Z,4E,10E,12E,14E)-6,8,10,14-tetramethylhexadeca-2,4,10,12,14-pentaenoate (47). 18-Crown-6 (0.976 g, 3.70 mmol) was added to potassium carbonate (0.255 g, 1.85 mmol) in toluene (8 mL) and the mixture stirred at r.t. for 1 h. After cooling $-20^\circ C$, a cooled solution of bis-(2,2,2-trifluoroethyl) (methoxycarbonylmethyl)phosphonate (0.098 g, 0.31 mmol) and the aldehyde **46** (0.08 g, 0.31 mmol) in THF (8 mL) was added and the mixture stirred at $0^\circ C$ for 3 h. Saturated aqueous ammonium chloride (20 mL) was added and the mixture extracted with ether (4 \times 40 mL). The organic extracts were washed with brine (40 mL), dried (Na_2SO_4) and concentrated under reduced pressure. Chromatography of the residue using ether : light petroleum (1 : 60) as eluent gave the *title compound* **47** as a light yellow liquid (0.083 g, 86%), a mixture of geometrical isomers, (2Z,4E,10E,12E,14E) : (2Z,4E,10E,12Z,14E) : (2Z,4E,10E,12E,14Z) = 79 : 6 : 15, R_f = 0.51 (1 : 9, ether : light petroleum), $[\alpha]_D^{20} +144$ (c 0.3, benzene) (Found: $M^+ + Na$, 339.2289. $C_{21}H_{32}O_2Na$ requires M , 339.2295); ν_{max}/cm^{-1} 2952, 2913, 2866, 1716, 1637, 1600, 1437, 1412, 1377, 1330, 1195, 1170, 1000, 958, 894, 816, 743 and 619; δ_H (400 MHz, C_6D_6)

(2*Z*,4*E*,10*E*,12*E*,14*E*)-isomer **47** 0.81 (3 H, d, *J* 6.5, 8-CH₃), 0.87 (3 H, d, *J* 6.5, 6-CH₃), 0.94 (1 H, ddd, *J* 13.5, 9.5, 5.0, 7-H), 1.28 (1 H, ddd, *J* 13.5, 9.5, 4.5, 7-H'), 1.60 (3 H, d, *J* 7.0, 16-H₃), 1.65-1.67 (4 H, m, 10-CH₃ and 8-H), 1.74 (3 H, t, *J* 1.0, 14-CH₃), 1.81 (1 H, dd, *J* 13.5, 7.5, 9-H), 1.97 (1 H, dd, *J* 13.5, 7.0, 9-H'), 2.27 (1 H, m, 6-H), 3.38 (3 H, s, OCH₃), 5.53 (1 H, q, *J* 7.0, 15-H), 5.62 (1 H, dd, *J* 15.5, 8.5, 5-H), 5.63 (1 H, d, *J* 11.5, 2-H), 6.02 (1 H, d, *J* 11.0, 11-H), 6.31 (1 H, t, *J* 11.5, 3-H), 6.34 (1 H, d, *J* 15.0, 13-H), 6.52 (1 H, dd, *J* 15.0, 11.0, 12-H) and 7.83 (1 H, dd, *J* 15.5, 11.5, 4-H); (2*Z*,4*E*,10*E*,12*Z*,14*E*)-isomer 5.92 (1 H, d, *J* 11.5, 11-H) and 6.24 (1 H, t, *J* 11.5, 12-H); (2*Z*,4*E*,10*E*,12*E*,14*Z*)-isomer 5.36 (1 H, q, *J* 7.0, 15-H), 6.07 (1 H, d, *J* 11.0, 11-H), 6.62 (1 H, dd, *J* 15.5, 11.0, 12-H) and 6.74 (1 H, d, *J* 15.5, 13-H); δ_{C} (100 MHz, C₆D₆) (2*Z*,4*E*,10*E*,12*E*,14*E*)-isomer **47** 12.5, 14.4, 17.0, 20.0, 21.6, 29.4, 35.6, 44.5, 49.2, 51.0, 116.3, 123.2, 126.5, 126.7, 128.3, 135.8, 136.6, 136.7, 146.1, 151.3 and 166.9; *m/z* (ES⁺) 339 (M⁺ + 23, 100%).

(6*R*,8*S*,2*Z*,4*E*,10*E*,12*E*,14*E*)-6,8,10,14-Tetramethylhexadeca-2,4,10,12,14-pentaenoic acid (48**).** Sodium hydroxide (37 mg, 0.92 mmol) in water (1.5 mL) was added to the methyl ester **47** (71 mg, 0.23 mmol) in ethanol (3 mL) at r.t. and the solution stirred at r.t. for 18 h. The mixture was added to a solution of tartaric acid (0.338 g, 2.25 mmol) in water (15 mL) at 0 °C with vigorous stirring for 2 min. The mixture was then extracted with ether (4 × 25 mL) that had been cooled to 0 °C. The organic extracts were washed with chilled water (2 × 25 mL) and brine (25 mL), dried (Na₂SO₄) and concentrated under reduced pressure to afford the *title compound* **48** as a light yellow liquid (0.062 g, 92%), a mixture of geometrical isomers, (2*Z*,4*E*,10*E*,12*E*,14*E*) : (2*Z*,4*E*,10*E*,12*Z*,14*E*) : (2*Z*,4*E*,10*E*,12*E*,14*Z*) = 77 : 6 : 17, *R_f* = 0.53 (1 : 1 ether : light petroleum), $[\alpha]_{\text{D}}^{20} +170$ (*c* 0.3, benzene) (Found: M⁺ - H, 301.2173. C₂₀H₂₉O₂ requires *M*, 301.2173); $\nu_{\text{max}}/\text{cm}^{-1}$ 2960, 2913, 2868, 1687, 1632, 1597, 1440, 1378, 1286, 1253, 1232, 1180, 1087, 1004, 959, 862, 795, 748 and 698; δ_{H} (400 MHz, C₆D₆) (2*Z*,4*E*,10*E*,12*E*,14*E*)-isomer **48** 0.78 (3 H, d, *J* 6.5, 8-CH₃), 0.84 (3 H, d, *J* 6.5, 6-CH₃), 0.91 (1 H, ddd, *J* 13.5, 9.5, 5.0, 7-H), 1.25 (1 H, ddd, *J* 13.5, 9.5, 4.5, 7-H'), 1.60 (3 H, d, *J* 7.0, 16-H₃), 1.66-1.68 (4 H, m, 10-CH₃ and 8-H), 1.75 (3 H, t, *J* 1.0, 14-CH₃), 1.81 (1 H, dd, *J* 13.5, 7.5, 9-H), 1.96 (1 H, dd, *J* 13.5, 7.0, 9-H'), 2.20 (1 H, m, 6-H), 5.55 (1 H, d, *J* 11.5, 2-H), 5.56 (1 H, m, 15-H), 5.58 (1 H, dd, *J* 15.5, 8.5, 5-H), 6.03 (1 H, d, *J* 10.5, 11-H), 6.26 (1 H, t, *J* 11.5, 3-H), 6.36 (1 H, d, *J* 15.0, 13-H), 6.54 (1 H, dd, *J* 15.0, 10.5, 12-H), 7.60 (1 H, dd, *J* 15.5, 11.5, 4-H) and 11.67 (1 H, br. s, OH); (2*Z*,4*E*,10*E*,12*Z*,14*E*)-isomer 5.93 (1 H, d, *J* 11.5, 11-H); (2*Z*,4*E*,10*E*,12*E*,14*Z*)-isomer 5.36 (1 H, q, *J* 7.5, 15-H), 6.07 (1 H, d, *J* 11.0, 11-H), 6.63 (1 H, dd, *J* 15.5, 11.0, 12-H) and 6.75 (1 H, d, *J* 15.5, 13-H); δ_{C} (100 MHz, C₆D₆) (2*Z*,4*E*,10*E*,12*E*,14*E*)-isomer **48** 12.6, 14.4, 17.0, 20.0, 21.5, 29.4, 35.6, 44.4, 49.2, 115.7, 123.2, 126.5, 126.7, 128.3, 135.8, 136.6, 136.7, 148.4, 152.7 and 172.9; *m/z* (ES⁻) 301 (M⁺ - 1, 100%).

(5*R*)-1-tert-Butyloxycarbonyl-3-[(6*R*,8*S*,2*Z*,4*E*,10*E*,12*E*,14*E*)-6,8,10,14-tetramethylhexadeca-2,4,10,12,14-pentaenoyl]-5-(prop-2-yl)pyrrolidin-2-one (50**).** 1,1'-Carbonyldi-imidazole (0.055 g, 0.34 mmol) was added to the acid **48** (82 mg, 0.27 mmol) in THF (1 mL) at r.t. and the mixture stirred at r.t. for 45 min. Ether (30 mL) was added and the ethereal solution washed with water (5 mL) and brine (5 mL). After drying (Na₂SO₄), concentration under reduced pressure gave the acylimidazolide **7** as a pale yellow liquid (81 mg, 85%).

A cooled solution of lithium hexamethyldisilazide (1.0 M in THF; 0.076 g, 0.45 mmol, 0.45 mL) was added to the pyrrolidinone **49** (0.103 g, 0.454 mmol) in THF (3 mL) at -78 °C and the solution was stirred at -78 °C for 1 h. A cooled solution of the imidazolide **7** (80 mg, 0.23 mmol) in THF (1 mL) was added and the mixture stirred at -78 °C for 2 h. Saturated aqueous ammonium chloride (2 mL) was added and the mixture allowed to warm to r.t. before the addition of more saturated aqueous ammonium chloride (10 mL). The aqueous layer was extracted with ether (4 × 20 mL) and the organic extracts dried (Na₂SO₄) and concentrated under reduced pressure. Chromatography of the residue using ether : light petroleum (1 : 10) as eluent gave the *title compounds* **50** as a light yellow liquid (67 mg, 58%), a mixture of geometrical isomers with extensive enolisation, (2*Z*,4*E*,10*E*,12*E*,14*E*) : (2*Z*,4*E*,10*E*,12*Z*,14*E*) : (2*Z*,4*E*,10*E*,12*E*,14*Z*) = 73 : 5 : 22, (2*Z*,4*E*) : (2*E*,4*E*) = 10 : 1 in all cases, *R_f* = 0.58 (1 : 5, ether : light petroleum), $[\alpha]_{\text{D}}^{18} +121$ (*c* 0.8, benzene) (Found: M⁺ + H, 512.3751. C₃₂H₅₀O₄N requires *M*, 512.3735); $\nu_{\text{max}}/\text{cm}^{-1}$ 2962, 2921, 2360, 1715, 1622, 1455, 1368, 1290, 1255, 1148, 1049, 996, 969, 850 and 800; δ_{H} (500 MHz, C₆D₆) (2*Z*,4*E*,10*E*,12*E*,14*E*)-isomer **50** as its enol 0.58 and 0.65 (each 3 H, d, *J* 7.0, 2 × 5-CHCH₃), 0.84 (3 H, d, *J* 6.5, 8'-CH₃), 0.93 (3 H, d, *J* 6.5, 6'-CH₃), 0.99 (1 H, ddd, *J* 13.5, 9.5, 5.0, 7'-H), 1.34 (1 H, ddd, *J* 13.5, 10.0, 4.5, 7'-H'), 1.49 (9 H, s, C(CH₃)₃), 1.61 (3 H, d, *J* 7.0, 16'-H₃), 1.68 (5 H, m, 10'-CH₃, 8'-H and 9'-H), 1.75 (3 H, s, 14'-CH₃), 1.85 (1 H, dd, *J* 13.5, 8.0, 9'-H'), 2.01 (2 H, m, 4-H₂), 2.35 (2 H, m, 6'-H and 5-CH), 3.93 (1 H, m, 5-H), 5.31 (1 H, d, *J* 11.5, 2'-H), 5.63 (1 H, q, *J* 7.0, 15'-H), 5.66 (1 H, dd, *J* 15.0, 8.5, 5'-H), 6.04 (1 H, d, *J* 11.0, 11'-H), 6.29 (1 H, t, *J* 11.5, 3'-H), 6.35 (1 H, d, *J* 15.5, 13'-H), 6.53 (1 H, dd, *J* 15.5, 10.0, 12'-H) 7.66 (1 H, dd, *J* 15.0, 11.5, 4'-H) and 12.97 (1 H, s, 1-OH); (2*Z*,4*E*,10*E*,12*Z*,14*E*)-isomer 5.92 (1 H, d, *J* 11.5, 11'-H); (2*Z*,4*E*,10*E*,12*E*,14*Z*)-isomer 3.99 (1 H, m, 5-H), 6.09 (1 H, d, *J* 11.0, 11'-H), 6.63 (1 H, dd, *J* 15.5, 11.5, 12'-H) and 6.75 (1 H, d, *J* 15.5, 13'-H); *m/z* (ES⁻) 510 (M⁺ - 1, 100%).

A chilled solution of lithium hexamethyldisilazide (1.0 M in THF; 30 mg, 0.18 mmol, 0.18 mL) was added to the pyrrolidinone **50** (63 mg, 0.12 mmol) in THF (1.5 mL) at -78 °C and the solution stirred at -78 °C for 30 min. A chilled solution of phenylselenanyl chloride (92 mg, 0.48 mmol) in THF (0.5 mL) was added and the mixture stirring at -78 °C for 4 h. Saturated aqueous ammonium chloride (2 mL) was added and the mixture was allowed to warm to r.t. before the addition of more saturated aqueous ammonium chloride (10 mL). The aqueous layer was extracted with ether (4 × 20 mL) and the organic extracts were dried (Na₂SO₄) and concentrated under reduced pressure. Chromatography of the residue using ether : light petroleum (1 : 20) as eluent gave the 3-phenylselenanylpyrrolidinone **51** as a light yellow liquid (49 mg, 60%).

A chilled solution of aqueous hydrogen peroxide (30%; 0.082 g, 0.73 mmol) in water (0.5 mL) was added to the selenide **51** (46 mg, 0.069 mmol) in CDCl₃ (4 mL) at -50 °C followed by a chilled solution of *m*-chloroperoxybenzoic acid (77%; 0.017 g, 0.076 mmol) in CDCl₃ (2 mL). The mixture was stirred at -50 °C for 40 min then removed from the -50 °C bath and placed in a 0 °C bath for 15 min with vigorous stirring. Chilled chloroform (3 mL) was added and the solution washed with chilled saturated aqueous sodium hydrogen carbonate (2 mL × 2) and water (2 mL). The organic layer was then dried (Na₂SO₄) and diluted with benzene (50 mL). The solution was heated under reflux for 5 h, but after cooling and concentration under reduced pressure, only small amounts (1 - 2 mg) of mixtures of products were isolated after chromatography using ether : light petroleum (5 : 1) as eluent.

(5R)-5-(Prop-2-yl)pyrrolidin-2-one (53). Trifluoroacetic acid (0.122 g, 1.07 mmol, 0.08 mL) was added to the pyrrolidinone **49** (0.122 g, 0.537 mmol) in dichloromethane (4 mL) at r.t. and the solution stirred at r.t. for 1 h. Saturated aqueous sodium hydrogen carbonate (20 mL) was added, the aqueous layer was extracted with dichloromethane (4 × 20 mL) and the organic extracts were dried (Na₂SO₄). After concentration under reduced pressure, chromatography of the residue using ether and methanol as eluent (gradient elution, ether to 1 : 10 methanol : ether) gave the *title compound* **53** as a white solid (0.57 g, 94%), $R_f = 0.46$ (1 : 10, MeOH : ether), m.p. 57.0-60.0 °C, $[\alpha]_D^{18} +12$ (c 0.4, benzene) (Found: $M^+ - C_3H_7$, 84.0441. C₄H₆ON requires M , 84.0444); ν_{max}/cm^{-1} 3198, 3092, 2960, 2934, 2892, 2875, 1682, 1658, 1470, 1451, 1392, 1371, 1346, 1315, 1291, 1269, 1214, 1168, 1140, 1076, 1033, 995, 975, 956, 922, 885, 766, 681 and 626; δ_H (400 MHz, CDCl₃) 0.89 and 0.94 (each 3 H, d, J 7.0, CHCH₃), 1.62 (1 H, m, 5-CH), 1.74 and 2.15 (each 1 H, m, 4-H), 2.25-2.38 (2 H, m, 3-H₂), 3.37 (1 H, q, J 7.0, 5-H) and 7.13 (1 H, br. s, NH); δ_C (100 MHz, CDCl₃) 18.0, 18.7, 24.5, 30.6, 33.4, 60.8 and 179.1; m/z (EI/CI) 127 (M^+ , 1%) and 84 ($M^+ - 43$, 100).

Lithium aluminium hydride (0.092 g, 2.4 mmol) in THF (3 mL) was added to the pyrrolidinone **53** (0.153 g, 1.21 mmol) in THF (5 mL) and the solution heated under reflux for 14 h. The reaction mixture was allowed to cool to r.t. then cooled to 0 °C before water (20 mL) was added slowly. The mixture was filtered through celite and the celite washed with ether (3 × 20 mL). The aqueous layer was extracted with ether (4 × 20 mL) and the organic extracts were dried (Na₂SO₄) and concentrated under reduced pressure at 0 °C to afford the pyrrolidine **54** as a clear liquid (0.095 g, 70%).

(*S*)-(+)-2-Methoxy-2-phenyl-3,3,3-trifluoropropanoyl chloride (45 mg, 0.18 mmol) in dichloromethane (0.5 mL) and pyridine (28 mg, 0.35 mmol, 0.03 mL) were added to the pyrrolidine **54** (10 mg, 0.088 mmol) in dichloromethane (0.5 mL) and the solution stirred at r.t. for 16 h. Water (5 mL) was added, the mixture was extracted with ether (4 × 10 mL), and the organic extracts dried (Na₂SO₄) and concentrated under reduced pressure. Chromatography of the residue using ether : light petroleum (1 : 7) as eluent gave the (*R*)-Mosher's derivative **55** as a white solid (20 mg, 70%), $R_f = 0.47$ (1 : 2, ether : light petroleum), m.p. 76.4-77.8 °C, $[\alpha]_D^{20} +160$ (c 0.5, benzene) (Found: $M^+ + H$, 330.1677. C₁₇H₂₃O₂NF₃ requires M , 330.1676); ν_{max}/cm^{-1} 2970, 2857, 1832, 1644, 1493, 1451, 1422, 1390, 1374, 1265, 1230, 1180, 1148, 1108, 1079, 1057, 1022, 992, 961, 945, 924, 896, 863, 786, 767, 741, 706, 691 and 651; δ_H (500 MHz, CDCl₃) 0.84 and 0.94 (each 3 H, d, J 7.0, 2-CHCH₃), 1.19 (1 H, m, 4-H), 1.56-1.64 (2 H, m, 4-H' and 3-H), 1.71 (1 H, m, 3-H'), 2.54 (1 H, m, 2-CH), 3.05 (1 H, ddd, J 11.5, 9.5, 6.0, 5-H), 3.14 (1 H, ddd, J 11.5, 7.5, 3.5, 5-H'), 3.73 (3 H, q, J 2.0, OCH₃), 4.21 (1 H, m, 2-H), 7.38 (3 H, m, ArH) and 7.54 (2 H, m, ArH); δ_C (125 MHz, CDCl₃) 16.4, 19.6, 23.7, 24.7, 29.0, 47.5, 55.2, 63.9, 124.9, 126.8, 128.2, 128.7, 129.2, 133.7 and 164.8; m/z (ES+) 352 ($M^+ + 23$, 82%) and 330 ($M^+ + 1$, 100).

Following the same procedure, pyrrolidine **54** (12 mg, 0.11 mmol) and (*R*)-(+)-2-methoxy-2-phenyl-3,3,3-trifluoropropanoyl chloride (54 mg, 0.21 mmol), after chromatography using ether : light petroleum (1 : 7) as eluent, gave the (*S*)-Mosher's derivative **56** as a white solid (26 mg, 75%), $R_f = 0.39$ (1 : 2, ether : light petroleum); m.p. 151.2-152.9 °C, $[\alpha]_D^{20} -81$ (c 0.3, benzene) (Found: $M^+ + H$, 330.1669. C₁₇H₂₃O₂NF₃ requires M , 330.1676); ν_{max}/cm^{-1} 2969, 2880, 1651, 1468, 1455, 1422, 1391, 1307, 1267, 1174, 1166, 1156, 1106, 1080, 1057, 1022, 991, 946, 925, 897, 868, 790, 768, 729, 706, 692 and 662; δ_H (500MHz, CDCl₃) 0.68 and 0.90 (each 3 H, d, J 7.0, 2-CHCH₃), 1.58-1.72 (3 H, m, 4-H₂ and 3-H), 1.76 (1 H, m, 3-H'), 2.22 (1 H, m, 5-H), 2.70 (1 H, m, 2-CH), 3.63 (1 H, ddd, J 11.5, 7.0, 4.5, 5-H'), 3.66 (3 H, q, J 2.0, OCH₃), 4.16 (1 H, m, 2-H), 7.38 (3 H, m, ArH) and 7.56 (2 H, m, ArH); δ_C (125 MHz, CDCl₃) 16.1, 19.5, 23.4, 25.2, 28.3, 46.7, 55.4, 63.5, 122.7, 125.0, 127.0, 128.0, 129.0, 134.2 and 164.1; m/z (ES+) 352 ($M^+ + 23$, 94%) and 330 ($M^+ + 1$, 100).

(5R)-1-Benzoyl-5-(prop-2-yl)pyrrolidin-2-one (57). Benzoyl chloride (18.0 g, 128 mmol, 14.9 mL) was added to the pyrrolidinone **53** (8.11 g, 63.9 mmol) in pyridine (160 mL) and the solution stirred at r.t. for 4 h. Ether (400 mL) was added and the solution was concentrated under reduced pressure using benzene to remove most of the pyridine as its azeotrope. Chromatography of the residue using ether : light petroleum (gradient elution, 1 : 10 to 1 : 1) as eluent gave the *title compound* **57** as a white solid (12.39 g, 84%), $R_f = 0.45$ (2 : 1, ether : light petroleum), m.p. 136.0-138.0 °C, $[\alpha]_D^{20} +230$ (c 0.7, benzene) (Found: $M^+ + H$, 232.1330. C₁₄H₁₈O₂N requires M , 232.1333); ν_{max}/cm^{-1} 2933, 2961, 2889, 2873, 1745, 1661, 1600, 1581, 1489, 1465, 1448, 1414, 1388, 1371, 1353, 1320, 1289, 1278, 1234, 1219, 1179, 1166, 1152, 1135, 1097, 1077, 973, 937, 883, 868, 836, 800, 744, 704, 667 and 622; δ_H (400 MHz, C₆D₆) 0.63 and 0.70 (each 3 H, d, J 7.0, 2-CHCH₃), 1.19-1.24 (2 H, m, 4-H₂), 1.86 and 2.07 (each 1 H, m, 3-H), 2.34 (1 H, m, 2-CH), 4.28 (1 H, m, 5-H), 7.19 (3 H, m, ArH) and 7.84 (2 H, d, J 7.5, ArH); δ_C (125 MHz, C₆D₆) 15.8, 18.1, 18.9, 29.3, 32.4, 61.8, 128.9, 130.2, 132.4, 136.2, 171.3 and 175.1; m/z (ES+) 254 ($M^+ + 23$, 35%) and 232 ($M^+ + 1$, 100).

(5R)-1-Benzoyl-3-hexanoyl-5-(prop-2-yl)pyrrolidin-2-one (58). A solution of lithium hexamethyldisilazide (1.0 M in THF; 1.01 g, 6.02 mmol, 6.02 mL) was cooled to -78 °C and added to the pyrrolidinone **57** (1.39 g, 6.02 mmol) in THF (20 mL) at -78 °C. The mixture was stirred at -78 °C for 1 h then a solution of hexanoylimidazolide (0.50 g, 3.01 mmol) in THF (10 mL) that had been cooled to -78 °C was added and the solution stirred at -78 °C for 5 h. Saturated aqueous ammonium chloride (30 mL) was added and the mixture allowed to warm to r.t. More saturated aqueous ammonium chloride (60 mL) was added and the aqueous layer extracted with ether (4 × 200 mL). The organic extracts were dried (Na₂SO₄) and concentrated under reduced pressure. Chromatography of the residue using ether : light petroleum (1 : 10) gave the partly enolised *title compound* **58** as a clear liquid (0.75 g, 76%), a 1 : 1 mixture of epimers at C(3), keto-epimers : enol tautomer = 2 : 1, $R_f = 0.39$ (1 : 2, ether : light petroleum), $[\alpha]_D^{20} +141$ (c 0.6, benzene) (Found: $M^+ + H$, 330.2062. C₂₀H₂₈NO₃ requires M , 330.2064); ν_{max}/cm^{-1} 2960, 2932, 2873, 1737, 1714, 1672, 1631, 1602, 1583, 1466, 1450, 1366, 1278, 1234, 1178, 1127, 1073, 1028, 1002, 971, 914, 884, 829, 803, 731, 694 and 657; δ_H (400 MHz, C₆D₆) keto-tautomers **58** 0.74, 0.79, 0.82 and 0.84 (each 1.5 H, d, J 7.5, 5-CHCH₃), 0.88-0.94 (3 H, m, 6'-H₃), 1.18-1.32 (4 H, m, 4'-H₂ and 5'-H₂), 1.54-1.68 (3 H, m, 3'-H₂ and 4-H), 2.24-2.43 (3 H, m, 5-CH and 2'-H₂), 2.52 (1 H, m, 4-H'), 3.18 (0.5 H, t, J 9.5, 3-H), 3.47 (0.5 H, dd, J 9.5, 7.5, 3-H), 4.51 (1 H, m, 5-H), 7.20 (3 H, m, ArH) and 7.79 (2 H, m, ArH); enol tautomer 2.04 (2 H, m, 2'-H₂), 2.60 (1 H, m, 5-CH), 2.91 (2 H, m, 4-H₂), 4.23 (1 H, m, 5-H) and 12.32 (1 H, br. s, OH); δ_C (100 MHz, C₆D₆) 14.5, 14.5, 14.5, 15.0, 15.9, 18.7, 19.0, 19.6, 20.5, 21.0, 23.1, 23.2, 23.6, 23.6, 26.1, 27.8, 29.3, 29.8, 31.8, 31.9, 32.0, 33.4, 43.2, 43.7, 55.3, 56.2, 60.0, 60.0, 60.7, 100.1, 128.2, 128.5, 128.6, 129.9, 130.0, 131.0, 132.2, 132.5, 133.0, 135.3, 135.7, 136.3, 170.8, 170.9, 171.4, 171.4, 171.9, 172.7, 173.7, 203.6 and 203.9; m/z (ES+) 352 ($M^+ + 23$, 100%) and 330 ($M^+ + 1$, 60).

(5R)-1-Benzoyl-3-hexanoyl-3-phenylselanyl-5-(prop-2-yl)pyrrolidin-2-one (59). A solution of lithium hexamethyldisilazide (1.0 M in THF; 0.387 g, 2.32 mmol, 2.32 mL) was cooled to $-78\text{ }^{\circ}\text{C}$ and added to the pyrrolidinone **58** (0.303 g, 0.773 mmol) in THF (10 mL) at $-78\text{ }^{\circ}\text{C}$. After stirring at $-78\text{ }^{\circ}\text{C}$ for 1 h, PhSeCl (0.445 g, 2.32 mmol) in THF (5 mL) was added and the mixture stirred at $-78\text{ }^{\circ}\text{C}$ for 2 h. Saturated aqueous ammonium chloride (20 mL) was added and the mixture allowed to warm to r.t. After the addition of more saturated aqueous ammonium chloride (30 mL) the aqueous layer was extracted with ether ($4 \times 100\text{ mL}$) and the organic extracts were dried (Na_2SO_4) and concentrated under reduced pressure. Chromatography of the residue using ether : light petroleum (1 : 100) gave the *title compound* **59** as a light yellow oil (0.29 g, 77%), a 1 : 0.4 mixture of epimers at C(3), $R_f = 0.58$ (1 : 2, ether : light petroleum), $[\alpha]_{\text{D}}^{20} +210$ (c 1, benzene) (Found: $\text{M}^+ + \text{H}$, 486.1545. $\text{C}_{26}\text{H}_{32}\text{NO}_3\text{Se}$ requires M , 486.1542); $\nu_{\text{max}}/\text{cm}^{-1}$ 3059, 2959, 2930, 2872, 1724, 1683, 1601, 1582, 1465, 1449, 1439, 1392, 1363, 1312, 1272, 1236, 1213, 1177, 1159, 1132, 1106, 1067, 1022, 1001, 982, 930, 887, 835, 802, 740, 691, 673 and 654; δ_{H} (400 MHz, C_6D_6) major epimer 0.53-0.58 (6 H, m, $2 \times \text{CHCH}_3$), 0.83 (3 H, m, 6'-H_3), 1.23 (4 H, m, 4'-H_2 and 5'-H_2), 1.75 (2 H, m, 3'-H_2), 1.85 (1 H, dd, J 15.0, 7.0, 4-H), 2.43-2.55 (2 H, m, 4-H' and 5-CH), 3.01 (1 H, ddd, J 17.5, 8.0, 6.5, 2'-H), 3.33 (1 H, ddd, J 17.5, 8.5, 7.0, 2'-H'), 4.40 (1 H, m, 5-H), 6.95 (3 H, m, ArH), 7.10 (3 H, m, ArH), 7.47 (2 H, m, ArH) and 7.77 (2 H, m, ArH); minor epimer 0.77 (3 H, m, 6'-H_3), 1.04-1.16 (4 H, m, 4'-H_2 and 5'-H_2), 1.56 (2 H, m, 3'-H_2), 2.00 (1 H, dd, J 13.5, 9.5, 4-H), 2.74 (1 H, m, 2'-H), 2.90 (1 H, dd, J 13.5, 7.5, 4-H'), 3.11 (1 H, m, 2'-H') and 4.30 (1 H, m, 5-H); δ_{C} (100 MHz, C_6D_6) major epimer 14.2, 15.0, 18.2, 22.9, 24.7, 26.9, 27.0, 31.7, 39.0, 58.5, 60.6, 128.2, 129.5, 129.5, 130.1, 130.3, 132.7, 135.0, 137.8, 171.1, 171.4, and 202.1; minor epimer 14.1, 14.7, 18.2, 22.8, 24.8, 27.2, 28.0, 31.4, 38.4, 60.3, 61.8, 126.8, 129.2, 129.3, 130.0, 130.4, 132.9, 134.6, 137.7, 171.1, 171.5 and 200.6; m/z (ES+) 508 ($\text{M}^+ + 23$, 100%) and 486 ($\text{M}^+ + 1$, 90).

(3S,4R,5R,8R,9S)-2-Benzoyl-9-hexanoyl-5,8-diphenyl-3-(prop-2-yl)-2,3,4,5,8,9-hexahydro-1H-isoindol-1-one (61). Chilled solutions of aqueous hydrogen peroxide (30%; 0.84 g, 7.42 mmol) in water (2 mL) and *m*-chloroperoxybenzoic acid (77%; 0.32 g, 1.41 mmol) in CHCl_3 (8 mL) were added to the selenide **59** (0.34 g, 0.707 mmol) in CHCl_3 (16 mL) at $-48\text{ }^{\circ}\text{C}$ and the mixture stirred at $-48\text{ }^{\circ}\text{C}$ for 45 min. The reaction mixture was then removed from the cooling bath and allowed to warm to $0\text{ }^{\circ}\text{C}$ over a period of 10 min. Chilled chloroform (30 mL) was added and the mixture washed with chilled saturated aqueous sodium carbonate ($2 \times 25\text{ mL}$) and ice-water (25 mL). The organic layer was dried (Na_2SO_4) and concentrated under reduced pressure to afford the pyrrolinone **60** as an orange gum (0.22 g, 95%).

(1*E*,3*E*)-1,4-Diphenylbuta-1,3-diene (1.39 g, 6.73 mmol) was added to the pyrrolinone **60** (0.22 g, 0.673 mmol) in toluene (5 mL) and the solution purged with nitrogen for 15 min. The mixture was heated under reflux for 96 h and then concentrated under reduced pressure. Chromatography of the residue using ether : light petroleum (gradient elution 1 : 100 to 1 : 10) as eluent gave the *title compound* **61** as a viscous white liquid (0.153 g, 43%), $R_f = 0.46$ (1 : 5, ether : light petroleum), $[\alpha]_{\text{D}}^{18} -16$ (c 0.2, benzene) (Found: $\text{M}^+ + \text{Na}$, 556.2832. $\text{C}_{36}\text{H}_{39}\text{NO}_3\text{Na}$ requires M , 556.2823); $\nu_{\text{max}}/\text{cm}^{-1}$ 3062, 3030, 2961, 2931, 2872, 1732, 1710, 1689, 1683, 1602, 1584, 1494, 1454, 1392, 1372, 1347, 1305, 1272, 1205, 1179, 1127, 1097, 1078, 1030, 1004, 924, 873, 825, 806, 747, 696 and 659; δ_{H} (400 MHz, C_6D_6) 0.45 and 0.66 (each 3 H, d, J 6.5, 3- CHCH_3), 0.77 (3 H, t, J 7.5, 6'-H_3), 0.87-1.02 (3 H, m, 3'-H and 5'-H_2), 1.06-1.15 (2 H, m, 4'-H_2), 1.29 (1 H, m, $3\text{'-H}'$), 1.60 (1 H, m, 3-CH), 2.25-2.39 (2 H, m, 2'-H_2), 2.80 (1 H, dq, J 10.5, 2.5, 5-H), 3.13 (1 H, d, J 10.5, 4-H), 4.13 (1 H, q, J 3.0, 8-H), 4.50 (1 H, d, J 10.5, 3-H), 5.78 (1 H, dt, J 10.0, 3.0, 7-H), 5.85 (1 H, dt, J 10.0, 2.5, 6-H), 7.00 (1 H, m, ArH), 7.06-7.11 (3 H, m, ArH), 7.15-7.20 (5 H, m, ArH), 7.31 (2 H, m, ArH), 7.41 (2 H, m, ArH) and 8.01 (2 H, m, ArH); δ_{C} (100 MHz, C_6D_6) 14.5, 19.4, 20.6, 23.1, 23.5, 31.7, 33.3, 42.8, 44.8, 45.0, 46.0, 65.2, 69.6, 127.7, 127.7, 128.8, 128.8, 129.4, 129.7, 130.3, 131.3, 131.8, 133.0, 133.1, 135.8, 141.1, 144.1, 172.0, 176.0 and 206.3; m/z (ES+) 1089 (47%) and 556 ($\text{M}^+ + 23$, 100).

(3S,4R,5R,8R,9S)-9-Hexanoyl-5,8-diphenyl-3-(prop-2-yl)-2,3,4,5,8,9-hexahydro-1H-isoindol-1-one (62). Sodium hydroxide (26 mg, 0.64 mmol) in methanol (1 mL) and water (0.04 mL) was added to isoindolone **61** (17 mg, 0.032 mmol) in methanol (1 mL) and the solution stirred at r.t. for 6 h. Water (4 mL) was added and the mixture extracted with ether ($3 \times 10\text{ mL}$). The organic extracts were washed with brine (4 mL), dried (Na_2SO_4) and concentrated under reduced pressure. Chromatography of the residue using ether : light petroleum (gradient elution 1 : 5 to neat ether) gave the *title compound* **62** as a clear liquid (8 mg, 60%), $R_f = 0.23$ (1 : 1, ether : light petroleum), $[\alpha]_{\text{D}}^{18} -12$ (c 0.3, benzene) (Found: $\text{M}^+ + \text{H}$, 430.2747. $\text{C}_{29}\text{H}_{36}\text{NO}_2$ requires M , 430.2741); $\nu_{\text{max}}/\text{cm}^{-1}$ 3199, 3029, 2958, 2929, 2871, 1691, 1602, 1493, 1454, 1388, 1266, 1132, 1077, 1030, 812, 754, 739, 698 and 634; δ_{H} (400 MHz, C_6D_6) 0.36 and 0.57 (each 3 H, d, J 6.5, 3- CHCH_3), 0.73 (3 H, t, J 7.5, 6'-H_3), 0.84-1.00 (3 H, m, 3'-H and 5'-H_2), 1.00-1.09 (2 H, m, 4'-H_2), 1.24 (1 H, m, 3-CH), 1.40 (1 H, m, $3\text{'-H}'$), 2.32-2.46 (2 H, m, 2'-H_2), 2.70 (1 H, br. d, J 9.5, 4-H), 2.86 (1 H, d, J 10.0, 5-H), 3.23 (1 H, d, J 10.0, 3-H), 4.28 (1 H, br. s, 8-H), 5.87-5.93 (2 H, m, 6-H and 7-H), 7.00-7.15 (8 H, m, ArH), 7.25 (1 H, d, J 5.0, NH) and 7.55 (2 H, m, ArH); δ_{C} (100 MHz, C_6D_6) 14.4, 19.3, 19.8, 23.1, 23.7, 31.7, 32.7, 42.3, 44.8, 46.1, 47.8, 65.1, 65.9, 127.5, 127.5, 129.0, 129.2, 129.5, 132.0, 132.2, 132.8, 141.8, 144.9, 177.5 and 207.7; m/z (ES+) 877 (100%), 876 (70), 447 ($\text{M}^+ + 18$, 100) and 430 ($\text{M}^+ + 1$, 82).

(4R,6S,8E)-10-tert-Butyldimethylsilyloxy-4,6,8-trimethyldeca-1,8-dien-3-ol (63). Vinyl magnesium bromide (1.0 M in THF; 5.19 g, 39.6 mmol, 39.6 mL) was added to the aldehyde **30** (7.40 g, 24.8 mmol) in THF (120 mL) at $-78\text{ }^{\circ}\text{C}$ and the mixture was allowed to warm to room temperature and was stirred for 50 min. Saturated aqueous ammonium chloride (300 mL) was added and the mixture stirred at r.t. for 5 min. The aqueous layer was extracted with ether ($4 \times 400\text{ mL}$) and the organic extracts were dried (Na_2SO_4) and concentrated under reduced pressure. Chromatography of the residue using ether : light petroleum (1 : 10) as eluent gave the *title compound* **63** as a clear liquid (5.99 g, 74%), a 2 : 1 mixture of epimers at C(3), $R_f = 0.28/0.25$ (1 : 5, ether : light petroleum), $[\alpha]_{\text{D}}^{22} +16$, (c 0.3, benzene) (Found: $\text{M}^+ + \text{Na}$, 349.2527. $\text{C}_{19}\text{H}_{38}\text{O}_2\text{NaSi}$ requires M , 349.2534); $\nu_{\text{max}}/\text{cm}^{-1}$ 3396(br), 2954, 2927, 2856, 2361, 1667, 1641, 1461, 1379, 1361, 1252, 1199, 1088, 1054, 1004, 920, 833, 813, 773 and 665; δ_{H} (400 MHz, C_6D_6) major epimer 0.12 (6 H, s, $2 \times \text{SiCH}_3$), 0.84 (3 H, d, J 6.5, 6- CH_3), 0.88 (3 H, d, J 7.0, 4- CH_3), 0.94 (1 H, m, 5-H), 1.01 [9 H, s, $\text{SiC}(\text{CH}_3)_3$], 1.09 (1 H, br. s, OH), 1.46 (1 H, m, 5-H'), 1.52 (3 H, s, 8- CH_3), 1.62-1.71 (3 H, m, 4-H, 6-H and 7-H), 2.02 (1 H, m, 7-H'), 3.83 (1 H, m, 3-H), 4.23 (2 H, d, J 6.5, 10- H_2), 5.03 (1 H, dt, J 10.5, 1.5, 1-H), 5.16 (1 H, dt, J 17.0, 1.5, 1-H'), 5.50 (1 H, m, 9-H) and 5.73 (1 H, ddd, J 17.0, 10.5, 5.5, 2-H); minor epimer 0.85 (3 H, m, 6- CH_3), 0.88 (3 H, d, J

7.0, 4-CH₃), 1.06 (1 H, br. s, OH), 1.40 (1 H, m, 5-H'), 1.50 (3 H, s, 8-CH₃), 3.77 (1 H, t, *J* 5.0, 3-H), 5.13 (1 H, dt, *J* 17.0, 1.5, 1-H'), 5.50 (1 H, m, 9-H), and 5.74 (1 H, ddd, *J* 17.0, 10.5, 6.0, 2-H); δ_{C} (100 MHz, C₆D₆) major epimer -4.5, 15.3, 16.6, 18.9, 21.0, 26.6, 28.7, 36.5, 41.1, 47.9, 60.7, 76.1, 114.8, 127.0, 136.3 and 141.2; minor epimer -4.5, 16.1, 16.6, 18.9, 21.1, 26.5, 28.8, 36.7, 40.9, 47.7, 60.7, 77.2, 115.6, 127.1, 136.1 and 140.0; *m/z* (ES+) 349 (M⁺ + 23, 100%).

Ethyl (6R,8S,4E,10E)-12-tert-Butyldimethylsilyloxy-6,8,10-trimethyldodeca-4,10-dienoate (64). Propionic acid (0.05 mL) was added to the alcohol **63** (4.64 g, 14.2 mmol) and triethyl orthoacetate (6.90 g, 42.6 mmol, 7.80 mL) in xylene (46 mL) and the solution heated under reflux for 6 h. After concentration under reduced pressure using benzene to azeotrope the xylene and triethylorthoacetate, chromatography of the residue using ether : light petroleum (1 : 40) as the eluent gave the *title compound 64* as a clear liquid (5.11 g, 91%); $R_f = 0.28$ (1 : 10, ether : light petroleum), $[\alpha]_{\text{D}}^{20} -2.7$ (*c* 0.6, benzene) (Found: M⁺ + Na, 419.2957. C₂₃H₄₄O₃NaSi requires *M*, 419.2952); $\nu_{\text{max}}/\text{cm}^{-1}$ 2954, 2928, 2857, 2360, 1737, 1666, 1462, 1374, 1252, 1163, 1086, 1054, 1006, 971, 939, 834, 813, 774 and 665; δ_{H} (400 MHz, C₆D₆) 0.09 (6 H, s, 2 × SiCH₃), 0.81 (3 H, d, *J* 6.5, 8-CH₃), 0.91 (1 H, m, 7-H), 0.92 (3 H, d, *J* 6.5, 6-CH₃), 0.98 (3 H, t, *J* 7.0, CH₂CH₃), 0.99 [9 H, s, SiC(CH₃)₃], 1.23 (1 H, ddd, *J* 13.5, 10.0, 4.5, 7-H'), 1.51 (3 H, s, 10-CH₃), 1.63 (1 H, m, 8-H), 1.76 (1 H, dd, *J* 13.0, 8.0, 9-H), 1.91 (1 H, dd, *J* 13.0, 7.0, 9-H'), 2.12 (1 H, m, 6-H), 2.16-2.20 and 2.23-2.29 (each 2 H, m, 2-H₂ or 3-H₂), 3.95 (2 H, q, *J* 7.0, CH₂CH₃), 4.21 (2 H, d, *J* 6.5, 12-H₂), 5.19 (1 H, ddt, *J* 15.5, 8.0, 1.0, 5-H), 5.32 (1 H, dt, *J* 15.5, 6.5, 4-H) and 5.46 (1 H, tq, *J* 6.5, 1.0, 11-H); δ_{C} (100 MHz, C₆D₆) -4.5, 14.7, 16.5, 18.9, 19.9, 22.5, 26.6, 28.6, 28.7, 34.9, 35.2, 44.9, 48.8, 60.3, 60.7, 127.2, 127.6, 136.0, 137.9 and 172.6; *m/z* (ES+) 420 (10%) and 265 (100).

Ethyl (6R,8S,4E,10E)-12-Hydroxy-6,8,10-trimethyldodeca-4,10-dienoate (65). Pyridinium toluene 4-sulfonate (0.32 g, 1.29 mmol) was added to the silyl ether **64** (5.11 g, 12.9 mmol) in dichloromethane (50 mL) and ethanol (50 mL) at r.t. and the mixture stirred at r.t. for 24 h. Saturated sodium hydrogen carbonate (250 mL) was added and the mixture extracted with ether (4 × 500 mL). The organic extracts were dried (Na₂SO₄) and concentrated under reduced pressure. Chromatography of the residue using ether : light petroleum (1 : 3) as eluent gave the *title compound 65* as a clear liquid (3.45 g, 95%), $R_f = 0.32$ (1 : 1, ether : light petroleum), $[\alpha]_{\text{D}}^{20} -8.0$ (*c* 0.5, benzene) (Found: M⁺ + Na, 305.2075. C₁₇H₃₀O₃Na requires *M*, 305.2088); $\nu_{\text{max}}/\text{cm}^{-1}$ 3358(br), 2956, 2913, 2868, 2359, 1735, 1668, 1445, 1373, 1345, 1296, 1255, 1163, 1096, 1067, 1008, 971, 856 and 777; δ_{H} (400 MHz, C₆D₆) 0.82 (3 H, d, *J* 6.5, 8-CH₃), 0.94 (1 H, m, 7-H), 0.94 (3 H, d, *J* 6.5, 6-CH₃), 0.97 (3 H, t, *J* 7.0, CH₂CH₃), 1.08 (1 H, br. s, OH), 1.24 (1 H, ddd, *J* 13.5, 10.0, 4.5, 7-H'), 1.49 (3 H, s, 10-CH₃), 1.64 (1 H, m, 8-H), 1.76 (1 H, dd, *J* 13.5, 8.0, 9-H), 1.92 (1 H, dd, *J* 13.5, 6.5, 9-H'), 2.14 (1 H, m, 6-H), 2.18-2.21 and 2.25-2.30 (each 2 H, m, 2-H₂ or 3-H₂), 3.96 (2 H, q, *J* 7.0, CH₂CH₃), 4.04 (2 H, d, *J* 6.5, 12-H₂), 5.21 (1 H, ddt, *J* 15.5, 8.0, 1.0, 5-H), 5.34 (1 H, dt, *J* 15.5, 6.5, 4-H) and 5.42 (1 H, dq, *J* 6.5, 1.0, 11-H); δ_{C} (100 MHz, C₆D₆) 14.7, 16.5, 19.9, 22.4, 28.6, 28.8, 34.9, 35.2, 44.9, 48.8, 59.7, 60.5, 126.9, 127.5, 137.2, 137.9 and 172.9; *m/z* (ES+) 305 (M⁺ + 23, 100%).

Ethyl (6R,8S,4E,10E)-6,8,10-trimethyl-12-oxododeca-4,10-dienoate (66). Activated manganese dioxide (4.25 g, 48.8 mmol) was added to the alcohol **65** (0.46 g, 1.63 mmol) in dichloromethane (50 mL) and the mixture stirred at r.t. for 1 h. The reaction mixture was then filtered through celite and the celite washed with ether (4 × 40 mL) and concentrated under reduced pressure. Chromatography of the residue using ether : light petroleum (1 : 5) as eluent gave the *title compound 66* as a light yellow liquid (0.39 g, 85%), $R_f = 0.56$ (1 : 1, ether : light petroleum), $[\alpha]_{\text{D}}^{22} +3.0$ (*c* 0.4, benzene) (Found: M⁺ + Na, 303.1937. C₁₇H₂₈O₃Na requires *M*, 303.1931); $\nu_{\text{max}}/\text{cm}^{-1}$ 2956, 2925, 2868, 1732, 1671, 1629, 1445, 1374, 1345, 1296, 1248, 1195, 1162, 1124, 1094, 1038, 972, 889, 859 and 808; δ_{H} (400 MHz, C₆D₆) 0.64 (3 H, d, *J* 6.5, 8-CH₃), 0.80 (1 H, ddd, *J* 13.5, 9.0, 4.5, 7-H), 0.87 (3 H, d, *J* 6.5, 6-CH₃), 0.98 (3 H, t, *J* 7.0, CH₂CH₃), 1.01 (1 H, ddd, *J* 13.5, 10.0, 4.0, 7-H'), 1.50-1.60 (2 H, m, 8-H and 9-H), 1.59 (3 H, d, *J* 1.0, 10-CH₃), 1.74 (1 H, m, 9-H'), 2.01 (1 H, m, 6-H), 2.16-2.30 and 2.23-2.28 (each 2 H, m, 2-H₂ or 3-H₂), 3.96 (2 H, q, *J* 7.0, CH₂CH₃), 5.11 (1 H, ddt, *J* 15.5, 8.5, 1.0, 5-H), 5.29 (1 H, dt, *J* 15.5, 6.0, 4-H), 5.83 (1 H, dq, *J* 8.0, 1.0, 11-H) and 9.90 (1 H, d, *J* 8.0, 12-H); δ_{C} (100 MHz, C₆D₆) 14.7, 17.1, 19.5, 22.3, 28.5, 28.8, 34.8, 35.0, 44.6, 49.2, 60.4, 127.9, 129.5, 137.4, 161.2, 172.7 and 190.1; *m/z* (ES+) 303 (M⁺ + 23, 100%).

Ethyl (6R,8S,4E,10E,12E,14E)-6,8,10,14-tetramethylhexadeca-4,10,12,14-tetraenoate (67). Lithium hexamethyldisilazide (1.0 M in THF; 0.408 g, 2.44 mmol, 2.44 mL) was added to a solution of the aldehyde **66** (0.456 g, 1.63 mmol) and sulphone **23** (0.653 g, 2.44 mmol) in THF (50 mL) at -78 °C and the mixture stirred at -78 °C for 1 h and at r.t. for 1 h. Saturated aqueous sodium hydrogen carbonate (50 mL) and ether (100 mL) were added and the aqueous layer was extracted with ether (4 × 100 mL). The organic extracts were washed with brine (100 mL), dried (Na₂SO₄) and concentrated under reduced pressure. Chromatography of the residue using ether : light petroleum (1 : 40) as eluent gave the *title compound 67* as a clear liquid (0.401 g, 74%), a mixture of geometrical isomers, (4E,10E,12E,14E) : (4E,10E,12Z,14E) : (4E,10E,12E,14Z) = 91 : 4 : 5, $R_f = 0.43$ (1 : 10 ether : light petroleum), $[\alpha]_{\text{D}}^{18} +29$ (*c* 0.4, benzene) (Found: M⁺ + Na, 355.2613. C₂₂H₃₆O₂Na requires *M*, 355.2608); $\nu_{\text{max}}/\text{cm}^{-1}$ 2954, 2913, 2868, 1736, 1642, 1444, 1373, 1344, 1296, 1246, 1161, 1096, 1034, 958, 855, 795 and 619; δ_{H} (400 MHz, C₆D₆) (4E,10E,12E,14E)-isomer **67** 0.86 (3 H, d, *J* 6.5, 8-CH₃), 0.93 (3 H, d, *J* 7.0, 6-CH₃), 0.96 (1 H, m, 7-H), 0.97 (3 H, t, *J* 7.0, CH₂CH₃), 1.27 (1 H, ddd, *J* 13.5, 10.0, 4.5, 7-H'), 1.60 (3 H, d, *J* 7.0, 16-H₃), 1.68-1.76 (7 H, m, 14-CH₃, 10-CH₃ and 8-H), 1.89 (1 H, dd, *J* 13.5, 8.0, 9-H), 2.04 (1 H, dd, *J* 13.5, 7.0, 9-H'), 2.14 (1 H, m, 6-H), 2.18-2.21 and 2.25-2.30 (each 2 H, m, 2-H₂ or 3-H₂), 3.96 (2 H, q, *J* 7.0, CH₂CH₃), 5.19 (1 H, dd, *J* 15.5, 8.0, 5-H), 5.34 (1 H, dt, *J* 15.5, 6.0, 4-H), 5.53 (1 H, q, *J* 7.0, 15-H), 6.05 (1 H, d, *J* 11.0, 11-H), 6.34 (1 H, d, *J* 15.5, 13-H) and 6.53 (1 H, dd, *J* 15.5, 11.0, 12-H); (4E,10E,12Z,14E)-isomer 5.67 (1 H, q, *J* 7.0, 15-H), 5.91 (1 H, d, *J* 11.5, 11-H) and 6.24 (1 H, t, *J* 11.5, 12-H); (4E,10E,12E,14Z)-isomer 6.10 (1 H, d, *J* 11.0, 11-H), 6.62 (1 H, dd, *J* 15.5, 11.0, 12-H) and 6.75 (1 H, d, *J* 15.5, 13-H); δ_{C} (100 MHz, C₆D₆) (4E,10E,12E,14E)-isomer **67** 12.6, 14.4, 14.7, 17.1, 20.0, 22.5, 28.6, 29.2, 34.9, 35.2, 45.0, 49.4, 60.4, 123.2, 126.6, 127.6, 128.3, 135.8, 136.6, 136.8, 137.9 and 172.7; *m/z* (ES+) 355 (M⁺ + 23, 100%).

(6R,8S,4E,10E,12E,14E)-6,8,10,14-Tetramethylhexadeca-4,10,12,14-tetraenoic acid (68). Sodium hydroxide (0.18 g, 4.51 mmol) in water (5 mL) was added to the ester **67** (0.365 g, 1.10 mmol) in ethanol (10 mL) at r.t. and the solution stirred at r.t. for 18 h. The reaction

mixture was then acidified to pH 5 by adding it to a solution of tartaric acid (1.65 g, 11.0 mmol) in water (60 mL) at 0 °C, with vigorous stirring for 2 min. The mixture was extracted with ether (4 × 100 mL) and the organic extracts were washed with chilled water (100 mL) and brine (100 mL), dried (Na₂SO₄) and concentrated under reduced pressure to afford the *title compound 68* as a light yellow liquid (0.33 g, 99%), a mixture of geometrical isomers, (4*E*,10*E*,12*E*,14*E*) : (4*E*,10*E*,12*Z*,14*E*) : (4*E*,10*E*,12*E*,14*Z*) = 89 : 4 : 7, $R_f = 0.37$ (1 : 2 ether : light petroleum), $[\alpha]_D^{18} +21$ (c 0.6, benzene) (Found: $M^+ - H$, 303.2319. C₂₀H₃₁O₂ requires M , 303.2329); $\nu_{\max}/\text{cm}^{-1}$ 3036, 2953, 2912, 2868, 2831, 1706, 1642, 1439, 1410, 1376, 1295, 1267, 1209, 1023, 958, 789 and 676; δ_H (400 MHz, C₆D₆) (4*E*,10*E*,12*E*,14*E*)-isomer **68** 0.87 (3 H, d, J 6.5, 8-CH₃), 0.93 (3 H, d, J 6.5, 6-CH₃), 0.96 (1 H, ddd, J 13.5, 9.5, 5.0, 7-H), 1.27 (1 H, ddd, J 13.5, 10.0, 4.5, 7-H'), 1.60 (3 H, d, J 7.0, 16-H₃), 1.70 (1 H, m, 8-H), 1.74 (6 H, m, 14-CH₃ and 10-CH₃), 1.91 (1 H, dd, J 13.5, 8.0, 9-H), 2.05 (1 H, dd, J 13.5, 7.0, 9-H'), 2.12-2.20 (5 H, m, 6-H, 3-H₂ and 2-H₂), 5.16 (1 H, dd, J 15.5, 8.0, 5-H), 5.26 (1 H, dt, J 15.5, 6.0, 4-H), 5.54 (1 H, q, J 7.0, 15-H), 6.06 (1 H, d, J 11.0, 11-H), 6.36 (1 H, d, J 15.0, 13-H), (1 H, dd, J 15.0, 11.0, 12-H) and 12.1 (1 H, br. s, OH); (4*E*,10*E*,12*Z*,14*E*)-isomer 5.68 (1 H, q, J 7.0, 15-H), 5.92 (1 H, d, J 11.5, 11-H) and 6.26 (1 H, t, J 11.5, 12-H); (4*E*,10*E*,12*E*,14*Z*)-isomer 5.36 (1 H, q, J 7.5, 15-H), 6.11 (1 H, d, J 11.0, 11-H), 6.64 (1 H, dd, J 15.5, 11.0, 12-H) and 6.76 (1 H, d, J 15.5, 13-H); δ_C (100 MHz, C₆D₆) (4*E*,10*E*,12*E*,14*E*)-isomer **68** 12.6, 14.4, 17.1, 20.0, 22.4, 28.2, 29.2, 34.7, 35.2, 44.9, 49.4, 123.2, 126.7, 127.0, 128.2, 135.8, 136.6, 136.8, 138.2 and 180.6; m/z (ES⁻) 341 (40%) and 339 ($M^+ + 35$, 100).

(6*R*,8*S*,4*E*,10*E*,12*E*,14*E*)-6,8,10,14-Tetramethylhexadeca-4,10,12,14-tetraenoyl (1*H*)-imidazolide (69). 1,1'-Carbonyldi-imidazole (0.536 g, 3.31 mmol) was added to the acid **68** (0.50 g, 1.66 mmol) in THF (20 mL) and the solution stirred at r.t. for 18 h. Chilled ether (150 mL) was added and the solution was washed with chilled water (2 × 50 mL) and brine (50 mL), then dried (Na₂SO₄) and concentrated under reduced pressure to afford the *title compound 69* as a light yellow liquid (0.366 g, 95%), a mixture of geometrical isomers, (4*E*,10*E*,12*E*,14*E*) : (4*E*,10*E*,12*Z*,14*E*) : (4*E*,10*E*,12*E*,14*Z*) = 88 : 4 : 8, $R_f = 0.18$ (3 : 1, ether : light petroleum), $[\alpha]_D^{18} +23$ (c 0.6, benzene) (Found: $M^+ + H$, 355.2757. C₂₃H₃₅N₂O requires M , 355.2744); $\nu_{\max}/\text{cm}^{-1}$ 3125, 3038, 2953, 2913, 2866, 1737, 1640, 1526, 1473, 1380, 1296, 1270, 1221, 1110, 1085, 1062, 1022, 958, 895, 797, 751, 663, 648 and 618; δ_H (400 MHz, C₆D₆) (4*E*,10*E*,12*E*,14*E*)-isomer **69** 0.87 (3 H, d, J 6.5, 8-CH₃), 0.94 (3 H, d, J 6.5, 6-CH₃), 0.98 (1 H, ddd, J 13.5, 9.5, 5.0, 7-H), 1.28 (1 H, ddd, J 13.5, 10.0, 4.5, 7-H'), 1.60 (3 H, d, J 7.0, 16-H₃), 1.67 (1 H, m, 8-H), 1.74 (6 H, m, 14-CH₃ and 10-CH₃), 1.88-1.96 (3 H, m, 9-H and 3-H₂), 2.05 (1 H, dd, J 13.5, 7.0, 9-H'), 2.09-2.18 (3 H, m, 6-H and 2-CH₂), 5.15 (1 H, dd, J 15.5, 7.0, 5-H), 5.20 (1 H, dt, J 15.5, 6.0, 4-H), 5.54 (1 H, q, J 7.0, 15-H), 6.07 (1 H, d, J 11.0, 11-H), 6.36 (1 H, d, J 15.5, 13-H), 6.54 (1 H, dd, J 15.5, 11.0, 12-H), 6.97 (1 H, m, 3'-H), 7.08 (1 H, s, 5'-H) and 7.72 (1 H, s, 6'-H); (4*E*,10*E*,12*Z*,14*E*)-isomer 5.68 (1 H, q, J 7.0, 15-H), 5.92 (1 H, d, J 11.5, 11-H) and 6.25 (1 H, t, J 11.5, 12-H); (4*E*,10*E*,12*E*,14*Z*)-isomer 5.36 (1 H, q, J 7.5, 15-H), 6.12 (1 H, d, J 11.0, 11-H), 6.64 (1 H, dd, J 15.5, 11.0, 12-H) and 6.76 (1 H, d, J 15.5, 13-H); δ_C (100 MHz, C₆D₆) (4*E*,10*E*,12*E*,14*E*)-isomer **69** 12.6, 14.4, 17.2, 20.1, 22.3, 27.5, 29.3, 35.1, 35.2, 44.9, 49.4, 116.2, 123.2, 126.4, 126.8, 128.3, 128.5, 131.6, 135.8, 136.6, 136.7, 138.7 and 168.9; m/z (ES⁺) 355 ($M^+ + 1$, 100%).

(5*R*)-1-Benzoyl-5-(prop-2-yl)-3-[(6*R*,8*S*,4*E*,10*E*,12*E*,14*E*)-6,8,10,14-tetramethylhexadeca-4,10,12,14-tetraenoyl]pyrrolidin-2-one (70). Lithium hexamethyldisilazide (1.0 M in THF; 0.50 g, 2.99 mmol, 2.99 mL) cooled to -78 °C was added to the pyrrolidinone **57** (0.69 g, 2.99 mmol) in THF (20 mL) at -78 °C and the solution was stirred -78 °C for 1 h. A solution of the imidazolide **69** (0.53 g, 1.50 mmol) in THF (5 mL) at -78 °C was added and the solution stirred at -78 °C for 6 h. Saturated aqueous ammonium chloride (20 mL) was added and the mixture allowed to warm to r.t. More saturated aqueous ammonium chloride (40 mL) was added and the aqueous layer was extracted with ether (4 × 120 mL). The organic extracts were dried (Na₂SO₄) and concentrated under reduced pressure. Chromatography of the residue using ether : light petroleum (1 : 7) as eluent gave the *title compounds 70* as a light orange liquid (0.609 g, 79%), a partly enolised mixture of isomers, (4*E*,10*E*,12*E*,14*E*) : (4*E*,10*E*,12*Z*,14*E*) : (4*E*,10*E*,12*E*,14*Z*) = 84 : 4 : 12, as 1 : 1 mixtures of epimers at C(3), keto-tautomers : enol tautomer = 2 : 1, $R_f = 0.46$ (1 : 2, ether : light petroleum), $[\alpha]_D^{18} +130$ (c 0.6, benzene) (Found: $M^+ + H$, 518.3629. C₃₄H₄₈NO₃ requires M , 518.3629); $\nu_{\max}/\text{cm}^{-1}$ 2959, 2915, 2871, 2360, 1737, 1716, 1673, 1633, 1602, 1449, 1378, 1279, 1236, 1177, 1134, 1117, 1077, 1028, 960, 888, 799, 738, 710, 693, 657 and 635; δ_H (400 MHz, C₆D₆) (4*E*,10*E*,12*E*,14*E*)-isomers **70** 0.68-0.74 (6 H, overlap. d, J 7.0, 2 × 5-CHCH₃), 0.85 and 0.94 (each 3 H, overlap. d, J 7.0, 6'-CH₃ or 8'-CH₃), 0.98 and 1.27 (each 1 H, m, 7'-H), 1.39 (1 H, m, 8'-H), 1.60 (3 H, d, J 7.0, 16'-H₃), 1.65-1.76 (7 H, m, 14'-CH₃, 10'-CH₃ and 6'-H), 1.89 (1 H, m, 4-H), 1.99-2.12 (2 H, m, 9'-H and 4-H'), 2.16 (1 H, m, 2'-H), 2.21-2.32 (3 H, m, 9'-H' and 3'-H₂), 2.36 (1 H, m, 5-CH), 2.48 (1 H, m, 2'-H'), 2.89 and 3.24 (each 0.5 H, dd, J 10.5, 9.0, 3-H), 4.42 (1 H, m, 5-H), 5.21 (1 H, m, 5'-H), 5.32 (1 H, m, 4'-H), 5.52 (1 H, q, J 7.0, 15'-H), 6.04 (1 H, d, J 10.5, 11'-H), 6.33 (1 H, d, J 15.0, 13'-H), 6.51 and 6.52 (each 0.5 H, dd, J 15.0, 10.5, 12'-H), 7.00-7.20 (3 H, m, ArH) and 7.76 (2 H, m, ArH); enol-tautomer 0.60 (3 H, d, J 7.0, CHCH₃), 2.94 (1 H, m), 4.10 (1 H, m, 5-H) and 12.29 (1 H, s, OH); (4*E*,10*E*,12*Z*,14*E*)-isomer 5.65 (1 H, q, J 7.0, 15'-H), 5.90 (1 H, d, J 12.0, 11'-H) and 6.22 and 6.23 (each 0.5 H, t, J 11.5, 12'-H); (4*E*,10*E*,12*E*,14*Z*)-isomer 6.09 (1 H, d, J 11.0, 11'-H), 6.59 and 6.63 (each 0.5 H, dd, J 15.5, 11.0, 12'-H) and 6.72 (1 H, d, J 15.5, 13'-H); δ_C (100 MHz, C₆D₆) (4*E*,10*E*,12*E*,14*E*)-isomers **70** and enol-tautomer 12.6, 12.6, 14.4, 15.0, 15.1, 15.9, 17.1, 17.1, 18.7, 18.7, 19.0, 19.4, 19.4, 20.0, 20.1, 20.2, 20.3, 21.1, 21.1, 22.4, 27.0, 27.8, 29.1, 29.2, 29.3, 29.4, 29.8, 33.8, 35.2, 35.2, 35.3, 43.2, 43.7, 44.9, 45.0, 49.4, 49.4, 55.3, 56.3, 60.0, 60.0, 60.5, 100.3, 123.2, 123.2, 123.3, 126.6, 126.6, 126.7, 127.4, 127.6, 127.6, 128.2, 128.6, 129.9, 130.1, 130.6, 132.2, 132.4, 133.0, 135.3, 135.7, 135.8, 135.8, 135.8, 136.3, 136.5, 136.5, 136.7, 136.9, 137.0, 137.8, 138.2, 170.8, 170.8, 171.1, 171.4, 171.6, 171.7, 173.6, 202.7 and 203.1; m/z (ES⁺) 518 ($M^+ + 1$, 100%).

(5*R*)-1-Benzoyl-5-(prop-2-yl)-3-(phenylselanyl)-3-[(6*R*,8*S*, 4*E*,10*E*,12*E*,14*E*)-6,8,10,14-tetramethylhexadeca-4,10,12,14-tetraenoyl]pyrrolidin-2-one (71). A cooled solution of lithium hexamethyldisilazide (1.0 M in THF; 0.203 g, 1.22 mL, 1.22 mmol) was added to the pyrrolidinone **70** (0.573 g, 1.11 mmol) in THF (18 mL) at -78 °C and the solution stirred at -78 °C for 30 min. Cooled phenylselanyl chloride (0.234 g, 1.22 mmol) in THF (6 mL) was added and the solution stirred at -78 °C for 2.5 h. Saturated aqueous sodium hydrogen carbonate (50 mL) was added and the mixture allowed to warm to r.t. before the addition of more saturated sodium hydrogen carbonate (50 mL). The aqueous layer was extracted with ether (4 × 200 mL) and the organic extracts dried (Na₂SO₄) and concentrated under reduced pressure. Chromatography of the residue using ether : light petroleum (1 : 10) gave the *title compound 71* as a

clear liquid (0.687 g, 92%), a mixture of geometrical isomers and epimers at C(3), (4*E*,10*E*,12*E*,14*E*) : (4*E*,10*E*,12*Z*,14*E*) : (4*E*,10*E*,12*E*,14*Z*) = 76 : 3 : 21, C(3)-epimers 2 : 1, $R_f = 0.37$ (1 : 4, ether : light petroleum); $[\alpha]_D^{18} + 192$ (c 0.6, benzene) (Found: $M^+ + Na$, 696.2939. $C_{40}H_{51}NO_3SeNa$ requires M , 696.2927); ν_{max}/cm^{-1} 2959, 2912, 2360 1725, 1686, 1600, 1438, 1362, 1273, 1235, 1177, 1130, 1105, 1022, 1000, 960, 890, 798, 740 and 691; δ_H (400 MHz, C_6D_6) (4*E*,10*E*,12*E*,14*E*)-isomers **71** 0.54 (2 H, d, J 7.0, CHCH₃), 0.55 and 0.57 (each 1 H, d, J 7.0, CHCH₃), 0.58 (2 H, d, J 7.0, CHCH₃'), 0.85 (1 H, d, J 6.5, 8'-CH₃), 0.87 (2 H, d, J 6.5, 8'-CH₃'), 0.92 (1 H, d, J 6.5, 6'-CH₃), 0.95 (2 H, d, J 6.5, 6'-CH₃'), 0.99 (1 H, m, 7'-H), 1.26 (0.33 H, m, 7'-H'), 1.29 (0.67 H, ddd, J 13.5, 9.5, 4.5, 7'-H'), 1.60 (3 H, d, J 7.0, 16'-H₃), 1.66-1.78 (6.7 H, m, 14'-CH₃, 10'-CH₃, 8'-H), 1.83 (0.67 H, dd, J 16.0, 7.5, 9'-H), 1.86-1.91 (1.33 H, m, 8'-H and 4-H), 1.99 (0.33 H, dd, J 14.0, 8.0, 4-H'), 2.05 (1 H, m, 9'-H'), 2.18 (1 H, m, 6'-H), 2.31 (0.67 H, m, 3'-H₂), 2.44-2.54 (3 H, m, 4-H', 5-CH and 3'-H₂), 2.83 (0.33 H, dt, J 18.0, 7.0, 2'-H), 2.89 (0.33 H, dd, J 12.0, 7.0, 9'-H), 3.12 (0.67 H, dt, J 18.0, 7.0, 2'-H), 3.27 (0.33 H, dt, J 17.5, 7.5, 2'-H'), 3.50 (0.67 H, dt, J 17.5, 7.5, 2'-H'), 4.31 (0.33 H, m, 5-H), 4.41 (0.67 H, m, 5-H), 5.19-5.36 (1.67 H, m, 4'-H and 5'-H), 5.42-5.55 (1.33 H, m, 4'-H and 15'-H), 6.05 (1 H, d, J 11.0, 11'-H), 6.34 (1 H, d, J 15.0, 13'-H), 6.52 (0.67 H, dd, J 15.0, 11.0, 12'-H), 6.53 (0.33 H, dd, J 15.0, 11.0, 12'-H), 6.89-7.00 (3 H, m, ArH), 7.05-7.15 (3 H, m, ArH), 7.39 (1.33 H, m, ArH), 7.53 (0.67 H, m, ArH) and 7.75-7.81 (2 H, m, ArH); (4*E*,10*E*,12*Z*,14*E*)-isomer 5.67 (1 H, q, J 7.0, 15'-H), 5.91 (1 H, d, J 12.0, 11'-H) and 6.24 (1 H, t, J 12.0, 12'-H); (4*E*,10*E*,12*E*,14*Z*)-isomer 6.10 (1 H, d, J 11.0, 11'-H), 6.61 (0.67 H, dd, J 15.5, 11.0, 12'-H), 6.62 (0.33 H, dd, J 15.5, 11.0, 12'-H) and 6.74 (1 H, d, J 15.5, 13'-H); δ_C (100 MHz, C_6D_6) (4*E*,10*E*,12*E*,14*E*)-isomers **71** major 3-epimer 12.6, 14.4, 15.3, 17.1, 18.5, 20.2, 22.3, 27.1, 27.3, 28.3, 29.2, 35.2, 39.6, 45.1, 49.4, 58.8, 60.9, 123.3, 126.6, 127.1, 127.9, 128.5, 129.9, 130.5, 130.7, 133.0, 135.3, 135.8, 136.5, 137.0, 137.8, 138.0, 138.2, 171.5, 171.6, and 201.7; minor 3-epimer 13.6, 14.2, 15.1, 16.7, 18.6, 20.1, 21.1, 27.1, 27.6, 28.3, 29.2, 35.1, 39.1, 45.0, 49.4, 60.6, 61.9, 123.4, 126.5, 127.1, 127.9, 128.5, 129.8, 130.4, 130.7, 133.3, 135.0, 135.9, 136.5, 137.1, 137.8, 138.0, 138.1, 171.4, 171.7 and 200.4; m/z (ES⁺) 691 ($M^+ + 18$, 100%).

Generation of pyrrolinone 72 and its intramolecular Diels-Alder reaction. A chilled solution of aqueous hydrogen peroxide (30%; 0.71 g, 6.27 mmol) in water (5 mL) was added to the selenide **71** (0.40 g, 0.597 mmol) in chloroform- d_1 (40 mL) at -48 °C followed by a chilled solution of *m*-chloroperoxybenzoic acid (77%; 0.16 g, 0.716 mmol) in chloroform- d_1 (18 mL) and the mixture stirred at -48 °C for 50 min. The reaction mixture was then removed from the cooling bath and allowed to warm up to 0 °C over the period of 10 min with vigorous stirring. Chilled chloroform- d_1 (30 mL) was added and the solution washed with chilled saturated aqueous sodium carbonate (2 × 20 mL) and chilled water (20 mL). The organic layer was dried (Na_2SO_4), diluted with toluene (400 mL) and deoxygenated by purging with nitrogen for 30 min at 40 °C before being heated at 90 °C for 10 h. After concentration under reduced pressure, chromatography of the residue using ether : light petroleum (gradient elution 1 : 80 to 1 : 15) as eluent gave a mixture of the (11*E*)-Diels-Alder products **73** and **74** as a clear oil (34 mg, 11%), **73** : **74** = 5 : 4 (Found: $M^+ + H$, 516.3486. $C_{34}H_{46}NO_2$ requires M , 516.3473); ν_{max}/cm^{-1} 2958, 2919, 2360, 2341, 1731, 1706, 1693, 1601, 1448, 1373, 1275, 1214, 1177, 1132, 1098, 970 and 751; m/z (ES⁺) 538 ($M^+ + 23$, 100%). The second fraction was a mixture of the (11*Z*)-Diels-Alder adducts **75** and **76** as a clear oil (38 mg, 12%), **75** : **76** = 5 : 4 (Found: $M^+ + H$, 516.3464. $C_{34}H_{46}NO_2$ requires M , 516.3473); ν_{max}/cm^{-1} 2957, 2913, 2360, 2340, 1734, 1682, 1600, 1448, 1373, 1275, 1217, 1178, 1140, 1098, 972, 911, 801 and 730; m/z (ES⁺) 538 ($M^+ + 23$, 100%). A mixed fraction was seen as an off-white liquid (5 mg, 2%).

(7*R*,9*S*,13*R*,16*R*,17*R*,18*S*,5*E*,11*E*,14*Z*)-7,9,11,15,16-Pentamethyl-18-(prop-2-yl)-19-aza-20-oxotricyclo[15.3.0^{1,17}]jicosa-5,11,14-trien-2-one (77). Sodium hydroxide (38 mg, 0.94 mmol) in methanol (1.4 mL) and water (0.05 mL) was added to the mixture of the (11*E*)-Diels-Alder adducts **73** and **74** (24 mg, 0.047 mmol) in methanol (1.4 mL) and the solution stirred at r.t. for 3 h. Water (10 mL) was added and the mixture extracted with ether (4 × 15 mL). The organic extracts were then washed with brine (10 mL), dried (Na_2SO_4) and concentrated under reduced pressure. Chromatography of the residue using ether : light petroleum (1 : 4) as eluent gave the (11*E*)-endo-isomer **78** as a clear oil (2 mg, 11%), but only as an impure mixture, $R_f = 0.4$ (2 : 1, ether : light petroleum) (Found: $M^+ + H$, 412.3211. $C_{27}H_{42}NO_2$ requires M , 412.3211); ν_{max}/cm^{-1} 3201, 2959, 2919, 2360, 1686, 1457, 1374, 1154, 972, 908 and 731; m/z (ES⁺) 434 ($M^+ + 23$, 100%). After mixed fractions of the (13*R*,16*R*)- and (13*S*,16*S*)-isomers **77** and **78** (6 mg, 32%), the second product was the (11*E*)-exo-isomer of the *title compound* **77** isolated as a clear liquid (6 mg, 32%), $R_f = 0.33$ (2 : 1, ether : light petroleum) (Found: $M^+ + H$, 412.3222. $C_{27}H_{42}NO_2$ requires M , 412.3211); ν_{max}/cm^{-1} 3205, 2957, 2914, 2869, 2360, 2341, 2247, 1691, 1455, 1376, 1287, 1260, 1153, 1101, 1047, 1000, 968, 907, 811, 728 and 646; δ_H (500 MHz, $CDCl_3$) 0.83 (3 H, d, J 6.5, 18-CHCH₃), 0.86 (3 H, d, J 6.5, 9-CH₃), 0.92 (3 H, d, J 7.0, 7-CH₃), 0.95 (1 H, m, 8-H), 1.00 (3 H, d, J 6.5, 18-CHCH₃'), 1.18 (3 H, d, J 7.5, 16-CH₃), 1.26-1.36 (3 H, m, 8-H', 9-H and 18-CH), 1.41 (1 H, dd, J 12.5, 11.0, 10-H), 1.67 (3 H, s, 15-CH₃), 1.80 (3 H, d, J 1.5, 11-CH₃), 1.89-2.00 (4 H, m, 4-H, 7-H, 10-H' and 16-H), 2.37 (1 H, m, 4-H'), 2.57 (1 H, ddd, J 20.0, 5.0, 2.0, 3-H), 2.64 (1 H, d, J 9.5, 18-H), 2.89 (1 H, ddd, J 20.0, 12.5, 2.5, 3-H'), 3.02 (1 H, dd, J 3.0, 1.5, 17-H), 3.77 (1 H, dd, J 9.5, 6.5, 13-H), 4.84 (1 H, dt, J 9.5, 1.5, 12-H), 5.36-5.38 (2 H, m, 5-H and 6-H), 5.45 (1 H, d, J 6.5, 14-H) and 5.93 (1 H, s, NH); δ_C (125 MHz, $CDCl_3$) 19.4, 19.5, 20.6, 21.8, 22.3, 22.6, 24.3, 30.3, 32.2, 34.0, 35.0, 37.2, 40.0, 41.5, 43.2, 44.0, 46.1, 63.7, 70.1, 121.4, 125.0, 127.5, 136.5, 137.0, 137.5, 175.7 and 206.0; m/z (ES⁺) 434 ($M^+ + 23$, 72%) and 412 ($M^+ + 1$, 100%).

(7*R*,9*S*,13*R*,16*R*,17*R*,18*S*,5*E*,11*Z*,14*Z*)- And (7*R*,9*S*,13*S*,16*S*,17*R*,18*S*,5*E*,11*Z*,14*Z*)-7,9,11,15,16-pentamethyl-18-(prop-2-yl)-19-aza-20-oxotricyclo[15.3.0^{1,17}]jicosa-5,11,14-trien-2-ones (79) and (80). Sodium hydroxide (33 mg, 0.82 mmol) in methanol (1.4 mL) and water (0.05 mL) was added to the mixture of Diels-Alder adducts **75** and **76** (26 mg, 0.05 mmol) in methanol (1.4 mL) and the solution stirred at r.t. for 3 h. Water (10 mL) was added and the mixture extracted with ether (4 × 15 mL). The organic extracts were washed with brine (10 mL), dried (Na_2SO_4) and concentrated under reduced pressure. Chromatography of the residue using ether : light petroleum (1 : 4) as eluent gave the (11*Z*)-endo-isomer of the *title compound* **80**, a clear liquid (6 mg, 29%), $R_f = 0.53$ (2 : 1, ether : light petroleum) (Found: $M^+ + H$, 412.3213. $C_{27}H_{42}NO_2$ requires M , 412.3211); ν_{max}/cm^{-1} 3201, 2960, 2916, 2364, 1688, 1457, 1384, 1338, 1306, 1223, 1144, 1098, 970, 909 and 733; δ_H (500 MHz, $CDCl_3$) 0.90-0.99 (14 H, m, 7-CH₃, 8-H, 9-H, 9-CH₃, 2 × 18-CHCH₃), 1.15 (3 H, d, J 7.0, 16-CH₃), 1.29 (1 H, m, 8-H'), 1.62 (1 H, m, 18-CH), 1.66 (3 H, d, J 1.5, 11-CH₃), 1.69-1.80 (5 H, m, 7-H, 10-H and 15-CH₃), 1.90 (1 H, m, 10-H'), 2.10 (1 H, m, 4-H), 2.27 (1 H, ddd, J 16.0, 6.0, 2.5, 3-H), 2.29 (1 H, m, 17-H), 2.51-2.61 (2 H, m, 4-H' and 16-H), 2.88 (1 H, t, J 4.5, 18-H), 3.04 (1 H, ddd,

J 16.0, 12.0, 2.5, 3-H'), 3.72 (1 H, br. d, J 10.5, 13-H), 5.32 (1 H, dt, J 16.0, 6.0, 5-H), 5.43 (1 H, br. s, 14-H), 5.49 (1 H, dd, J 16.0, 6.0, 6-H), 5.62 (1 H, d, J 10.5, 12-H) and 6.02 (1 H, s, NH); δ_C (125 MHz, $CDCl_3$) 14.5, 16.7, 16.9, 20.1, 20.7, 22.3, 23.5, 26.4, 30.9, 33.5, 34.4, 34.6, 38.4, 39.1, 45.4, 49.1, 51.4, 59.8, 67.1, 123.5, 125.4, 127.7, 135.9, 136.9, 138.1, 176.1 and 209.3; m/z (ES+) 434 ($M^+ + 23$, 100%) and 412 ($M^+ + 1$, 47). After a mixed fraction (2 mg, 9%), the second product to be eluted was the (1*Z*)-exo-isomer of the *title compound 79* isolated as a clear liquid (8 mg, 38%), $R_f = 0.28$ (2 : 1, ether : light petroleum) (Found: $M^+ + H$, 412.3219. $C_{27}H_{42}NO_2$ requires M , 412.3211); ν_{max}/cm^{-1} 3211, 2957, 2916, 2866, 2360, 1693, 1455, 1386, 1284, 1260, 1117, 972, 910, 800, 732, 667 and 648; δ_H (500 MHz, $CDCl_3$) 0.83 (3 H, d, J 6.5, 18-CHCH₃), 0.94 (3 H, d, J 7.0, 9-CH₃), 0.96 (3 H, d, J 7.0, 7-CH₃), 0.99 (3 H, d, J 6.5, 18-CHCH₃'), 1.02 (1 H, ddd, J 13.5, 8.5, 2.5, 8-H), 1.21 (3 H, d, J 7.5, 16-CH₃), 1.31 (1 H, m, 8-H'), 1.38-1.43 (2 H, m, 9-H and 18-CH), 1.66 (1 H, m, 10-H), 1.69 (3 H, s, 11-CH₃), 1.70 (3 H, s, 15-CH₃), 1.80-1.89 (2 H, m, 7-H and 10-H'), 1.92-1.99 (2 H, m, 4-H and 16-H), 2.45 (1 H, m, 4-H'), 2.58 (1 H, ddd, J 19.5, 5.5, 2.0, 3-H), 2.70 (1 H, d, J 9.0, 18-H), 2.85 (1 H, ddd, J 19.5, 12.0, 2.5, 3-H'), 2.86 (1 H, dd, J 4.0, 2.0, 17-H), 3.76 (1 H, dd, J 9.5, 6.0, 13-H), 4.81 (1 H, d, J 9.5, 12-H), 5.35-5.41 (2 H, m, 5-H and 14-H), 5.52 (1 H, dd, J 16.0, 7.5, 6-H) and 5.94 (1 H, br. s, NH); δ_C (125 MHz, $CDCl_3$) 16.7, 19.1, 19.4, 20.7, 22.2, 22.4, 23.8, 24.5, 30.5, 32.5, 34.8, 38.8, 39.6, 40.8, 44.5, 46.9, 48.9, 63.8, 68.6, 122.4, 122.7, 126.5, 136.2, 137.5, 137.8, 175.8 and 206.3; m/z (ES+) 434 ($M^+ + 23$, 100%).