VII (0.475 g) as a viscous light yellow oil. Purification was achieved by short column chromatography (24 g, ca. 13 × 2.5 cm, hexane/ethyl acetate, v/v, 6:1), giving chromatographically homogeneous VII (0.204 g, 43%) as a thick (very viscous) colorless oil. An analytical sample was prepared by Kugelrohr distillation at 0.001 mm (air bath temperature ca. 150 °C): NMR ($CDCl_3$) 1.33 (s, 1 CH_3), 1.46 (s, 1 CH_3), 1.7 (m, 2 CH_3), 3.30 (d, J = 11.5 Hz, CHS), 5.21 (v br t, J = 7 Hz) and 5.65 (br d, J = 11.5 Hz, 2 CCH), 7.0–7.6 (m, aromatic CH); mass spectrum, m/e (relative intensity) 330 (2), 220 (7), 203 (25), 202 (34), 187 (32), 174 (13), 163 (70), 162 (51), 161 (11), 160 (11), 159 (59), 147 (51), 145 (12), 134 (14), 133 (12), 131 (10), 121 (10), 120 (12), 119 (23), 110 (100), 109 (25), 107 (27), 95 (17), 94 (21), 93 (17), 91 (25), 81 (36), 79 (19), 77 (22), 69 (13), 66 (30), 65 (15), 59 (75), 55 (15), 51 (11), 43 (25), 41 (24), 39 (14). Anal. Calcd for $C_{21}H_{30}SO$: C, 76.31; H, 9.15; S, 9.70. Found: C, 76.39; H, 9.19; S, 9.83.

Reduction of VII. A mixture of 0.110 g of VII (0.29 mmol) in ca. 1 mL of tetrahydrofuran and 20 mL of liquid ammonia, cooled in dry ice–2-propanol, was treated with 0.020 g of lithium wire (3 mmol), a deep blue color ensuing. The cooling bath was removed, and the reaction mixture maintained at under reflux for 0.5 h. Thereafter, ammonium chloride was added (discharging the blue color) and the condenser removed to allow evaporation of the ammonia. The residue was partioned between water and hexane, the organic extracts were dried over anhydrous sodium sulfate, and the solvent was removed in vacuo, giving 0.077 g of colorless oil (theoretical 0.074 g). TLC analysis (hexane/ethyl acetate, v/v, 4:1) indicated only one significant product, characterized by R_{st} 0.8. Preparative TLC furnished 0.0625 g of pure VIII (85%); an analytical sample was prepared by Kugelrohr distillation at 0.001 mm (air bath temperature ca. 110 °C): NMR ($CDCl_3$) 1.18 (s, 1 CH_3), 1.21 (s, 1 CH_3), 2.72 (br s, 2 CH_3), 5.32 (br t, J = 8 Hz, 2 C=CH); IR (CCl_4) 3615, 1665, 1155, 880, 860 cm^{-1}; mass spectrum, m/e (relative intensity) 222 (1), 204 (43), 189 (43), 164 (12), 162 (13), 161 (74), 149 (17), 147 (14), 135 (22), 133 (17), 123 (10), 122 (10), 121 (38), 109 (19), 108 (16), 107 (56), 105 (34), 95 (34), 94 (207), 93 (76), 91 (20), 82 (11), 81 (47), 80 (12), 77 (12), 71 (14), 69 (24), 68 (18), 67 (35), 59 (100), 55 (26), 53 (15), 44 (16), 43 (38), 41 (44), 39 (12), 29 (12), 18 (78), 17 (15). Anal. Calcd for $C_{15}H_{26}O$: C, 81.02; H, 11.785. Found: C, 80.88; H, 11.83.

Dehydration of VIII. A solution of 0.169 g of VIII (0.75 mmol) in 3.0 mL of pyridine cooled in an ice–water bath was treated with 0.22 g of thionyl chloride (1.85 mmol). The reaction mixture was stirred and cooling of the mixture was maintained for ca. 15 min. The reaction mixture was poured into chilled aqueous bicarbonate, extracted with hexane, washed with dilute hydrochloric acid and saturated bicarbonate, and dried over anhydrous sodium sulfate. Evaporation of the solvent under reduced pressure furnished a slightly cloudy oil, 0.097 g (theoretical 0.153 g). TLC analysis (hexane/ethyl acetate, v/v, 4:1) indicated the absence of VIII and products at R_{st} ca. 1.6 as well as significant material at the origin; GLC analysis (122 °C) indicated two major volatile components in a somewhat variable ratio, initially ca. 10:1 but only 4:1 for samples standing for sometime. On chromatography over silver nitrate impregnated silica gel (hexane/ethyl acetate, v/v, 1:1), the major component appeared as the slower moving. Preparative TLC over argenated silica gel furnished this component (0.044 g, ca. 20%) as homogeneous: NMR ($CDCl_3$) 1.68 (m, 1 CH_3), 1.71 (m, 2 CH_3), 4.68 (br s, 2 CCH), 5.27 (br, C=CH_2); IR (CCl_4) 3075, 3030, 1645, 890 cm^{-1}; mass spectrum, m/e (relative intensity) 204 (50), 189 (56), 162 (10), 161 (57), 148 (16), 147 (49), 135 (16), 134 (11), 133 (23), 122 (13), 121 (43), 120 (10), 119 (28), 109 (15), 108 (28), 107 (54), 106 (11), 105 (36), 95 (29), 94 (28), 93 (87), 92 (11), 91 (29), 81 (29), 81 (62), 80 (12), 79 (41), 77 (19), 69 (20), 68 (100), 67 (56), 65 (10), 55 (34), 53 (36), 43 (15), 41 (64), 40 (11), 39 (29), 29 (20), 27 (16), high-resolution mass spectrum, calcd for $C_{15}H_{24}$ 204.1878, found 204.1877.

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Registry No. IV, 75023-40-4; V, 28413-58-3; VIa, 74986-29-1; VIb, 60441-27-2; VII, 60441-28-3; VIII, 60479-01-8; *cis,trans*-farnesol, 61764-67-8; thiophenol, 108-98-5; 10-bromo-*cis,trans*-farnesyl sulfide, 74986-30-4; *cis,trans*-8-(1-methylethenyl)-18-dimethyl-1,5-cyclodecadiene, 69460-22-6.

Novel Cyclization Reaction of Methyl Styryl Sulfone with Ketone Enolates

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α,β-Unsaturated sulfur compounds have been used as important reagents in synthetic chemistry,[1] for example, vinyl sulfides as carbonyl synthons[2] and vinylsulfonium salts as precursors of cyclopropanes.[3] However, application of vinyl sulfones has been restricted since conversion of the sulfonyl group to another functional moiety is generally difficult. Posner demonstrated that the addition reaction of organocuprates to methyl vinyl sulfones was unsuccessful or gave low yields due to predominant proton abstraction from the methyl group.[4] In a previous communication, we reported the synthesis of 2-thiadecalin derivatives from cyclohexanone enolates and dimethylstyrylsulfoniuim salts.[5] If this annelation reaction was applicable to methyl styryl sulfone, it would be expected to introduce two alkyl groups into the carbonyl substrate by removal of the sulfonyl group from the resulting cyclic sulfones. We report herein the reaction of methyl styryl sulfone with lithium ketone enolates and desulfonylation of the products.

Methyl styryl sulfone (**1**) was allowed to react with lithium cyclohexanone enolate in THF–DMF (1:2) at 80 °C to give 8a-hydroxy-4-phenyl-2-thiadecalin 2,2-dioxide (**2**) in quantitative yield. A similar reaction between **1** and other lithium ketone enolates gave the corresponding cyclic sulfones in fairly good yields (Table I).[6]

The sulfone **2** was identified with an authentic sample prepared from 8a-hydroxy-4-phenyl-2-thiadecalin and *m*-chloroperbenzoic acid. Although **2** was proved to be single isomer by TLC and NMR, its stereochemistry could not be settled with certainty because five protons at C^1, C^3, and C^4 appeared as a multiplet at δ 3.10–3.20. Four protons at C^1 and C^3 were easily deuterated by treatment with sodium carbonate and deuterium oxide.[7] The NMR of the deuterated sulfone showed a doublet at δ 3.20, assignable to C^4 proton, and its coupling constant was 6.8 Hz, indicating an axial–axial relationship between the protons at C^4 and C^{4a}. This structural assignment is in agreement with the annelation reaction of butadienylsulfonium salts and cyclohexanone.[8] Structures of other cyclic sulfones were confirmed by NMR data, similar to that of **2**. In the reaction of 2-decalone and cycloheptanone, dehydrated products (**6**, **11**) were obtained in addition to β-hydroxy sulfones in 18 and 44% yields, respectively. Methyl vinyl sulfone (**1**) reacted with acetone enolate also to give cyclic sulfone **12** in a relatively low yield. On the basis of these results, it is clear that methyl vinyl sulfone (**1**) is predominantly transformed into cyclic sulfones by the addition of ketone enolates and subsequent

(1) B. M. Trost, *Chem. Rev.*, **78**, 363 (1978).
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(6) In the reaction of **1** with 2-methylcyclohexanone, a byproduct assignable to **15** was traced in the first fraction of chromatrography.
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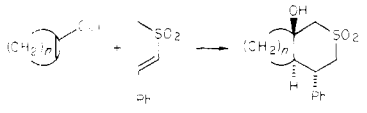
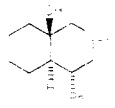
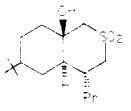
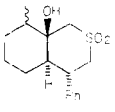
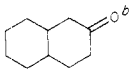
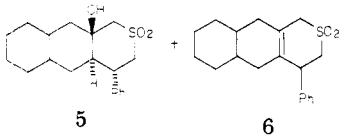
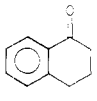
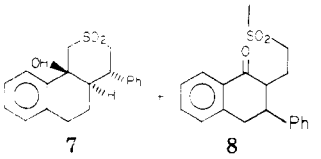
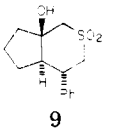
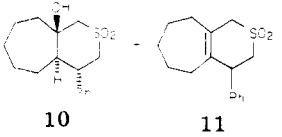
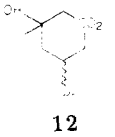
Table I. Reaction of Methyl Styryl Sulfone (1) with Lithium Ketone Enolates



1 n = 3-5

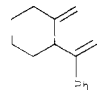
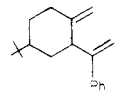
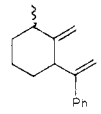
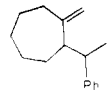
ketone	products	% yield[a]
	 2	100
	 3	100
	 4	78
	 5 6	73 + 18
	 7 8	43 + 18
	 9	89
	 10 11	32 + 44
	 12	57

[a] Yield of products purified by chromatography or distillation. [b] Mixture of cis and trans (52:48).

condensation reactions, contrasting with the dimethylstyrylsulfonium salt where a cyclization reaction competes with spirocyclopropanation, depending on the ring size and electrophilicity of the ketones.[5]

Then, we studied Ramberg–Bäcklund reaction of the resulting cyclic sulfones to examine the possibility of the synthesis of cyclopentene derivatives. This effort was unfortunately unsuccessful, since sulfone **2** was not halogenated under various conditions, even by the treatment with n-butyllithium and iodine.[9] Although a number of methods for hydrogenolysis of alkyl or aryl sulfones have been reported, most of them resulted in the fission of carbon–sulfur bond only.[10] Therefore, we have undertaken a study of desulfonylation of the cyclic β-hydroxy sulfones which are potentially useful for olefin synthesis.[11]

Table II. Desulfonylation of the Cyclic Sulfones

sulfone	product	% yield[a]
2	 13	70
3	 14	74
4	 15	50
9	 16	54
10	 17	81

[a] Yield of products purified by distillation.

The sulfone **2** was treated with sodium (5.0 equiv) and absolute ethanol (5.8 equiv) in dry THF[12] under reflux for 7.5 h to yield 1-methylene-2-(α-styryl)cyclohexane (**13**) in 70% yield (Table II). On the other hand, similar treatment of **9** and **10** gave monoolefins **16** and **17** in 54 and 81% yields, respectively. Part of the difference mentioned above may be attributed to the different size of the cyclic sulfones; however, this process is mechanistically unclear at this stage.

Finally, methyl styryl sulfone (**1**) is a useful annelation reagent, providing cyclic β-hydroxy sulfones in good yields. The resulting sulfones are readily desulfonylated by treatment with sodium and ethanol to give olefins. From a synthetic point of view, these total reactions would be available for vicinal dialkylation of cyclic ketones.

Experimental Section

General. All melting points were determined with a Yanagimoto micro melting point apparatus and were uncorrected. The NMR spectra were obtained on JEOL JNM-PMX-60 and JNM-PS-100 spectrometers with tetramethylsilane as an internal standard. The IR spectra were recorded with a Hitachi 215 spectrometer. The mass spectra were taken with Hitachi RMU-6E and Hitachi RMU-6D spectrometers.

Reaction of Methyl Styryl Sulfone (1) with Lithium Ketone Enolates. General Procedure. To a stirred solution of lithium diisopropylamide (12 mmol) in dry THF (40 mL) was

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(10) (a) G. H. Posner and D. J. Brunelle, *Tetrahedron Lett.*, 935 (1973); (b) V. Pascali and A. Umani-Ronchi, *J. Chem. Soc., Chem. Commun.*, 351 (1973); (c) J. F. Biellmann and J. B. Ducep, *Tetrahedron*, **27**, 5861 (1971); (d) P. T. Lansbury, R. W. Erwin, and D. A. Jeffrey, *J. Am. Chem. Soc.*, **102**, 1602 (1980).

(11) (a) T. Shono, Y. Matsumura, S. Kashimura, *Chem. Lett.*, 69 (1978); (b) P. J. Kocienski, B. Lythgoe, and S. Ruston, *J. Chem. Soc., Perkin Trans. 1*, 829 (1978).

(12) D. Savoia, C. Trombini, and A. Umani-Ronchi, *J. Chem. Soc., Perkin Trans. 1*, 123 (1977).

added an equimolar amount of ketone under nitrogen at −70 °C. After 3 h, methyl styryl sulfone (1 10 mmol) in dry DMF (80 mL) was added. The reaction mixture was warmed to room temperature and then heated at 80 °C for 12 h. Water (40 mL) was added after cooling and the mixture was acidified with aqueous hydrochloric acid until neutral pH. The organic layer was extracted with chloroform (3 × 40 mL), washed with saturated brine, and dried over sodium sulfate. After concentration of the solvent in vacuo, the residue was chromatographed on silica gel with benzene and benzene–ethanol.

8a-Hydroxy-4-phenyl-2-thiadecalin 2,2-dioxide (2): mp 177–178 °C (benzene–hexane); IR (Nujol) 3500, 1300, 1140 cm^{-1}; mass spectrum (70 eV), m/e 280 (M^+); NMR ($CDCl_3$) δ 1.10–1.90 (m, 9 H), 3.10–3.20 (m, 5 H), 4.00 (s, 1 H, OH), 7.05–7.50 (m, 5 H, aromatic).

Anal. Calcd for $C_{15}H_{20}O_3S$: C, 64.27; H, 7.19; S, 11.42. Found: C, 64.35; H, 7.09; S, 11.45.

A solution of **2** (250 mg) and sodium carbonate (8 mg) in deuterium oxide (2 mL) and 1,2-dimethoxyethane (8 mL) was refluxed for 18 h. After concentration of the solvent, the sulfone was recovered by extraction with chloroform followed by washing with brine, drying over sodium sulfate, and concentration of the extract. Such treatment was repeated three times. The sulfone (87 mg) was recovered finally, containing 14% d_2, 49% d_3, and 29% d_4 species by mass spectroscopy; NMR ($CDCl_3$) δ 0.91–1.94 (m, 9 H), 3.20 (m and d, J = 6.8 Hz, 1.7 H), 3.68 (br, 0.9 H, OH), 7.02–7.45 (m, 5 H, aromatic).

6-*tert*-Butyl-8a-hydroxy-4-phenyl-2-thiadecalin 2,2-dioxide (3): mp 205.5–206.5 °C (benzene–hexane); IR (Nujol) 3500, 1300, 1110 cm^{-1}; mass spectrum (70 eV), m/e 336 (M^+); NMR (Me_2SO-d_6) δ 0.68 (s, 9 H, 3 CH_3), 0.78–2.17 (m, 8 H), 2.80–4.07 (m, 6 H), 7.10–7.50 (m, 5 H, aromatic).

Anal. Calcd for $C_{19}H_{28}O_3S$: C, 67.83; H, 8.39. Found: C, 67.84; H, 8.72.

8a-Hydroxy-8-methyl-4-phenyl-2-thiadecalin 2,2-dioxide (4): bp 155–160 °C (1 mm, bath temperature); IR (Nujol) 3500, 1295, 1120 cm^{-1}; mass spectrum (70 eV), m/e 294 (M^+); NMR ($CDCl_3$) δ 0.73–2.57 (m, 12 H), 2.77–3.93 (m, 5 H), 6.97–7.47 (m, 5 H, aromatic).

9a-Hydroxy-4-phenyl-2-thiaperhydroanthracene 2,2-dioxide (5): mp 201–203 °C (ethanol); IR (Nujol) 3500, 1310, 1125 cm^{-1}; mass spectrum (70 eV), m/e 334 (M^+); NMR (CD_3CN) δ 0.50–2.40 (m, 16 H), 2.77–4.13 (m, 5 H), 7.00–7.53 (m, 5 H, aromatic). Anal. Calcd for $C_{19}H_{26}O_3S$: C, 68.24; H, 7.84; S, 9.57. Found: C, 68.35; H, 7.78; S, 9.40.

4-Phenyl-2-thia-1,3,4,5,6,7,8,8a,9,10,10a-undecahydroanthracene 2,2-dioxide (6): mp 180–182 °C (ethanol); IR (Nujol) 1300, 1140 cm^{-1}; mass spectrum (70 eV), m/e 316 (M^+); NMR (CD_3CN) δ 0.67–2.43 (m, 15 H), 3.00–4.27 (m, 4 H), 7.20–7.53 (m, 5 H, aromatic).

Anal. Calcd for $C_{19}H_{24}O_2S$: C, 72.12; H, 7.65; S, 10.12; Found: C, 72.23; H, 7.67; S, 9.83.

4a-Hydroxy-1-phenyl-3-thia-1,2,4,9,10,10a-hexahydrophenanthrene 3,3-dioxide (7): mp 208–209 °C (benzene–hexane); IR (Nujol) 3500, 1300, 1115 cm^{-1}; mass spectrum (70 eV), m/e 328 (M^+); NMR (Me_2SO-d_6) δ 1.00–4.50 (m, 10 H), 5.50–5.73 (s, 1 H, OH), 6.83–7.43 (m, 8 H, aromatic), 7.50–7.83 (m, 1 H, aromatic).

Anal. Calcd for $C_{19}H_{20}O_3S$: C, 69.50; H, 6.14; S, 9.74. Found: C, 69.77; H, 5.88; S, 9.57.

2-(2-(Methylsulfonyl)-1-phenylethyl)-3,4-dihydro-1-(2*H*)-naphthalenone (8): mp 153–154 °C (benzene–hexane); IR (Nujol) 1680, 1300, 1115 cm^{-1}; mass spectrum (70 eV), m/e 328 (M^3); NMR (Me_2SO-d_6) δ 1.40–3.13 (m, 5 H), 2.60 (s, 3 H, CH_3), 3.43–4.13 (m, 3 H), 6.83–7.67 (m, 8 H, aromatic), 7.85–8.20 (m, 1 H, aromatic).

Anal. Calcd for $C_{19}H_{20}O_3S$: C, 69.50; H, 6.14; S, 9.74. Found: C, 69.40; H, 6.01; S, 9.80.

3a-Hydroxy-7-phenyl-5-thiaperhydroindan 5,5-dioxide (9): mp 184.5–185.5 °C (benzene–hexane); IR (Nujol) 3450, 1295, 1115 cm^{-1}; mass spectrum (70 eV), m/e 266 (M^+); NMR ($CDCl_3$) δ 1.28–2.05 (m, 7 H), 3.03–3.90 (m, 5 H), 4.20 (s, 1 H, OH), 6.98–7.63 (m, 5 H, aromatic).

Anal. Calcd for $C_{14}H_{18}O_3S$: C, 63.14; H, 6.81; S, 12.02. Found: C, 63.30; H, 6.84; S, 11.92.

1-Hydroxy-8-phenyl-10-thiabicyclo[5.4.0]undecane 10,10-dioxide (10): mp 158.5–159.5 °C (benzene–hexane); IR (Nujol) 3450, 1300, 1120 cm^{-1}; mass spectrum (70 eV), m/e 294 (M^+); NMR ($CDCl_3$) δ 0.80–2.20 (m, 11 H), 2.83–3.52 (m, 5 H), 3.95 (br, 1 H, OH), 6.97–7.55 (m, 5 H, aromatic).

Anal. Calcd for $C_{16}H_{22}O_3S$: C, 65.29; H, 7.53. Found: C, 65.26; H, 7.44.

8-Phenyl-10-thiabicyclo[5.4.0]undec-1(7)-ene 10,10-dioxide (11): mp 134–135 °C (benzene); IR (Nujol) 1295, 1105 cm^{-1}; mass spectrum (70 eV), m/e 276 (M^+); NMR ($CDCl_3$) δ 0.93–2.43 (m, 10 H), 2.93–4.27 (m, 5 H), 6.93–7.67 (m, 5 H, aromatic).

Anal. Calcd for $C_{16}H_{20}O_2S$: C, 69.54; H, 7.30. Found: C. 69.32; H, 7.23.

3-Hydroxy-3-methyl-5-phenylthiane 1,1-dioxide (12): mp 118–120 °C (benzene–hexane); IR (Nujol) 3450, 1300, 1140 cm^{-1}; mass spectrum (70 eV), m/e 240 (M^+); NMR ($CDCl_3$) δ 1.40 (s, 3 H, CH_3), 1.60–2.33 (m, 2 H), 3.00–3.28 (m, 4 H), 3.33–3.95 (m, 2 H), 7.03–7.60 (m, 5 H, aromatic).

Anal. Calcd for $C_{12}H_{16}O_3S$: C, 59.99; H, 6.71. Found: C, 60.28; H, 6.61.

Desulfonylation of the Cyclic β-Hydroxy Sulfones. General Procedure. A solution of the cyclic β-hydroxy sulfone (5.36 mmol) and sodium (0.62 g, 27 mmol) in absolute ethanol (1.81 mL, 31 mmol) and dry THF (22 mL) was refluxed for 7.5 h. After the solution was cooled, methanol (18 mL) and then water (30 mL) were added cautiously, followed by extraction with chloroform, drying over sodium sulfate, and concentration of the solvent. The residue was purified by short-path distillation in vacuo.

1-Methylene-2-(α-styryl)cyclohexane (13): bp 64.5–65.5 °C (1.5 mm, bath temperature); IR (neat) 1640, 1620, 890 cm^{-1}; mass spectrum (70 eV), m/e 198 (M^+); NMR ($CDCl_3$) δ 1.00–2.67 (m, 8 H), 3.00–3.33 (m, 1 H), 4.57–4.83 (m, 2 H, vinylic), 5.08 (d, J = 1.3 Hz, 1 H, vinylic), 5.45 (d, J = 1.3 Hz, 1 H, vinylic), 7.00–7.67 (m, 5 H, aromatic).

Anal. Calcd for $C_{15}H_{18}$: C, 90.85, H, 9.15. Found: C, 91.19; H, 8.79.

4-*tert*-Butyl-1-methylene-2-(α-styryl)cyclohexane (14): bp 80–85 °C (1 mm, bath temperature); IR (neat) 1640, 1620, 890 cm^{-1}; mass spectrum (70 eV), m/e 254 (M^+); NMR ($CDCl_3$) δ 0.88 (s, 9 H, 3 CH_3), 1.03–2.50 (m, 7 H), 2.88–3.27 (m, 1 H), 4.60 (m, 2 H, vinylic), 5.05 (d, J = 1.2 Hz, 1 H, vinylic), 5.47 (d, J = 1.2 Hz, 1 H, vinylic), 7.02–7.47 (m, 5 H, aromatic).

Anal. Calcd for $C_{19}H_{26}$: C, 89.70; H, 10.30. Found: C, 89.35; H, 10.59.

1-Methylene-6-methyl-2-(α-styryl)cyclohexane (15): bp 55–57 °C (1 mm, bath temperature); IR (neat) 1640, 1620, 890 cm^{-1}; mass spectrum (70 eV), m/e 212 (M^+); NMR ($CDCl_3$) δ 1.05 (d, J = 6.0 Hz, 3 H, CH_3), 1.18–2.35 (m, 7 H), 2.90–3.30 (m, 1 H), 4.70 (m, 2 H, vinylic), 5.10 (d, J = 1.2 Hz, 1 H, vinylic), 5.55 (d, J = 1.2 Hz, 1 H, vinylic), 7.10–7.53 (m, 5 H, aromatic).

Anal. Calcd for $C_{16}H_{20}$: C, 90.50; H, 9.50. Found: C, 90.43; H, 9.25.

1-Methylene-2-(1-phenylethyl)cyclopentane (16): bp 48–52 °C (2 mm, bath temperature); IR (neat) 1645, 1595, 880 cm^{-1}; mass spectrum (70 eV), m/e 186 (M^+); NMR ($CDCl_3$) δ 1.00–3.07 (m, 11 H), 4.77–5.43 (m, 2 H), 6.97–7.70 (m, 5 H, aromatic).

Anal. Calcd for $C_{14}H_{18}$: C, 90.26; H, 9.74. Found: C, 90.46; H, 9.36.

1-Methylene-2-(1-phenylethyl)cycloheptane (17): bp 55–60 °C (1 mm, bath temperature); IR (neat) 1630, 1590, 890 cm^{-1}; mass spectrum (70 eV), m/e 214 (M^+); NMR ($CDCl_3$) δ 0.80–2.57 (m, 15 H), 4.70–4.97 (m, 2 H), 7.00–7.30 (m, 5 H, aromatic).

Anal. Calcd for $C_{16}H_{22}$: C, 89.65; H, 10.35. Found: C, 89.50; H, 10.29.

Registry No. 1, 5342-84-7; 2, 69263-13-4; 3, 75011-17-5; 4, 75011-18-6; 5, 75011-19-7; 6, 75011-20-0; 7, 75011-21-1; 8, 75011-22-2; 9, 75011-23-3; 10, 75011-24-4; 11, 75011-25-5; 12, 75011-26-6; 13, 75011-27-7; 14, 75011-28-8; 15, 75011-29-9; 16, 75011-30-2; 17, 75011-31-3; cyclohexanone, 108-94-1; 4-*tert*-butylcyclohexanone, 98-53-3; 2-methylcyclohexanone, 583-60-8; *cis*-β-decalone, 1579-21-1; *trans*-β-decalone, 16021-08-2; 3,4-dihydro-1(2*H*)-naphthalenone, 529-34-0; cyclopentanone, 120-92-3; cycloheptanone, 502-42-1; acetone, 67-64-1.