

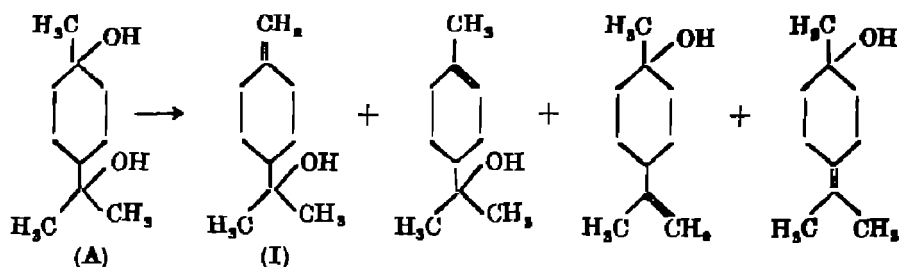
Terpenoids. Part XXIV. Synthesis of Δ -Terpineol

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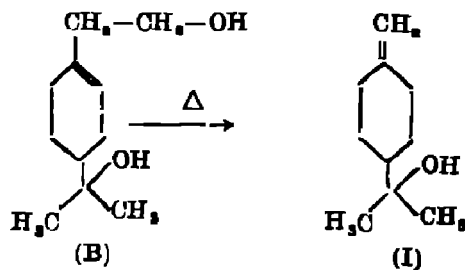
A synthesis of Δ -terpineol has been accomplished.

Synthesis of various terpenoids through an application of Wittig reaction on appropriate ketones or diketones have been reported in our earlier communications¹⁻⁴. In continuation of this work, the synthesis of the title compound is now being reported.

Δ -Terpineol, a monocyclic monoterpene alcohol, anticipated as one of the dehydration products of the terpin hydrate (A) has neither been isolated from natural sources

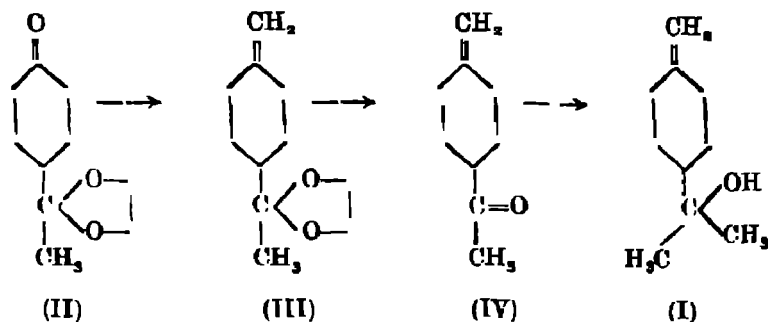


nor synthesised so far. However, very recently Mitzner and Lemberg⁵ have proved beyond doubt that commercial terpineol contains Δ -terpineol in less than 0.5 per cent concentration. These workers also obtained this tertiary carbinol as a product of pyrolysis of dipenol (B) and found that the formulation (I) for Δ -terpineol is firmly supported by the I.R. as well as N.M.R. spectra⁵.



1. Vig *et al.*, *This Journal*, 1966, 43, 27.
2. Vig *et al.*, *ibid.*, 1965, 42, 581.
3. Vig *et al.*, *ibid.*, 1965, 42, 773.
4. Vig *et al.*, *ibid.*, 1965, 42, 841.
5. Mitzner and Lemberg, *J. Org. Chem.*, 1966, 31, 2022.

A total unambiguous synthesis of this compound is now achieved by the following reaction sequence:



4, 1', 1'-ethylenedioxyethylcyclohexanone (II), prepared according to the procedure reported in an earlier communication² was subjected to Wittig reaction⁶ with methyl triphenyl phosphonium iodide to yield 1-methylene-4, 1', 1'-ethylenedioxyethylcyclohexane (III) in 84 per cent yield. This compound showed characteristic I.R. peaks at 1650, 890 cm^{-1} (exo-methylene) and 1050 cm^{-1} (ketal). The compound (III) was deketalised with *p*-toluenesulphonic acid in aqueous acetone solution under mild conditions to furnish, in 82 per cent yield, 4-acetyl-1-methylene-cyclohexane (IV). The latter was characterised through its dinitrophenylhydrazone and semicarbazone derivatives. The structure was further confirmed by the I.R. absorption spectrum which showed characteristic peaks at 1720 cm^{-1} (C=O) 1650, 895 cm^{-1} (exomethylene) and 1455, 1385 cm^{-1} (C-CH₃).

The ketone (IV) was finally submitted to the Grignard reaction with methylmagnesium iodide to afford the carbinol (I) in 60 per cent yield.

The identity of the synthetic compound was established through its I.R. absorption spectrum which showed peaks at 3400, 3075, 2980, 1650, 1480, 1455, 1380, 1295, 1200, 1140, 1120, 1085, 1000, 985, 955, 905, 890, 850, 790, 780 and 760 cm^{-1} comparable in all respects with those reported³ for Δ -terpineol.

EXPERIMENTAL*

4, 1', 1'-Ethylenedioxyethyl-cyclohexanone (II) was prepared according to the procedure reported in an earlier communication².

1.-Methylene-4, 1', 1'-ethylenedioxyethylcyclohexanone (III).—Methylene phosphorane was prepared under nitrogen atmosphere from sodium hydride (0.6 g.), dimethyl sulphoxide (12.5 ml.) and methyl triphenyl phosphonium iodide (10 g.) in sulphoxide (15 ml.) in the usual way. To this was added in cold, ketal ketone (II, 3.0g.) in T.H.F. (5 ml.). The contents were stirred and heated for $\frac{1}{2}$ hr. at 50° and left overnight at room temperature. The material was taken up in petroleum ether (40-60°). After drying and solvent removal,

6. Greenwald *et al.*, *J. Org. Chem.*, 1963, 28, 1128.

*M.p.s and b.p.s. are uncorrected. Microanalysis was done by Mr. B. N. Anand, Punjab University Chemistry Department, Chandigarh. I.R. spectra were recorded on Beckman I. R.—5 with sodium chloride optics using a thin liquid film.

the residue was chromatographed on alumina (30 g.) when elution with petroleum ether (40-60°, 100 ml.) afforded the ketal (III) which was further purified by distillation under reduced pressure at b.p. 110°/8 mm., yield 2.5 g. (84%); η_D^{20} 1.4530. (Found C, 72.34; H, 9.65; $C_{11}H_{18}O_2$ requires C, 72.54; H, 9.88%).

1-Methylene-4-acetylcyclohexane (IV).—The ketal (III) (2.3 g.) was dissolved in acetone (50 ml.) and water (6 ml.). To this was added *p*-toluenesulphonic acid (200 mg.), and the contents were stirred well for 2 hr. at room temperature. The resulting solution was neutralised with sodium bicarbonate and the product was isolated by ether extractions. The extract was washed with water and then dried over anhydrous sodium sulphate. Solvent having been expelled, the residual oil on distillation in vacuum provided 1.4 g. (80%) of the ketone (IV), b.p. 90°/7 mm. η_D^{20} 1.4860. (Found: C, 78.61; H, 9.85; $C_7H_{12}O$ requires C, 78.25; H, 10.14%).

The ketone (IV) formed 2:4 D.N.P.H. which formed yellow needles after recrystallisation from ethanol, having m.p. 151-152°. (Found: N, 17.51; $C_{10}H_{16}N_4O_4$ requires N, 17.61%). The semicarbazone prepared in the usual way, melted at 158-60° (from aqueous ethanol). (Found: N, 21.65; $C_{10}H_{17}N_3O$ requires N, 21.54%).

1-Methylene-4, 1'-hydroxy- 1'-methylcyclohexane (I).—Grignard reagent was prepared to the exclusion of moisture, from dry magnesium turnings (400 mg.), methyl iodide (2.3 g.) and anhydrous ether (75 ml.). This was cooled in ice-cooled water and the ketone (IV, 2.0 g.) in anhydrous ether (15 ml.) was added dropwise with constant stirring during a period of 20 min. After the addition was complete, the contents were left overnight at room temperature and thereafter the reaction mixture was heated under reflux for about an hour to complete the reaction. The cooled contents were decomposed with saturated solution of ammonium chloride. The organic layer was separated and aqueous phase extracted many times with ether. The total ether extract was dried over anhydrous sodium sulphate, and the solvent was removed. The residue was distilled under diminished pressure to obtain (I) as a colourless oil, b.p. 100°/10 mm., yield 1.5 g. (69%). (Found: C, 78.05; H, 11.62; $C_{10}H_{18}O$ requires C, 77.92 H, 11.68%).

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