The Synthesis of (−)-7-Epichrysanthenol and its Conversion into (+)-(1*R*)-1-Formyl-2,2,4-trimethylcyclohex-3-ene

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Summary We report the synthesis of the alcohol (−)-7-epichrysanthenol (**3a**) by a two-step route from (+)-3,7-epoxypinan-2-ol, a by-product of permanganate oxidation of (−)-α-pinene; (**3a**), which can be oxidised to chrysanthenone, yields quantitatively, by a thermal rearrangement, the aldehyde (+)-(1*R*)-1-formyl-2,2,4-trimethylcyclohex-3-ene (**5**) in an optically active form.

We have shown[1] that during oxidation of (−)-α-pinene, $[\alpha]_D$ − 38°, by the procedure described by Delepine,[2] (+)-3,7-epoxypinan-2-ol (**1**) is formed in low yield. (**1**), when dehydrated in the cold using thionyl chloride with an excess of pyridine, affords (+)-3,7-epoxypin-2(10)-ene (**2**) in high yield.[1]

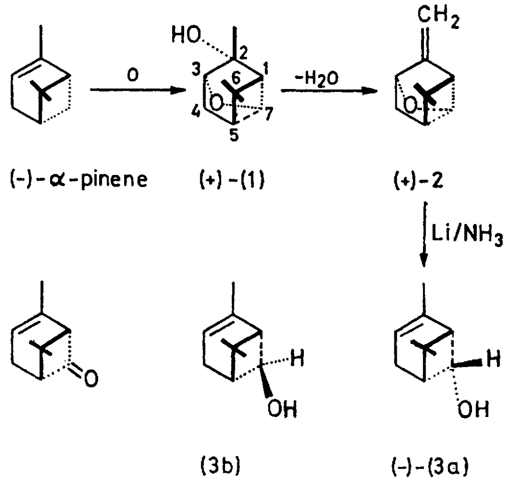
When (**2**) is added to a solution of lithium in liquid ammonia, cleavage of the ether bond is observed, and (−)-7-epichrysanthenol (**3a**) is formed† in a crude yield estimated to be nearly quantitative (n.m.r. analysis). A purified sample of (**3a**) was identified on the basis of its spectral analysis: n.m.r. (60 MHz, CCl_4) τ 4·40—4·60 (m, 3-H), 7·10—7·50 (m, C*HOH*), 8·32 (m, 2-Me), 8·81 and 9·15 (gem-Me_2 singlets); mass spectra in good agreement; $[\alpha]_D$ −49·8° (cyclohexane).

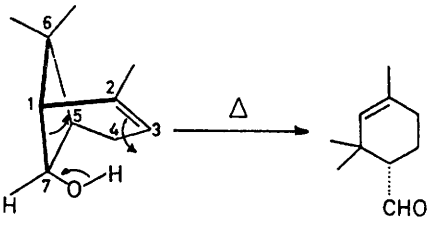
This result was corroborated by chemical transformations: when (**3a**) is oxidised by the C_5H_5N–CrO_3 complex procedure,[3] a mixture of chrysanthenone (**4**) (properties identical with those reported,[4,5] ν_{CO} 1780 cm^{-1}) and the aldehyde (**5**), is obtained in 45% overall yield.

The sequence outlined has the advantage of providing a relatively simple synthesis of (**3a**), otherwise inaccessible,† and thus clearly relates the configuration of (−)-chrysanthenol to (−)-α-pinene.

During the attempted purification of (**3a**) by g.l.c. at 180 °C, total transformation into the isomeric aldehyde (**5**) is observed.‡ (**5**) is known in a racemic form.[4,6]

Examination of a stereo-model of (**3a**) reveals that the hydroxy-group is ideally disposed for interaction with the carbon–carbon double bond, and thus for a 1,5 proton transfer, without inversion of configuration on the C-5





(−)-(3a) (+)-(5)

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† Lithium aluminium hydride reduction of chrysanthenone (**4**) leads only to chrysanthenol (**3b**) [to the exclusion of the epimer (**3a**)], which is the result of a regiospecific attack by hydride ion, coming from the side remote from the gem-dimethyl bridge. See also P. Teisseire, P. Rouiller, and A. Galfre, *Recherches*, 1967, **16**, 68.

asymmetric carbon. It follows, therefore that (**5**) is (1*R*)-1-formyl-2,2,4-trimethylcyclohex-3-ene:[7] n.m.r. (60 MHz, CCl_4) τ 0·10 (d, *J* 2 Hz, C*H*O), 4·92 (m, 3-H), 8·32 (m, 4-Me), 8·50 and 9·00 (gem-Me_2 singlets); i.r. ν_{CO} 1722 cm^{-1}, $[\alpha]_D$ +31·2° (cyclohexane);§ 2,4-dinitrophenylhydrazone, m.p. 150—151° (hexane).[6]‡

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‡ Satisfactory analytical data were obtained for this compound.

§ Autoxidation of this aldehyde (**5**) to the known acid occurs readily within a few days.

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