Stereospecific Synthesis of 4,11-Epoxy-*cis*-eudesmane, a Tricyclic Sesquiterpene Defence Secretion from the Termite *Amitermes evuncifer*

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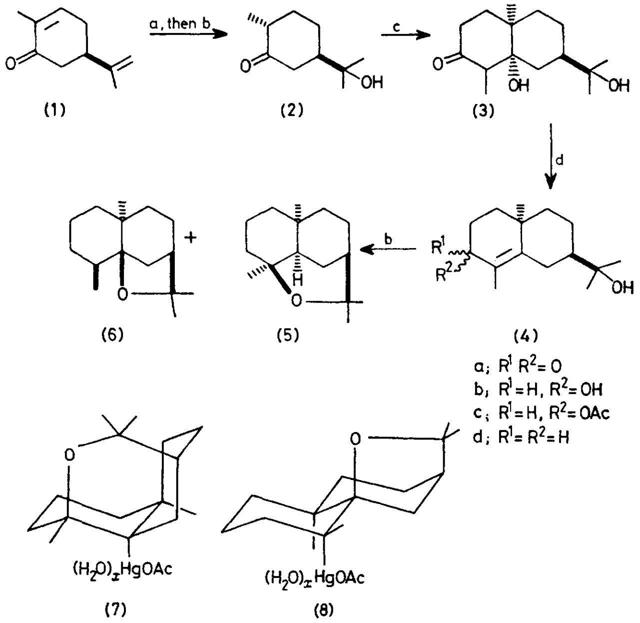
Summary The title compound has been synthesised by an unambiguous route from (—)-carvone involving an intramolecular oxymercuration procedure; the synthetic and naturally occurring materials from *A. evuncifer* have identical $[\alpha]_D$ values.

The soldier caste of the West African termite *Amitermes evuncifer* is responsible for colony defence. The soldiers possess mandibles which are used in mechanical defence but also possess a well developed frontal gland which produces a defence secretion which has formicidal activity. This secretion consists predominantly of one major component (>90%), which we previously isolated and assigned the structure (**5**)[1] from spectroscopic and microscale reaction data.† We now report an unambiguous synthesis of (**5**), which confirms the identity of the naturally occurring compound.

Epi-γ-eudesmol (**4d**) was synthesised from (—)-carvone (**1**) (Scheme) by a modification of the procedure of Marshall and Pike[2] in which the key step was the annulation of (**2**) with 1-chloropentan-3-one. Oxymercuration of (**4d**) with mercuric acetate in a tetrahydrofuran (THF)–water mixture (1 : 1), followed by *in situ* reduction of the intermediate mercury complex with aqueous alkaline sodium borohydride gave a 3 : 1 mixture of (**5**) together with isodihydroagarofuran (**6**)‡ in 80% yield.

The oxymercuration processes leading to (**5**) and (**6**) are necessarily stereospecific since formation of an intermediate with the mercury atom on the α-face of (**4d**) is required for intramolecular attack from the β-face by the C-11 hydroxy group to form the intermediates (**7**) and (**8**), respectively. The reduction of these intermediates by alkaline sodium borohydride proceeds with retention of configuration. Thus (**5**) must be formed with a *cis* ring junction, a fact which is also supported by the isolation of (**6**) as a minor product in which the C-4 methyl group is in an equatorial position.

Although (**5**) has 4 asymmetric centres, steric constraints demand that (**5**) can only exist as two enantiomers. The synthesis described here starting from (—)-carvone will clearly produce only one enantiomer. The optical rotation of the synthetic product ($[\alpha]_D^{28}$ $-22°$, $CHCl_3$) compares exactly with that obtained for the isolated natural product, and therefore the absolute stereochemistry of (**5**) is as shown. All other spectral details of the synthetic and natural compounds were identical.



Scheme. Reagents: a, Zn–NaOH–EtOH–H_2O; b, (i) $Hg(OAc)_2$–THF–H_2O, (ii) alkaline $NaBH_4$; c, (i) NaH–THF. (ii) $ClCH_2CH_2COCH_2Me$; d, (i) conc. HCl–EtOH ,(ii) $LiAlH_4$–THF, (iii) Ac_2O–pyridine, (iv) Li–liq.NH_3.

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† In more recent studies on newly collected samples of the termite the 220 MHz ^1H n.m.r. and ^{13}C n.m.r. spectra of a sample of (**5**) are in complete accord with the structure proposed.

‡ The identity of (**6**) was established by comparison of spectroscopic data with those reported for an authentic sample (*cf.* A. Asselin, M. Mongrain, and P. Deslongchamps, *Canad. J. Chem.*, 1968, **46**, 2817).

[1] L. J. Wadhams, R. Baker, and P. E. Howse, *Tetrahedron Letters*, 1974, 1967.

[2] J. A. Marshall and M. T. Pike, *J. Org. Chem.*, 1968, **33**, 435.