

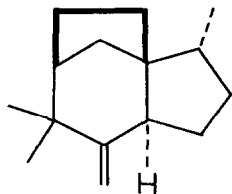
ZIZAANE SESQUITERPENES. SYNTHESIS OF THE  
COATES-SOWERBY TRICYCLIC KETONE

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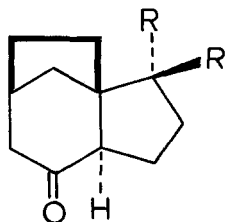
**Summary** The cycloadduct (5), which is conveniently prepared by irradiation of (4), is converted via a 4-step sequence, into the tricyclic ketone (2a) and its epimer (2b); the sequence formally completes a new total synthesis of ( $\pm$ )-zizaene (1) and its Me-epimer.

Zizaene (1) (also known as tricyclovetivene, khusinene and khusene) is the parent hydrocarbon of the zizaane family of sesquiterpenes found in vetiver oil.<sup>1</sup> The first syntheses of zizaene were published contemporaneously by Coates and Sowerby<sup>2</sup> and by Wiesner and his collaborators.<sup>3</sup> The tricyclic ketone (2a) is a key intermediate in the synthesis of Coates and Sowerby, and an alternative synthesis of this ketone has recently been described by Piers and Banville.<sup>4</sup> We now report a new approach to (2), whereby the tricycle is constructed in a single step by intramolecular photocycloaddition followed by Grob fragmentation.<sup>5</sup>

Alkylation of the bis-anion derived from cyclopentane-1,3-dione with (5-methylcyclopent-1-enyl)methyl bromide led (55%) to the dione (3)<sup>6</sup> which was then converted into a mixture of the corresponding isomeric enol acetates [(4) predominating]. Irradiation of the mixture of enol acetates produced a 7:3 mixture of the photoadducts (5) and (6) resulting from intramolecular [2+2] photocycloaddition, which was separated by chromatography. Reduction of the major photoadduct (5) [ $\nu_{\max}$  1765, 1735  $\text{cm}^{-1}$ ,  $\delta$  0.77, 0.75 (d, J 7, CHMe),



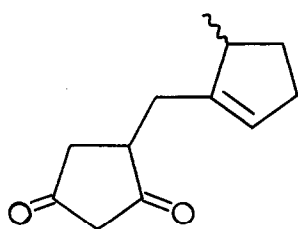
(1)



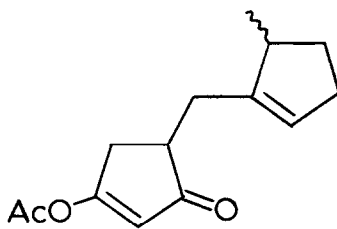
(2)

a R = Me, R' = H  
b R = H, R' = Me

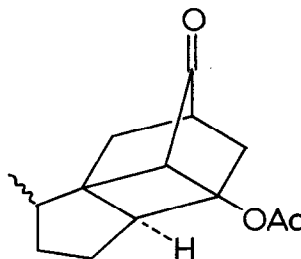
2.02, 2.04 (OAc) (1:3 mixture of  $\alpha$ - and  $\beta$ -Me epimers)] using  $\text{NaBH}_4$  in methanol at  $0^\circ$ , followed by mesylation of the resulting carbinol led to the mesylate (7) (70% overall),  $\nu_{\text{max}}$   $1730\text{ cm}^{-1}$ ,  $\delta$  3.03, 3.01 ( $\text{SO}_2\text{Me}$ ). Treatment of the mesylate with 0.5 M NaOH in aqueous dioxan at  $60^\circ$  for 1 h. effected simultaneous saponification and Grob fragmentation, with the formation of a mixture of Me-epimers of the alkene (8)<sup>7</sup>  $\nu_{\text{max}}$   $1695, 1620\text{ cm}^{-1}$ ,  $\delta$  5.68, 5.83 (d,  $\underline{J}$  5.5,  $:\underline{\text{CH}}$ ), 5.99, 6.03 (dd,  $\underline{J}$  2.5, 5.5,  $-\text{CH} \cdot \underline{\text{CH}}$ : Hydrogenation of the alkene (10% Pd on C, hexane-ether) then gave the tricyclic ketone (2a)  $\delta$  0.97 (d,  $\underline{J}$  7,  $\text{CHMe}$ ) accompanied by the epimer (2b)  $\delta$  0.92 (d,  $\underline{J}$  7). Since the tricyclic ketone (2a) has been converted previously into ( $\pm$ )-zizaene (1),<sup>2</sup> our new approach to (2) constitutes a new total synthesis of racemic zizaene and its Me-epimer.



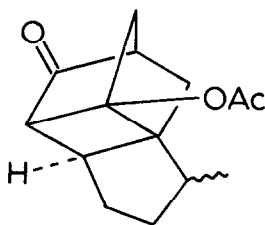
(3)



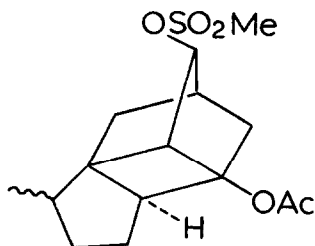
(4)



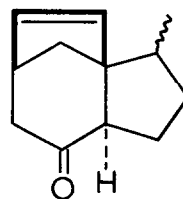
(5)



(6)



(7)



(8)

We thank the S.R.C. for a studentship (to A.J.B), and Professors Coates and Piers for providing p.m.r. spectral data on their synthetic tricyclic ketone (2).

#### References

1. For full bibliography and previous synthetic work see refs. 2, 3 and 4.
2. R.M. Coates and R.L. Sowerby, *J. Amer. Chem. Soc.*, 1972, **94**, 5386.
3. A. Deljac, W.D. MacKay, C.S.J. Pan, K.J. Wiesner, *Canad. J. Chem.*, 1972, **50**, 726.
4. E. Piers and J. Banville, *J.C.S. Chem. Comm.*, 1979, 1138.
5. cf. A.J. Barker and G. Pattenden, *Tetrahedron Letters*, 1980, 3513.
6. cf. M. Mellor and G. Pattenden, *Synth. Comm.*, 1979, **1**.
7. We were unable to detect any epimerisation at the ring fused position under these conditions.

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