

## INTRAMOLECULAR CYCLIZATION OF DIAZOKETONES: NEW STEPWISE SYNTHESIS OF SEMIBULLVALENE

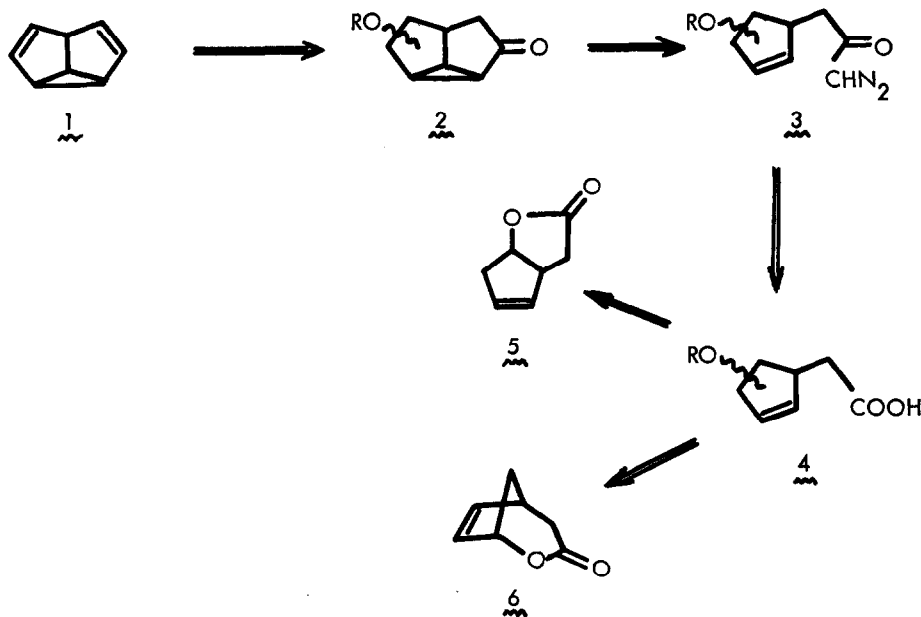
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All the reported syntheses of semibullvalene (1), except the more recent one by Malherbe<sup>1</sup>, involve some skeletal rearrangement of a cyclic key intermediate<sup>2</sup>. However, pertinent structural analysis and subsequent antithetic manipulations show that semibullvalene can be synthesized straightforward from either one of the two lactones 5 or 6.

The present communication describes a rational synthesis of semibullvalene, starting from the readily available lactone 5<sup>3</sup>, that proceeds strictly in the opposite direction to the one shown in Scheme 1.



SCHEME 1

Lactone 5 was allowed to react with *n*-butylamine at 80–90°, for 6 h, to give *cis*-*N*-butyl-(2-hydroxycyclopent-4-en-1-yl)acetamide 4, m.p. 72–3°, in 70% yield, and the hydroxy group was then protected as the tosyl derivative (m.p. 78–9°; 66% yield). Nitrosation with nitrogen dioxide, in methylene dichloride at –20°, afforded the *N*-nitroso derivative in quantitative yield, which was cleaved with potassium hydroxide in THF-water, at –20–5°, to give *cis*-(2-tosyloxycyclopent-4-en-1-yl)acetic acid (4, OR = 2-OTs), m.p. 111–2° (dec), in 66% yield.

The crude diazoketone 3 (OR = 2-OTs) –prepared from the acid 4 via acid chloride– was catalytically decomposed by copper acetylacetonate in a boiling mixture of hexane and benzene (6:1), to give, in 54% yield (from the acid), 6-*endo*-tosyloxycyclo[3.3.0.0<sup>2,8</sup>]octan-3-one (2, OR = 6-*endo*-OTs), m.p. 97–8° ( $M^+ = 292$ ). Treatment with sodium acetate in acetic acid at 120°, for 2 h, gave 6-*endo*-acetoxycyclo[3.3.0.0<sup>2,8</sup>]octan-3-one (2, OR = 6-*endo*-OAc) as an oily product (100% yield), which has been already transformed to semibullvalene in a three-step sequence<sup>1</sup>.

It is worth noting that acetolysis of the tosyloxy derivative 2 (OR = 6-*endo*-OTs) takes place readily with retention of configuration<sup>5</sup>. This behavior suggests some sort of electronic assistance (from the cyclopropane ring) which shields the *exo* side and directs the nucleophile to the sterically more hindered *endo* side; a non-classical trishomocyclopropenyl cation, such as 7, may be postulated as intermediate<sup>6</sup>.



#### References and notes

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2. H.E. Zimmerman and G.L. Grunewald, *J. Am. Chem. Soc.*, **88**, 183 (1966); H.E. Zimmerman and H. Iwanura, *ibid.*, **90**, 4763 (1968); H.E. Zimmerman, R.W. Binkley, R.S. Given, G.L. Grunewald, and M.A. Sherwin, *ibid.*, **91**, 3316 (1969); J. Meinwald and D. Schmidt, *ibid.*, **91**, 5877 (1969); H.E. Zimmerman, J.D. Robbins, and J.S. Schantl, *ibid.*, **91**, 5878 (1969); L.A. Paquette, *ibid.*, **92**, 5765 (1970); R. Askani, *Tetrahedron Letters*, 3349 (1970); R.M. Moriarty, Ch.-L. Yeh, and N. Ishibi, *J. Am. Chem. Soc.*, **93**, 3085 (1971); D.R. James, G.H. Birnbery, and L.A. Paquette, *ibid.*, **96**, 7454 (1974).
3. E.J. Corey, Z. Arnold, and J. Hutton, *Tetrahedron Letters*, 307 (1970); P.A. Grieco, *J. Org. Chem.*, **37**, 2363 (1972); Prostaglandin Intermediates "synton 148", Dynachim (France).
4. All the reported compounds gave satisfactory elemental analyses and/or spectral data.
5. The *endo* configuration was assigned by analogy with the n.m.r. spectrum of the tosyloxy derivative and by double resonance experiments, as well as by comparison with the data discussed in ref. 1 and 6c.
6. a) S. Winstein and J. Sonnenberg, *J. Am. Chem. Soc.*, **83**, 3235 and 3244 (1961); b) H. Tanida, *Accounts Chem. Res.*, **1**, 239 (1968); c) J.S. Haywood-Farmer and R.E. Pincock, *J. Am. Chem. Soc.*, **91**, 3020 (1969).