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INTRAMOLECULAR CYCLIZATION OF TRIS-α-DIAZOKETONES: A NEW STEPWISE SYNTHESIS OF BULLVALENE

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The catalytic decomposition of α-diazoketones leading to <u>trans</u>-1,2-diacylethylenes is a very well known reaction[1], and it has been recently extended to bis-α-diazoketones as a method to prepare cyclohept-2-ene-1,4-diones by means of an intramolecular cyclization[2]. On the other hand, a method of cyclopropanation of α-diazoketones <u>via</u> sulfonium ylides has also been described[1], and its application to intramolecular reactions remained as a possible synthetic entry to polycyclic cage structures.

In the present communication we wish to report a new synthesis of bullvalene[3](I) that proceeds in three steps from methane(tri-α-diazoacetone)(III).

Although the tris-α-diazoketone III was already known[4], we found that it could be prepared in excellent overall yield by the following sequence of reactions which involves a Wittig reaction and a catalytic hydrogenation of the resulting unsaturated ester:

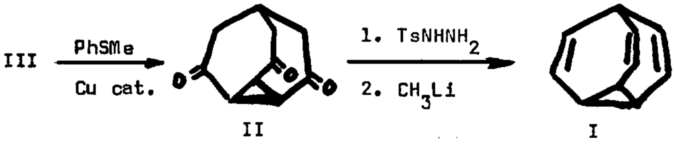
$$Ph_3P{=}CH{-}COOCH_3 \; + \; O{=}C(CH_2{-}COOCH_3)_2 \xrightarrow[76\%]{C_6H_6} CH_3OCO{-}CH{=}C(CH_2{-}COOCH_3)_2$$

$$\xrightarrow[92\%]{PtO_2/H_2} HC(CH_2{-}COOCH_3)_3 \xrightarrow[91\%]{\text{Hydrol.}} HC(CH_2{-}COOH)_3 \xrightarrow[94\%]{PCl_5}$$

$$HC(CH_2{-}COCl)_3 \xrightarrow[64\%]{CH_2N_2} \underset{\text{III}}{HC(CH_2{-}CO{-}CHN_2)_3}$$

The catalytic decomposition of methane(tri-α-diazoacetone)(III) in boiling xylene, in the presence of anhydrous copper sulfate and thioanisole[1], under the high dilution conditions of Ruggli-Ziegler, afforded tricyclo$[3.3.2.0^{2,8}]$decane-3,7,9-trione ("bullvalanetrione", II) in ~2% yield as a white crystalline solid, m.p. 230-232°; ν_{max} (KBr) 3015, 2905, 1690, 1320, 1200 and 870 cm^{-1}. The n.m.r. spectrum, in deuteropyridine, is very simple: τ 6.99 (d, J = 4.2 Hz)(6H), 7.10 (s)(3H) and 7.6 (m, J = 4.2 Hz)(1H), indicating a degenerate conformational change at room temperature (a "to-and-fro"[5] or *oscillating* molecule). As anticipated, the yields of the key intermediate II are very low since the intramolecular reaction requires three reactive centers approaching one to the other at the same time (or nearly so), and very high dilution must be used in order to favor cyclization over polymerization. However, the yields could be improved up to 4.3% by using soluble copper chelates as catalyst (*Cfr.* ref. 2).

Treatment of the tris-tosylhydrazone of II with excess of methyllithium[6] gave bullvalene (I) in 20 ± 5% [††], which was identified by direct comparison with an authentic sample prepared according to the method of Schröder[3b].



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[††] The optimal experimental conditions for this step are presently being investigated. However, even the reported yield is fairly good if one realizes that three functional groups are converted in one step (~60% *per* group).

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