

Trishomocubanone (Pentacyclo[6,3,0,0^{2,6},0^{3,10},0^{5,9}]undecan-4-one)

By PHILIP E. EATON,* RICHARD A. HUDSON, and CLAUDIO GIORDANO
(Searle Chemistry Laboratory, The University of Chicago, Chicago, Illinois 60637)

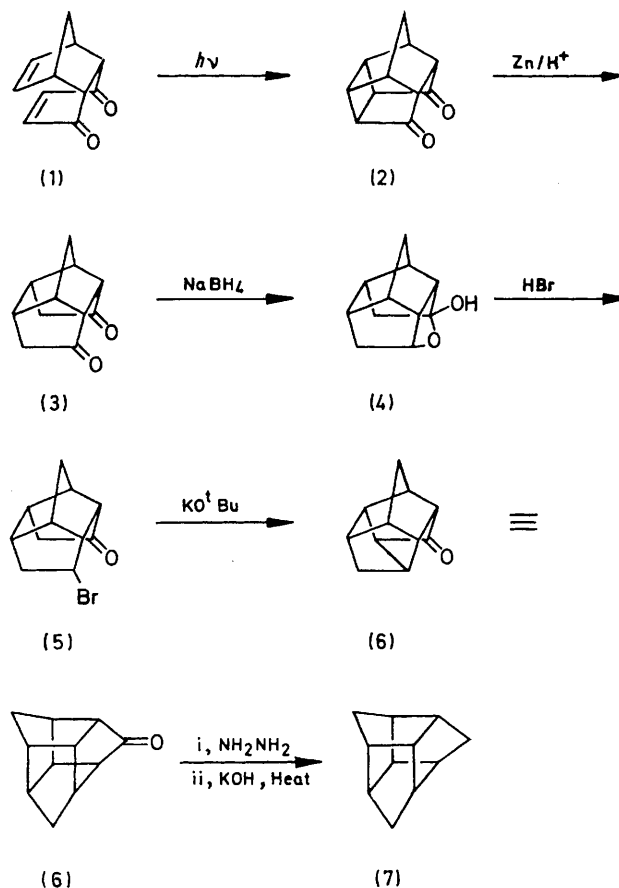
Summary A method is outlined for the conversion of the cyclopentadiene-quinone Diels-Alder adduct into trishomocubanone and trishomocubane.

WE have found a direct synthetic route to trishomocubanone (6).¹ The pentacyclic framework of this ketone, unlike that in most other highly condensed cage systems, contains no cyclobutane rings: the skeleton is constructed of five-membered rings. It is intrinsically chiral. Trishomocubanone is a key member of the system as the carbonyl group provides a ready 'handle' for optical resolution and for the introduction of other functional groups.

Unlike other entries into the trishomocubane system our synthesis does not involve a carbonium ion rearrangement.^{1b,c} The well known cage compound (2), produced by photocyclization of the cyclopentadiene-*p*-benzoquinone Diels-Alder adduct (1),² is reduced with Zn-AcOH to the tetracycle (3).^{1a,3} Reduction of (3) with NaBH₄ in aqueous EtOH gives, in nearly quantitative yield, the hydroxy-ketone as the internal hemiacetal (4), m.p. 223–223.5° (from hexane). Treatment of (4) with excess of 32% HBr in AcOH at 100° for 8 h under pressure gives at least 64% of the bromoketone (5), m.p. 63–65° (from hexane), ν_{\max} (CCl₄) 1748 cm⁻¹. This bromoketone reacts quantitatively at room temperature with a suspension of KOBu^t in anhydrous Et₂O to produce the title ketone (6), m.p. 163–164° after sublimation, ν_{\max} (CCl₄) 1785 (sh), 1778, and 1757 cm⁻¹, 2,4-dinitrophenylhydrazones m.p. 207.5–208.5 (from MeCN). Wolff-Kishner reduction of (6) using standard Huang-Minlon conditions gives the hydrocarbon (7), m.p. 149–151° (from MeCN) (lit.^{1b} 147–149°).

The ¹H and ¹³C n.m.r. spectra of (6) and (7) are completely consistent with the structural assignments. Compound (6), ¹H n.m.r. (270 MHz; CDCl₃) δ 2.47 (2H, *W*₁ ca. 12 Hz), 2.40 (4H, *W*₁ ca. 7 Hz), 1.79 (2H, *W*₁ ca. 10 Hz), 1.69 (2H, d, *J* 10.5 Hz), and 1.43 (2H, d, *J* 10.5 Hz); ¹³C n.m.r. (22.63 MHz; proton-decoupled; CDCl₃) δ (from Me₄Si) 217.3(w), 50.2, 47.6, 41.1, 40.9, and 35.5 p.p.m. (intensity of upper 5 lines approximately equal). Compound (7), ¹H n.m.r. (270 MHz; CDCl₃) δ 2.0 (6H, *W*₁ ca. 10 Hz), 1.8 (2H, *W*₁ ca. 15 Hz), and 1.32 (6H, *W*₁ ca. 3 Hz); ¹³C n.m.r. (22.63 MHz; proton-decoupled; CDCl₃) δ 47.7, 41.5, and 33.2 p.p.m., intensity ratio roughly 6:2:3. The presence of only three resonances in the proton-decoupled ¹³C n.m.r. spectrum of (7) establishes unambiguously the arrangement of the methano-bridges in this trishomocubane as shown. Other permutations would give rise to five or more resonances in the ¹³C spectrum. (There are altogether nine

possible arrangements of the methano bridges, excluding mirror images).



We thank the National Science Foundation for support, Jeannette Manello and Arthur Kushner for assistance, and the National Institutes of Health and the National Science Foundation for grants assisting the purchase of the n.m.r. instruments used in this work. C. G. thanks Montedison S.p.A., Centro Ricerche di Chimica Organica for a leave of absence.

(Received, 15th August 1974; Com. 1053.)

¹ (a) Entry into this ring system was reported first by one of us at the 155th Meeting of the American Chemical Society, San Francisco, April, 1968. The method presented then was a primitive version of that described here. (b) Another approach to the ring system (but not the ketone) has been given by G. R. Underwood and B. Ramamoorthy (*Tetrahedron Letters*, 1970, 4125). (c) P. v. R. Schleyer, S. A. Godleski, E. Osawa, and G. J. Kent, preceding communication, have synthesised trishomocubane by AlBr₃-isomerization of the hydrocarbon derived from (2). We thank Dr. Schleyer for informing us of this result prior to publication.

² R. C. Cookson, E. Crundwell, and J. Hudec, *Chem. and Ind.*, 1958, 1003.

³ E. Wenkert and J. E. Yoder, *J. Org. Chem.*, 1970, 35, 2986.