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CYCLOPROPYLIDENE FORMATION IN 7,7-DIBROMONORCAR-3-ENE OXIDES.
SYNTHESIS OF DERIVATIVES OF HOMOBENZVALENE OXIDE.

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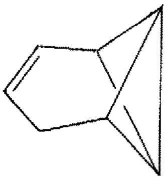
Abstract. Treatment of 4b, 4c, and 4d with methyllithium affords 5b, 6b; 5c, 6c; and 5d respectively in serviceable yields via carbenoid cyclization.

The ready availability of tricyclo[4.1.0.0.^{2,7}]hept-3-ene (1) ("homobenzvalene") and several of its methylated derivatives[1] has afforded access to ring systems of higher strain level.[2] The value of this precursor is somewhat attenuated by the high reactivity of 1 and additionally by its propensity for electrophilic addition at the bicyclobutane as well as the olefin site.[3]



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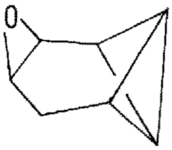
We wish to report the synthesis of several derivatives of 3-oxotetracyclo[5.1.0.0.^{2,4}0.^{6,8}] octane (2) ("homobenzvalene oxide"), in which additional functionalization has been introduced into the bridging carbons.



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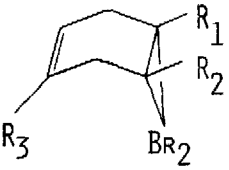
Our approach was to carry out the complete functionalization of the bridging carbons before formation of the sensitive bicyclobutane moiety.[4] Thus, 7,7-dibromonorcar-3-ene (3a) was added to m-chloroperoxybenzoic acid, affording the epoxide (4a).



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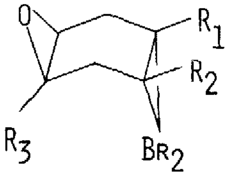

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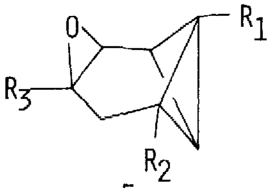

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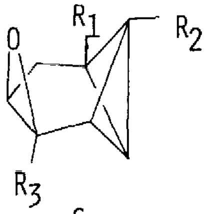
A $R_1 = R_2 = R_3 = H$

B $R_1 = CH_3 : R_2 = R_3 = H$

C $R_1 = R_3 = CH_3 : R_2 = H$

D $R_1 = R_2 = CH_3 : R_3 = H$



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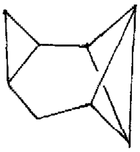

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The epoxide was subjected to the action of ethereal methyllithium. It was envisioned that carbenoid cyclization would occur to afford (5a). However, aside from a very small amount of benzyl alcohol, no volatile products were observed in the reaction mixture.

While conformational effects in carbenoid systems have been shown to be of major importance,[5] the successful closure to the cyclopropyl system (7) indicates that, in a similar conformational environment, cyclization does occur. Competitive attack of methyllithium at the epoxide linkage should be minimal, in the absence of added Lewis acids.[6] Our view is that the electron-withdrawing properties of the epoxide oxygen serve to deactivate the C-H bond to insertion. Similar phenomena have been observed in other systems.[5]

In order to circumvent this problem, recourse was made to bridgehead alkylated systems. In such a way conformational constraints could be imposed on the skeleton so as to enhance the possibility of C-H insertion.[5]

Treatment of an ethereal solution of 4b, obtained by epoxidation of 1-methyl-7,7-dibromonorcar-3-ene (3b), with an excess of halide-free methyllithium[7] at 0° under argon for 90 minutes, followed by aqueous workup afforded, upon flash distillation, a 54% yield of a clear liquid. GC/MS analysis indicated the presence of 3 isomers of the formula $C_8H_{10}O$ in the ratio 6:1.5:1. Isolation, via preparative gc permitted identification of the major component as 5b [$\delta^{CDCl_3}_{TMS}$ 3.12 (t, J = 4Hz,1); 2.84 (m,1); 2.50 (m,1); 2.02 (m,1); 1.77 (m,2); 1.53 (s,3); 1.27 (m,1)] and intermediate component as 6b [$\delta^{CDCl_3}_{TMS}$ 3.30-2.80 (m,2); 2.71 (m,1); 1.90-1.50 (m,4); 1.05 (s,3)]. The minor isomer has not yielded to positive identification.

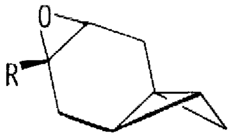
Similar treatment of the analogously formed dimethyl compound (5c) with halide-free methyllithium afforded, in 76% yield, a mixture of three isomers in the ratio 7:1:1.5. The structure of the major isomer was formulated as 6c [$\delta^{CDCl_3}_{TMS}$ 2.95 (d, J = 3Hz,1); 2.50 (br q J = 3Hz,1); 2.00 (m,1); 1.80-1.50 (m,5, inc s at 1.55); 1.20 (m,4, inc s at 1.20)] and the minor constituent as 7c [$\delta^{CDCl_3}_{TMS}$ 2.78 (m,1); 2.45 (t, J = 3Hz,1); 1.60 (m,2); 1.38 (s,3); 1.20 (m,2); 1.05 (s,3)]. The intermediate isomer has not been positively identified.

Cyclization of the symmetrical dibromide (4d) afforded, in 58% yield, a single volatile product, identified as 5d [$\delta^{CDCl_3}_{TMS}$ 3.20-2.75 (m,2); 2.50 (t, J = 1.5Hz,1); 1.75 (m,2); 1.50 (s,3); 1.33 (m,1); 1.05 (s,3)].

Note should be made of the precedented[5] preference for "bridge" substitution to "wing" substitution in the cyclization (ratio 5b/6b and 5c/6c).

Those unidentified products arising from reaction of 4b and 4c appear to be structurally related. Spectral measurements indicate the following: 1) epoxide moiety retains its identity, 2) no vinyl protons are produced, 3) one methyl resonance has been altered into resonances for several differing aliphatic protons, and 4) resonances suggesting strained cyclopropyl groups are present.

In light of the above evidence, we have tentatively assigned structures to these compounds arising via cyclopropylidene insertion into the proximal methyl group.[8] Such an insertion would give rise, in the case of 4b, to the isolation of 8a ($\delta^{CDCl_3}_{TMS}$ 3.35-2.90 (m,2); 2.25-2.00 (d, of d,



8A R = H
8B R = CH_3

J = 6, 1.5Hz,1); 1.92 (t, J = 2Hz,1); 1.85-1.60 (m,1); 1.50 (d, J = 2Hz,1); 1.10-0.90 (m,1); 0.83 (m,2); 0.65 (m,1)]. In the instance of 4c, the analogous product is 8b ($\delta^{CDCl_3}_{TMS}$ 3.00 (m,1); 2.70 (m,1); 2.20 (m,1); 1.93 (m,1); 1.80 (d, J = 4Hz,1); 1.48 (d, J = 4Hz,1); 1.30 (s,3); 1.30-0.70 (m,2); 0.60 (m,1)].[9]

Footnotes and References

1. a. L. A. Paquette E. Chamot and A. R. Browne, J. Amer. Chem. Soc., 102, 637 (1980).
   b. M. Cristl and B. Bruntrup, Ang. Chem. Int. Ed., 13, 208 (1974).
   c. R. T. Taylor and L. A. Paquette, Tetrahedron Lett., 2741 (1976).
2. L. A. Paquette and R. T. Taylor, Tetrahedron Lett., 2745 (1976).
3. P. Bischof, R. Gleiter, R. T. Taylor, A. R. Browne and L. A. Paquette, J. Org. Chem., 43, 2391 (1978).
4. We have as yet been unable to establish conditions for the alternative procedure, namely epoxidation of homobenzvalene.
5. See L. A. Paquette and R. T. Taylor, J. Amer. Chem. Soc., 99, 5708 (1977), and references therein.
6. R. W. Herr, D. M. Wieland and C. R. Johnson, J. Amer. Chem. Soc., 92, 3813 (1970).
7. Use of halide-free methyllithium appears to be critical. Reaction with CH_3Li-LiBr complex gave complicated mixtures, not amenable to analysis.
8. For previously noted insertion into sidechains, see R. B. Reinarz and G. J. Fonken, Tetrahedron Lett., 4013 (1973).
9. The financial support of the Research Corporation is gratefully acknowledged.

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