Isoprenoid Synthons† *via* a New 1,2-Dihalogenocyclopropane Synthesis

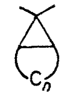
By WILLIAM E. BARNETT* and RALPH F. KOEBEL
(*Chemistry Department, University of Georgia, Athens, Georgia* 30601)

Summary Isoprenoid synthons having the 1,2-dihalogenocyclopropane structure have been prepared by selective removal of one bromine atom from dibromocarbene adducts of 1-halogenoisobutenes.

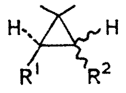
THE 1,2-dialkyl-3,3-dimethylcyclopropane ring is a common structural feature of a wide variety of terpenoids,[1] but only a few methods exist for the construction of such a moiety. Constructions by intramolecular alkylation of a suitably located 2-halogeno-2-propyl substituent have been reported, the carbanions employed being derived from a nitrile,[2] an ester,[2] and a vinylogous aldehyde;[3] and carboxylic acid derivatives have been synthesized by reactions of ethyl diazoacetate with isopropylidene compounds.[4] However, the most exciting methods reported to date have in common the insertion of the *gem*-dimethyl-bearing carbon atom into the double bond of a suitable cycloalkene or alkene to give, respectively, molecules of the type (I) and (II). Thus for electrophilic olefins either 2-diazopropane[5] or diphenylsulphonium isopropylide[6] can be used; and for unactivated olefins the insertion of dibromocarbene[7] followed by double displacement of the *geminal* bromines using lithium dimethylcopper[8] accomplishes the transformation. In principle, the alternate use of pre-formed cyclopropyl units might be of value for syntheses of (I) and (II). We report the construction of synthons[9] having the 1,2-dihalogeno-3,3-dimethylcyclopropane structure (III).

Although many polyhalogenated cyclopropanes have been reported, syntheses of simple 1,2-dihalogenocyclopropanes are rare. In the only known cases,[10] the synthesis was accomplished by halogen addition to cyclopropene. Although by formal analogy the addition of halogen to the known 3,3-dimethylcyclopropene[11] could give the desired synthons, such addition reactions to alkyl-substituted cyclopropenes have not been reported and this approach was not used. Instead a new method for the synthesis of 1,2-dihalogenocyclopropanes was developed. For the construction of (III), the appropriate 1-halogenoisobutene was treated with tribromomethylphenylmercury[7] to generate the 1,1-dibromo-2-halogeno-3,3-dimethylcyclopropanes (IV a and b). Selective removal of one bromine atom with triphenyltin hydride[12] then gave the desired synthons.

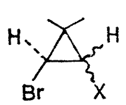
Stereospecificity in the reduction was not expected[13] and in practice this was advantageous since both stereoisomers of (III a and b) were desired. Stereoidentities for (III a) have not been determined, but the major reduction products of (IV b) have been identified as *cis*- and *trans*-(III b). The n.m.r. spectrum‡ of *trans*-(III b) in CCl$_4$ showed a 2H singlet at δ 2·93 and a 6H singlet at δ 1·32; *cis*-(IIIb) in CCl$_4$ showed a 2H singlet at δ 3·05 and two 3H singlets at δ 1·24 and 1·26. From considerations of the stereospecific insertion of dibromocarbene[14] and of the great selectivity of tin hydride reducing agents for bromine as opposed to chlorine,[12] it was supposed that the same sequence could be useful for the stereospecific preparation of 1,2-dichlorocyclopropanes; accordingly, *cis*-1,2-dichloroethylene afforded pure *cis*-1,2-dichlorocyclopropane *via* intermediate tetrahalide (IV c). The n.m.r. spectrum of (IV c) showed a singlet at δ 3·86 and the H–H coupling constant as determined from ^{13}C satellites [J(^{13}C–H) 195·7 c./sec.] was 7·7 c./sec. These are in good agreement with values reported for other *cis*-cyclopropyl hydrogens.[15]



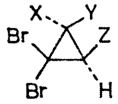
(I)



(II)



(III) X=Halogen
(IIIa) X=Cl
(IIIb) X=Br



(IV) a, X=Y=Me, Z=Cl
b, X=Y=Me, Z=Br
c, X=H, Y=Z=Cl

We thank the Research Corporation and the Petroleum Research Fund for support of this work.

(*Received, June* 13*th*, 1969; *Com.* 849.)

---

† See reference 9.

‡ N.m.r. spectra were recorded on a Varian HA-100 instrument; chemical shifts are standardized to Me$_4$Si = δ 0·00.

[1] R. Soman, *J. Sci. Ind. Res. (India)*, 1967, **26**, 508.
[2] M. Julia, S. Julia, and B. Cochet, *Bull. Soc. chim. France*, 1964, 1476 and 1487.
[3] G. Büchi, W. Hofheinz, and J. V. Paukstelis, *J. Amer. Chem. Soc.*, 1966, **88**, 4113.
[4] L. Crombie, S. H. Harper, and K. C. Sleep, *J. Chem. Soc.*, 1957, 2743.
[5] C. Berger, M. Franck-Neumann, and G. Ourisson, *Tetrahedron Letters*, 1968, 3451.
[6] E. J. Corey and M. Jautelat, *J. Amer. Chem. Soc.*, 1967, **89**, 3912.
[7] D. Seyferth, J. M. Burlitch, R. J. Minaz, J. Y. Mui, H. D. Simmons, A. J. H. Treiber, and S. R. Dowd, *J. Amer. Chem. Soc.*, 1965, **87**, 4259; D. Seyferth and J. M. Burlitch, *J. Organometallic Chem.*, 1965, **4**, 127.
[8] E. J. Corey and G. H. Posner, *J. Amer. Chem. Soc.*, 1967, **89**, 3911.
[9] E. J. Corey, *Pure and Appl. Chem.*, 1967, **14**, 19. "Synthon" is defined on p. 20.
[10] K. B. Wiberg and W. J. Bartley, *J. Amer. Chem. Soc.*, 1960, **82**, 6375.
[11] G. L. Closs, L. E. Closs, and W. A. Böll, *J. Amer. Chem. Soc.*, 1963, **85**, 3796.
[12] H. G. Kuivila, *Accounts Chem. Res.*, 1968, **1**, 299.
[13] D. Seyferth, H. Yamazaki, and D. L. Alleston, *J. Org. Chem.*, 1963, **28**, 703.
[14] G. L. Closs, "Topics in Stereochemistry," ed. N. L. Allinger and E. L. Eliel, Vol. 3, Interscience, New York, 1968, p. 193.
[15] J. W. Emsley, J. Feeney, and L. H. Sutcliffe, "High Resolution Nuclear Magnetic Resonance Spectroscopy," Vol. 2, Pergamon Press, London, 1966, p. 592.