Tetrahedron Letters No. 37, pp 3295 - 3296, 1974. Pergamon Press. Printed in Great Britain.

1-BROMOCYCLOPROPYLLITHIUM DERIVATIVES. CARBENOID INTERMEDIATES FOR THE PREPARATION OF CYCLOBUTANONES, CYCLOPROPYL KETONES, AND 1,1-CYCLOPROPANEDICARBOXYLATES

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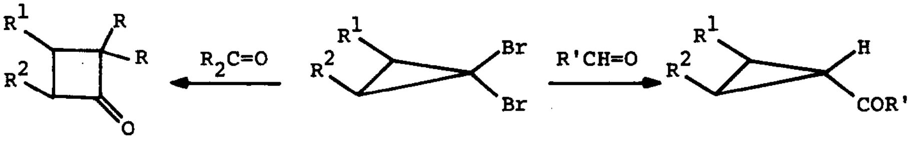
(Received in Japan 6 July 1974; received in UK for publication 25 July 1974)

A recent report[1] by Seebach et al. has prompted this publication of independent results obtained on the same reaction (I → II) as well as on the sequence (I → III) which has not been mentioned in that paper.



II I III

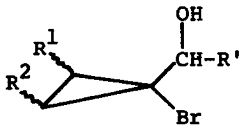
A dibromocyclopropane I (2.00 mmol in 13 ml of tetrahydrofuran (THF)) was treated at -95° (liq. nitrogen-toluene bath) with equimolar n-butyllithium (1.45 M hexane solution) and then a ketone (2.00 mmol in 0.5 ml of THF) was added at the same temperature. Stirring at -95° for 1.5 hr and at -78° for 4 hr, followed by work-up, gave an intermediary oxaspiropentane (ν_{C-O} 1200 cm^{-1}, and no carbonyl absorption) which isomerized to cyclobutanone II upon tlc (SiO_2) purification or upon treatment with dil perchloric acid. The results now disclosed are [R^1, R^2, R, Yield (%) of II[2]]: [Ph, H, Me, 40], [$-(CH_2)_4-$, Me, 29], [$-(CH_2)_6-$, Me, 20], [$n-C_6H_{13}$, H, Me, 41]. The low yield is ascribed to the enolization of the ketones instead of the desired carbonylation.

With aldehydes the intermediary β-bromoalcohols IV were isolated and subsequently treated with three molar sodium hydride in dioxane at reflux to yield cyclopropyl ketones III.[3] [R^1, R^2, R', Yield (%)[4a] of IV,[2] Yield (%)[4a] of III[2]]: [$-(CH_2)_4-$, Ph, —, 77[4b]], [$-(CH_2)_4-$, Me, 55, 70[4c]], [$-(CH_2)_4-$, $n-C_6H_{13}$, 60, 80[4c]],

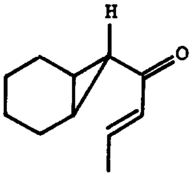
[$-(CH_2)_4-$, MeCH=CH, 62, 90 (V)[4c]], [Ph, H, Ph, 76,[4d] 72,69[4c,e]], [Ph, H, Me, 58,[4f] 93,95[4b,e]], [n-C_6H_{13}, H, n-C_6H_{13}, 96, 95[4b]]. Whereas heating the THF solution of the intermediary lithium alcoholate of IV (R^1,R^2 = $-(CH_2)_4-$, R' = Ph) for 3 hr gave the corresponding III in a 53% yield, replacing the solvent by dioxane improved this to 77%. Although some IV's were found to be diastereoisomeric mixtures, every III obtained proved to be homogeneous and the thermodynamically more stable *trans* or *exo* isomer: 7,7-dibromonorcarane → 7-*exo* isomer, 2-phenyl-1,1-dibromocyclopropane → *trans* isomer.

The carbenoid from 7,7-dibromonorcarane reacted with crotonaldehyde in the 1,2 fashion. The adduct was directly converted to cyclopropyl vinyl ketone V.

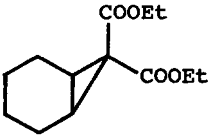
Further versatility of the title carbenoid is evidenced by the reaction of 7,7-dibromonorcarane with two molar n-butyllithium and diethyl carbonate which gave 7,7-diethoxycarbonylnorcarane (VI) in 72% yield. This reaction sequence assures to avoid the use of diazomalonate.



IV



V



VI

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2. All new compounds were identified spectrometrically and analytically.
3. Cyclopropyl ketone synthesis: G. Stork and P. A. Grieco, *Tetrahedron Lett.*, 1807 (1971); T. Saegusa, Y. Ito, K. Yonezawa, Y. Inubushi, and S. Tomita, *J. Amer. Chem. Soc.*, **93**, 4049 (1971); M. Jones, Jr. and W. Ando, *ibid.*, **90**, 2200 (1968); W. Hampel and M. Kapp, *J. Prakt. Chem.*, **312**, 394 (1970); J. M. Conia and J. P. Barnier, *Tetrahedron Lett.*, 4981 (1971); J. P. Barnier, J. M. Denie, J. R. Salaün, and J. M. Conia, *J. Chem. Soc. Chem. Commun.*, 103 (1973).
4. (a) Yield of pure sample. (b) Pure *trans* isomer. (c) Pure *exo* isomer. (d) Diastereoisomeric mixture (3:1). (e) From each diastereomeric alcohol. (f) Diastereoisomeric mixture of 1:1.