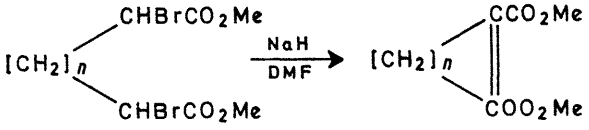
A Convenient Cyclization of Dimethyl Esters of C_6—C_9 α,α′-Dibromoalkanedioic Acids to the Corresponding Dimethyl Cycloalk-1-ene-1,2-dicarboxylates

By RICHARD N. MCDONALD* and ROBERT R. REITZ†

(*Department of Chemistry, Kansas State University, Manhattan, Kansas* 66502)

Summary Several dimethyl α,α′-dibromoalkanedicarboxylates when treated with sodium hydride in dimethylformamide yield the corresponding dimethyl cycloalk-1-ene-1,2-dicarboxylates: evidence is presented supporting the existence of dimethyl cycloprop-1-ene-1,2-dicarboxylate as an intermediate in the reaction of dimethyl α,α′-dibromoglutarate with potassium t-butoxide.

WE report a new synthesis of several dimethyl cycloalk-1-ene-1,2-dicarboxylates by a convenient and time-saving method. The dimethyl α,α′-dibromoalkanedicarboxylates (**1**) (C_6—C_9 acids) when treated with sodium hydride in dimethylformamide (DMF) yield the corresponding dimethyl cycloalk-1-ene-1,2-dicarboxylates (**2**).



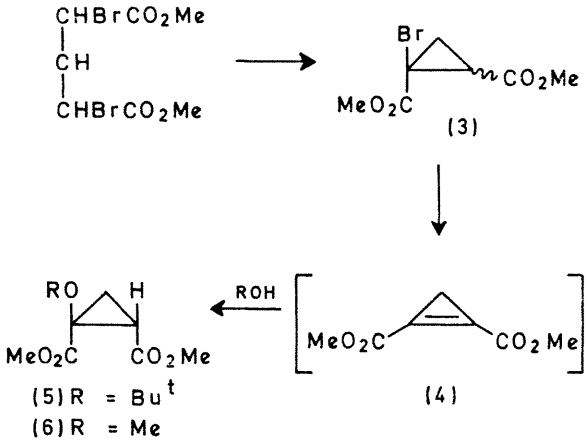
(**1**) (**2**)

The homologous dibromodiesters, (**1**), (prepared in 90—96% yield[1,2]) were treated with two equivalents of sodium hydride (mineral oil dispersion) in DMF at ice-bath temperatures. When hydrogen evolution had ceased the reaction was complete. The Table summarizes the results obtained in these combined cyclization–elimination reactions.[3]

Dibromodiester (**1**)	Reaction time	Cycloalkenediester[a] (**2**) (% yield)
$n=1$ (Glutarate)	1·5 h	0[b]
2 (Adipate)	1·0 h	48[4]
3 (Pimelate)	1·5 h	69[5]
4 (Suberate)	3·0 h	71[6]
5 (Azelate)	1·5 days[c]	21
6 (Sebacate)	1·5 days[c]	0

[a] None of the isomeric cycloalkenedicarboxylates was observed.
[b] Longer reaction times and increases in reaction temperature only gave increasing amounts of polymeric material.
[c] Reaction carried out at room temperature; slow hydrogen evolution.

Reaction of dimethyl α,α′-dibromoglutarate (**1**; $n = 1$) with sodium hydride in DMF, after the initial, steady evolution of hydrogen had ceased, gave dimethyl *cis*- and *trans*-1-bromocyclopropane-1,2-dicarboxylate (**3**) (77%) [g.l.p.c. showed the *cis* : *trans* ratio of (**3**) as 1 : 3; structural assignments based on n.m.r. spectra]. No cyclopropene (**4**) was found. Treatment of (**1**; $n = 1$) with two equivalents of potassium t-butoxide in t-butyl alcohol gave two products, dimethyl *cis*-1-t-butoxycyclopropane-1,2-dicarboxylate (**5**) (46%) and dimethyl *cis*-1-methoxycyclopropane-1,2-dicarboxylate (**6**) (9%) (structural assignments based on



their n.m.r. spectra). Repetition of this reaction with only one equivalent of potassium t-butoxide leads to the formation of *cis*- and *trans*-(**3**); further treatment of this mixture of *cis*- and *trans*-(**3**) leads to a mixture of (**5**) and (**6**).

These results rule out prior nucleophilic displacement of bromide by alkoxide followed by cyclization to (**5**) and (**6**). The possibility that (**5**) and (**6**) may be formed from the cyclopropene (**4**) by elimination followed by addition of an alcohol is consistent with the addition of t-butyl alcohol to ethyl cyclopropene-1-carboxylate.[7]

The conversion (**1**) → (**2**) is a simple, one-step process with reasonably good isolated yields of (**2**; $n = 2$—4), and provides a new and easier synthesis of (**2**; $n = 2$—5).‡

We acknowledge support of this research by the National Science Foundation.

(*Received, September 28th*, 1970; *Com.* 1663.)

† National Defense Education Act Trainee, 1968—1970.
‡ Satisfactory analyses were obtained for all new compounds.

[1] P. C. Guha and D. K. Sankaran, *Org. Synth. Coll. Vol.*, 1955, **3**, 623.
[2] E. Buchman, A. Reims, T. Skei, and M. Schlatter, *J. Amer. Chem. Soc.*, 1942, **64**, 2697.
[3] Small amounts of the diacids of (**2**; ($n = 2$, 3) and (**4**) have been obtained from base hydrolyses of the corresponding esters of (**1**); see A. Hassell and C. K. Ingold, *J. Chem. Soc.*, 1926, 1465, and F. R. Goss and C. K. Ingold, *ibid.*, p. 1471.
[4] W. H. Perkins, *J. Chem. Soc.*, 1894, **65**, 950; F. B. Kipping and J. J. Wren, *ibid.*, 1957, 1733. See R. C. Fuson and T. Y. Kao, *J. Amer. Chem. Soc.*, 1929, **51**, 1537 for the preparation of cyclobutane-1,2-dicarboxylic acid.
[5] E. Hayworth and W. H. Perkin, *J. Chem. Soc.*, 1894, **65**, 978.
[6] A. Baeyer, *Annalen*, 1890, **258**, 203; G. Kon and B. Nandi, *J. Chem. Soc.*, 1933, 1633.
[7] K. B. Wiberg, R. K. Barnes, and J. Albin, *J. Amer. Chem. Soc.*, 1957, **79**, 4994.