June 15th Group Meeting Literature Presentation

J|A|C|S COMMUNICATIONS

Published on Web 05/07/2009

Selective Reductions of Cyclic 1,3-Diesters Using SmI_2 and H_2O

Giuditta Guazzelli,[†] Sara De Grazia,[†] Karl D. Collins,[†] Hiroshi Matsubara,[‡] Malcolm Spain,[†] and David J. Procter*[,†]

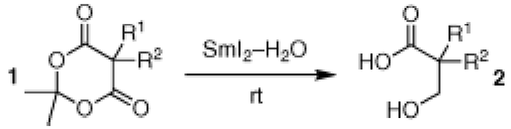
School of Chemistry, University of Manchester, Oxford Road, Manchester, M13 9PL, U.K., and Department of Chemistry, Graduate School of Science, Osaka Prefecture University, Sakai, Osaka 599-8531, Japan

Received March 11, 2009; E-mail: david.j.procter@manchester.ac.uk

J. Am. Chem. Soc., **2009,** ***131, 7214–7215***

The SmI_2-H_2O reductive system convert cyclic 1,3-diesters into β-hydroxyl monoester without over reducing…

Table 1. Reduction of Cyclic 1,3-Diesters with SmI_2-H_2O

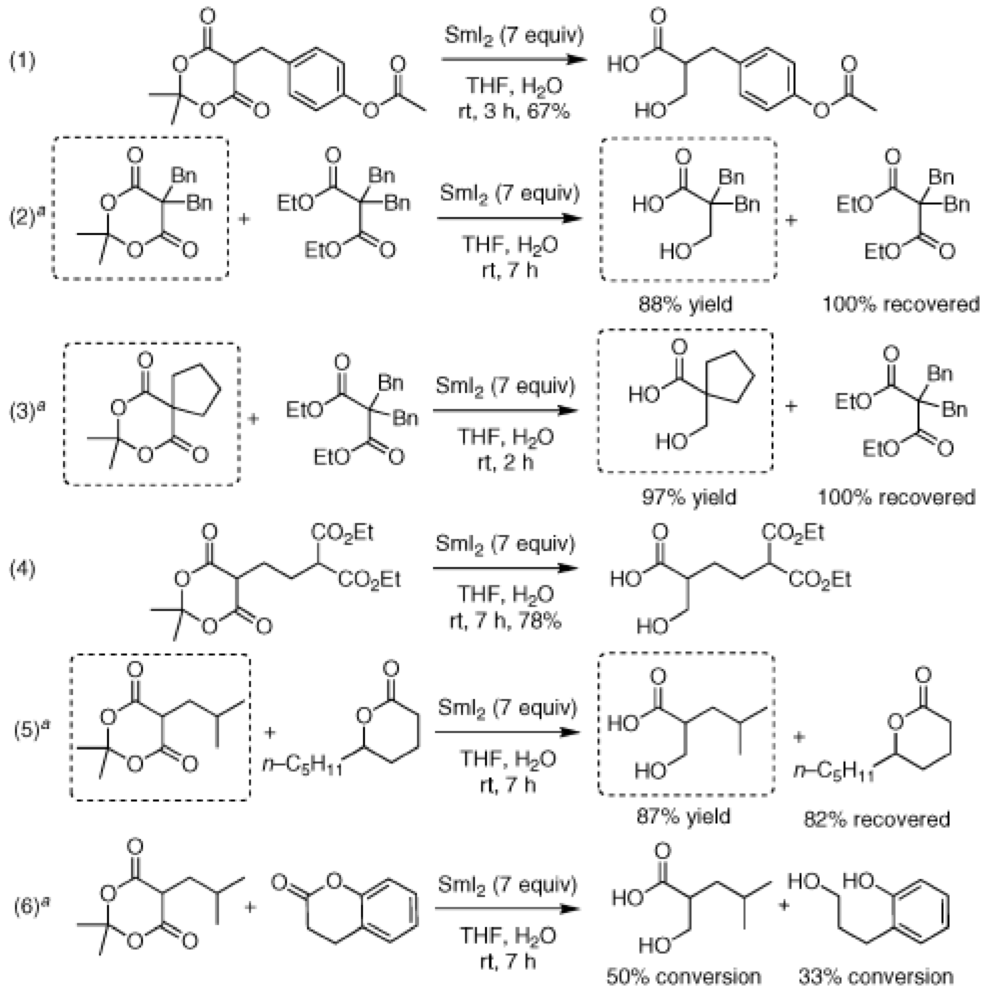


	R^1	R^2		R^1	R^2	yield of 2
1a	Bn	Bn	**2a**	Bn	Bn	88%[a]
1b	—$(CH_2)_4$—		**2b**	—$(CH_2)_4$—		81%[a]
1c	H	Bn	**2c**	H	Bn	68%[a]
1d	H	4-C_6H_4OMe	**2d**	H	4-C_6H_4OMe	78%[a]
1e	H	4-C_6H_4Br	**2e**	H	4-C_6H_4Br	77%[a]
1f	H	*i*-Bu	**2f**	H	*i*-Bu	94%[a]
1g	Me	Bn	**2g**	Me	Bn	98%[a]
1h	H	Ph	**2h**	H	Ph	72%[a]
1i	=CHPr-*i*		**2f**	H	*i*-Bu	87%[b]
1j	=CHC_6H_4OMe-4		**2d**	H	4-C_6H_4OMe	69%[b]
1k	—CH_2CH_2—		**2k**	H	Et	75%[c]

[a] Conditions: SmI_2 (7 equiv), THF, H_2O, 2−12 h. [b] Conditions: SmI_2 (9 equiv), THF, H_2O, 6−12 h. [c] Conditions: SmI_2 (10 equiv), THF, H_2O, 1 h.

…and selectivity against acyclic diesters.

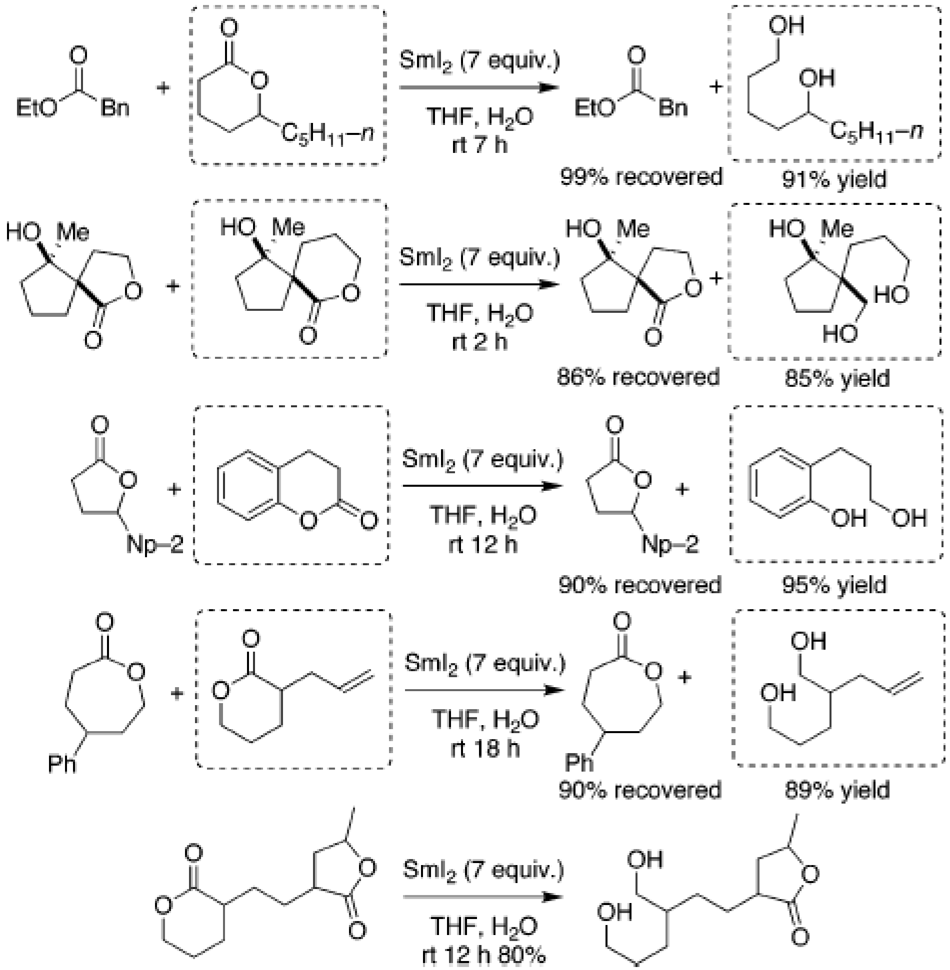
Scheme 1. Selective Reductions of Cyclic 1,3-Diesters with SmI_2-H_2O



[a] 1:1 mixture of substrates.

The same two groups studied the reduction of γ-lactones recently, and found selectivity of 6-mem ring against both larger and smaller rings.

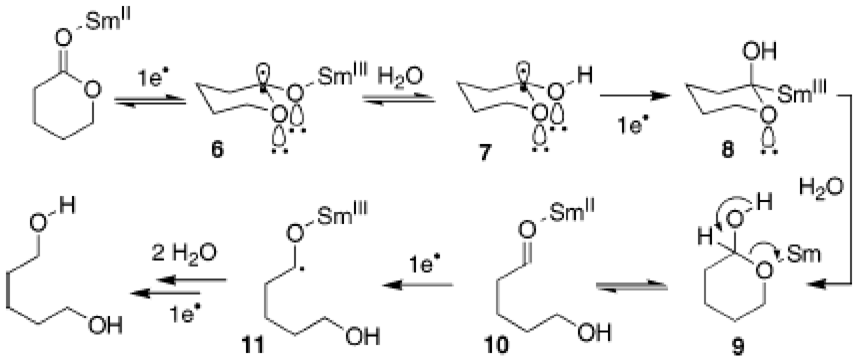
Scheme 2. Selective Reductions of Six-Membered Lactones



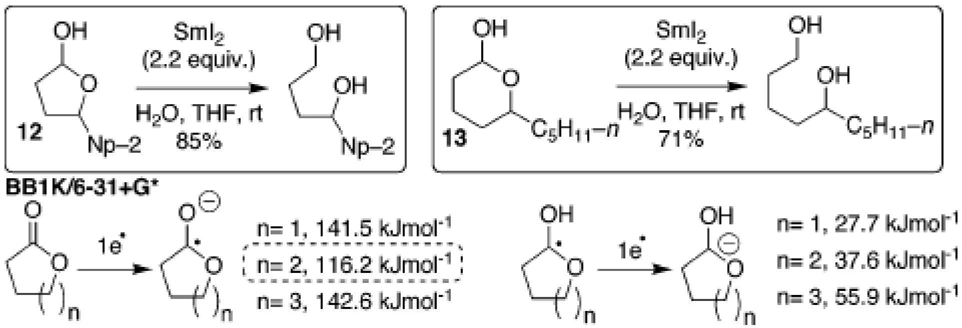
J. Am. Chem. Soc., ***2008, 130, 1136-1137***

To explain the selectivity, mechanism is proposed

Scheme 3. Mechanism for the Reduction of Lactones Using SmI_2-H_2O



Scheme 4. Investigating the Origin of the Selectivity



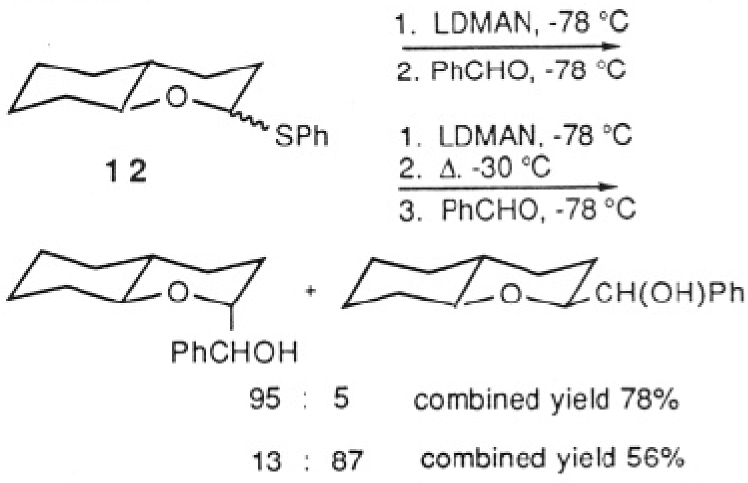
The lactols are both rapidly reduced by SmI2, so that the authors argued the first reduction is the rate limiting step and the origin of selectivity.

And they illustrated results of theoretical studies, showing the first electron transfer is the rate limiting step and differentiates the ring size.

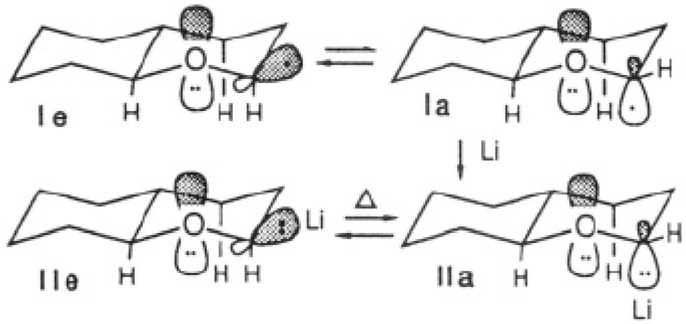
They claimed it is due to anomeric stablization in **6** that leads to preference of axial radical.

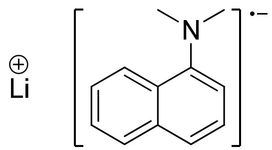
J. Am. Chem. Soc., ***2008, 130, 1136-1137***

Preference of axial radical

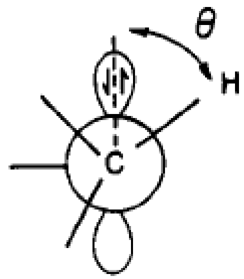


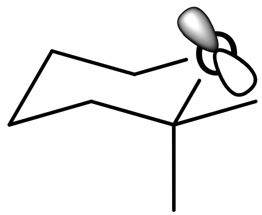
Scheme II





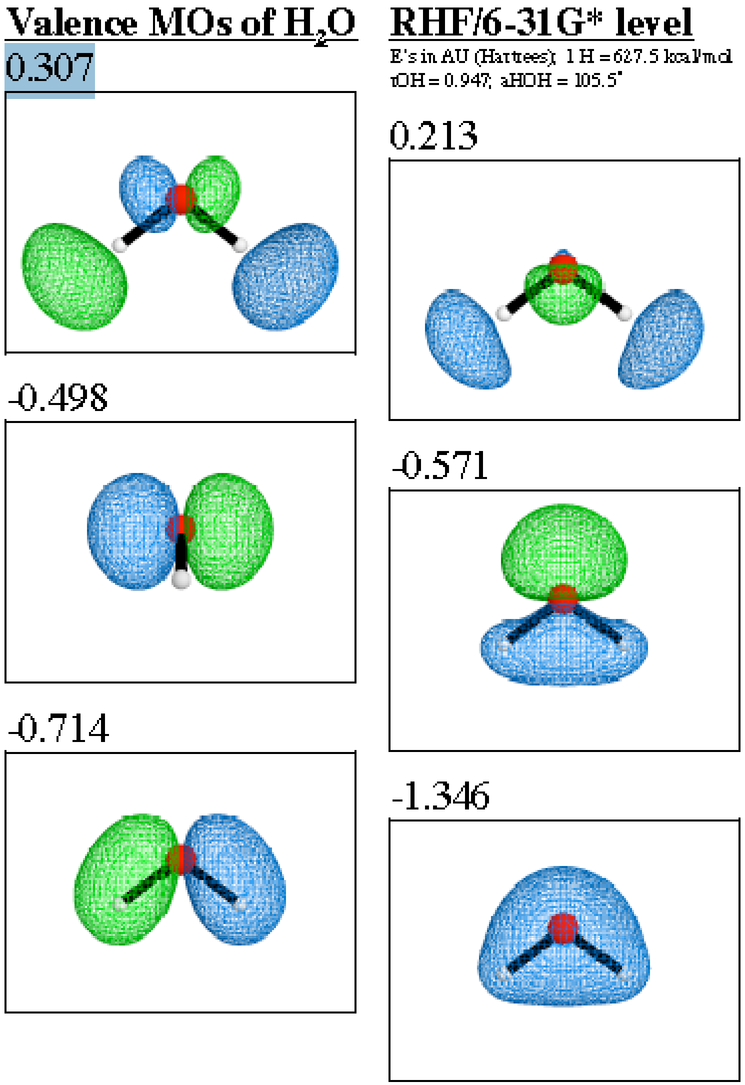
Cohen, T.; Bhupathy, M. *Acc. Chem. Res.* ***1989, 22, 152***





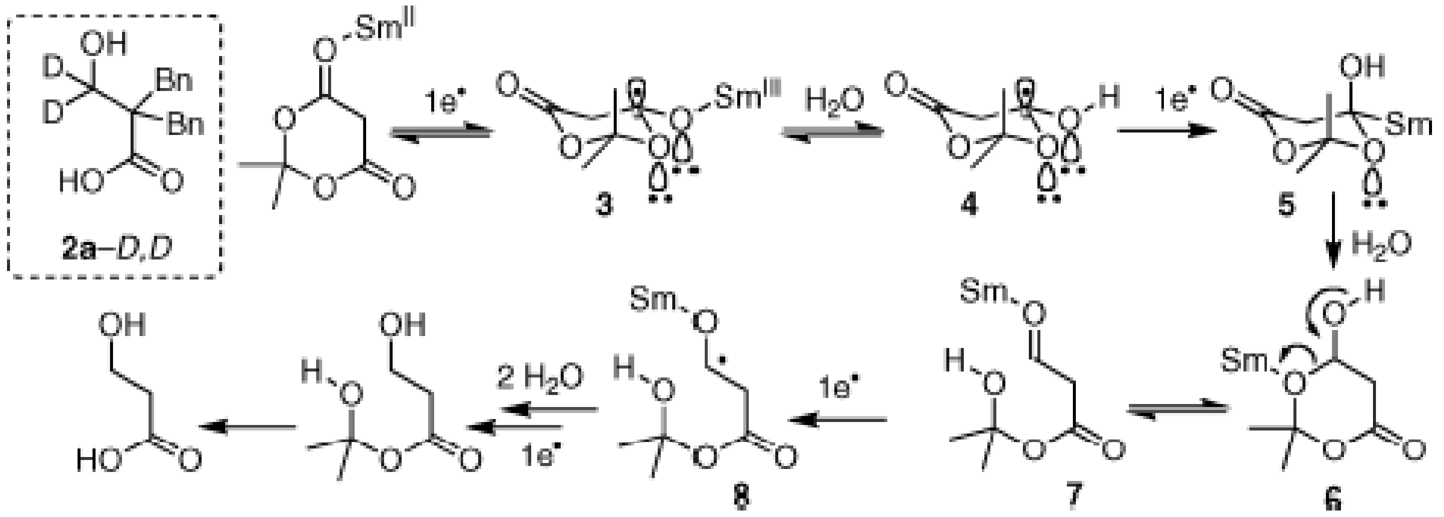
Malatesta, V., Ingold, K. U., *J. Am. Chem. Soc.,* ***1981, 103, 609-614***

Lone pairs of Oxygen in water

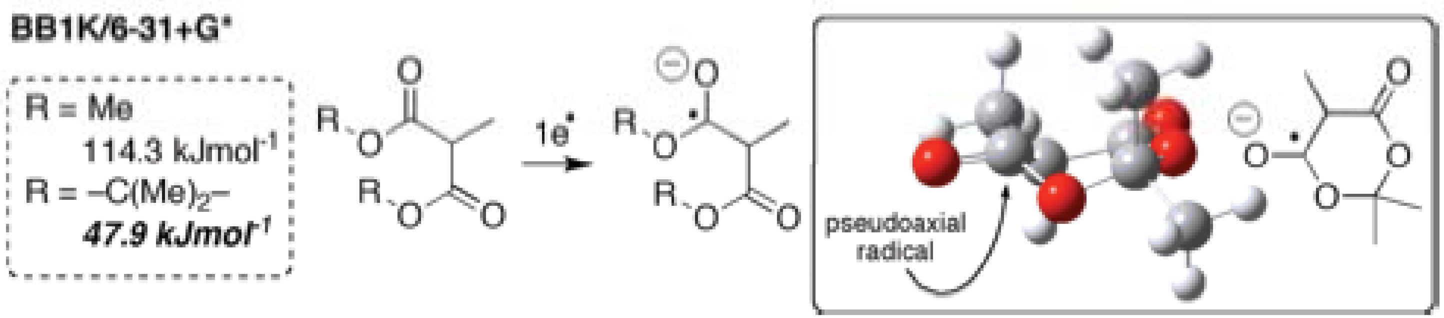


Ring opening at 6->7 accounts for no over reduction

Scheme 2. Mechanism of the Monoreduction of Cyclic 1,3-Diesters Using SmI_2-H_2O

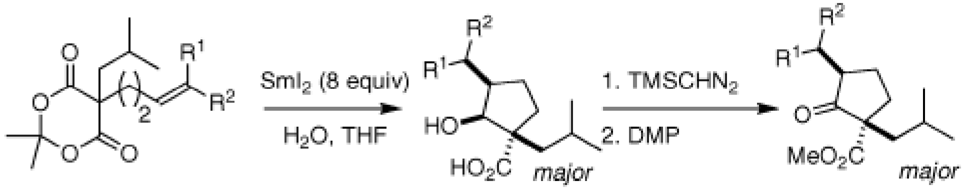


Scheme 3. Investigating the Origin of the Selectivity



J. Am. Chem. Soc., **2009, *131, 7214–7215***

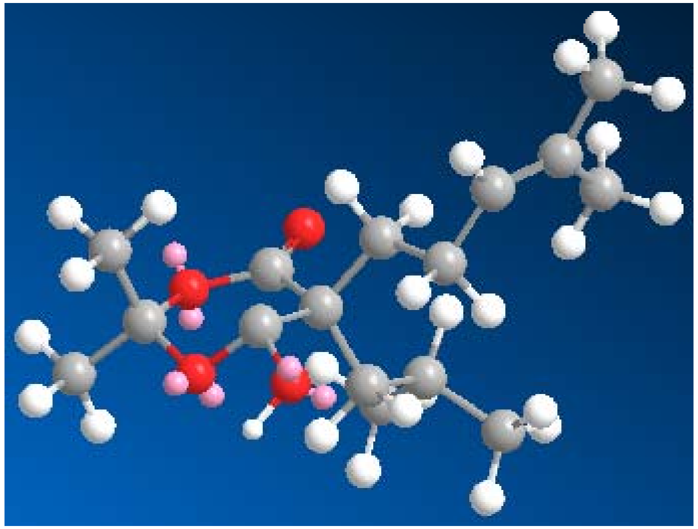
Scheme 4. Radical Cyclization Reactions of Cyclic 1,3-Diesters

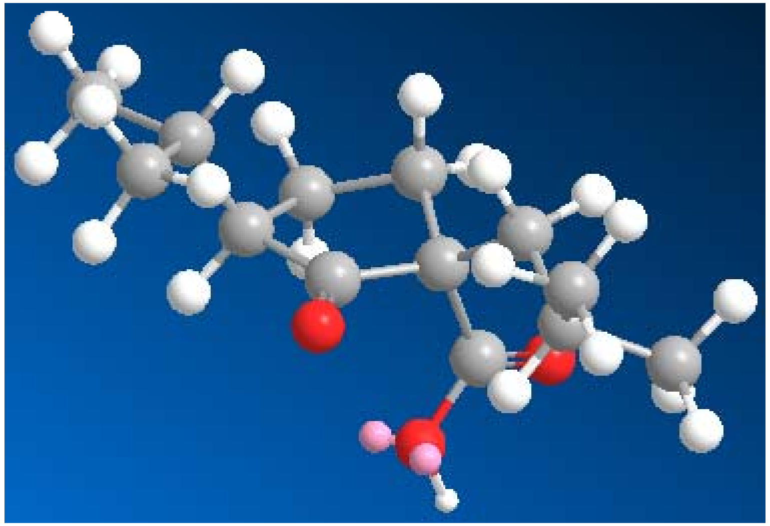


9 $R^1 = R^2 = H$
10 $R^1 = H$, $R^2 = Ph$
11 $R^1 = R^2 = Ph$

12 92% ***X–ray***
13 94%
14 66%

15 74% (2 steps), dr 2:1
16 73% (2 steps), dr 5:2
17 65% (2 steps), dr 5:1





J. Am. Chem. Soc., **2009**, ***131*, *7214–7215***