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Regiocontrol in Reductive Ring Opening of Epoxides Derived from Asymmetrized 2-Alkenyl-1,3-propanediols

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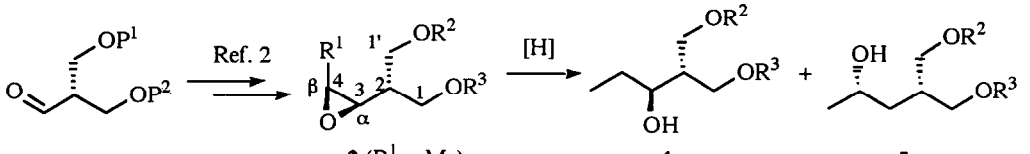
Abstract: Homochiral *cis* epoxides derived from asymmetrized 2-alkenyl-1,3-propanediols are efficiently opened by a variety of hydride donors in the presence of Lewis acids to differently protected triols with a regioselectivity up to 99 : 1.

Epoxides are very versatile intermediates that can be achieved from a variety of starting materials and by very different strategies.[1] One of the most popular method involves the epoxidation of an olefinic bond and the diastereo- and enantioselective version of this reaction has been thoroughly studied, either by starting from chiral substrates[1 - 2] or by using chiral catalysts.[1] On the other side, the polarity and strain of the three-membered ring makes these compounds susceptible to reaction with a large number of reagents, such as electrophiles, nucleophiles, and reducing agents. Opening of oxiranes involving nucleophiles in neutral or basic medium usually occurs at the less substituted carbon, while in acidic medium there is generally a greater tendency for nucleophilic attack at the carbon atom that can better accommodate a positive charge. Walden inversion at the attacked oxiranic carbon is usually observed, through a normal or 'borderline' S_N2 mechanism.[1a - b] Moreover, the presence of an acid not only can modify the reaction mechanism, but also accelerates the ring opening. The presence of an hydroxy or alkoxy group near the oxiranic ring usually affects the regiochemistry of the ring

Scheme 1



1

2 (R^1 = Me)
3 (R^1 = Pr)

4

5

	R^2	R^3		R^2	R^3
a	PMBOM	H	**d**	TIPS	PMP
b	TIPS	H	**e**	TIPS	Ac
c	PMBOM	BOM			

Ac = MeCO; BOM = $PhCH_2OCH_2$; PMBOM = 4-$MeOC_6H_4CH_2OCH_2$; PMP = 4-$MeOC_6H_4$; TIPS = $(i\text{-Pr})_3Si$;

opening and can be also useful in the preceding step, that is the stereo- and enantioselective[2] synthesis of the epoxides themselves.

Recently we reported[2] the enantio- and diastereospecific synthesis of *cis* epoxides **2** and **3** (Scheme 1). These highly functionalized intermediates were prepared in any desired absolute configuration at the centres 2, 3 and 4 by epoxidation of asymmetrized 2-alkenyl-1,3-propanediols, in turn obtained from **1**.[3]

Continuing our researches on the exploitation of **1** and its synthetic equivalents in asymmetric synthesis, we undertook a study on the reaction of chiral epoxides **2** with different hydride donors[4-9] with the purpose to define the most suitable protocol for obtaining hydroxy alcohols **4** which are useful intermediates in the asymmetric synthesis of some biological targets.

Extensive data are available in literature on the reaction of epoxides with a large variety of hydride donors, in the absence[4, 5] or in the presence[4, 6-9] of Lewis acids, and many of these methods have been successfully applied to protected or non-protected epoxy alcohols.[5, 6, 9]

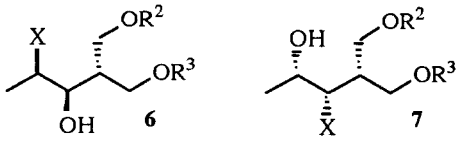
The reductive ring opening reaction of **2** to **4** and **5** (Scheme 1) has been studied by us under several conditions, using different hydride donors in the presence or in the absence of Lewis acids. We examined in details also the effect of protecting groups. Most significant data are reported in Table 1.

Examination of these data reveals that, in general, both acidic (DIBAH) and basic [$LiAlH_4$, $LiBH_4$, $Zn(BH_4)_2$] hydrides are scarcely reactive towards both diprotected and monoprotected epoxides, requiring large excess of reagent, high temperatures and prolonged reaction times. The more encumbered basic hydride Red-Al® [sodium bis(2-methoxyethoxy)aluminiumhydride] did not react at all with the epoxide **2a**. This behaviour is not surprising[9b] and can be related to the bulkiness of the two protected hydroxymethyl groups. The steric hindrance is also responsible for the observed regioselectivity: in all cases the hydride attack occurs preferentially on β carbon, with formation of **4** as the main regioisomer.[10]

As above stressed, the accelerating effect of Lewis acids in the oxirane ring opening by a variety of nucleophiles is well known, both in intramolecular[6] or intermolecular[5] processes. Also in the case of **2**, the addition of a Lewis acid to the starting oxirane gives rise to an increase of the reactivity, generally accompanied by an increase of regioselectivity (for example, *cfr.* entries 9 and 10).

Hardly reproducible results were obtained using lithium aluminiumhydride combined with $AlCl_3$ (see entry 4): the outcome of this reaction proved to be dependent both on hydride to Lewis acid ratio[4a, 11] and on the modalities of mixing the reagents (see Experimental) and some decomposition of starting epoxide (probably due to protecting group deblocking) was observed. Moreover, in some cases considerable amounts of chlorohydrins **6c** and **7c** (X = Cl) were isolated in about 4 : 1 ratio.[4b] Similar results were obtained using Et_2AlCl as Lewis acid (entry 5), both with diprotected (**2c**) and with monoprotected (**2b**) epoxides: in the former case, also a cyclic product (oxolane) was formed as a by-product.[12, 13] It is apparent that epoxides **2** are attacked more easily by the halogenide ions than by the hydride. Only $BF_3{\cdot}Et_2O$ did not transfer the halogen atom (see entries 6, 22 - 23). Halohydrins were identified by NMR spectroscopy, by correlation with corresponding reduced product (*via* radical dehalogenation[9, 14]), and by correlation with starting epoxide (*via* basic treatment[15]).

As already mentioned, an important role in all these reactions is played by the protecting group of the hydroxy function. BOM, PMBOM, PMP, and TIPS have been used. The last two appear to be the most suitable, especially when strong Lewis acids are used as catalysts, due to the less stability of acetal-like protections in the presence of these species (for example, see entry 22). Actually, when the two hydroxy groups were protected as PMP and TIPS ethers, the use of DIBAH - $BF_3{\cdot}Et_2O$ allowed to obtain **4d** in good chemical and stereochemical yield (entry 23).[16] Also monoprotected alcohols can be used when borohydrides are employed as hydride donor, but in this case the regioselectivity decreases (see entries 7 - 10).



(X = Cl, Br, I)

	R^2	R^3
c	PMBOM	BOM
d	TIPS	PMP

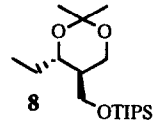
Excellent results are obtained using radical reductive

Table 1. Reductive ring opening of epoxides **2**.

Entry	H donor	Lewis acid[a]	Exp. cond.: solv., T, t	Substrate (R^2, R^3)	Yield (%)[b]	**4** : **5**[c]
1	$LiAlH_4$	-	THF, r. t., 2 h	**2b** (TIPS, H)	36[d]	69 : 31
2	$LiAlH_4$	-	THF, r. t. → 60°C, 24 h	**2c** (PMBOM, BOM)	-[e]	-
3	$LiAlH_4$	-	THF, reflux, 20 h	**2d** (TIPS, PMP)	-[e]	-
4	$LiAlH_4$	$AlCl_3$[f]	Et_2O, r. t., 2 h	**2c** (PMBOM, BOM)	55[d]	54 : 46
5	$LiAlH_4$	Et_2AlCl	Et_2O, -78°C → r. t.	**2c** (PMBOM, BOM)	-[g]	-
6	$LiAlH_4$	$BF_3{\cdot}Et_2O$	Et_2O, reflux, 6 h	**2d** (TIPS, PMP)	traces	-
7	$LiBH_4$	-	PhH, reflux, 20 h	**2b** (TIPS, H)	83 (92)	68 : 32
8	$LiBH_4$[h]	$Ti(i\text{-}PrO)_4$	PhH, r. t. → 50°C, 10 h	**2b** (TIPS, H)	68	82 : 18
9	$Zn(BH_4)_2$	-	THF, reflux, 12 h	**2b** (TIPS, H)	56 (83)	62 : 38
10	$Zn(BH_4)_2$	SiO_2	THF, r. t. → reflux, 6 h	**2b** (TIPS, H)	70 (79)	80 : 20
11	$Zn(BH_4)_2$	SiO_2	THF, r. t. → reflux, 15 h	**2d** (TIPS, PMP)	24 (37)[d]	> 99 : 1
12	BuCuHLi	-	Et_2O, -40°C → r. t., 40 h	**2c** (PMBOM, BOM)	27[i]	> 99 : 1
13	Bu_3SnH[l]	ZnI_2	DME, r. t. → 80°C, 15 h	**2b** (TIPS, H)	38[m]	> 99 : 1
14	Bu_3SnH[l]	ZnI_2	DME, r. t. → 80°C, 15 h	**2d** (TIPS, PMP)	traces[n]	-
15	Bu_3SnH[l]	ZnI_2	DME, r. t. → 80°C, 15 h	**2e** (TIPS, Ac)	traces[m]	-
16	**Bu_3SnH[l, o]**	**MgI_2**	**PhMe, -40°C → 110°C, 1 h**	**2d (TIPS, PMP)**	**99**	**> 99 : 1**
17	Bu_3SnH[l, o]	MgI_2	PhMe, -40°C → 110°C, 1 h	**2c** (PMBOM, BOM)	81 (88)	92 : 8
18	DIBAH	-	PhH, r. t., 8 h	**2c** (PMBOM, BOM)	61 (86)	78 : 22
19	DIBAH	-	PhMe, r. t.	**2a** (PMBOM, H)	-[p]	-
20	DIBAH	-	PhMe, reflux, 124 h	**2b** (TIPS, H)	-[e]	-
21	DIBAH	-	PhMe, reflux, 20 h	**2d** (TIPS, PMP)	traces	-
22	DIBAH	$BF_3{\cdot}Et_2O$	CH_2Cl_2, -78°C → -30°C, 1 h	**2c** (PMBOM, BOM)	21[d]	> 99 : 1
23	**DIBAH**	**$BF_3{\cdot}Et_2O$**	**CH_2Cl_2, -78°C, 3.5 h**	**2d (TIPS, PMP)**	**75 (97)**	**95 : 5**
24	DIBAH	$MgBr_2{\cdot}Et_2O$	Et_2O, -78°C → r. t., 48 h	**2d** (TIPS, PMP)	-[q]	-

DIBAH = $(i\text{-Bu})_2AlH$; DME = $MeOCH_2CH_2OMe$; THF = tetrahydrofuran

[a] Unless otherwise stated, the order of mixing is: substrate + Lewis acid + hydride donor (direct addition). [b] Isolated total yield; yield in parenthesis is referred to unrecovered substrate. [c] Products identification rests on ^1H and ^{13}C NMR spectra, with the aid of DEPT, COSY, and HETCOR experiments. Relative configuration of **4b** was confirmed by conversion into 1,3-dioxane **8** (see ref. 2); **4d** and **4e** were correlated to **4b** by removing R^2. Products ratio was usually determined by weighing isolated regioisomers and in some cases confirmed by ^1H NMR spectra of the mixture of isomers. [d] Some decomposition (deblocking of protecting groups) of substrate was observed. [e] No reaction was observed. [f] Lewis acid and hydride donor were premixed at r. t. before adding substrate (inverse addition). When $AlCl_3$ and $LiAlH_4$ were premixed at 0°C, chlorohydrins (X = Cl) were formed (48%, **6c** : **7c** = 80 : 20). [g] Chlorohydrins (X = Cl) were formed (67%, **6c** : **7c** = 90 : 10). [h] Using more reactive and more encumbered complex borohydrides [$LiEt_3BH$, $Li(s\text{-Bu})_3BH$] resulted in sluggish reactions and lower regioselectivity. [i] A substantial amount of **9** was isolated. Even worse results were obtained with **2b** (which did not react at all) and **2d** (only traces of a product corresponding to alkyl addition were detected). [l] AIBN was added as a radical initiator. [m] A substantial amount of a cyclic product (oxolane) was formed. [n] Only a rearrangement product (ketone) was observed. [o] When $(Me_3Si)_3SiH$ was used as reducing agent, similar results were obtained. [p] Only decomposition of substrate was observed. [q] Bromohydrins (X = Br) were formed (66%, **6d** : **7d** = 90 : 10).



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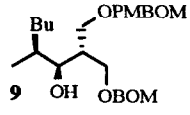


9

conditions (entries 16 and 17) in the presence of MgI_2.[9] In this case the iodohydrin (**6c** or **6d**, X = I) is formed as an intermediate that can be isolated or directly reduced by Bu_3SnH/AIBN or $(Me_3Si)_3SiH$.[14] The advantage of this methodology is that, since MgI_2 is not a strong Lewis acid, either TIPS-PMP (entry16) or BOM-PMBOM (entry 17) protections can be used. Commercially available ZnI_2 gave definitely worse results, leading to formation of large amounts of cyclic[12] or rearranged products (formation of ketones from epoxides in the presence of Lewis acidic metal cation is well documented[1]). High regioselectivity was observed also with $Zn(BH_4)_2$ / SiO_2 (entry 11), although the chemical yield is not satisfactory.

Interestingly, also the complex copper(I) hydride[17] (entry 12) reacts with the diprotected epoxide with high regioselectivity, but unfortunately competition between hydride and alkyl transfer occurred, despite the reported selectivity of this reagent as a hydride donor towards a series of electrophiles, like halogenoderivatives, esters, and saturated and unsaturated carbonyl compounds.

On the basis of the collected data, we can conclude that the reductive ring opening of epoxide **2** is a rather slow reaction that can be accelerated by Lewis acids, but in this case an accurate combination of acid, protection, and reducing agent must be used. The best results, with regard to both chemical and regiochemical outcome, are obtained using DIBAH and $BF_3{\cdot}Et_2O$ or MgI_2 and (*n* -Bu)$_3$SnH, the latter method being more general for the larger flexibility in the protective group acceptance.

By this work, a new[3] route for achieving polyols like **4** starting from **1** *via* epoxides has been disclosed. The usefulness of this method is due to the fact that, thanks to the *double stereodivergency* of **1** and related systems,[3] any of the four stereoisomers of **4** can be achieved starting from a single chiral precursor **1**.[2] The exploitation of polyols like **4** in the asymmetric syntyhesis of some biological targets is under development in our laboratory.

EXPERIMENTAL

General

NMR spectra were recorded as $CDCl_3$ solutions on a Varian Gemini 200 spectrometer using tetramethylsilane (TMS) as internal standard; chemical shifts (δ) are in ppm, coupling constants (J) are in Hz; a * means that the value was obtained through double resonance experiments. ^1H NMR data for epoxides **2** are reported in Table 2, data for alcohols **4** in Table 4, data for alcohols **5** in Table 5, data for halohydrins **6** and **7** in Table 6. Optical rotatory powers ($[\alpha]_D$) were measured as 1 - 2% $CHCl_3$ solutions. IR spectra were recorded as $CHCl_3$ solutions on a Perkin Elmer 881 spectrometer. IR and analytical data for some selected compounds are reported in Table 7.

'Usual workup' means that the given reaction mixture was extracted (Et_2O, CH_2Cl_2, or AcOEt), the organic layer was dried (Na_2SO_4), filtered, and evaporated to dryness under reduced pressure.

Silica gel supported $Zn(BH_4)_2$ was prepared as described in ref. 8. About 0.2 M MgI_2 solutions in Et_2O / PhMe were prepared as described[18] and used within 8 h.

Tetrahydrofuran (THF) was always freshly distilled from K / Ph_2CO; CH_2Cl_2, Et_2O, PhMe, *N, N*-dimethylformamide (DMF), 1,2-dimethoxyethane (DME), and PhH were purchased as dry solvents from Aldrich and stored over 4 Å molecular sieves. All reactions requiring dry conditions were run under an inert atmosphere (N_2).

TLC analyses were carried out on silica gel plates, which were developed by spraying a solution of $(NH_4)_4MoO_4{\cdot}4H_2O$ (21 g) and $Ce(SO_4)_2{\cdot}4H_2O$ (1 g) in H_2SO_4 (31 ml) and H_2O (469 ml) and warming. R_f were measured after an elution of 7 - 9 cm. Column chromatographies were run following the method of 'flash chromatography',[19] using 230 - 400 mesh silica gel (Merck).

4-(Dimethylamino)pyridine is abbreviated as DMAP, diisobutylaluminiumhydride as DIBAH, α, α'-azo-

Table 2. ^{1}H NMR data for *cis* diprotected epoxides **2**.

	*Me*CH (d, 3 H)[a]	CHC*H*O (dd, 1 H)[a]	MeC*H*O (dq, 1 H)[a]	CH_2CHCH_2 (m, 1 H)	CH_2OR^2 (2 H)[a]	CH_2OR^3 (2 H)[a]	Others
2c	1.32 (5.5)	2.96 (4.1, 9.3)	3.13 (4.3*, 5.4)	1.73-1.90	3.68 & 3.74[b] (5.8, 7.0, 9.9); 3.82[c] (4.4)		3.80 (s, 3 H, *Me*O); 4.52 (s, 2 H, CH_2Ar); 4.61 (s, 2 H, CH_2Ph); 4.72 (s, 2 H, CH_2OCH_2Ar); 4.79 (s, 2 H, CH_2OBn); 6.85-6.90 (m, 2 H, Ar*H*); 7.23-7.40 (m, 7 H, Ar*H*).
2d	1.34 (5.4)	3.05 (4.2, 9.5)	3.15 (4.4, 5.4)	1.77-2.00	4.08-4.18[d]	3.94[c] (5.4)	1.00-1.10 (m, 21 H, 3 x Me_2CHSi); 3.77 (s, 3 H, *Me*O); 6.80-6.85 (m, 4 H, Ar*H*).
2e	1.32 (5.5)	2.94 (4.2, 9.4)	3.10 (4.4, 5.5)	1.75-1.90	4.28 & 4.34[b] (4.9, 7.0, 11.2)	3.80[c] (5.4)	1.00-1.10 (m, 21 H, 3 x Me_2CHSi); 2.06 (s, 3 H, *Me*CO).

[a] Coupling constants J (Hz) are reported in parentheses. [b] AB Part of an ABX system. [c] Apparent doublet. [d] Multiplet.

isobutyronitrile [2, 2'-azobis(2-methylpropionitrile)] as AIBN, and petroleum ether (b. p. 40 - 60°C) as PE.

Synthesis and spectral data of optically active epoxides **2a, b** have been already reported in Ref. 2b, as well as the synthesis and spectral data of 1, 3-dioxane **8**.

Synthesis of diprotected epoxide 2c. - Monoprotected epoxide **2a** (1.0 mmol) was dissolved in dry CH_2Cl_2 (8 ml) at 0°C and added with *i*-Pr_2NEt (1.7 mmol) and (benzyloxymethoxymethyl)chloride (1.5 mmol). Cooling bath was removed and the reaction mixture was stirred at r. t. for 8 h. Additional portions of *i*-Pr_2NEt (0.85 mmol) and (benzyloxymethoxymethyl)chloride (0.75 mmol) were added, and stirring was continued for additional 15 h. Et_2NH (1 mmol) was added, then reaction mixture was diluted with brine and subjected to usual workup (Et_2O). After chromatographic purification (PE / Et_2O 6 : 4, containing 0.5% of Et_3N), pure **2c** (97%) was obtained. R_f = 0.39 (PE / Et_2O 6 : 4); $[\alpha]_D$ = +2.8°; ^{1}H NMR: see Table 2.

Synthesis of diprotected epoxide 2d. - Monoprotected epoxide **2b** (1.0 mmol) was dissolved in dry CH_2Cl_2 (13 ml) and added with Ph_3P (1.5 mmol), 4-methoxyphenol (3.0 mmol), and DEAD (1.5 mmol). The reaction mixture was stirred ad r. t. for 15 h, then it was diluted with brine and subjected to usual workup (Et_2O). After chromatographic purification (PE / Et_2O 95 : 5, containing 0.5% of Et_3N), pure **2d** (87%) was obtained. R_f = 0.35 (PE / Et_2O 9 : 1), 0.85 (PE / Et_2O 1 : 1); $[\alpha]_D$ = +23.3°; ^{1}H NMR: see Table 2.

Synthesis of diprotected epoxide 2e. - Monoprotected epoxide **2b** (1.0 mmol) was dissolved in dry pyridine (9 ml) at 0°C and added with Ac_2O (1.4 mmol). The reaction mixture was allowed to slowly reach r. t. and stirred at the same temperature for 24 h. An additional portion of Ac_2O (1.4 mmol), along with a catalytic amount of DMPA, was added, and reaction mixture was stirred for additional 6 h. Pyridine was evaporated under reduced pressure and the residue was directly subjected to chromatographic purification (PE / Et_2O 7 : 3, containing 0.5% of Et_3N) to give pure **2e** (quantitative). R_f = 0.46 (PE / Et_2O 7 : 3); ^{1}H NMR: see Table 2.

Reductive opening of epoxides using $LiAlH_4$. - Total reaction yields and products ratios can be found in Table 1, chromatographic data in Table 3, and ^{1}H NMR data of products can be found in Table 4 (alcohols **4**), Table 5 (alcohols **5**), and Table 6 (halohydrins **6** and **7**).

*Epoxides **2b, 2c, and 2d** in THF (entries 1 - 3 in Table 1).* - A solution of **2b** (0.10 mmol) in dry THF (1.5 ml) was treated at 0°C with a 1 M THF solution of $LiAlH_4$ (0.20 mmol) and stirred at r. t. for 2 h. The re-

Table 3. Chromatographic data for oxirane ring opening products **4**, **5**, **6**, and **7**.

	R^2, R^3	Eluant	R_f			R^2, R^3	X	Eluant	R_f	
			4	**5**					**6**	**7**
4b & 5b	TIPS, H	PE / Et_2O 4 : 6	0.39	0.19	**6c & 7c**	PMBOM, BOM	Cl	PE / Et_2O 4 : 6	0.56	0.44
4c & 5c	PMBOM, BOM	PE / Et_2O 4 : 6	0.33	0.16	**6c & 7c**	PMBOM, BOM	I	PE / Et_2O 6 : 4	0.22	0.17
4d & 5d	TIPS, PMP	PE / Et_2O 9 : 1	0.35	-	**6d & 7d**	TIPS, PMP	Br	PE / Et_2O 8 : 2	0.32	0.19
4e & 5e	TIPS, Ac	PE / Et_2O 7 : 3	0.19	-	**6d & 7d**	TIPS, PMP	I	PE / Et_2O 9 : 1	0.42	-

action was cooled to 0°C and carefully quenched by addition of the stoichiometric amount of aqueous NaOH. The mixture was stirred at r. t. for 1 h and filtered, washing the solid with Et_2O, and the filtrate was evaporated to dryness to give a mixture of crude diols, which were separated by column chromatography to give pure diols **4b** and **5b** as colourless oils.

When a similar reaction was applied to **2c** and **2d**, no reaction was observed even if a large excess of $LiAlH_4$ was used and reaction mixture heated at refluxing temperature for several hours.

Epoxide 2c in Et_2O, with the addition of $AlCl_3$ (entry 4 in Table 1). - Anhydrous $AlCl_3$ (0.25 mmol) was suspended in dry Et_2O (2.5 ml) at ice-bath temperature and a $LiAlH_4$ (0.75 mmol) suspension in dry Et_2O (0.8 ml) was added. The temperature was allowed to slowly raise to r. t. and the clear solution was stirred at the same temperature for 1 h. Substrate **2c** (0.10 mmol) dissolved in dry Et_2O (1 ml) was added at 0°C and the reaction mixture was stirred at r. t. for 1 h, then cooled to 0°C and quenched by addition of water and subjected to usual workup (Et_2O). Chromatographic separation (eluant contained 0.5% Et_3N) gave pure **4c** and **5c**.

When the same reaction was run by premixing $LiAlH_4$ and $AlCl_3$ for 30' at ice-bath temperature, chlorohydrins **6c** and **7c** were obtained after chromatographic purification (PE / Et_2O 4 : 6, containing 0.5% Et_3N).

Epoxide 2c in Et_2O, with the addition of Et_2AlCl (entry 5 in Table 1). - To a solution of $LiAlH_4$ (0.21 mmol) in dry Et_2O (2 ml) cooled at ice-bath temperature a 1.8 M solution of Et_2AlCl in toluene (0.21 mmol) was added. After stirring for 30' at the same temperature, the reaction mixture was cooled to -78°C and a solution of epoxide **2c** (0.10 mmol) in dry Et_2O (2 ml) was added. The reaction mixture was allowed to slowly reach r. t., while monitoring by TLC, then a second aliquot of Et_2AlCl (0.8 mmol) was added, and reaction mixture stirred at r. t. for additional 5 h. Water was added, and, after usual workup (Et_2O) and chromatographic purification (eluant contained 0.5% of Et_3N), chlorohydrins **6c** and **7c** were obtained.

Reductive opening of epoxides using $LiBH_4$. - Total reaction yields and products ratios can be found in Table 1, chromatographic data in Table 3, and ^1H NMR data of products can be found in Table 4 (alcohols **4**) and Table 5 (alcohols **5**).

Epoxide 2b in benzene (entry 7 in Table 1). - A solution of **2b** (0.10 mmol) in dry PhH (3 ml) was treated at 0°C with a 2 M solution of $LiBH_4$ in THF (0.38 mmol). The cooling bath was removed and the reaction mixture was stirred at r. t. for 15 h, then it was heated to 50°C for 5 h. Additional $LiBH_4$ solution (0.10 mmol) was added and the reaction mixture was refluxed for 15 h. After cooling to 0°C and quenching with saturated aqueous NH_4Cl, the reaction was diluted with Et_2O and stirred until two clear layers separated. Usual workup (AcOEt) and chromatography afforded pure diols **4b** and **5b**.

Epoxide 2b in benzene, with the addition of Ti(i-PrO)$_4$ (entry 8 in Table 1). - A solution of Ti(*i*-PrO)$_4$ (0.14 mmol) in dry PhH (2 ml) was added to a solution of substrate **2b** (0.10 mmol) in PhH (1.5 ml) at r. t.; after stirring for 10', a 2 M $LiBH_4$ solution in THF (0.35 mmol) was added and the mixture was stirred at 50°C for 8 h, at r. t. for 15 h, and then at 50°C for 1 h. The reaction mixture was diluted with Et_2O and quenched with aqueous saturated NH_4Cl under vigorous stirring until two clear layers separated. Usual workup (Et_2O)

and chromatographic separation gave pure diols **4b** and **5b**.

Reductive opening of epoxides using $Zn(BH_4)_2$. - Total reaction yields and products ratios can be found in Table 1, chromatographic data in Table 3, and ^1H NMR data of products can be found in Table 4 (alcohols **4**) and Table 5 (alcohols **5**).

*Epoxide **2b** in THF (entry 9 in Table 1).* - A solution of **2b** (0.10 mmol) in dry THF (1 ml) was treated at 0°C with a freshly prepared 1 M solution of $Zn(BH_4)_2$ in DME (1.0 mmol) and stirred at r. t. for 2 h. An additional aliquot of the same $Zn(BH_4)_2$ / DME solution (1.0 mmol) was added and stirring continued at r. t. for 2 h and then at the refluxing temperature for 10 h. Another additional aliquot of $Zn(BH_4)_2$ / DME (1.0 mmol) was added and reaction was refluxed for 2 h, then cooled to 0°C and quenched by cautious addition of water. The resulting slurry was filtered and the filtrate was subjected to usual workup (AcOEt) to give, after chromatographic separation, pure diols **4b** and **5b**.

*Epoxides **2b** and **2d** in THF, using $Zn(BH_4)_2$ supported on SiO_2 (entries 10 and 11 in Table 1).* - To a solution of **2b** (0.10 mmol) in dry THF (2 ml) silica gel supported $Zn(BH_4)_2$ (0.30 mmol) was added and the reaction mixture was stirred at r. t. for 3 h. Another aliquot of silica gel supported $Zn(BH_4)_2$ (0.30 mmol) was added and reaction mixture stirred at r. t. for 15 h and then refluxed for 6 h. The reaction mixture was cooled to 0°C and quenched by cautious addition of water, filtered, and subjected to usual workup (AcOEt). Chromatographic purification gave pure diols **4b** and **5b**.

The same procedure was applied to **2d**, except that refluxing was prolonged for 15 h. Final chromatographic purification gave pure **4d**.

Reductive opening of epoxide 2c using BuCuHLi (entry 12 in Table 1). - The mixed copper(I) hydride was prepared as described in ref. 17a. A solution of epoxide **2c** (0.10 mmol) in dry Et_2O (1.5 ml) was added to a solution of the hydride (1.5 mmol) in dry Et_2O at -40°C under a helium atmosphere. After stirring at the same temperature for 3 h, reaction mixture was allowed to reach r. t. and stirred at the same temperature for additional 40 h. Saturated aqueous NH_4Cl was added; usual workup and chromatographic purification gave **4c**, along with a substantial amount of **9**. See Tables 1, 3 and 4 for other details. **9**: R_f = 0.56 (PE / Et_2O 4 : 6); ^1H NMR: 0.88 (d, 3 H, J 6.7 Hz, *Me*CH), 1.00 - 1.80 (m, 7 H, $CHCH_2CH_2CH_2Me$), 2.04 - 2.13 (m, 1 H, $CHCH_2O$), 3.42 - 3.53 (m, 1 H, CHOH), 3.76 - 3.89 (m, 4 H, CH_2OR & CH_2OR'), 3.80 (s, 3 H, *Me*O), 4.53 (s, 2 H, CH_2Ar), 4.60 (s, 2 H, CH_2Ph), 4.74 (s, 2 H, OCH_2OCH_2Ar); 4.75 (s, 2 H, OCH_2OCH_2Ph), 6.85 - 6.89 (m, 2 H, Ar*H*), 7.25 - 7.34 (m, 7 H, Ar*H*).

Under the same reaction conditions, **2b** did not react at all, as well as **2d**, even when a catalytic amount of $BF_3{\cdot}Et_2O$ was added. In the latter case, only a trace of a product probably due to alkyl transfer was observed.

Reductive opening of epoxides using Bu_3SnH. - Total reaction yields and products ratios can be found in Table 1, chromatographic data in Table 3, and ^1H NMR data of products can be found in Table 4 (alcohols **4**), Table 5 (alcohols **5**), and Table 6 (halohydrins **6** and **7**).

*Epoxides **2b**, **2d**, and **2e** in DME, with the addition of ZnI_2 (entries 13 - 15 in Table 1).* - Epoxide **2b** (0.10 mmol) was dissolved in dry DME (1 ml) and ZnI_2 (0.23 mmol) and *n*-Bu_3SnH (0.23 mmol) were sequentially added, along with a catalytic amount of AIBN. The reaction mixture was refluxed for 7 h, then additional *n*-Bu_3SnH (0.23 mmol) and AIBN (catalytic) were added, and refluxing continued for 8 h. Solvent was evaporated under reduced pressure and the residue directly chromatographated, eluting first with PE and then with PE / Et_2O 6 : 4. Diol **4b** was obtained, along with a substantial amount of a by-product that was identified, on the basis of the spectroscopic data, as oxolane **10** (62%). **10**: R_f = 0.54 (PE / Et_2O 6 : 4); ^1H NMR: 1.03 -

Table 4. ^{1}H NMR data for alcohols **4**.

	MeCH_2 (t, 3 H)[a]	Me*CH_2* (2 H)[a]	*CH*OH (m, 1 H)	CH_2CHCH_2 (1 H)[a]	CH_2OR^2 (2 H)[a]	CH_2OR^3 (2 H)[a]	Others
4b	0.92 (7.4)	1.52[b] (7.3)	3.72-3.83	1.66[c] (5.0)	3.86[d] (1.9, 5.3); 3.86 & 3.94[e] (4.5, 6.7, 9.9)		1.07-1.11 (m, 21 H, 3 x *Me*$_2$*CH*Si).
4c	0.99 (7.4)	1.57[b] (7.4)	3.68-3.87	1.96[c] (5.4)	3.68-3.87[f]		3.80 (s, 3 H, *Me*O); 4.53 (s, 2 H, C*H*$_2$Ar); 4.60 (s, 2 H, C*H*$_2$Ph); 4.74 (s, 2 H, C*H*$_2$OC*H*$_2$Ar); 4.75 (s, 2 H, C*H*$_2$OC*H*$_2$Ph); 6.85-6.90 (m, 2 H, Ar*H*); 7.24-7.40 (m, 7 H, Ar*H*).
4d	1.00 (7.3)	1.60 & 1.64[e] (7.3, 8.0, 11.2)	3.84-3.96	2.02[g] (3.8)	4.08-4.24;[h] 3.36 & 4.17[e] (2.1, 2.1, 9.9).		1.00-1.10 (m, 21 H, 3 x *Me*$_2$*CH*Si); 3.77 (s, 3 H, *Me*O); 6.80-6.90 (m, 4 H, Ar*H*).
4e	0.91 (7.4)	1.52[i] (5.5, 7.1)	3.66-3.80	1.75-1.88[l]	4.19 & 4.29[e] (4.6, 8.4, 11.2)	3.81 & 3.95[e] (3.9, 4.0, 10.0)	0.90-1.05 (m, 21 H, 3 x *Me*$_2$*CH*Si); 1.98 (s, 3 H, *Me*CO).

[a] Coupling constants J (Hz) are reported in parentheses. [b] Apparent quintuplet. [c] Apparent sextuplet. [d] Apparent doublet of doublet. [e] AB Part of an ABX system. [f] Multiplet, 4 H. [g] Apparent heptuplet. [h] Multiplet, 2 H. [i] Apparent doublet of quartet. [l] Multiplet.

1.08 (m, 21 H, 3 x *Me*$_2$*CH*Si), 1.26 (d, 3 H, J 6.3 Hz, *Me*CHO), 2.41 - 2.59 (m, 1 H, C*H*CH$_2$OSi), 3.68 - 4.04 (m, 6 H, OC*H*Me & C*H*OH & C*H*$_2$OCH & C*H*$_2$OSi); ^{13}C NMR: 11.68 (3 x *C*HSi), 17.83 (3 x *Me*$_2$CHSi), 18.65 (*Me*CHO), 43.59 (CHCHCH$_2$), 61.58 & 68.02 (OCH$_2$CHCH$_2$O), 78.97 & 81.90 (OCHMe & *C*HOH).

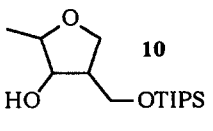
When the same procedure was applied to **2d**, the ketone **11** (19%) was obtained as the main product, along with traces of **4d**. **11**: R_f = 0.55 (PE / Et$_2$O 8 : 2); ^{1}H NMR: 1.06 - 1.09 (m, 21 H, 3 x *Me*$_2$*CH*Si), 2.65 (app dq, 2 H, J 2.7 & 7.3 Hz, C*H*$_2$CO), 3.21 (app quint, 1 H, J 5.1 Hz, C*H*CO), 3.80 (s, 3 H, *Me*O), 4.02 (app d, 2 H, J 6.2 Hz, C*H*$_2$OR), 4.10 & 4.20 (AB part of an ABX system, 2 H, J 6.1 & 7.0 & 9.3 Hz, C*H*$_2$OR'), 6.85 (s, 4 H, Ar*H*).

When the same procedure was applied to **2e**, again a by-product, probably the *O*-acetyl derivative of **10**, was obtained as the main product, along with traces of **4e**.

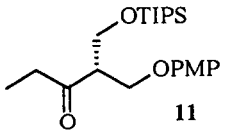
Epoxides 2c and 2d in toluene, with the addition of MgI_2 (entries 16 and 17 in Table 1). - A solution of the epoxide **2c** (0.10 mmol) in dry toluene (2 ml) was cooled to -78°C and added with a ≈ 0.2 M MgI_2 solution in Et$_2$O / PhMe (0.20 mmol). After stirring 40' at the same temperature, a 25% aqueous solution of Na_2SO_3 was added (1 ml) and the reaction mixture was worked up as usual (Et$_2$O) to give, after chromatographic purification, iodohydrins **6c** (87%) and **7c** (7%), which were dissolved in dry toluene (2 ml), added with *n*-Bu$_3$SnH (0.20 mmol) and AIBN (catalytic) and refluxed for 30'. Solvent was distilled off under reduced pressure and the residue subjected to column chromatography to give pure **4c** and **5c**.

The same procedure was applied to **2d**, so that iodohydrin **6d** was isolated in quantitative yield and then reduced to give **4d**.

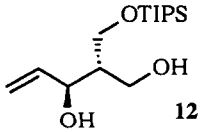
Alternatively, after stirring the mixture of epoxide **2d** and MgI_2 at -78°C for 40', *n*-Bu$_3$SnH and AIBN were directly added to the reaction mixture, which was then refluxed for 30'.



10



11



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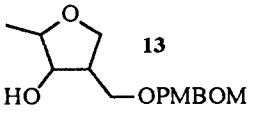

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Table 5. ^{1}H NMR data for alcohols **5**.

	*Me*CH (d, 3 H)[a]	*CH*OH (1 H)[a]	CHC*H*$_2$CH (m, 2 H)	CH$_2$C*H*CH$_2$ (1 H)[a]	C*H*$_2$OR[2] (2 H)[a]	C*H*$_2$OR[3] (2 H)[a]	Others
5b	1.22 (6.2)	3.96[b] (3.3, 6.2, 8.8)	1.50-1.70	1.98[c] (6.0)	3.69[d] (2.4) & 3.72[d] (5.4); 3.77 & 3.83[e] (5.7, 6.3, 9.8)		1.00-1.10 (m, 21 H, 3 x *Me*$_2$*CH*Si).
5c	1.21 (6.2)	3.86[f] (2.0, 6.4)	1.55-1.70	2.10[g] (5.7)	3.50-3.70[h]		3.80 (s, 3 H, *Me*O); 4.53 (s, 2 H, C*H*$_2$Ar); 4.60 (s, 2 H, C*H*$_2$Ph); 4.73 (s, 2 H, C*H*$_2$OCH$_2$Ar); 4.76 (s, 2 H, C*H*$_2$OCH$_2$Ph); 6.80-6.90 (m, 2 H, Ar*H*) ; 7.20-7.40 (m, 7 H, Ar*H*).
5d	1.22 (7.1)	3.70-4.20[i]	1.46-1.76	1.96-2.08[i]	3.70-4.20[h]		1.00-1.10 (m, 21 H, 3 x *Me*$_2$*CH*Si); 3.77 (s, 3 H, *Me*O); 6.83-6.86 (m, 4 H, Ar*H*).

[a] Coupling constants J (Hz) are reported in parentheses. [b] Apparent doublet of doublet of doublet. [c] Apparent sextuplet. [d] Apparent doublet, 1 H. [e] AB Part of an ABX system. [f] Apparent triplet of quartet. [g] Apparent heptuplet. [h] Multiplet, 4 H. [i] Multiplet.

Reductive opening of epoxides using DIBAH. - Total reaction yields and products ratio can be found in Table 1, chromatographic data in Table 2, and ^{1}H NMR data of products can be found in Table 4 (alcohols **4**), Table 5 (alcohols **5**), and Table 6 (halohydrins **6** and **7**).

*Epoxide **2c** in benzene (entry 18 in Table 1).* - A solution of epoxide **2c** (0.10 mmol) in dry benzene (4 ml) was cooled to 0°C, treated with a 1 M DIBAH solution in PhMe (0.20 mmol), allowed to reach r. t., and stirred at the same temperature for 4.5 h. An additional aliquot of the DIBAH / PhMe solution (0.20 mmol) was added, and stirring continued for 3.5 h. The reaction mixture was cooled to 0°C, quenched by the addition of a saturated aqueous solution of NH_4Cl (2 ml), diluted with a saturated aqueous solution of sodium potassium tartrate, and stirred for 15', until two clear layers separated. Usual workup (Et_2O) and chromatographic purification (eluant contained 0.5% of Et_3N) gave pure **4c** {$[\alpha]_D$ = -1.0°} and **5c** {$[\alpha]_D$ = +1.2°}.

*Epoxides **2a**, **2b**, and **2d** in toluene (entries 19 - 21 in Table 1).* - When similar conditions applied to **2c** in benzene were applied to **2a** in toluene, only decomposition products were observed. Both **2b** and **2d** did not react, even when a large excess of reagent was added and reaction mixtures were refluxed for several hours.

In the case of **2b**, addition of Ti(*i*-PrO)$_4$ resulted in formation of allyl alcohol[20] **12** (62%, 70% based on unrecovered substrate). R_f = 0.29 (PE / Et_2O 1 : 1); ^{1}H NMR: 1.06 - 1.11 (m, 21 H, 3 x *Me*$_2$*CH*Si), 1.85 (app sextuplet, 1 H, J 5.2 Hz), C*H*CH$_2$OSi), 3.89 (app d, 2 H, J 5.1 Hz, C*H*$_2$OR), 3.89 & 3.97 (AB part of an ABX system, 2 H, J 5.1 & 5.5 & 10.0 Hz, C*H*$_2$OR'), 4.44 (app tt, 1 H, J 1.3 & 5.5 Hz, C*H*OH), 5.18 - 5.38 (m, 2 H, C*H*$_2$=CH), 5.94 (ddd, 1 H, J 5.9 & 10.5 & 16.4, C*H*=CH$_2$); ^{13}C NMR: 11.87 (3 x *C*HSi), 17.98 (3 x *Me*$_2$CHSi), 47.36 (CH$_2$*C*HCH$_2$), 62.19 & 64.04 (*C*H$_2$OH & *C*H$_2$OSi), 73.69 (*C*HOH), 115.62 (*C*H$_2$=), 139.37 (*C*H=).

*Epoxides **2c** and **2d** in dichloromethane, with the addition of BF_3·Et_2O (entries 22 and 23 in Table 1).* - A solution of epoxide **2d** (0.10 mmol) in dry CH_2Cl_2 (3 ml) was cooled to -78°C, added with BF_3·Et_2O (0.20 mmol) and stirred at the same temperature for 5'. A 1 M solution of DIBAH in CH_2Cl_2 (0.30 mmol) was added and stirring continued for 3.5 h. A saturated aqueous solution of NH_4Cl was added, followed by a saturated solution of sodium potassium tartrate, and reaction mixture stirred at r. t. until two clear layers separated. Usual workup (Et_2O) and chromatographic purification afforded **4d** and **5d**.

Epoxide **2c** was subjected to the same reaction conditions, except that reaction temperature was allowed to slowly reach (within 1 h) -30°C. Ring opening product **4c** was isolated, along with a cyclic oxolane by-product (R_f = 0.39, PE / Et_2O 1 : 1), that was identified as oxolane **13** (71%) on the basis of spectroscopic data. **13**: ^{1}H NMR: 1.09 (d, 3 H, J 6.6 Hz, *Me*CH), 2.00 - 2.14 (m, 1 H, C*H*CH$_2$O), 3.45 - 4.00 (m, 6 H,

Table 6. ^{1}H NMR data for halohydrins **6** and **7**.

	X	*Me*CH (3 H)[a]	CH*X* (1 H)[b]	*CH*OH (1 H)[a]	CH_2CHCH_2 (1 H)[a]	CH_2OR^2 (2 H)[a] CH_2OR^3 (2 H)[a]	Others
6c	Cl	1.57[b] (6.8)	4.28[c] (4.5, 6.7)	3.75[d] (3.9*, 5.4)	2.17[e] (5.7)	3.69[f] (2.1, 5.4); 3.78-3.92[g] (9.7*)	3.80 (s, 3 H, *Me*O), 4.52 (s, 2 H, CH_2Ar), 4.60 (s, 2 H, CH_2Ph), 4.72 (s, 2 H, CH_2OCH_2Ar), 4.76 (s, 2 H, CH_2OCH_2Ph) 6.85-6.95 (m, 2 H, Ar*H*), 7.24-7.35 (m, 7 H, Ar*H*).
6c	I	1.98[b] (7.0)	4.41[c] (4.2, 7.0)	3.01[i] (4.6, 6.5)	2.09[h] (5.3, 6.4)	3.64[l] (5.1); 3.82 & 3.89[m] (5.2, 6.1, 9.8)	3.81 (s, 3 H, *Me*O), 4.52 (s, 2 H, CH_2Ar), 4.61 (s, 2 H, CH_2Ph), 4.70 (s, 2 H, CH_2OCH_2Ar), 4.76 (s, 2 H, CH_2OCH_2Ph) 6.85-6.95 (m, 2 H, Ar*H*), 7.20-7.35 (m, 7 H, Ar*H*).
6d	Br	1.80[b] (6.8)	4.51[c] (5.1, 6.8)	3.74[n] (5.7)	2.25[e] (5.4)	3.89 & 3.98[m] (4.4, 4.8, 10.1); 4.10 & 4.23[m] (5.7, 6.5, 9.3)	1.00-1.10 (m, 21 H, 3 x Me_2CHSi), 2.69 (d, J 6.2 Hz, 1 H, O*H*), 3.77 (s, 3 H, *Me*O), 6.83 (broad s, 4 H, Ar*H*).
6d	I	2.01[b] (7.0)	4.54[c] (5.0, 7.0)	3.24[n] (6.0)	2.19[e] (5.4)	3.87 & 3.97[m] (4.0, 4.6, 10.2); 4.14 & 4.23[m] (5.5, 6.6, 9.3)	1.00-1.10 (m, 21 H, 3 x Me_2CHSi), 2.74 (d, J 6.0 Hz, 1 H, O*H*), 3.77 (s, 3 H, *Me*O), 6.83 (broad s, 4 H, Ar*H*).
7c	Cl	1.25[b] (6.1)	4.02-4.12[o]	3.45-3.85[c]	2.32[e] (5.3)	3.45-3.85[p]	3.73 (s, 3 H, *Me*O), 4.46 (s, 2 H, CH_2Ar), 4.53 (s, 2 H, CH_2Ph), 4.66 (s, 2 H, CH_2OCH_2Ar), 4.70 (s, 2 H, CH_2OCH_2Ph) 6.78-6.85 (m, 2 H, Ar*H*), 7.20-7.30 (m, 7 H, Ar*H*).
7c	I	1.27[b] (5.9)	4.48-4.85[o]	3.18-3.30[c]	1.96-2.02[o]	3.49-3.87[p]	3.80 (s, 3 H, *Me*O), 4.48-4.85 (m, 8 H, CH_2OCH_2Ar & CH_2OCH_2Ph), 6.85-6.91 (m, 2 H, Ar*H*), 7.24-7.36 (m, 7 H, Ar*H*).
7d	Br	1.33[b] (6.1)	4.36[d] (2.4, 4.2)	3.83-4.01[c]	2.38-2.50[o]	3.83-4.01[e]; 3.88 & 4.10[m] (4.5, 7.0, 10.4)	1.00-1.10 (m, 21 H, 3 x Me_2CHSi), 3.71 (d, J 3.2 Hz, 1 H, O*H*), 3.77 (s, 3 H, *Me*O), 6.83 (broad s, 4 H, Ar*H*).

[a] Coupling constants J (Hz) are reported in parentheses. [b] Doublet. [c] Doublet of quartet. [d] Doublet of doublet. [e] Apparent sextuplet. [f] Apparent doublet of doublet, 1 H. [g] Multiplet, 3 H. [h] Apparent doublet of quintet. [i] Apparent doublet of triplet. [l] Apparent doublet, 2 H. [m] AB Part of an ABX system. [n] Apparent quartet. [o] Multiplet. [p] Multiplet, 4 H. [q] Multiplet, 2 H.

C*H*Me & C*H*OH & OCH_2CHCH_2O), 3.72 (s, 3 H, *Me*O), 4.51 (s, 2 H, OCH_2Ar), 4.67 (s, 2 H, OCH_2O), 6.76 - 6. 81 (m, 2 H, Ar*H*), 7.19 - 7.23 (m, 2 H, Ar*H*).

Epoxide **2d** *in ethyl ether, with the addition of* $MgBr_2 \cdot Et_2O$ *(entry 24 in Table 1).* - Magnesium bromide etherate (0.10 mmol) was quickly added as a solid to a solution of epoxide **2d** in dry Et_2O (2 ml) at -78°C. After ageing for about 10' at the same temperature, a 1.5 M DIBAH solution in PhMe (0.20 mmol) was added and reaction mixture was stirred at the same temperature for 30'. Then the reaction mixture was allowed to reach r. t. and stirred at the same temperature for 48 h. Saturated aqueous NH_4Cl and saturated aqueous sodium potassium tartrate were sequentially added, and reaction mixture was stirred until two clear layers separated. Usual workup and chromatographic separation gave bromohydrins **6d** and **7d**, along with a substantial amount of ketone **11**.

Synthesis of diol 4b from 4d. - A solution of **4b** (0.10 mmol) in MeCN / H_2O 4 : 1 (8 ml) was cooled to 0°C and added with CAN (5.1 mmol) and pyridine (10 mmol). Reaction was stirred while allowing to slowly reach r. t. (3 h), then brine and a 5% aqueous solution of $Na_2S_2O_3$ (4 ml) were added. Usual workup and chromatographic purification afforded **4b** in 27% yield (some removal of silylated protecting group occurred as well under reaction conditions, that were not optimised).

Table 7. IR and analytical data.

	Formula	Calculated		Found		IR ($CHCl_3$): ν_{max} (cm^{-1})
		H	C	H	C	
2c	$C_{23}H_{30}O_6$	7.51	68.64	7.60	69.36	2951 & 2880 (str. CH)
2d	$C_{22}H_{38}O_4Si$	9.71	66.96	9.79	66.66	2942 & 2865 (str. CH).
4b	$C_{15}H_{34}O_3Si$	11.80	62.02	11.66	62.15	3437 (str. OH), 2932 & 2875 (str. CH).
4c	$C_{23}H_{32}O_6$	7.97	69.29	7.80	69.22	3522 (str. OH), 2932 & 2880 (str. CH).
4d	$C_{22}H_{40}O_4Si$	10.16	66.62	10.23	66.60	3471 (str. OH), 2933 & 2866 (str. CH).
6c (X = Cl)	$C_{23}H_{31}ClO_6$	7.12	62.94	7.11	63.01	3497 (str. OH), 2956 & 2870 (str. CH).
6c (X = I)	$C_{23}H_{31}IO_6$	5.89	52.08	5.81	51.96	3497 (str. OH), 2935 & 2880 (str. CH).
6d (X = Br)	$C_{22}H_{39}BrO_4Si$	8.27	55.57	8.16	56.00	3549 (str. OH), 2943 & 2866 (str. CH).
6d (X = I)	$C_{22}H_{39}IO_4Si$	7.52	50.57	7.50	50.45	3523 (str. OH), 2944 & 2860 (str. CH).
9	$C_{27}H_{40}O_6$	8.75	70.41	8.84	69.99	3516 (str. OH), 2929 & 2870 (str. CH).
12	$C_{15}H_{32}O_3Si$	11.18	62.45	11.20	63.04	3472 (str. OH), 2941 & 2865 (str. CH), 1459 (str. C=C).

Synthesis of diol 4b from 4e. - A solution of **4e** (0.10 mmol) in absolute MeOH (1 ml) was treated with a 0.2 N methanolic solution of KOH (0.15 mmol) at r. t. for 2 h. A saturated aqueous solution of NH_4Cl was added. Usual workup and chromatographic purification gave **4b** (91%).

Reductive dehalogenation of halohydrins 6b (X = Cl, Br), 6d (X = Cl, Br, I), and 6e (X = Cl). - Chromatographic data are reported in Table 3.

Using n-Bu_3SnH. - A solution of bromohydrin **6b** (0.20 mmol) in dry toluene (5 ml) was added with *n*-Bu_3SnH (4 mmol) and AIBN (catalytic amount) and refluxed for 1 h. More *n*Bu_3SnH (4 mmol) and AIBN (catalytic amount) were added, and refluxing continued for one additional hour. Reaction mixture was concentrated and directly subjected to column chromatography (PE, then PE / Et_2O) to give pure diol **4b** (52%).

When chlorohydrin **6d** was subjected to the same procedure (but crude product was taken up in MeCN and extracted with hexane in order to remove by-products containing tin before column chromatography), **4d** was obtained in 77% yield.

When chlorohydrin **6e** was subjected to the same procedure, pure **4e** was obtained in 76% yield.

Using $(Me_3Si)_3SiH$. - A solution of chlorohydrin **6b** (0.10 mmol) in dry toluene (2 ml) was added with $(Me_3Si)_3SiH$ (0.12 mmol) and AIBN (catalytic amount) and heated to about 80°C for 2 h. More $(Me_3Si)_3SiH$ (0.10 mmol) and AIBN (catalytic amount) were added, and heating continued for 2 h, then more $(Me_3Si)_3SiH$ (0.10 mmol) and AIBN (catalytic amount) were again added, and heating continued for 2 h. Reaction mixture was concentrated and directly subjected to column chromatography to give **4b** (64%). $[\alpha]_D = -2.1°$.

When chlorohydrin **6d** was subjected to the same procedure [but using a larger total excess of silane (about 20 eq) and longer total reaction time (24 h)], **4d** was obtained in 58% yield (quantitative, based on unrecovered substrate).

When bromohydrin **6d** was subjected to the same procedure, **4d** was obtained in 20% yield (58%, based on unrecovered substrate).

When iodohydrin **6d** was subjected to the same procedure, **4d** was obtained in 71% yield.

Synthesis of epoxide 4c from chlorohydrins 6c and 7c. - Chlorohydrin **6c** or **7c** (0.10 mmol) was dissolved in absolute MeOH (1 ml) and treated with K_2CO_3 (0.30 mmol) at r. t.. Formation of the epoxide **4c** was monitored by TLC.

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10. Despite the generally low yields, basic ($LiAlH_4$) reduction was used to confirm the relative configuration between epoxidic ring and the original asymmetric carbon atom (C-2) in some epoxides **3** (see ref. 2).
11. It is apparent that when a chloroalane instead of alane is formed (see Mori, A.; Fujiwara, J.; Maruoka, K.; Yamamoto, H. *J. Organomet. Chem.* **1985**, *285*, 83-94) the chloride ion is preferentially transferred to our epoxides.
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16. As far as we know, the addition of $BF_3{\cdot}Et_2O$ to DIBAH to accelerate the epoxide reduction has been previously described in only one report (see ref. 7), using an unsimmetrically substituted epoxide, which showed a reversal of regiocontrol passing from uncatalyzed to catalyzed reaction. In our case, where both the oxiranic carbon atoms have almost the same electronic situation and the discrimination between α and β position can occur only on the basis of steric hindrance, a neat increase in regioselectivity is observed passing from uncatalyzed to Lewis acid catalyzed reactions (*cfr.* entries 18 and 22).
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20. Formation of allyl alcohols from epoxides under basic conditions is well documented (see refs 1a - b).

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