The Phenyldimethylsilyl Group as a Masked Form of the Hydroxy Group†

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The phenyldimethylsilyl group can be converted in two steps, protodesilylation and peracid-mediated rearrangement, into a hydroxy group with retention of configuration: β-phenyldimethylsilyl carbonyl compounds are thus revealed to be masked aldol products.

We have reported several reactions in which our phenyldimethylsilyl-cuprate reagent delivers a phenyldimethylsilyl group as a nucleophile to such substrates as enones,[1] acetylenes,[2] and allylic acetates.[3] In most of this work, we used the phenyldimethylsilyl group, rather than the trimethylsilyl group, because it was easier to make phenyldimethylsilyl-lithium[4] than trimethylsilyl-lithium.[5] However, we were also attracted to the phenyldimethylsilyl group because it had striking potential as a masked hydroxy group. We now report how this potential can be realised.

Conjugate addition of the silyl-cuprate reagent to the enones (**1b**) and (**1c**) followed by hydrogenolysis gave the silanes (**2b**) and (**2c**). The silane (**2a**) was more conveniently prepared by silylation of the 3-phenylpropyl Grignard reagent. In all three of these compounds the phenyldimethylsilyl group is now remote from any functionality. Were it a trimethylsilyl group, it would not be possible to remove it except with the most vigorous of reagents, such as concentrated sulphuric acid, and even then it is probable that the methyl groups would be cleaved off before the larger alkyl chain. However, protodesilylation of the phenyl group (tetrafluoroboric acid diethyl ether complex in dichloromethane at room temperature for 2 h) converted each of the silanes (**2**) into the fluorosilanes (**3**), and these reacted with three or more equivalents of *m*-chloroperbenzoic acid in the presence of either triethylamine (an excess in ether at room temperature for 2 h) [(**3a**) and (**3b**)] or potassium fluoride in dimethylacetamide[6] [(**3c**)] to give the corresponding alcohols (**4**). Both steps of this sequence are known: protodesilylation of arylsilanes has been well studied,[7] and the peracid reaction is based on a discovery of Buncel and Davies,[8] recently developed by Kumada and his co-workers[9] as well as by us here.

We have now established, not only that the sequence works for primary, secondary, and tertiary silanes in the absence of functional groups, but also that the rearrangement regularly takes place with retention of configuration, and that it is compatible with ketone and ester groups. Thus we prepared the stereoisomeric β-silylketones (**7**)[10] and (**8**), and converted them into the β-hydroxyketones (**9**) and (**10**) in yields which are quite respectable for such sensitive products. The configurations of the β-silylketones followed from their method of synthesis from the enones (**5**) and (**6**),[10] and the stereochem-

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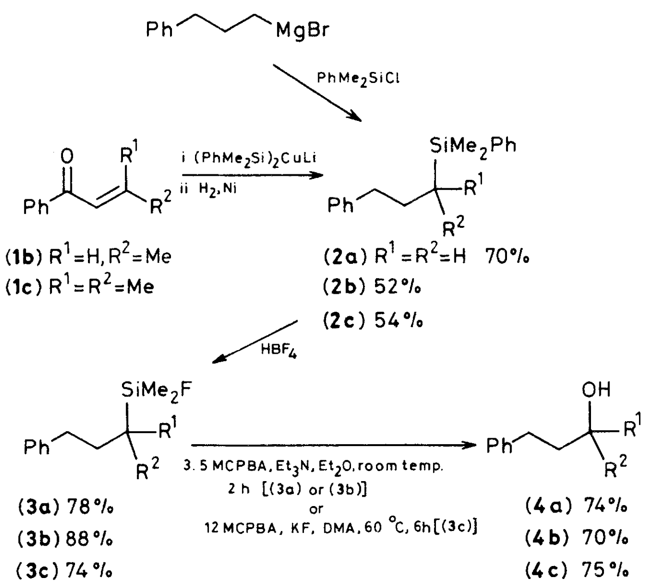
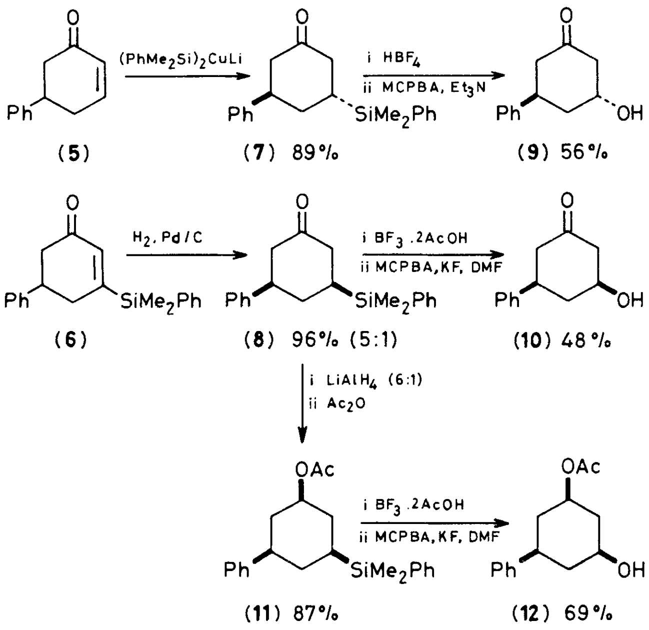
† No reprints available.



a; R^1 = R^2 = H
b; R^1 = H, R^2 = Me
c; R^1 = R^2 = Me

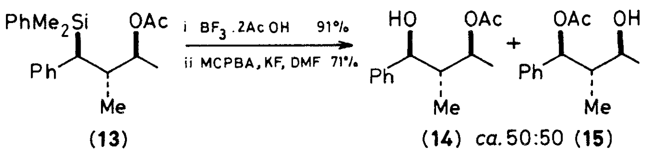
MCPBA = *m*-chloroperbenzoic acid, DMA = *N*,*N*-dimethylacetamide.

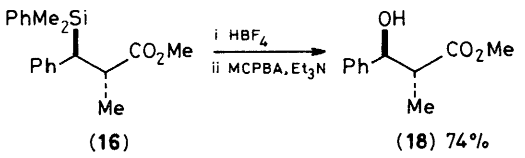


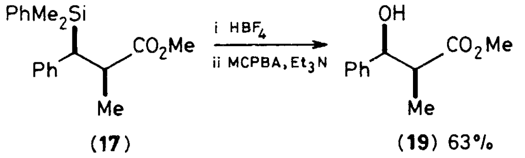
DMF = *N*,*N*-dimethylformamide.

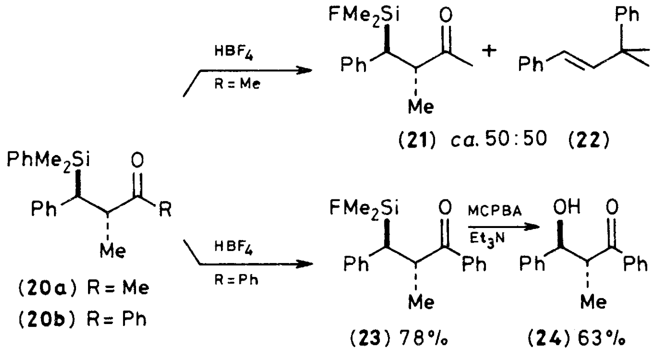
istry of the alcohols (**9**) and (**10**) from their n.m.r. spectra. The overall result was retention of configuration, as expected. The ester-silane (**11**) similarly gave the ester-alcohol (**12**), and in the open-chain series, the ester-silane (**13**) gave a mixture of the diol-monoacetates (**14**) and (**15**).

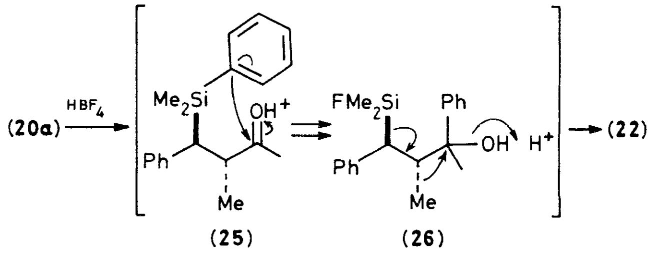
We believe the phenyldimethylsilyl group has great potential as a masked‡ hydroxy group, since it is electronically quite different and will influence the chemistry of the molecules in which it is embedded in quite different ways from protected hydroxy groups (it is electropositive rather than electronegative, it conjugates poorly, and it has no lone-pairs, for example). For now we point out only how it has served, as











described in the preceding paper,[11] to allow the alkylation of an enolate, without any risk that the silyl group will leave in a nucleofugal sense.[12] Yet application of the sequence of reactions described in this paper reveals that the products (**16**) and (**17**) described in that paper [numbered (**2d**) and (**3d**) there] can be converted into the β-hydroxy-esters (**18**) and (**19**), respectively, in what amounts to a completely new approach to the diastereoselective synthesis of aldols.

Although the sequence worked well with the esters (**16**) and (**17**), the ketone (**20a**) gave a by-product (**22**) in the protodesilylation step along with (**21**); this product can be accounted for by a sequence beginning with electrophilic attack by the protonated ketone group on the phenyl group, (**25**), followed by ionisation of the derived tertiary alcohol (**26**), methyl shift, and loss of the silyl group, in a pathway for which we have provided ample precedent.[13] This pathway was

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‡ We should like to suggest a distinction between a 'masked' group and a 'protected' group, aware that, although the distinction is clear here, there is a borderline area where the distinction is not so easy to make.

unavailable to the cyclic ketones (**7**) and (**8**), and did not occur with the phenyl ketone (**20b**), which gave the aldol-type product (**24**) from (**23**). The aldol products (**18**), (**19**), and (**24**) are all known, and confirm the stereochemical assignments made in the preceding paper.

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10 We thank Dr. N. D. Emslie for preparing these compounds and for preliminary work on this project.

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