Asymmetric Autocatalysis Triggered by Carbon Isotope ($^{13}C/^{12}C$) Chirality

Kawasaki, T.; Matsumura, Y.; Tsutsumi, T.; Suzuki, K.; Ito, M.; Soai, K.
Science, **2009**, *324*, 492.

Hong Ren

06-19-09

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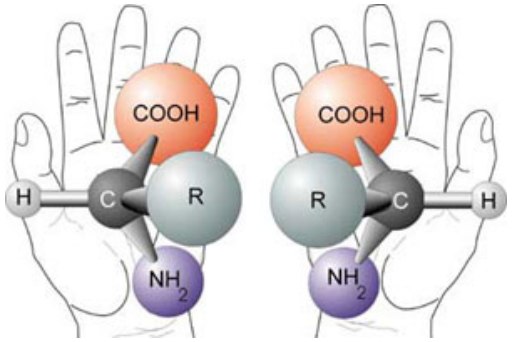
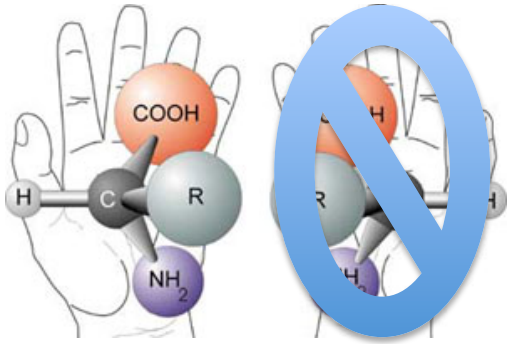
The Homochirality Remains a Puzzle…



The Homochirality Remains a Puzzle…



All the 20 natural amino acids are left-handed.

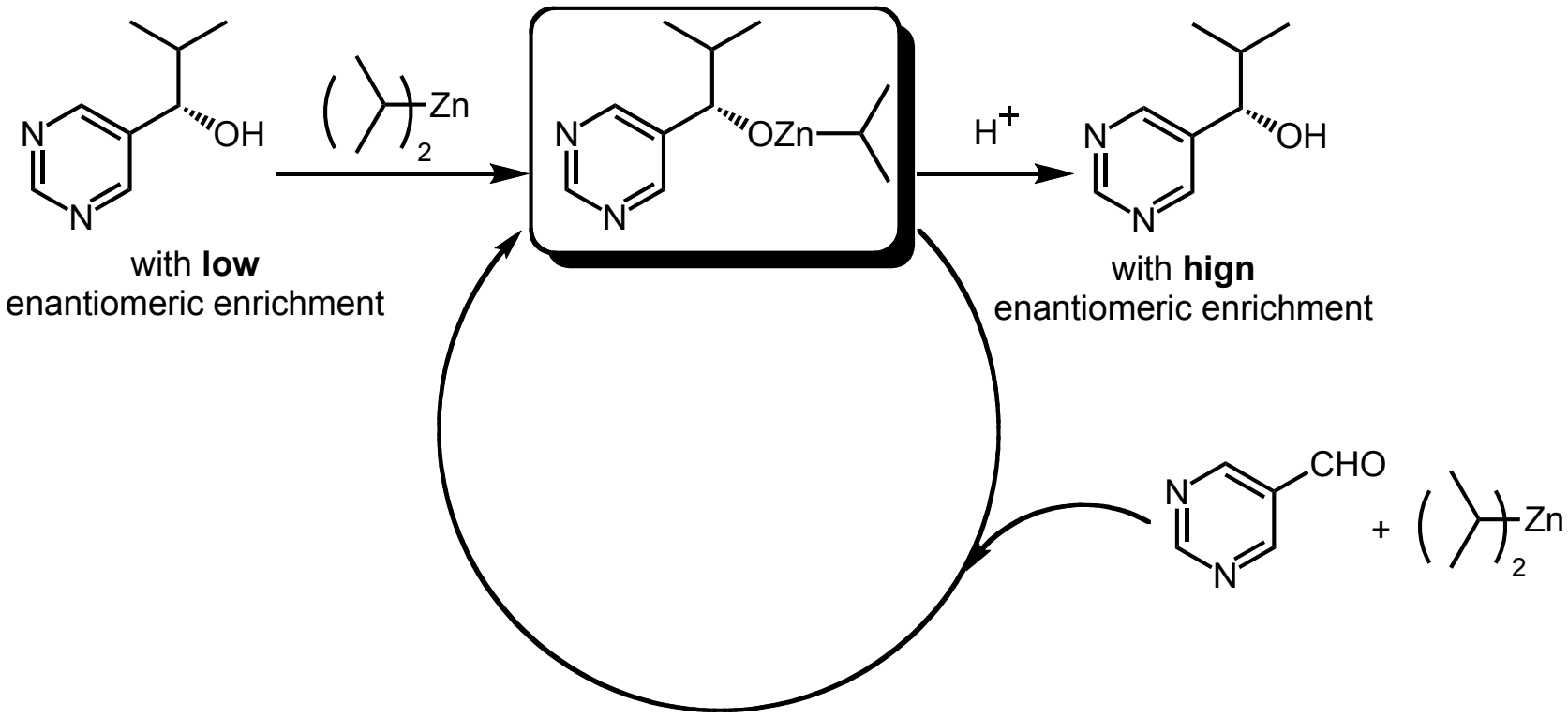
A proposed theory to explain the origin of the homochirality:

1st step Shattering the mirror: Absolute Asymmetric Synthesis

2nd step Propagating the imbalance: Asymmetric Autocatalysis

Blackmond, D. G. PNAS, 2004, 101, 5732-5736.

Asymmetric Autocatalysis and Its Implications for the Chemical Origin of Life



Soai, K.; Shibata, T.; Morioka, H.; Choji, K. Nature, **1995**, *378*, 767-768.

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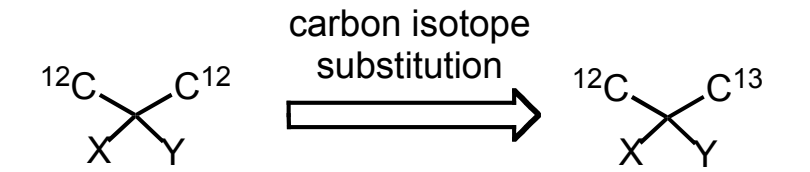
06-19-09

Generation of Chirality by Carbon Isotope Substitution



Achiral compound Isotopic enantiomers

Problem:

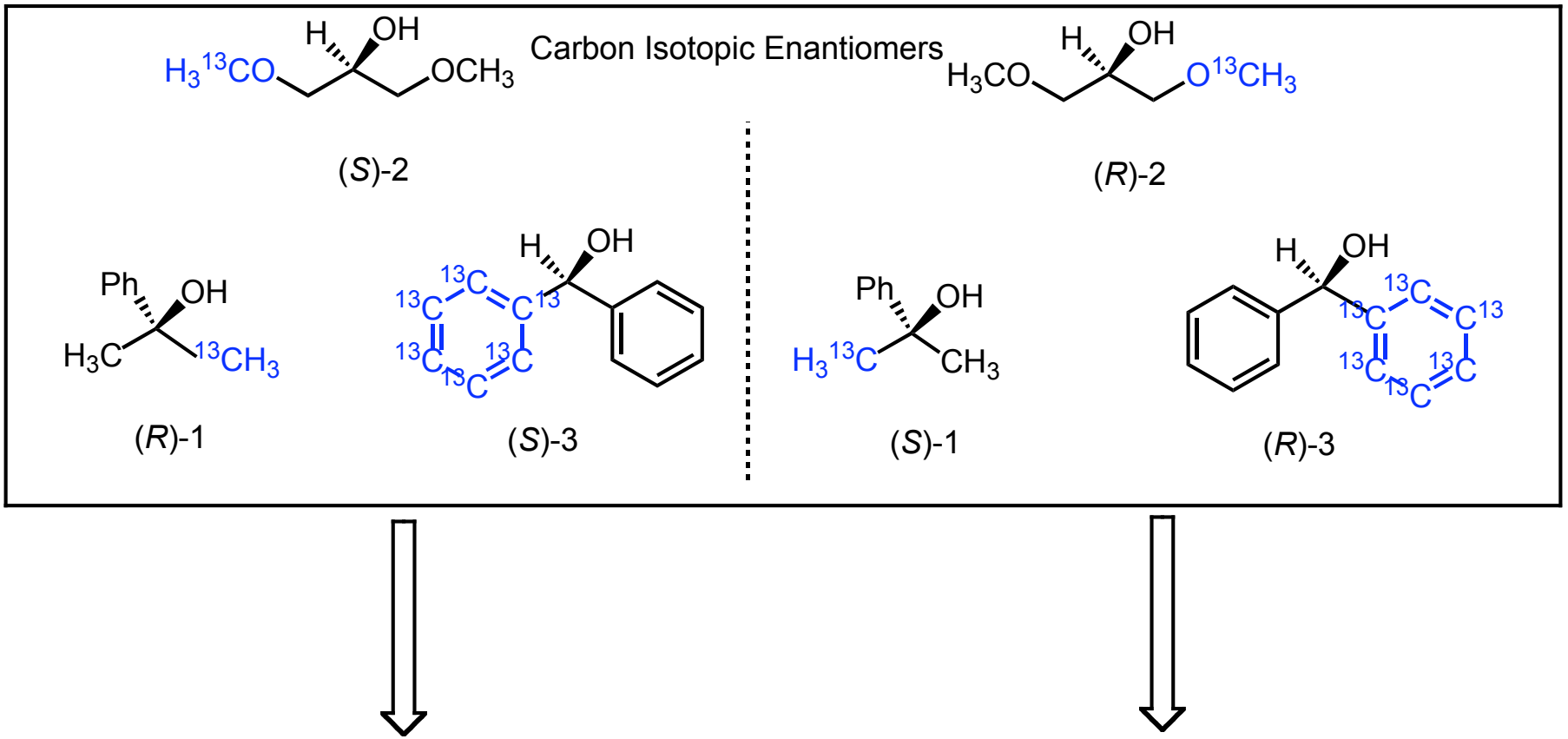
Experimentally inaccessible: very small difference between ^{13}C and ^{12}C

Solution:

Asymmetric Autocatalysis

Kawasaki, T.; Matsumura, Y.; Tsutsumi, T.; Suzuki, K.; Ito, M.; Soai, K. *Science*, **2009**, *324*, 492.

Discrimination of the Carbon Isotopic Chirality by Asymmetric Autocatalysis



Kawasaki, T.; Matsumura, Y.; Tsutsumi, T.; Suzuki, K.; Ito, M.; Soai, K. *Science*, **2009**, *324*, 492.

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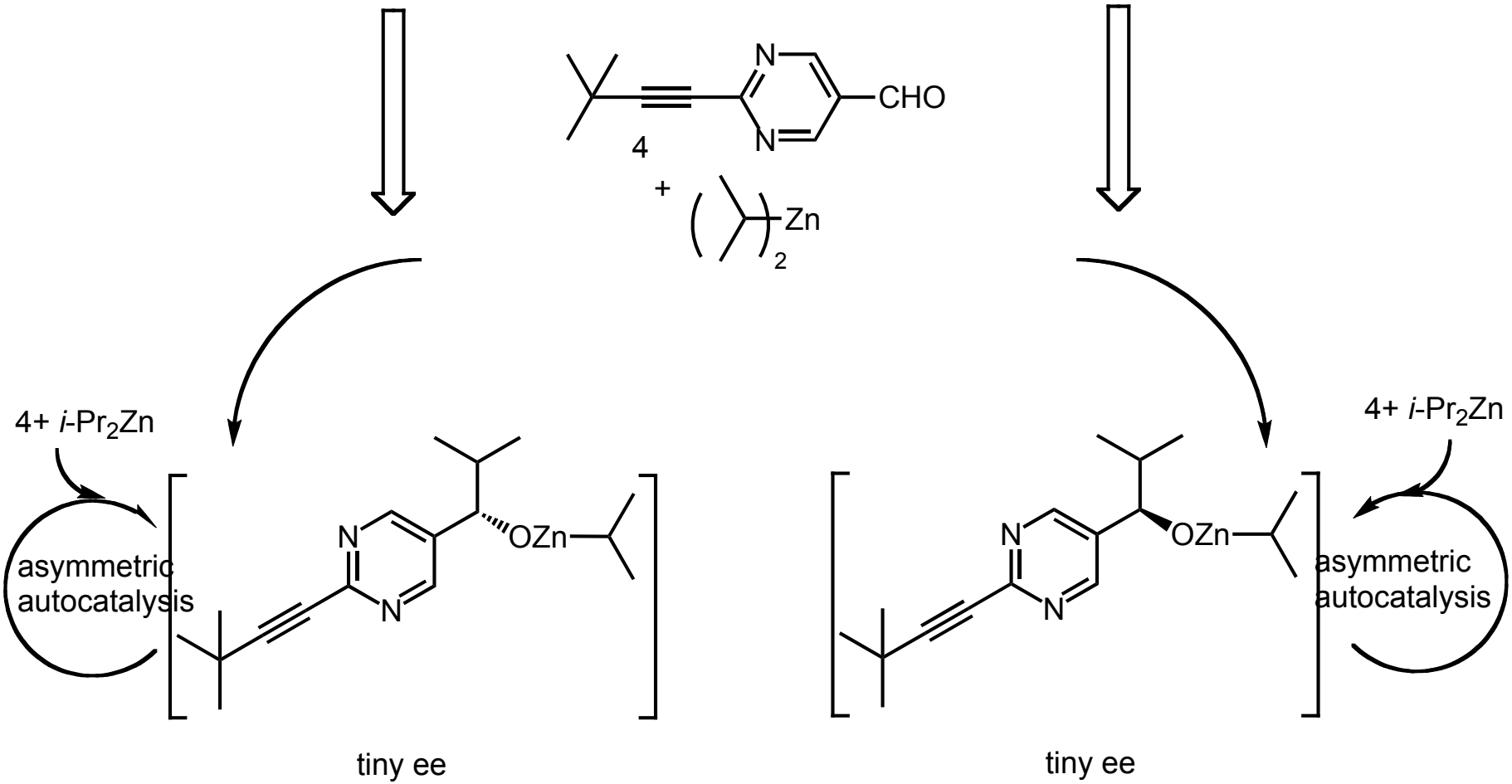

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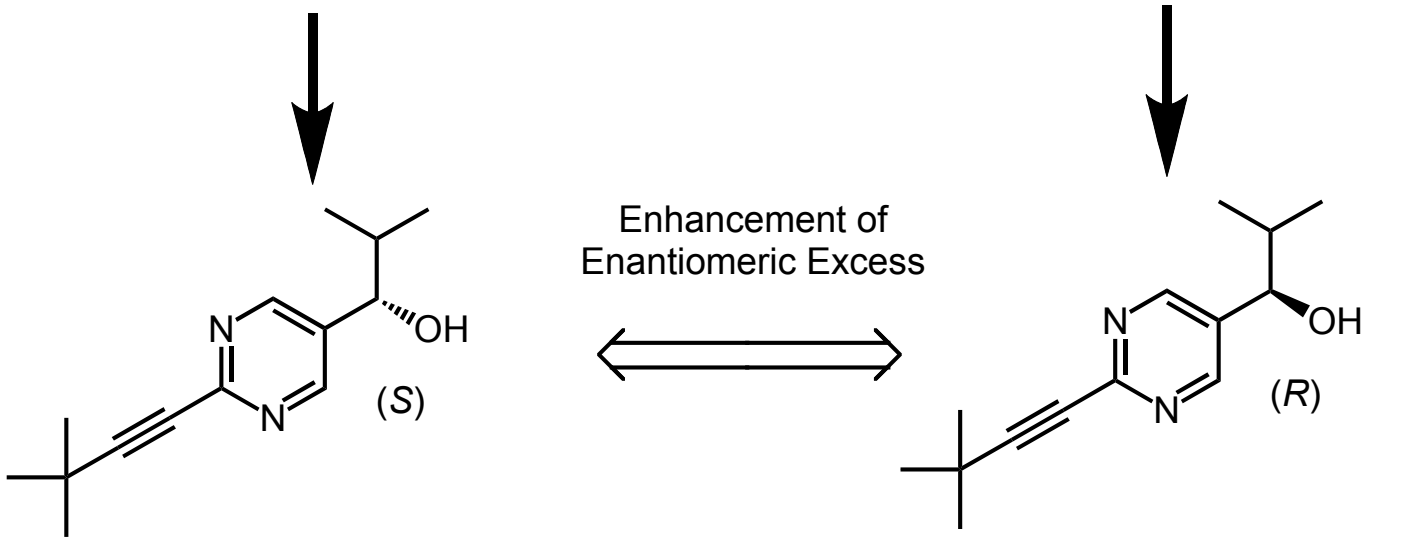

Highly Enantioenriched (*S*)-5

Highly Enantioenriched (*R*)-5

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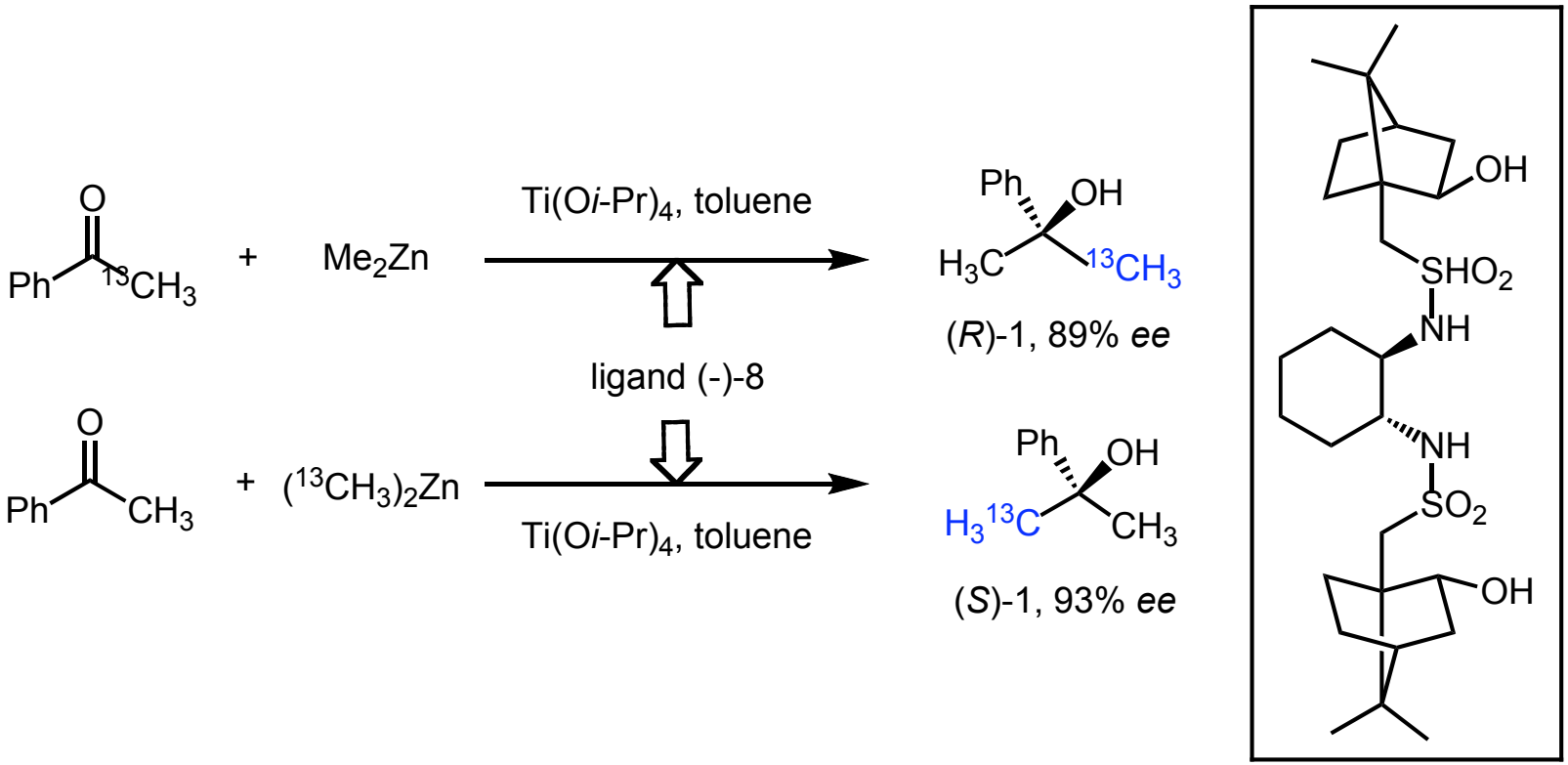
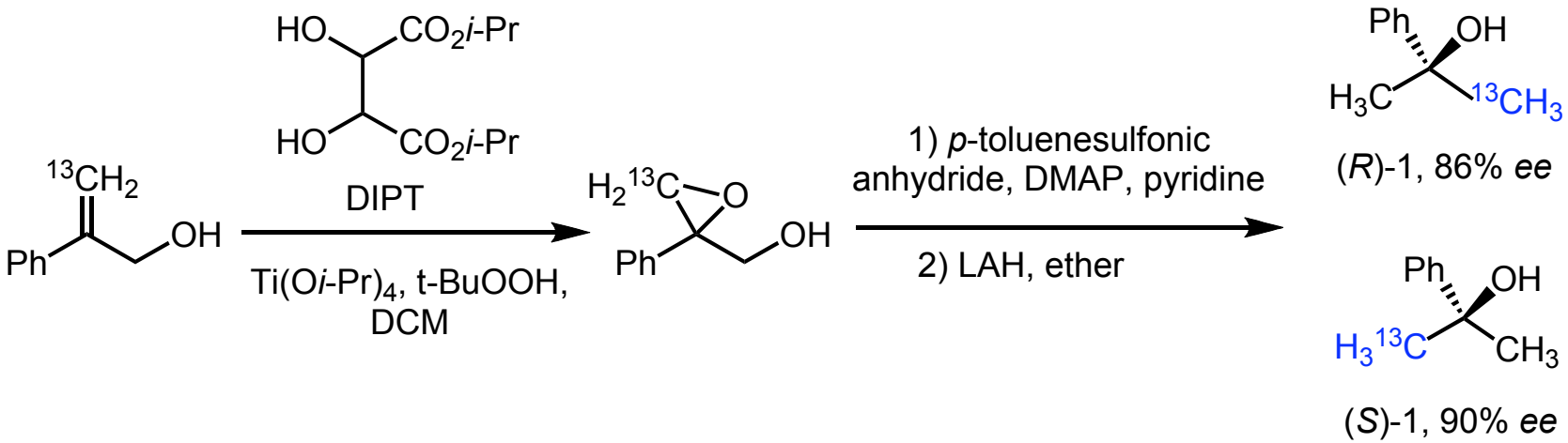
Synthesis of Compound 1---Route 1



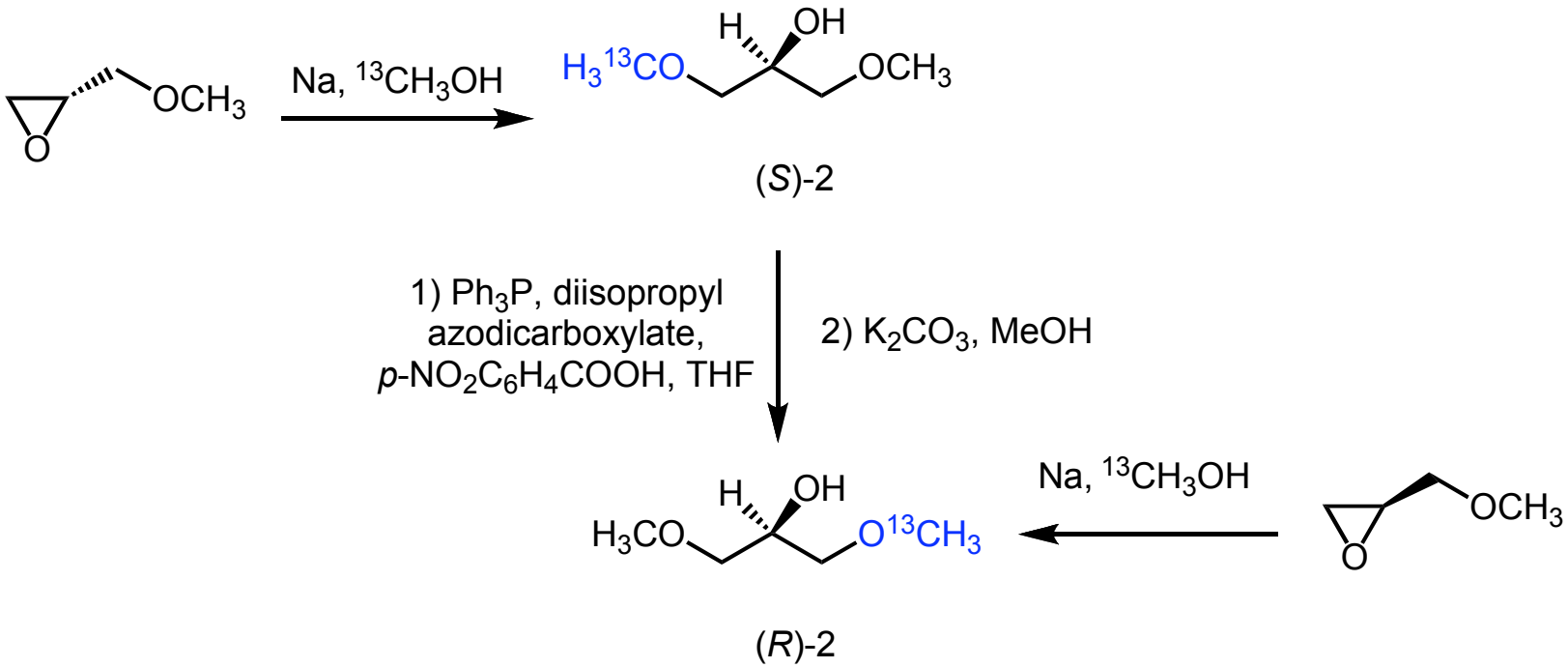
Kawasaki, T.; Matsumura, Y.; Tsutsumi, T.; Suzuki, K.; Ito, M.; Soai, K. *Science*, **2009**, *324*, 492.

Synthesis of Compound 1---Route 2



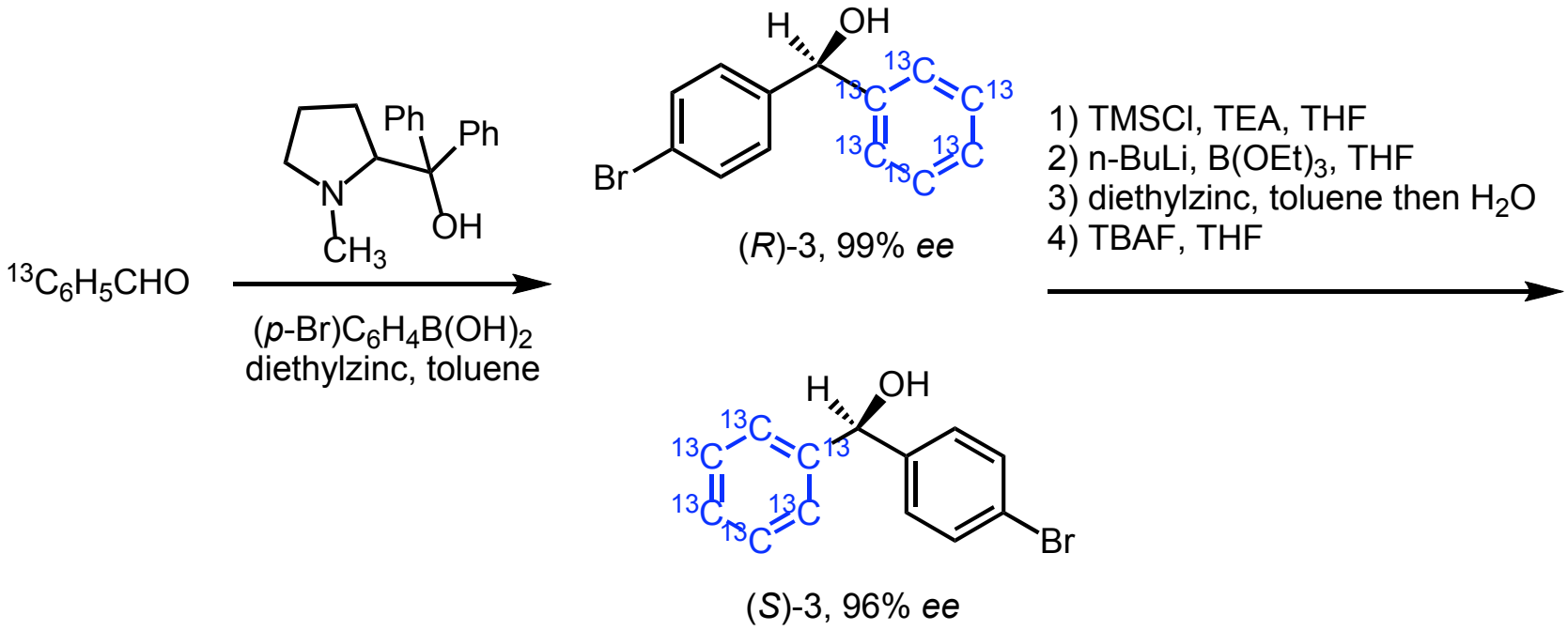
Kawasaki, T.; Matsumura, Y.; Tsutsumi, T.; Suzuki, K.; Ito, M.; Soai, K.
Science, **2009**, *324*, 492.

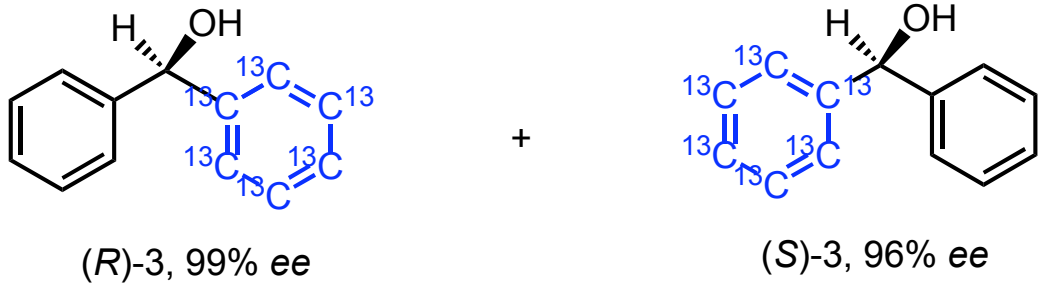
Synthesis of Compound 2



Kawasaki, T.; Matsumura, Y.; Tsutsumi, T.; Suzuki, K.; Ito, M.; Soai, K. *Science*, **2009**, *324*, 492.

Synthesis of Compound 3





Kawasaki, T.; Matsumura, Y.; Tsutsumi, T.; Suzuki, K.; Ito, M.; Soai, K. *Science*, **2009**, *324*, 492.

Chiral Discrimination of the Isotopic Carbons Using Compound 1 from Route 1

Entry	Chiral alcohol	Isolated yield	ee	configurition
1	(*R*)-1 (89% *ee*)	94	92	*S*
2	(*S*)-1 (93% *ee*)	95	96	*R*
3	(*R*)-1 (89% *ee*)	80	88	*S*
4	(*S*)-1 (93% *ee*)	94	96	*R*
5	(*R*)-1 (89% *ee*)	96	88	*S*
6	(*S*)-1 (93% *ee*)	97	94	*R*
7	(*R*)-1 (89% *ee*)	ND	93	*S*
8	(*S*)-1 (93% *ee*)	92	93	*R*

Kawasaki, T.; Matsumura, Y.; Tsutsumi, T.; Suzuki, K.; Ito, M.; Soai, K. *Science*, **2009**, *324*, 492.

Chiral Discrimination of the Isotopic Carbons Using Compound 1 from Route 2

Entry	Chiral alcohol	Isolated yield	ee	configurition
1	(*R*)-1 (86% *ee*)	94	94	*S*
2	(*S*)-1 (86% *ee*)	87	95	*R*
3	(*R*)-1 (86% *ee*)	93	94	*S*
4	(*S*)-1 (90% *ee*)	98	93	*R*
5	(*R*)-1 (86% *ee*)	85	92	*S*
6	(*S*)-1 (84% *ee*)	93	88	*R*
7	(*R*)-1 (86% *ee*)	88	89	*S*
8	(*S*)-1 (90% *ee*)	93	90	*R*

Kawasaki, T.; Matsumura, Y.; Tsutsumi, T.; Suzuki, K.; Ito, M.; Soai, K. *Science*, **2009**, *324*, 492.

Wine Time