

# Propellane Triquinane Natural Products - The Modhephene Family

## Molecule in Review

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Snyder Group  
July 24, 2009

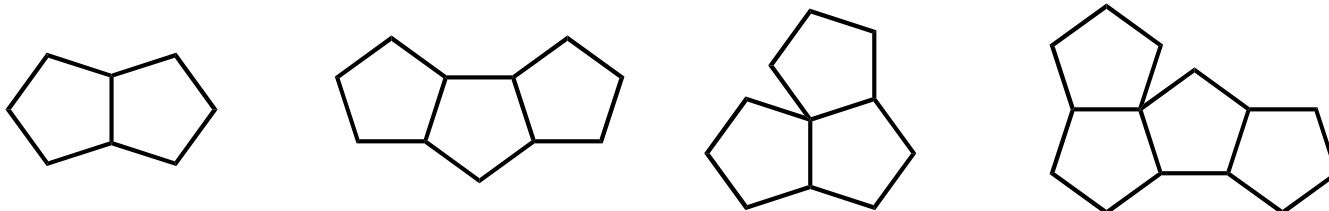
Synthesis Literacy Group  
Columbia University  
Chemistry



# *Polyquinane Natural Products*

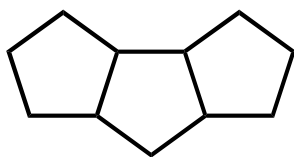
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- Terpenes composed entirely of fused 5-membered rings
  - Up to four fused 5-membered rings
- More than 250 natural products encountered among plant, marine and microbial sources
- First structure elucidated in 1966 (hirsutic acid-C)
- Polyquinane synthesis significant area of research during last three decades

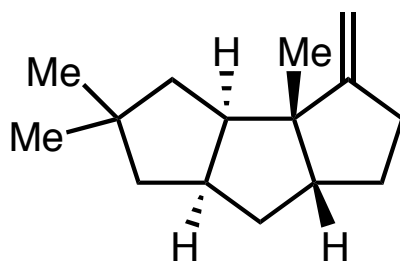


# Triquinane Natural Products

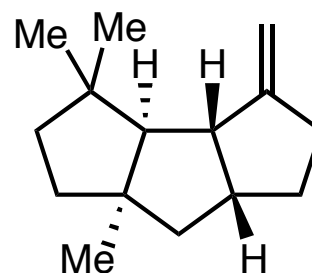
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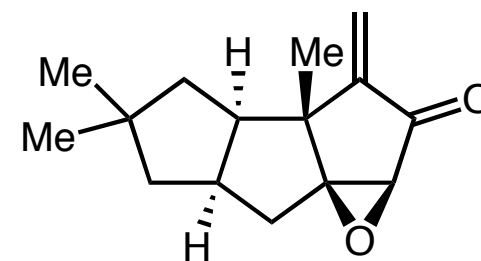
linear triquinane



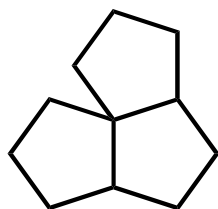
hirsutene



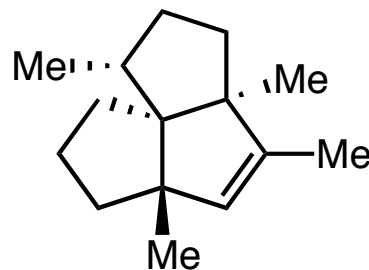
capnellene



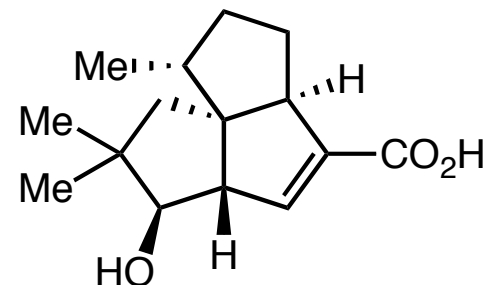
hypnophyllin



angular triquinane

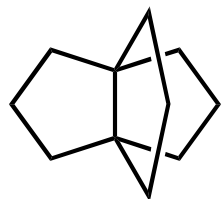


isocomene

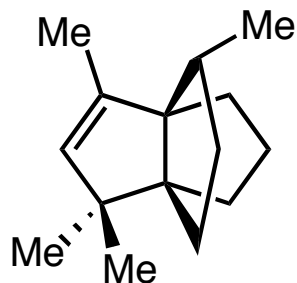


pentalenic acid

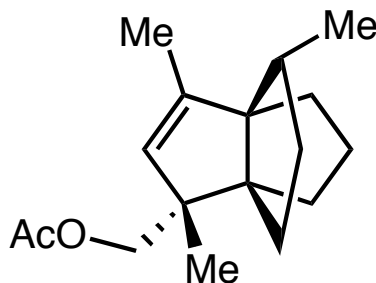
# Triquinane Natural Products



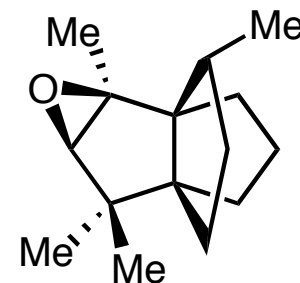
propellane triquinane



modhephene



13-OAc-modhephene



modhephene epoxide

- Modhephene isolated in 1978 from Rayless goldenrod (*Isocoma wrightii*) plant

Zalkow, L. H. *et al.* *J. Chem. Soc., Chem. Commun.* **1978**, 420.

Bohlmann, F.; Zdero, C.; Bohlmann, R.; King, R. M.; Robinson, H. *Phytochemistry* **1980**, *19*, 579.

- Modhephene synthesized >10 times
- Modhephenes were only carbocyclic propellane natural product known until 2004



Kontes 4 - CU Synthesis Lit Group - Modhephene

# Other Propellane Natural Products

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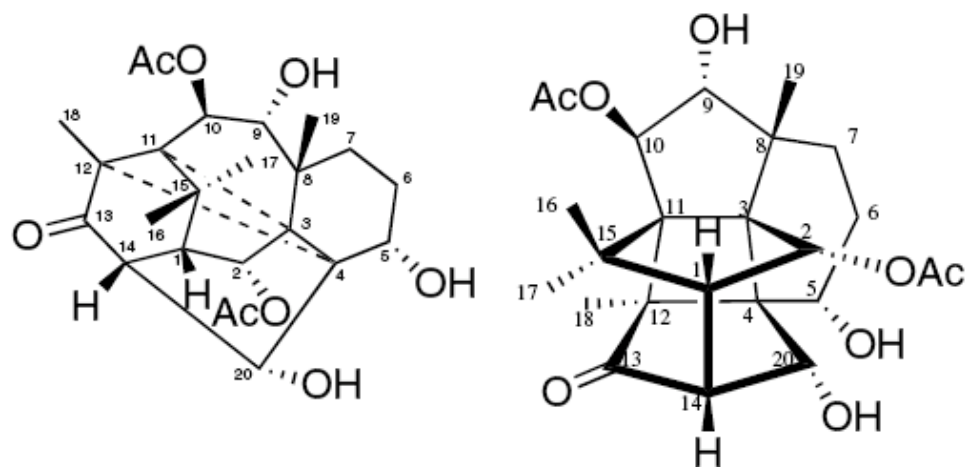
- Propellane taxanes isolated from Canadian yew (*Taxus canadensis*) needles

Shi, Q.-W. *et al.* *Chem. Commun.* **2004**, 544.

Shi, Q.-W. *et al.* *Chem. Commun.* **2007**, 48, 2721.

Shi, Q.-W. *et al.* *Eur. J. Org. Chem.* **2008**, 5414.

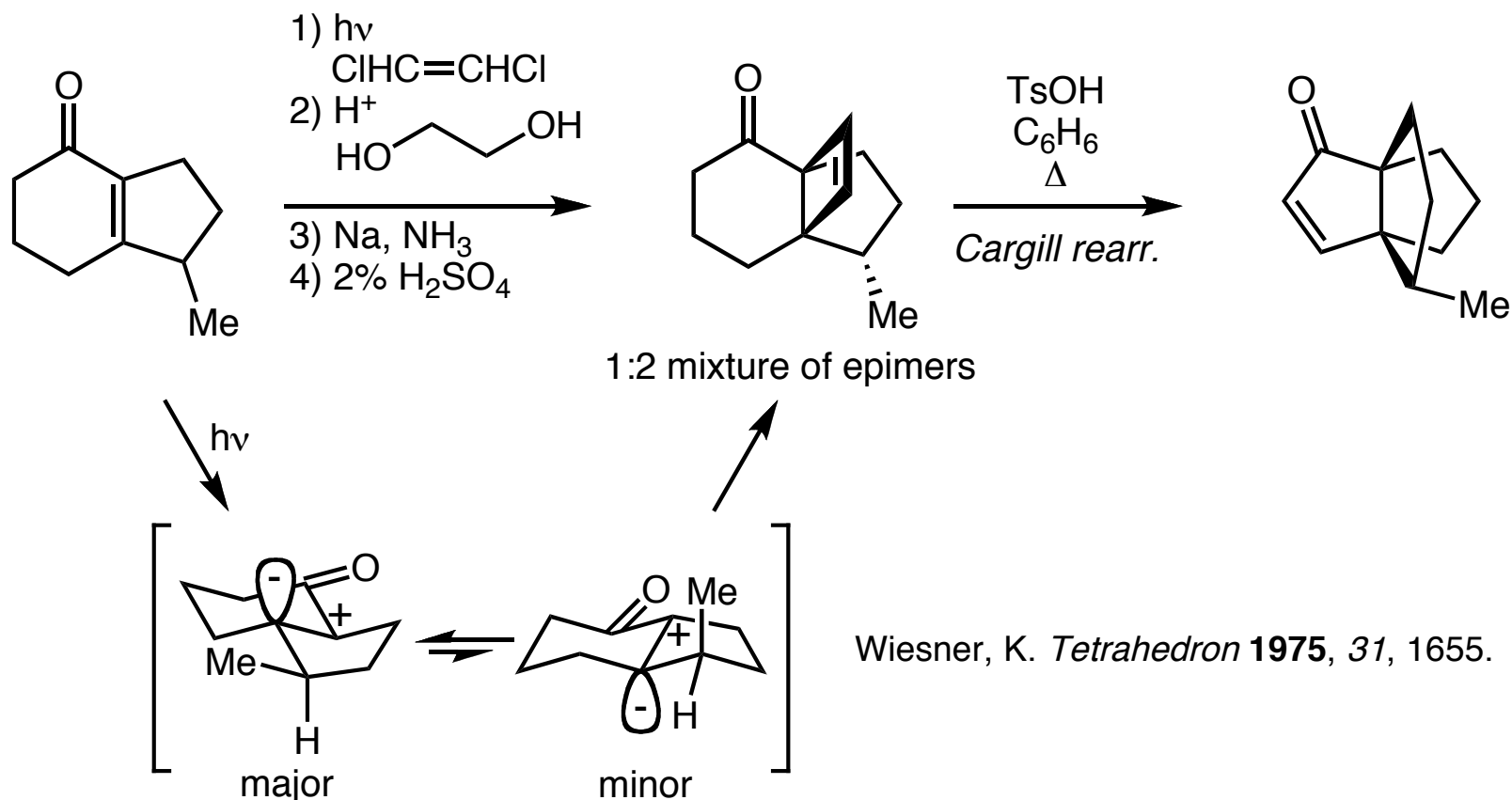
etc.



# Smith's Synthesis of Modhephene

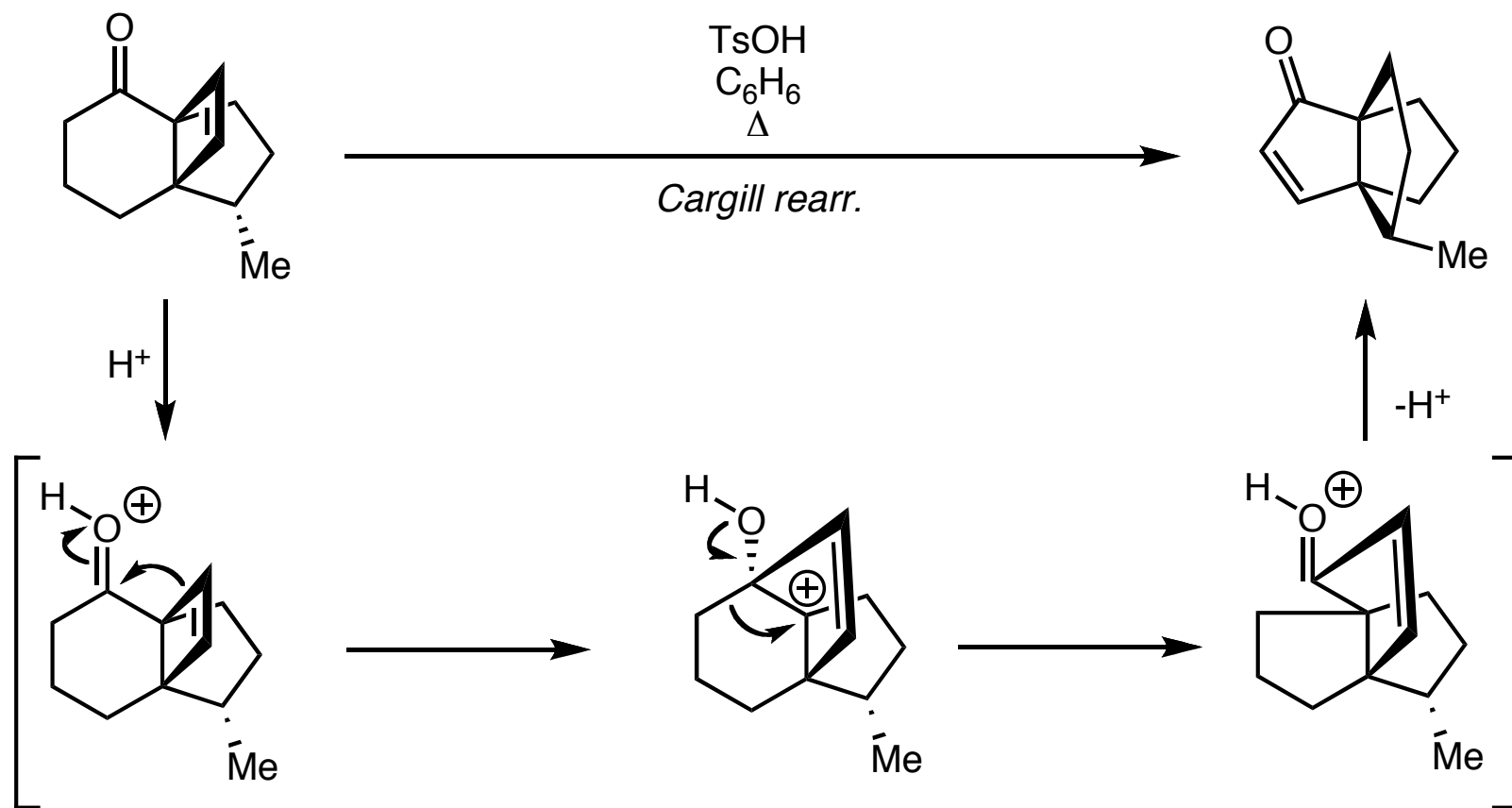
Smith, A. B. III; Jerris, P. J. *J. Am. Chem. Soc.* **1981**, *103*, 194–195.

Smith, A. B. III; Jerris, P. J. *J. Org. Chem.* **1982**, *47*, 1845–1855.

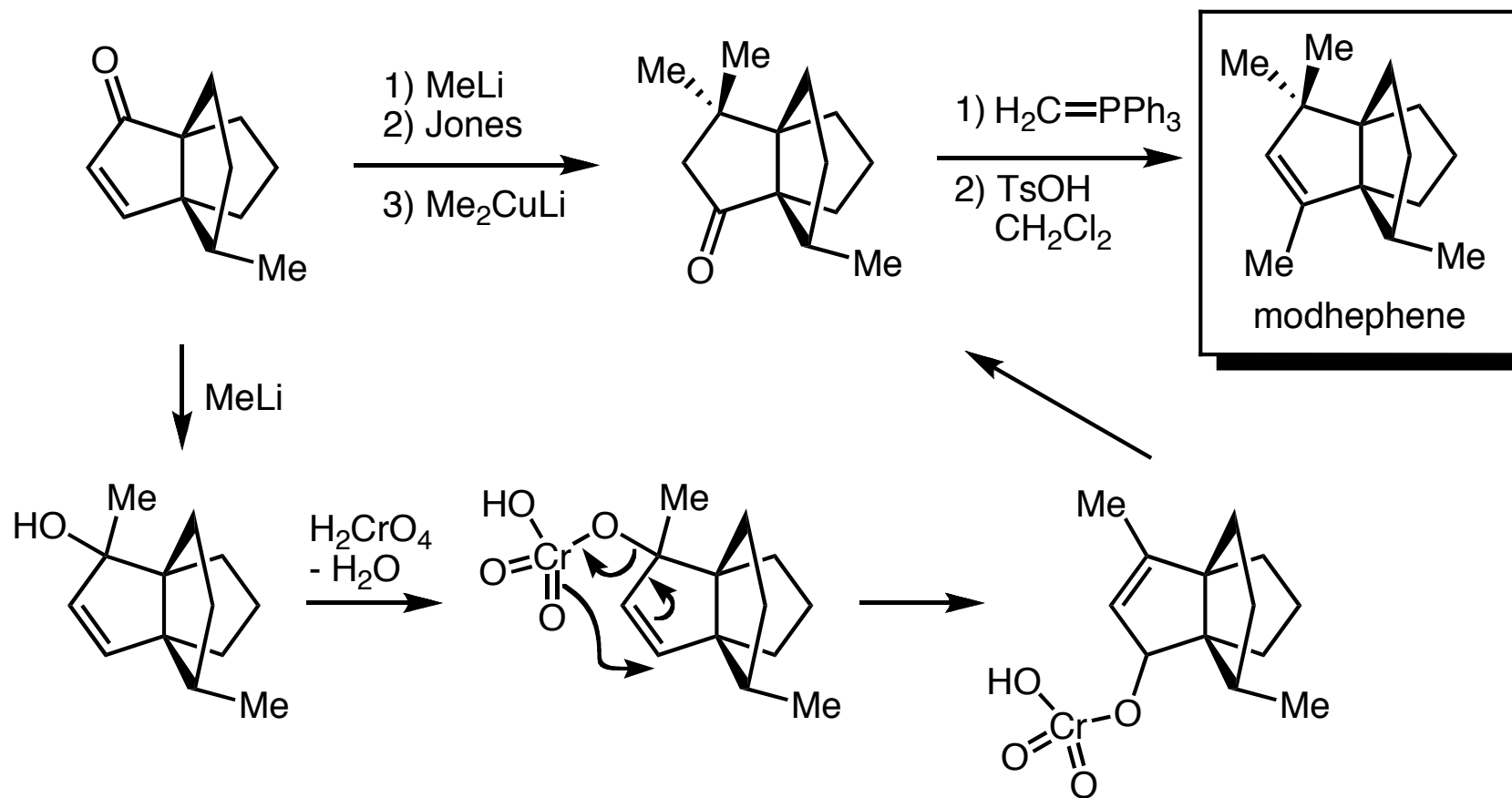


Kontes 6 - CU Synthesis Lit Group - Modhephene

# Smith's Synthesis of Modhephene



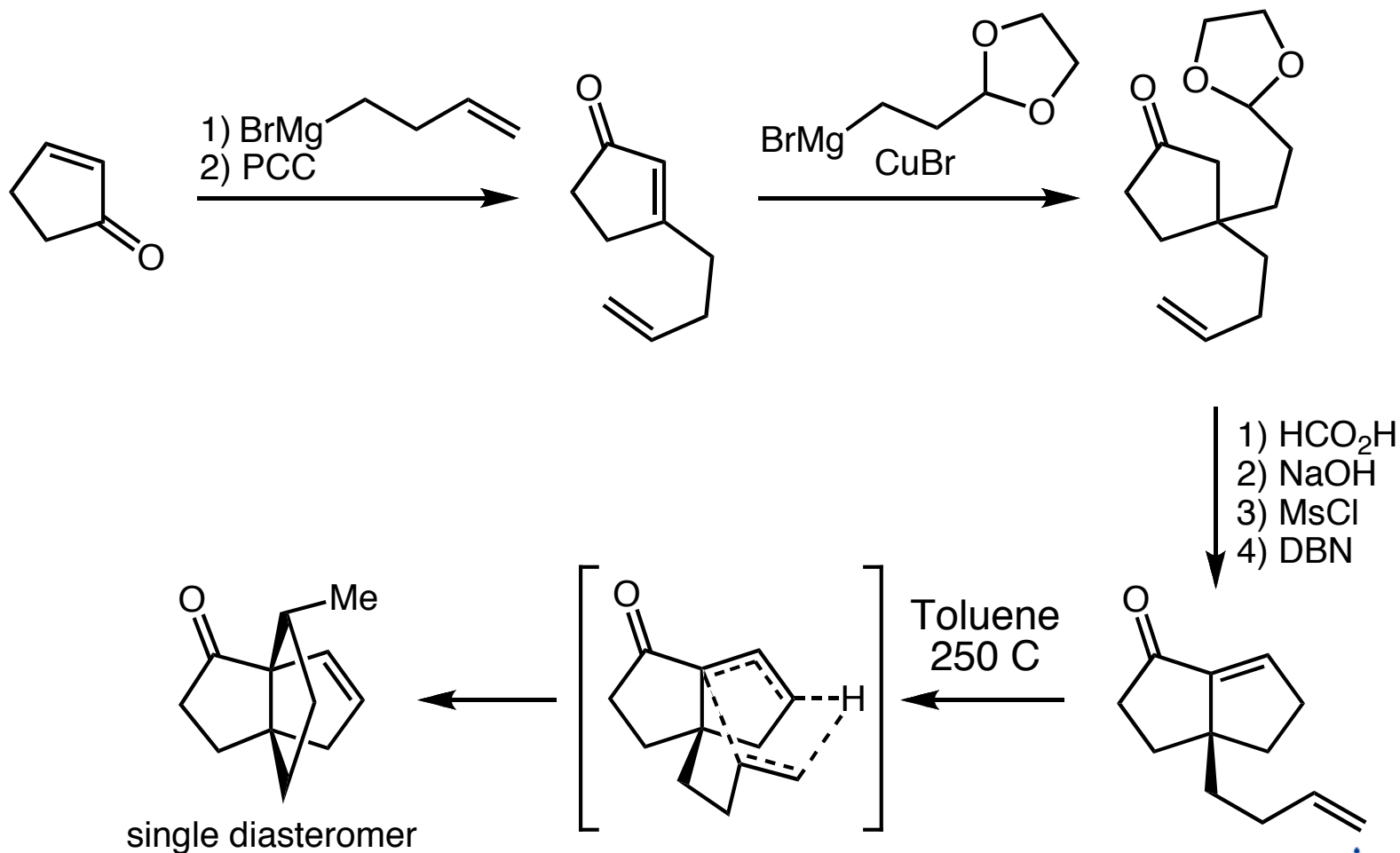
# Smith's Synthesis of Modhephene



Kontes 8 - CU Synthesis Lit Group - Modhephene

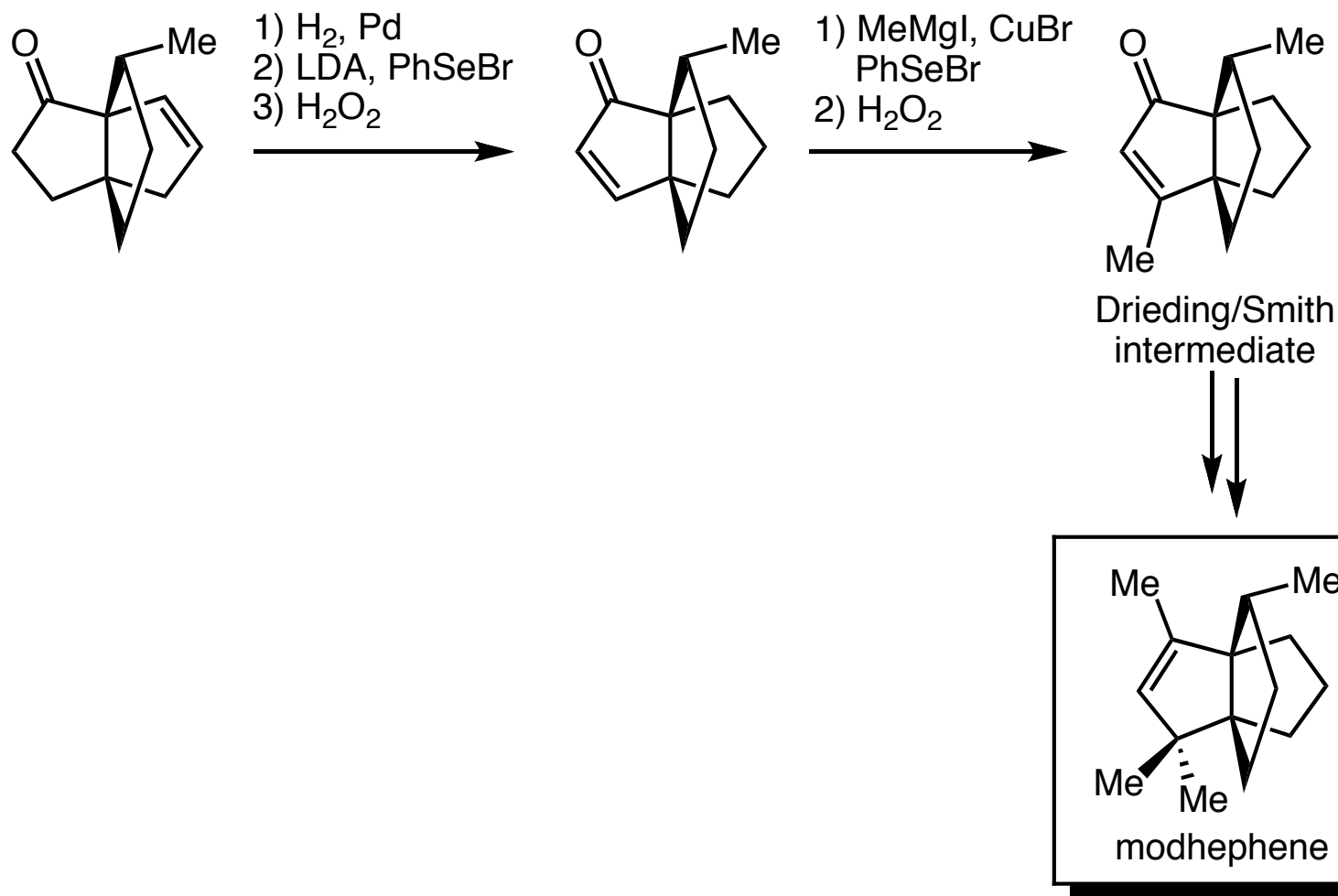
# Oppolzer's Synthesis of Modhephene

Oppolzer, W.; Marazza, F. *Helv. Chim. Acta* **1981**, *64*, 1575–1578.



Kontes 9 - CU Synthesis Lit Group - Modhephene

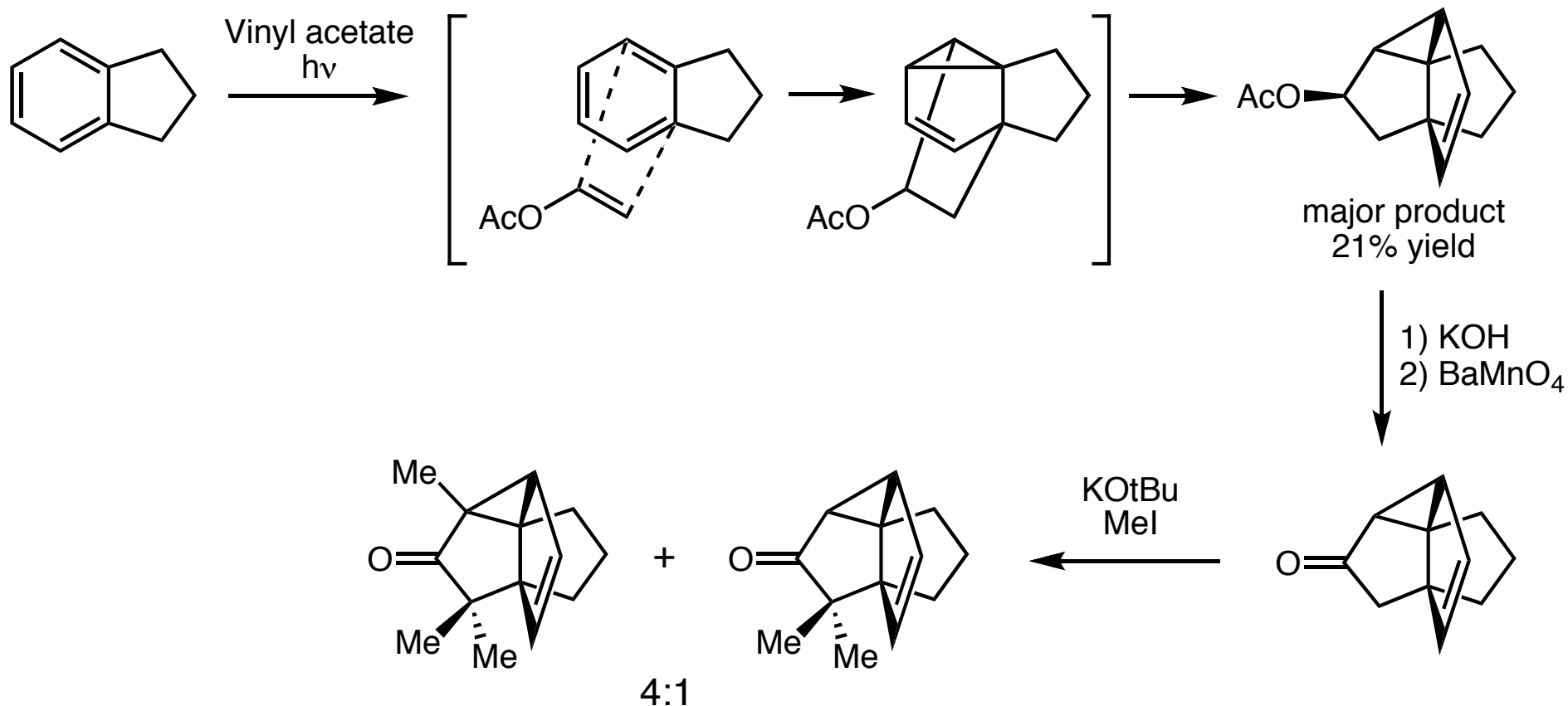
# Oppolzer's Synthesis of Modhephene



Kontes 10 - CU Synthesis Lit Group - Modhephene

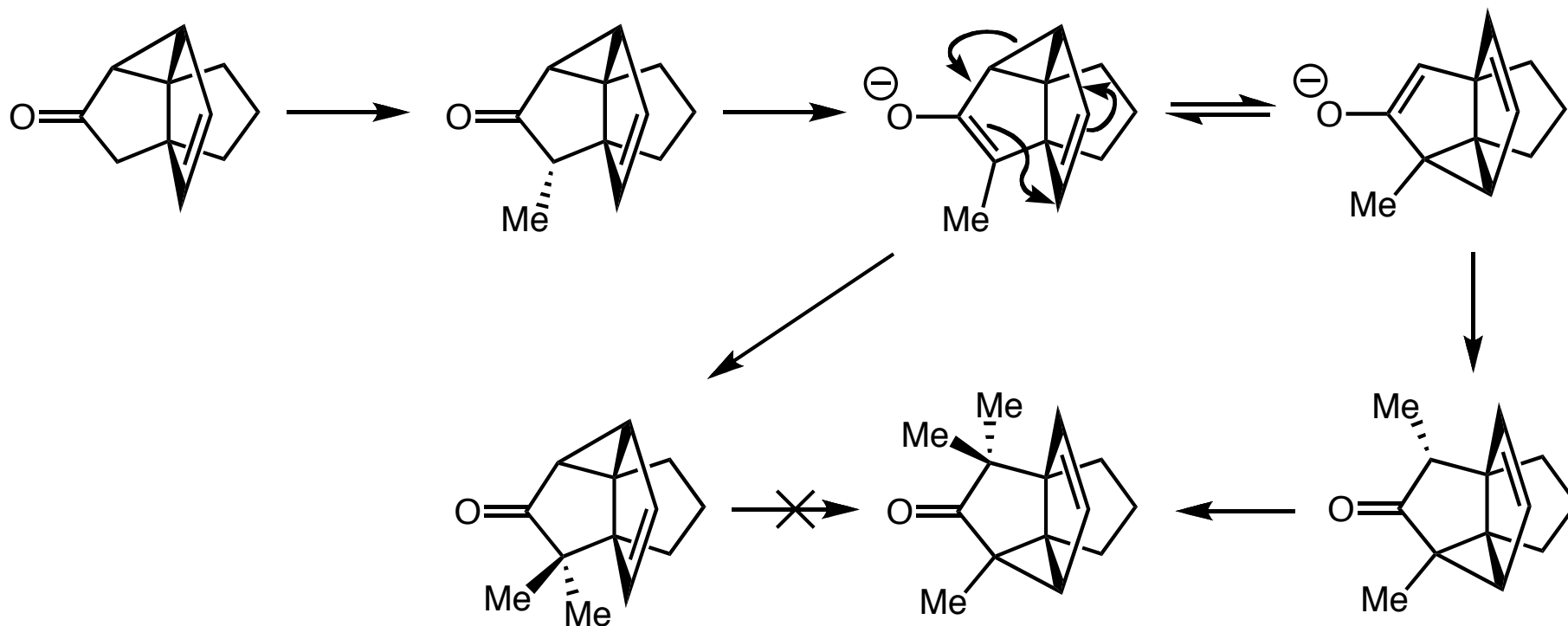
# Wender's Synthesis of Modhephene

Wender, P. A.; Dreyer, G. B. *J. Am. Chem. Soc.* **1982**, *104*, 5805–5807.



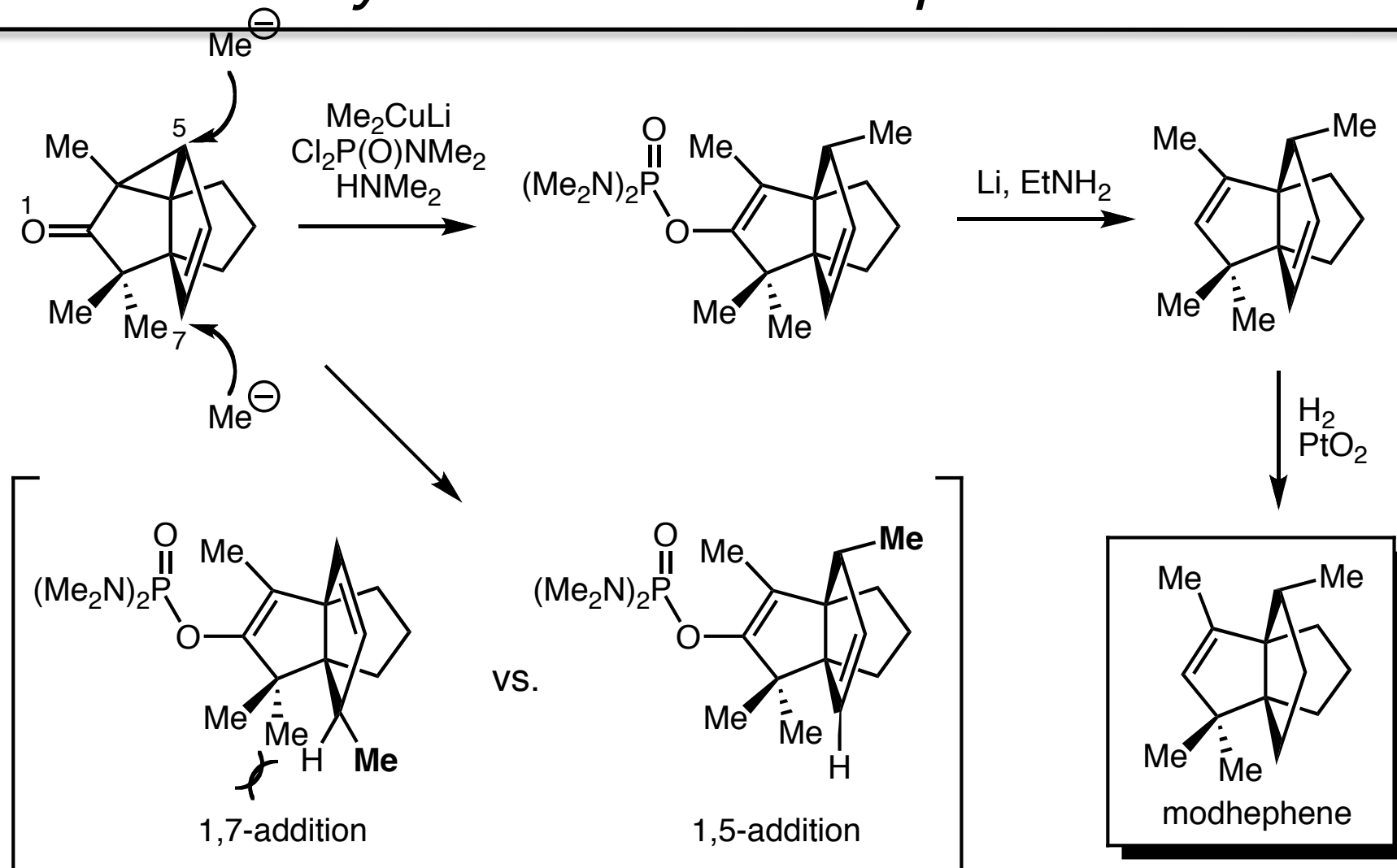
Kontes 11 - CU Synthesis Lit Group - Modhephene

# Wender's Synthesis of Modhephene



Kontes 12 - CU Synthesis Lit Group - Modhephene

# Wender's Synthesis of Modhephene

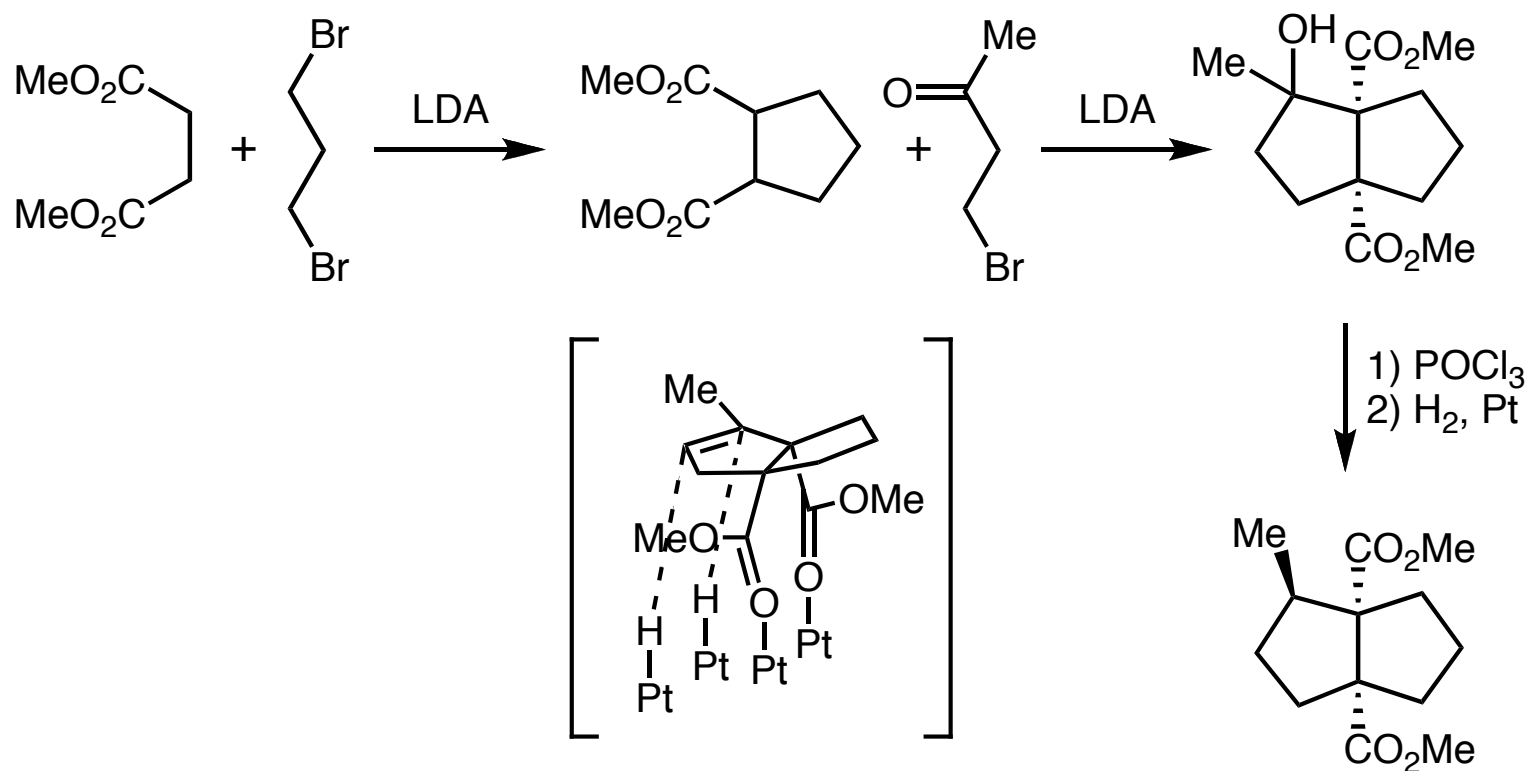


Kontes 13 - CU Synthesis Lit Group - Modhephene

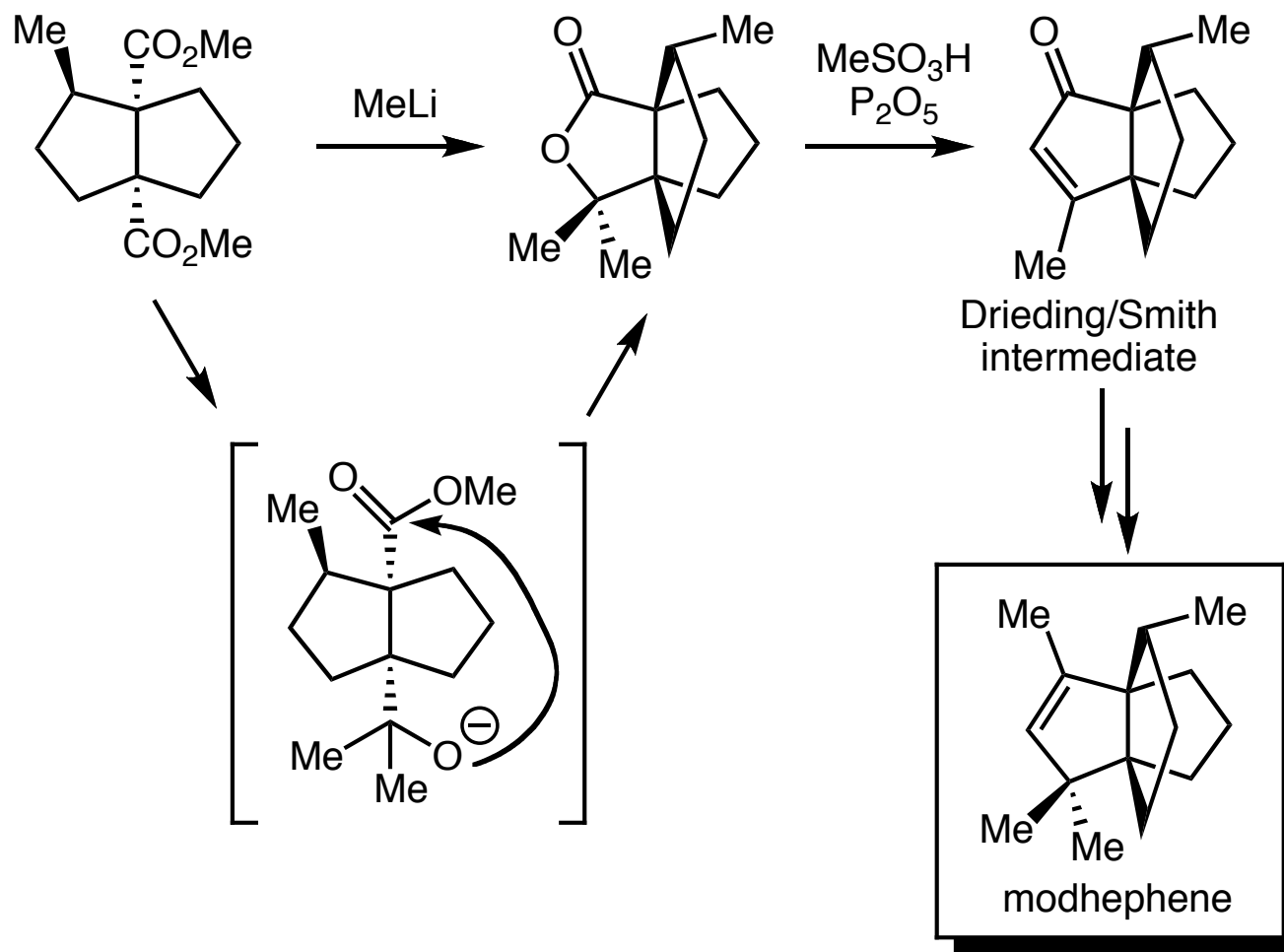
# Mundy's Synthesis of Modhephene

Wilkening, D.; Mundy, B. P. *Tet. Lett.* **1984**, *25*, 4619–4622.

Wilkening, D.; Mundy, B. P. *J. Org. Chem.* **1985**, *50*, 5727–5731.



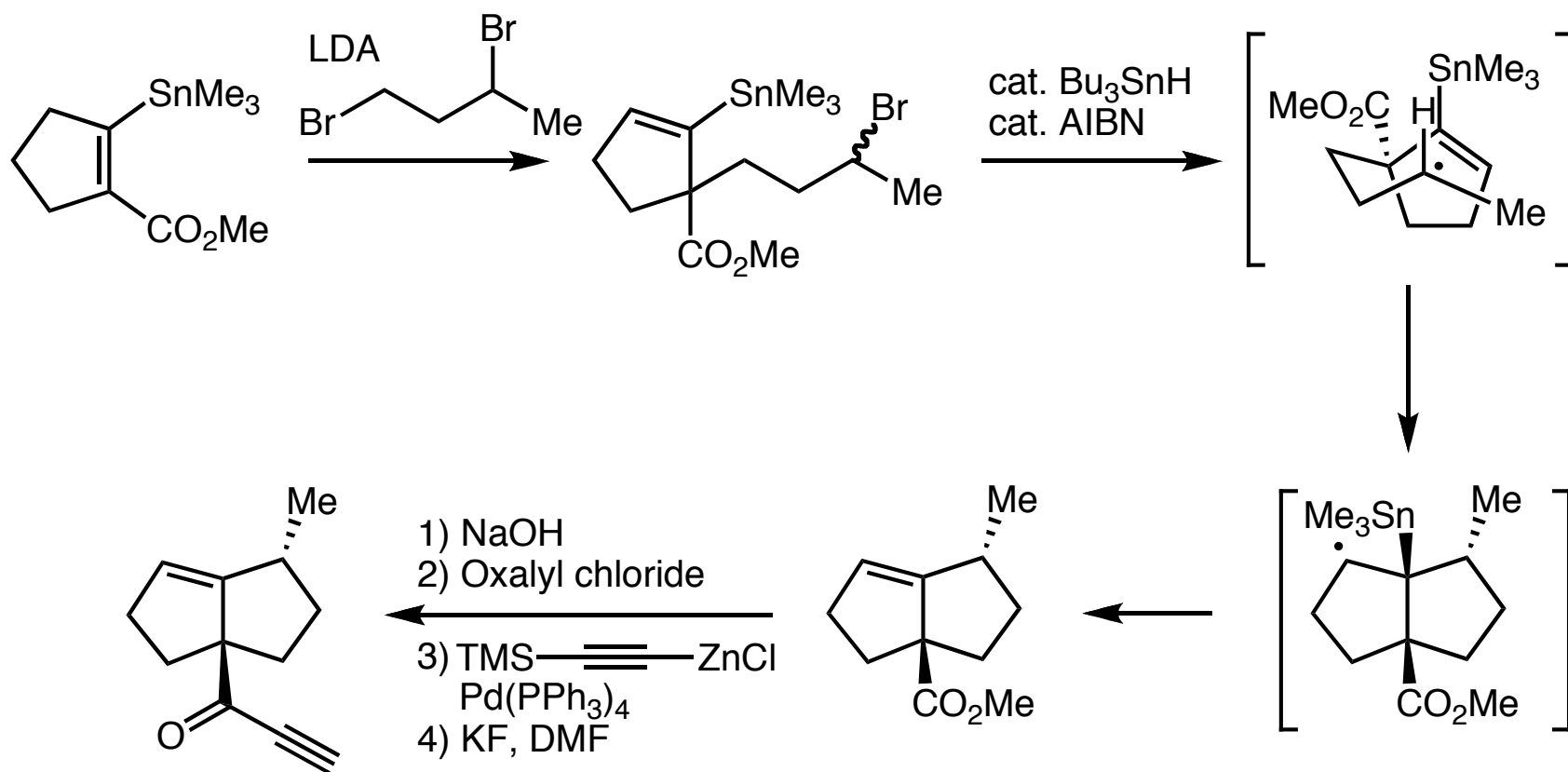
# Mundy's Synthesis of Modhephene



Kontes 15 - CU Synthesis Lit Group - Modhephene

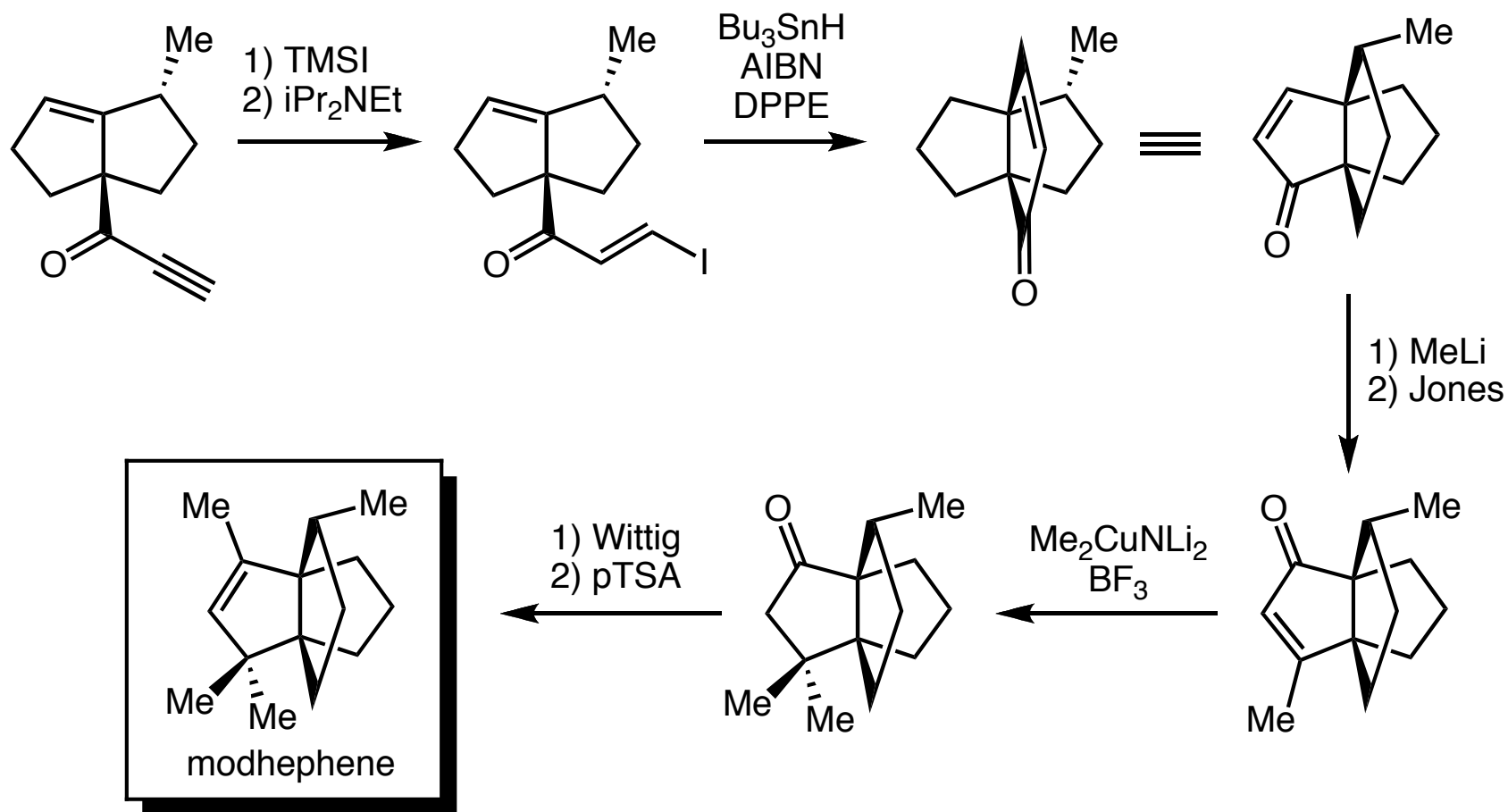
# Curran's Synthesis of Modhephene

Jasperse, C. P.; Curran, D. P. *J. Am. Chem. Soc.* **1990**, 5601–5609.



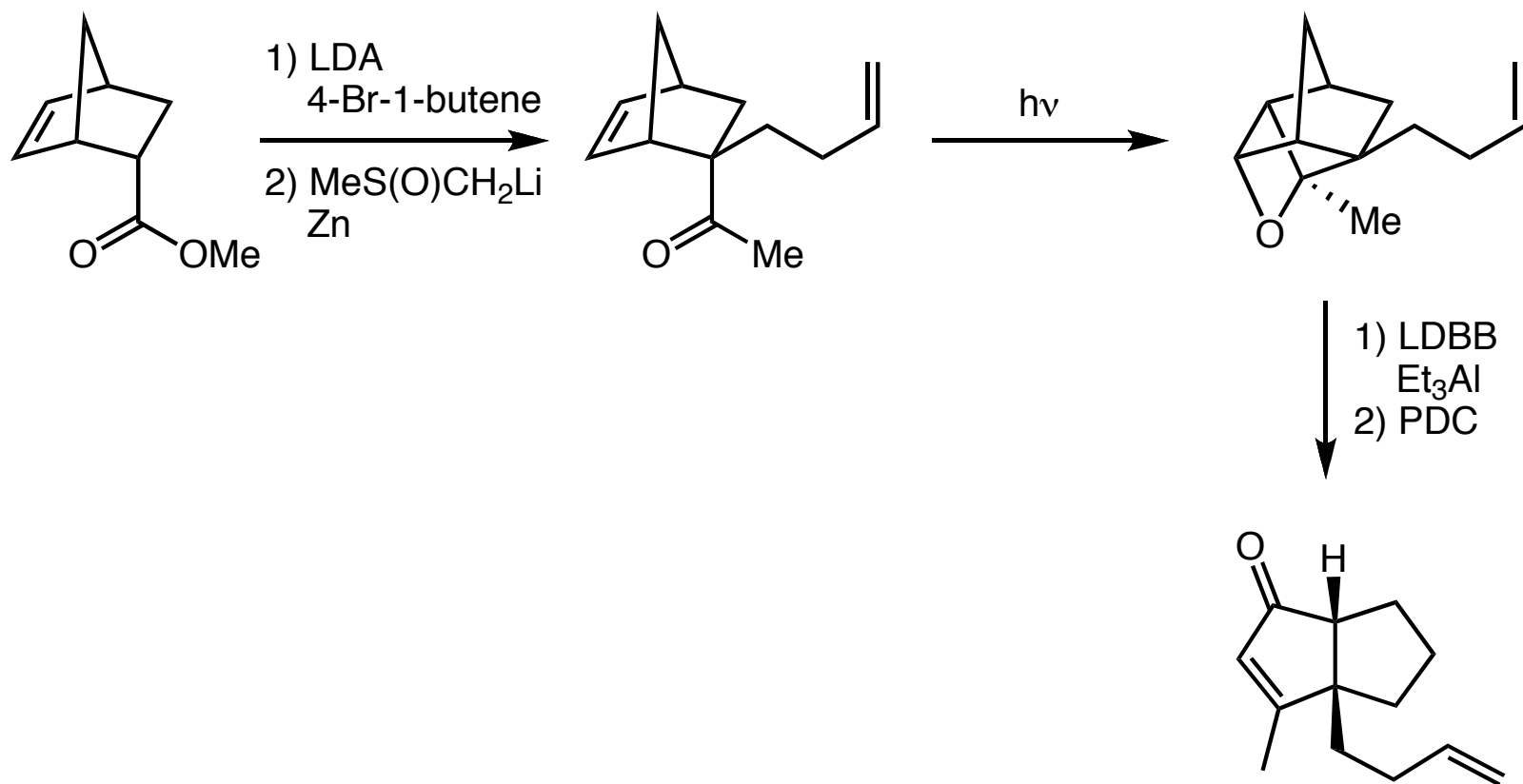
Kontes 16 - CU Synthesis Lit Group - Modhephene

# Curran's Synthesis of Modhephene



# Rawal's Synthesis of Modhephene

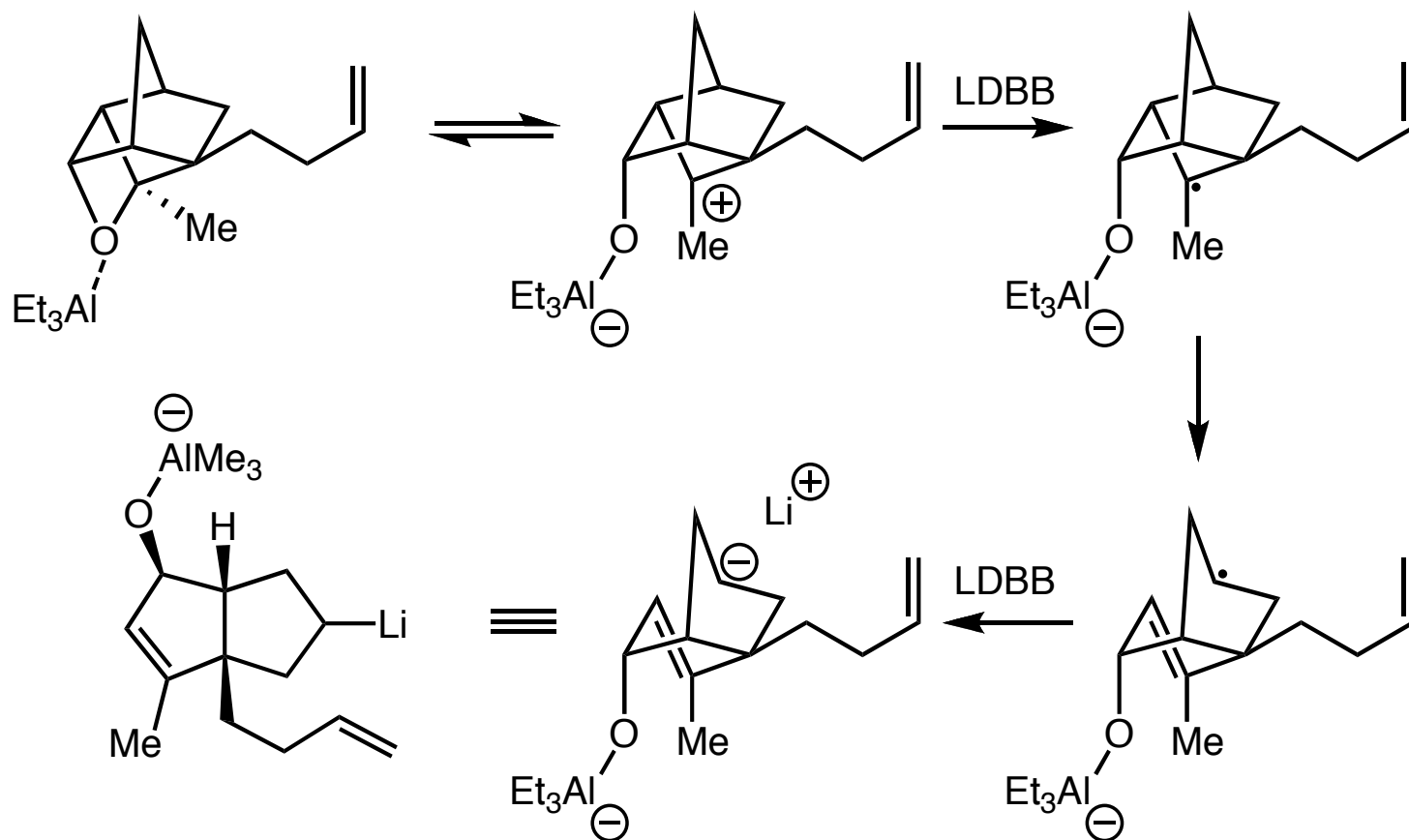
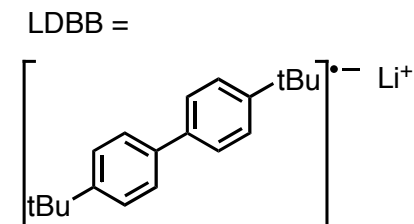
Dworak, C. A.; Rawal, V. H. *Chem. Commun.* **1997**, 2381–2382.



Kontes 18 - CU Synthesis Lit Group - Modhephene

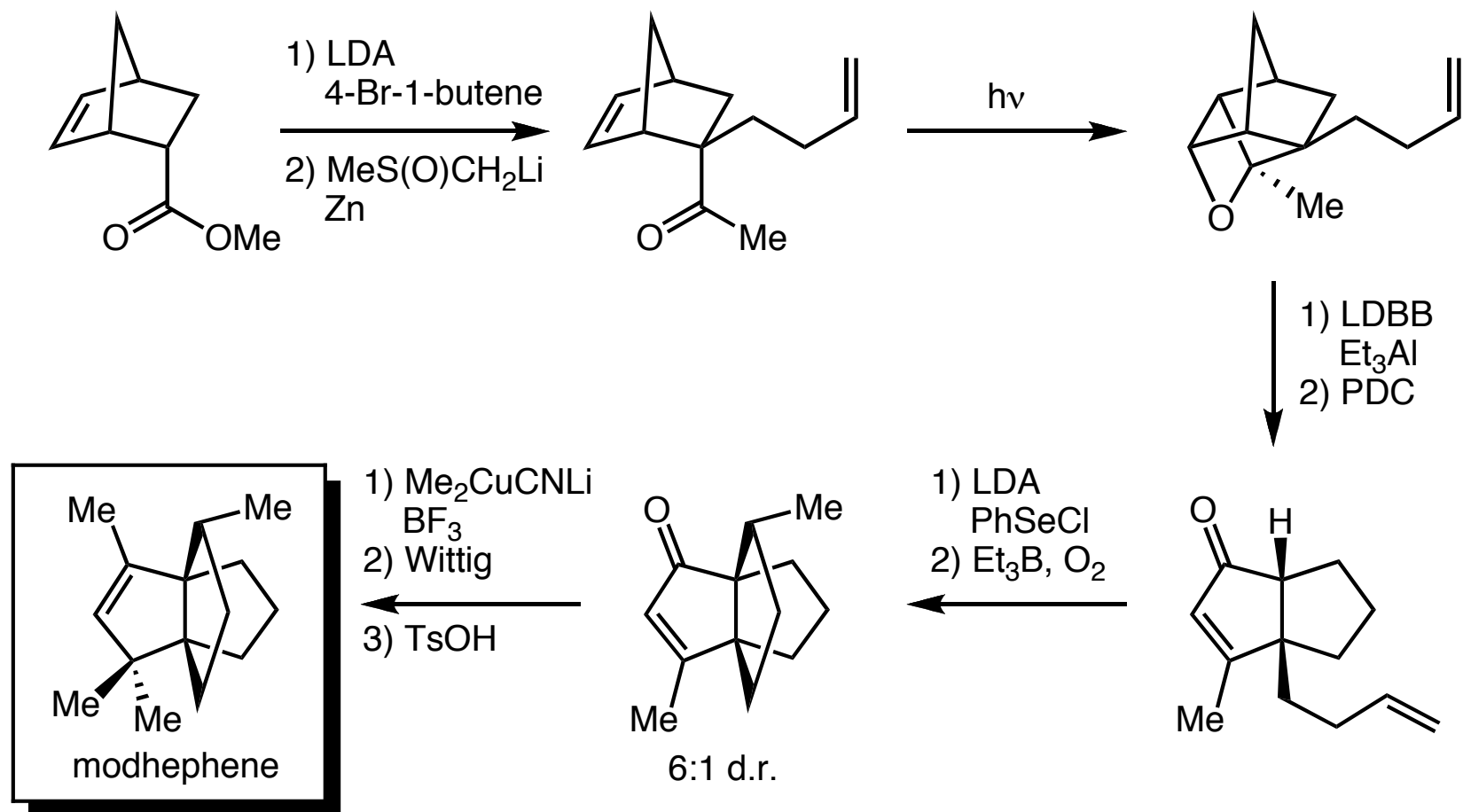
# Rawal's Synthesis of Modhephene

Murdyk, B.; Cohen, T. *J. Org. Chem.* **1991**, *56*, 5760.



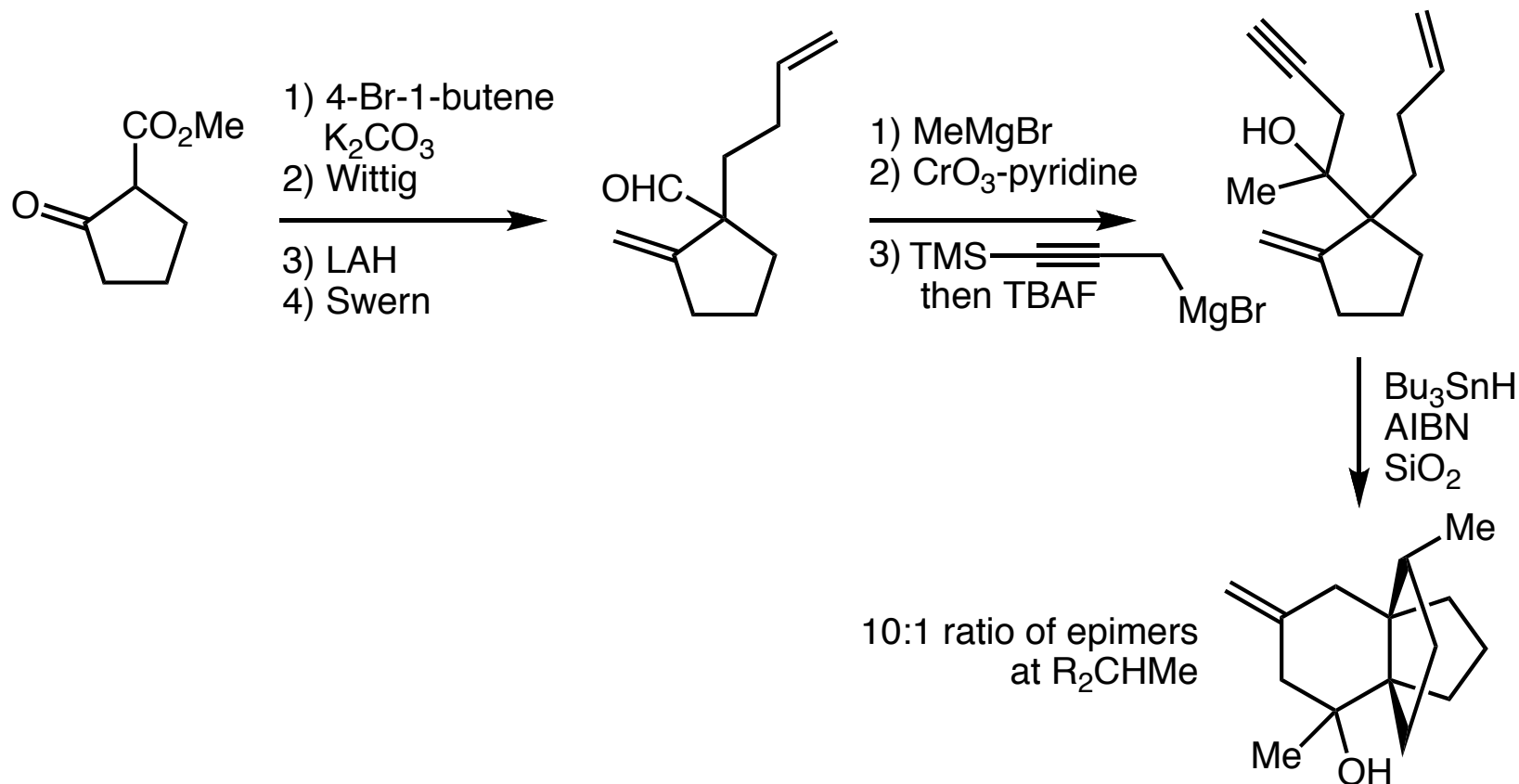
Kontes 19 - CU Synthesis Lit Group - Modhephene

# Rawal's Synthesis of Modhephene



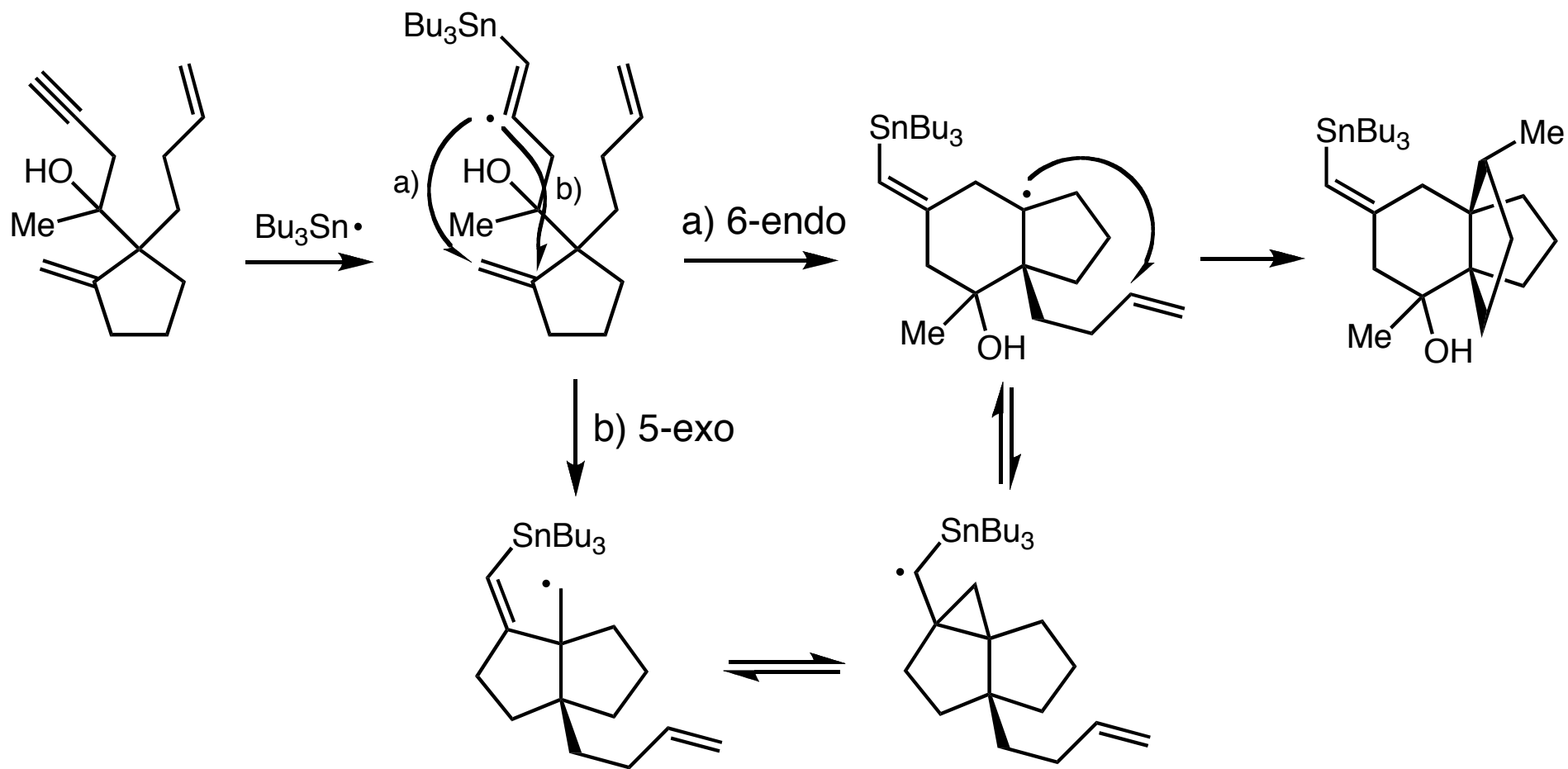
# Lee's Synthesis of Modhephene

Lee, H.-Y.; Moon, D. K.; Bahn, J. S. *Tet. Lett.* **2005**, *46*, 1455–1458.



Kontes 21 - CU Synthesis Lit Group - Modhephene

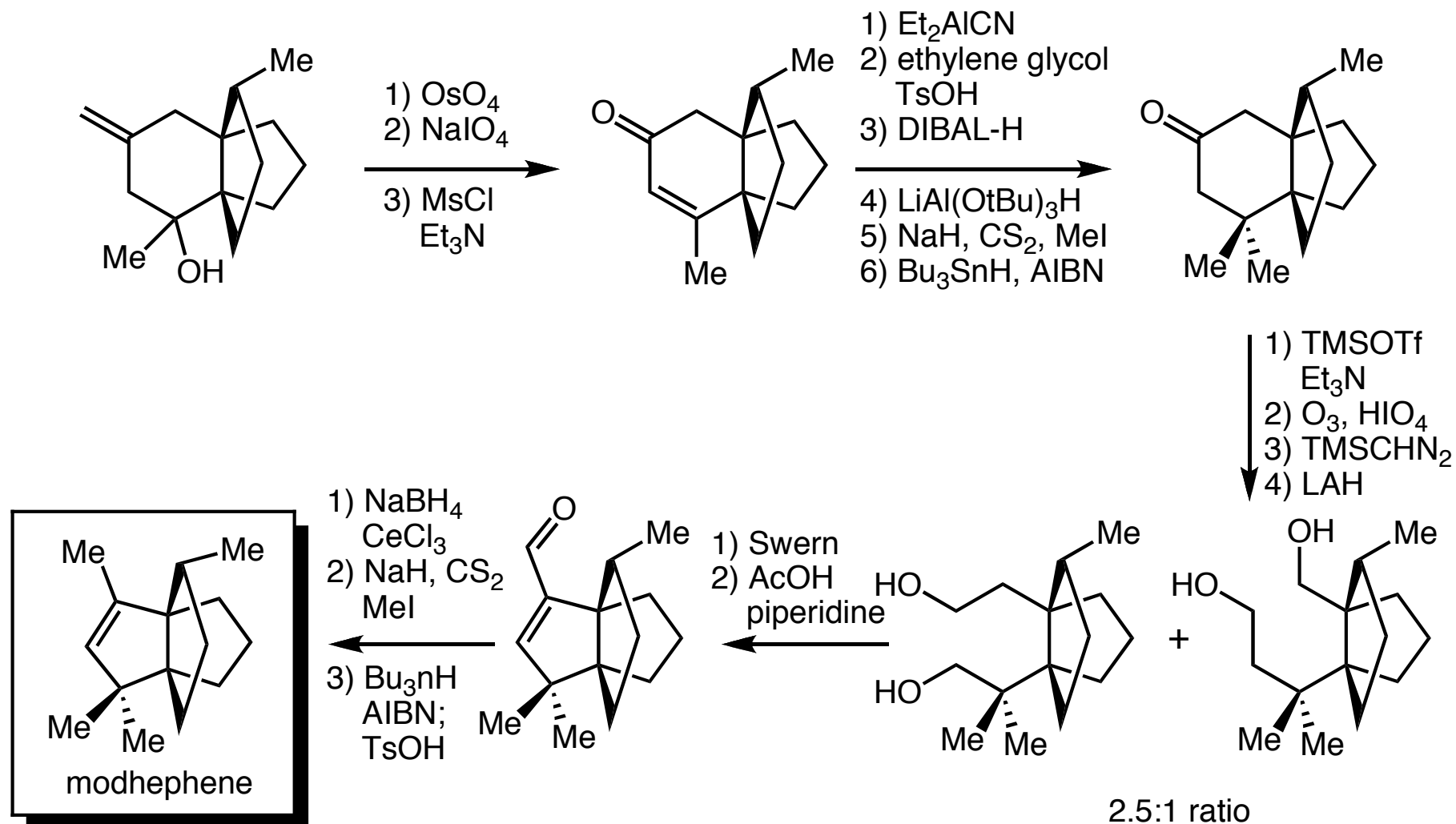
# Lee's Synthesis of Modhephene



Stork, G.; Mook, R. J. *Tet. Lett.* **1986**, *38*, 4529–4532.

Kontes 22 - CU Synthesis Lit Group - Modhephene

# Lee's Synthesis of Modhephene



Kontes 23 - CU Synthesis Lit Group - Modhephene

# *Conclusion*

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- Favorite synthesis?
- Questions?

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