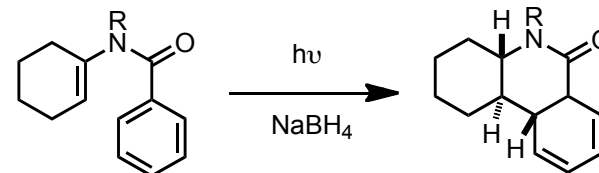

Photochemical keysteps in the synthesis of alkaloids

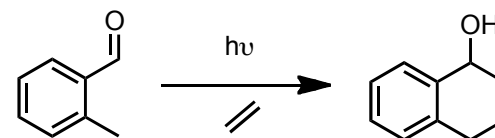
**Ruben Eckermann
Gaich-Group Seminar
December 10, 2012**

Overview

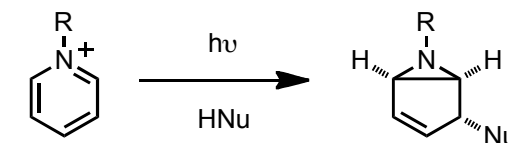
1) Enamide 6π – Photocyclization



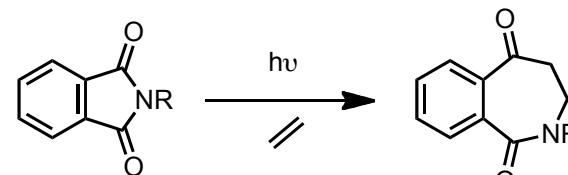
2) *ortho* – Quinodimethanes



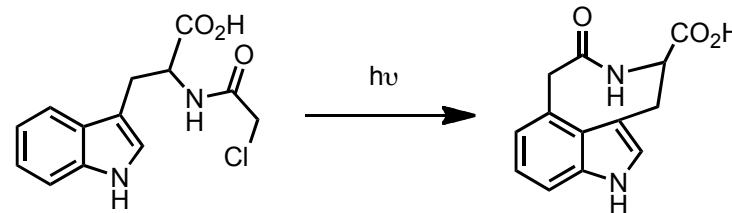
3) Pyridinium salts 4π – Photocyclization



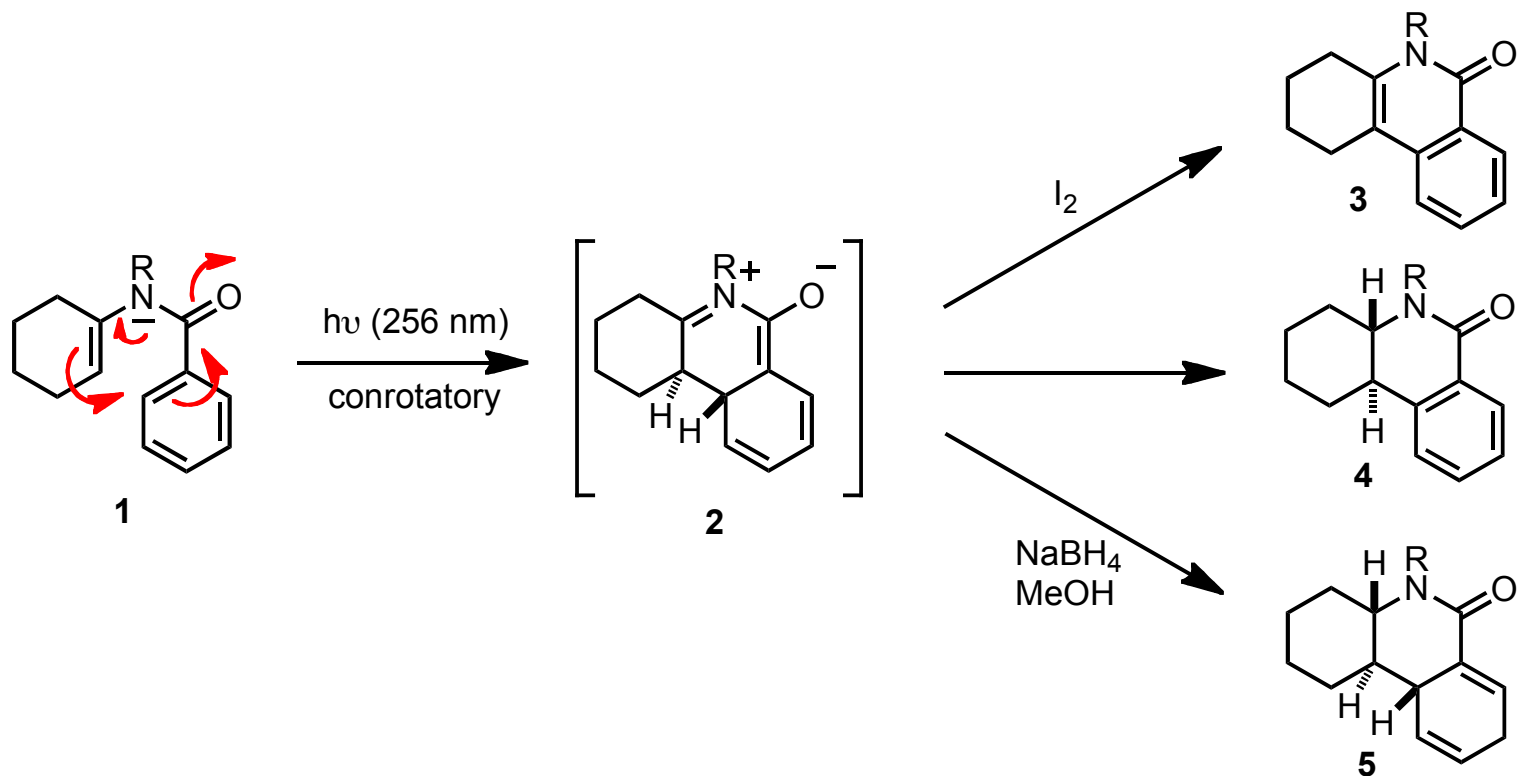
4) Phthalimide/Maleimide Photochemistry



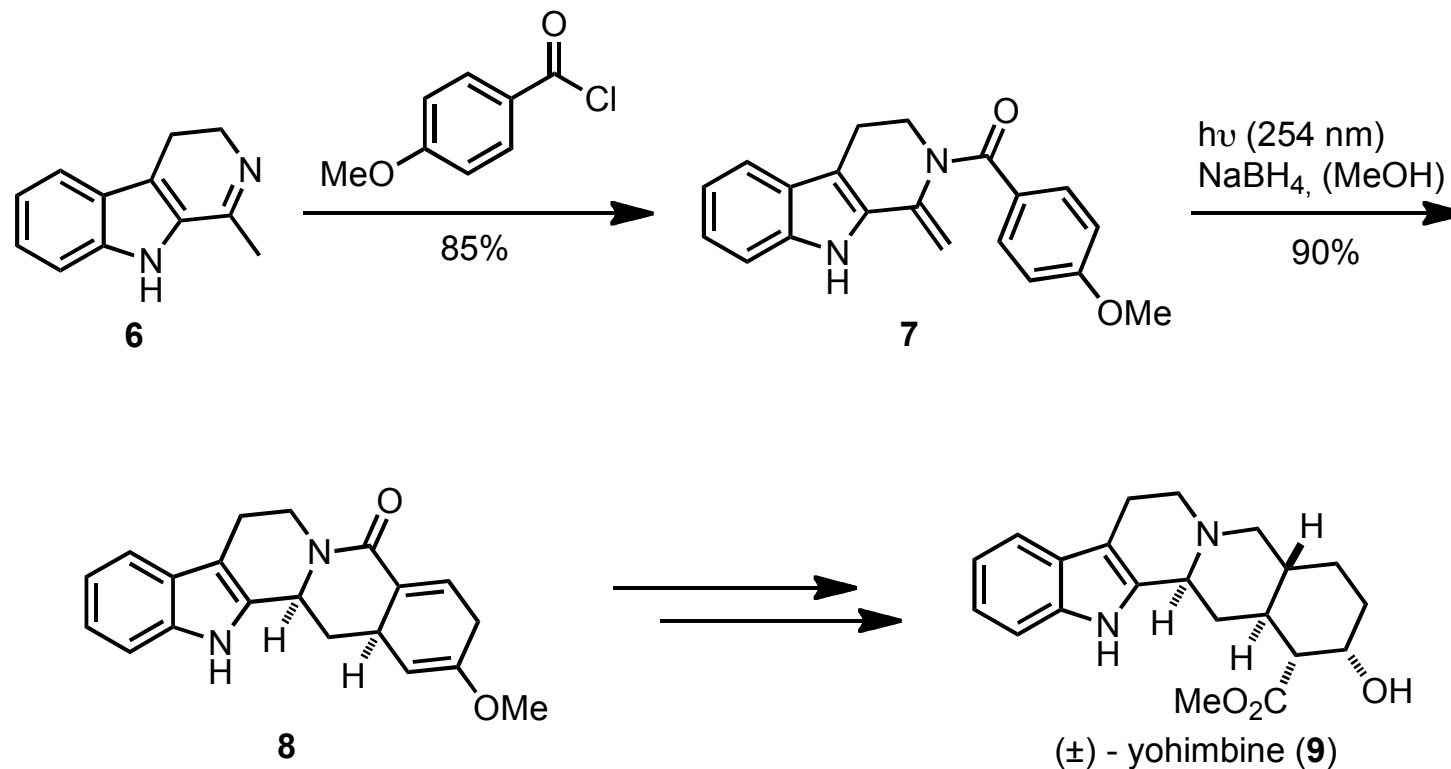
5) Indole - Photochemistry



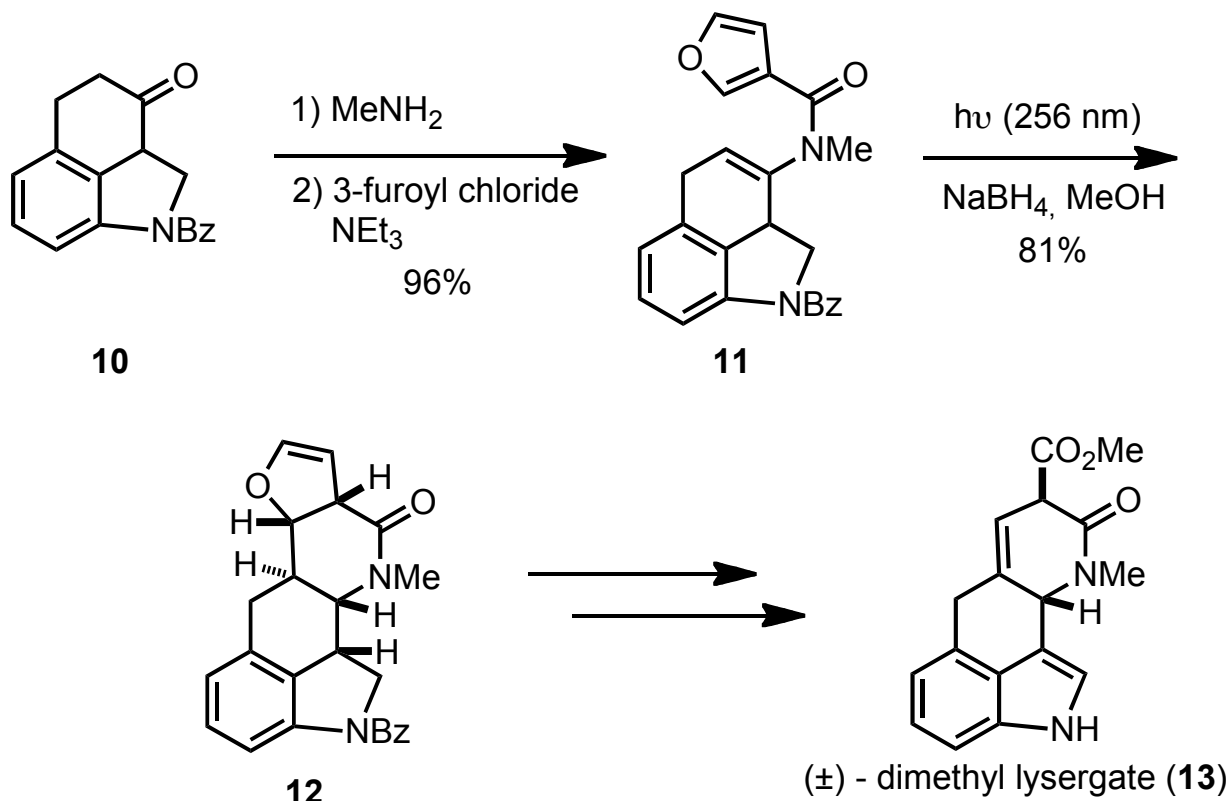
Enamide 6 π – Photocyclization



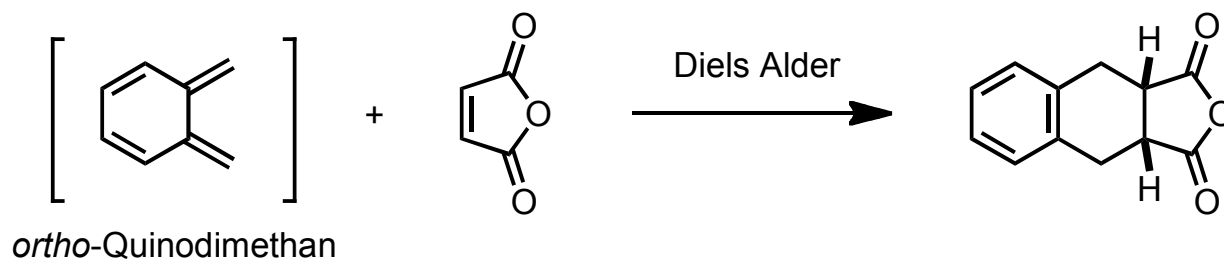
(±) – Yohimbine



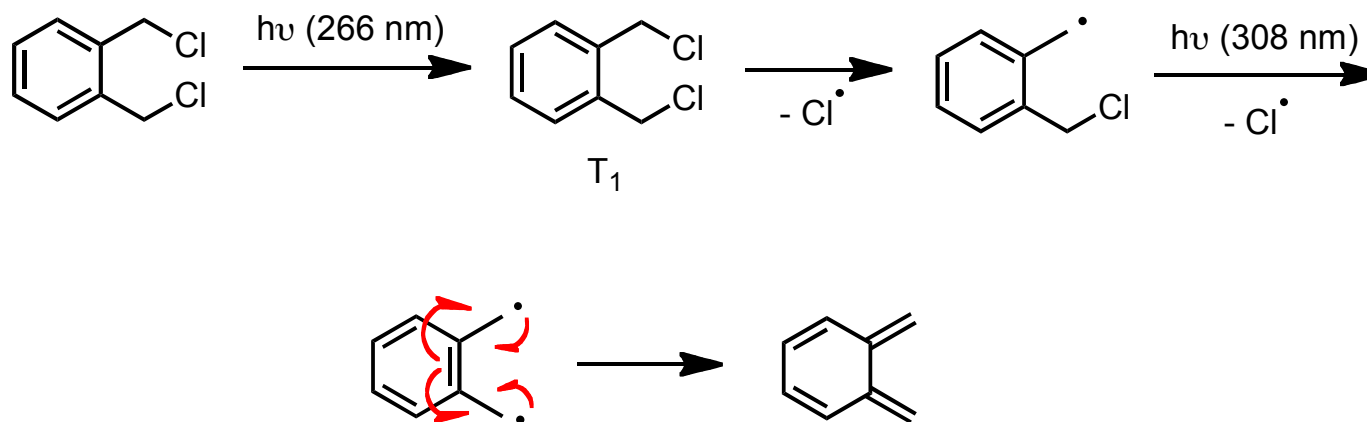
(±) – Methyl lysergate



ortho – Quinodimethanes

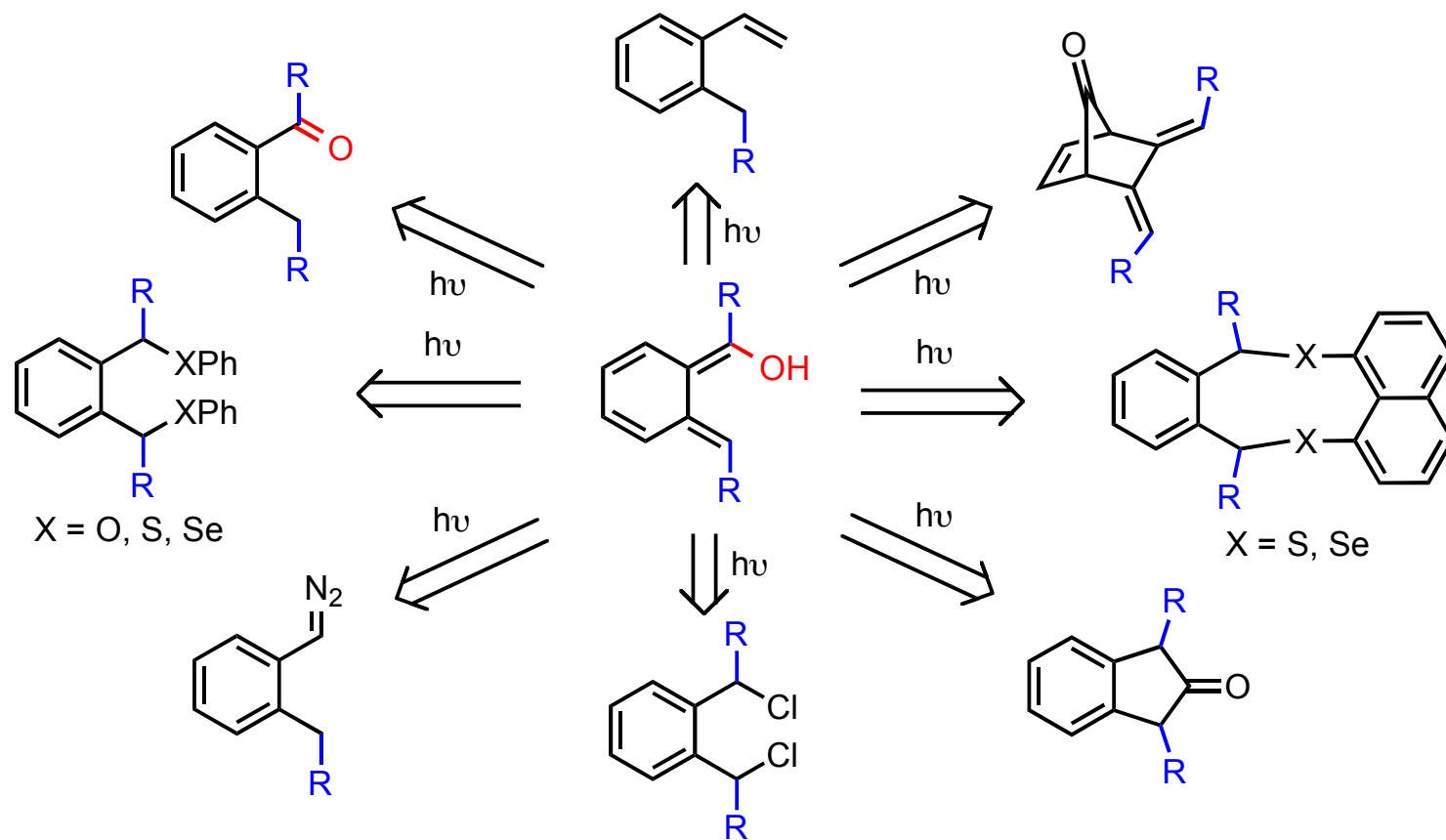


Mechanism:

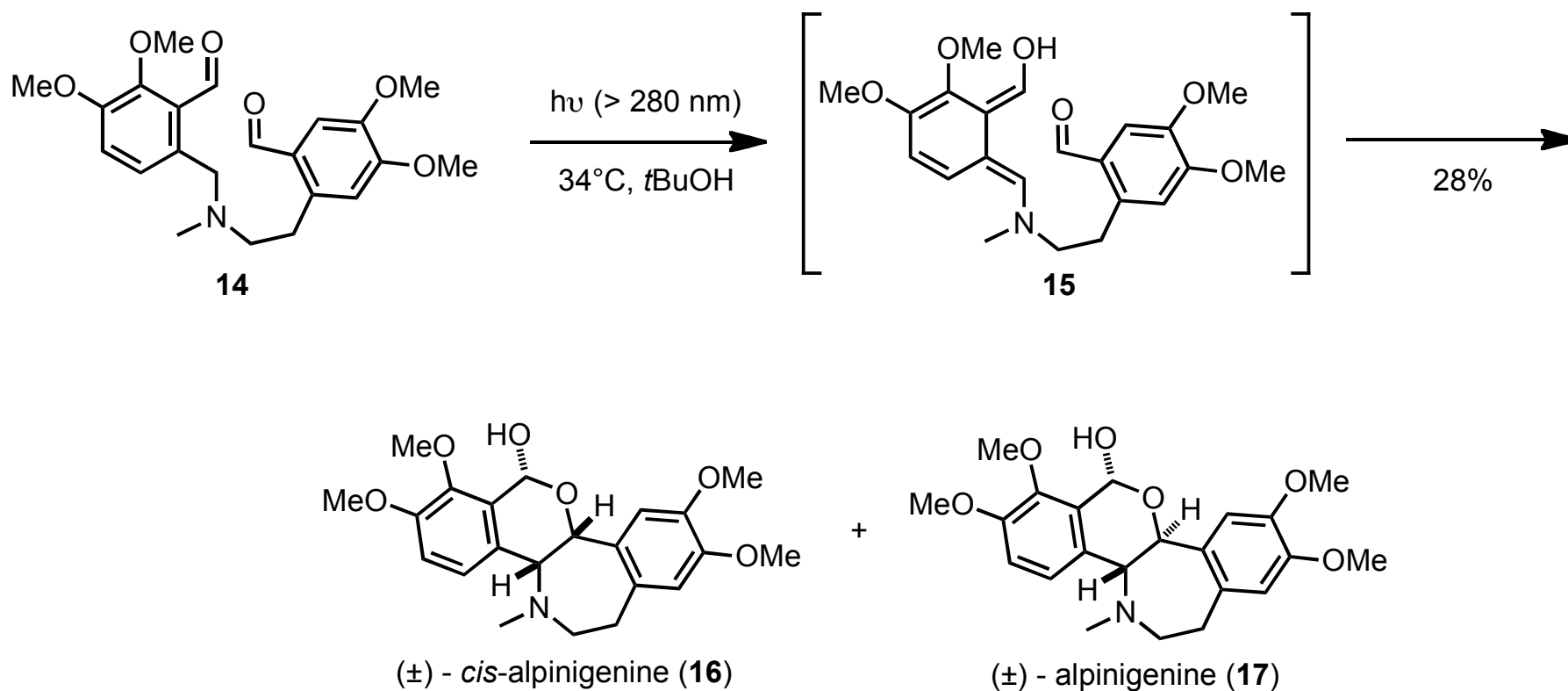


ortho – Quinodimethanes

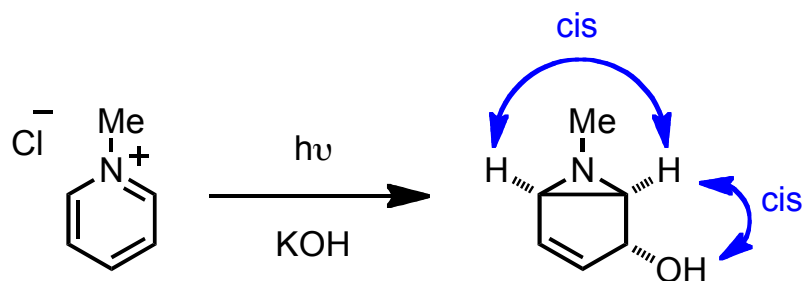
Photochemical generation



(±) – Alpinigenine

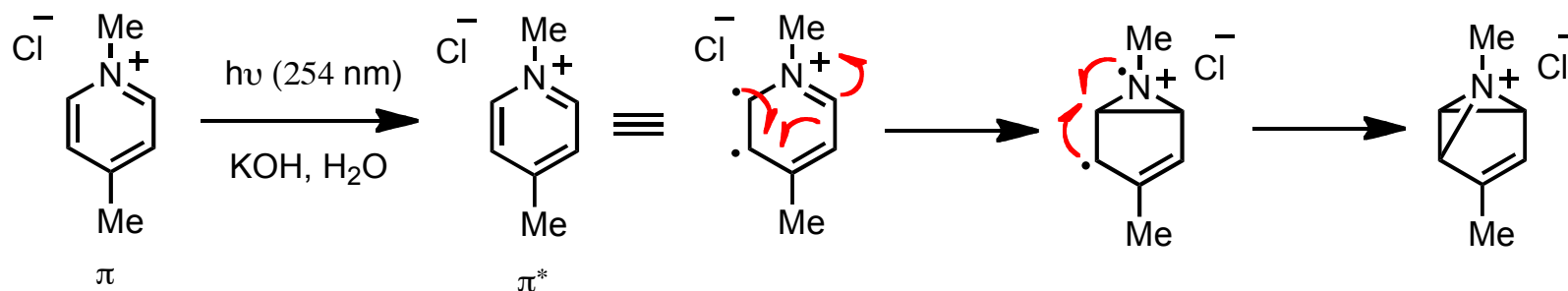


Pyridinium salts 4π – Photocyclization

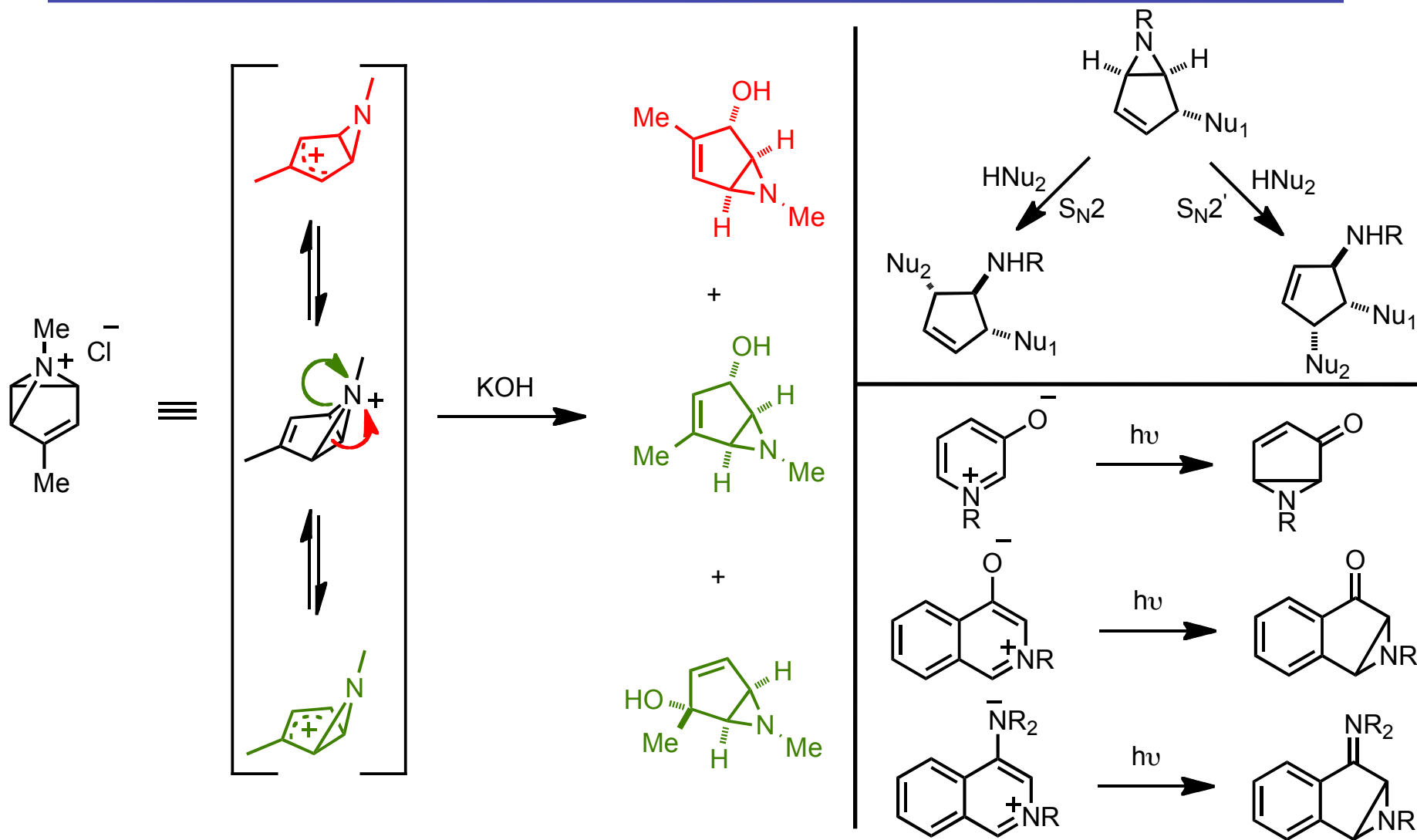


Observation of
 Kaplan, Wilzbach &
 Pavlik in the late 1960s

Mechanism:

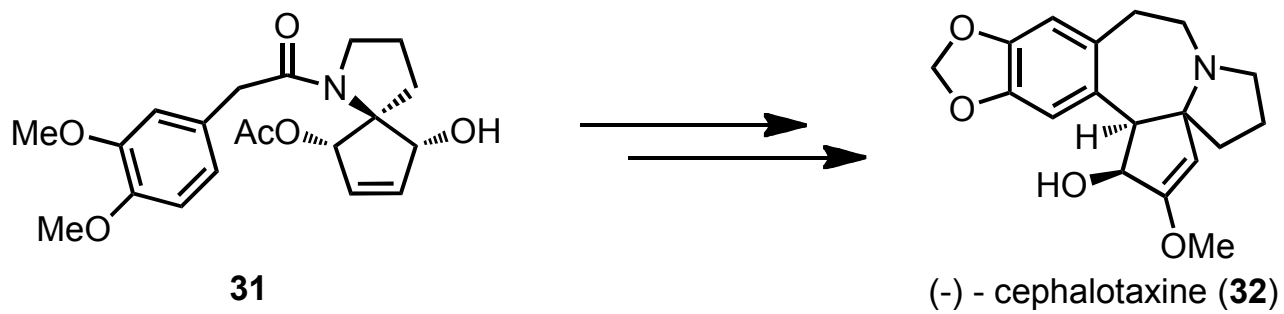
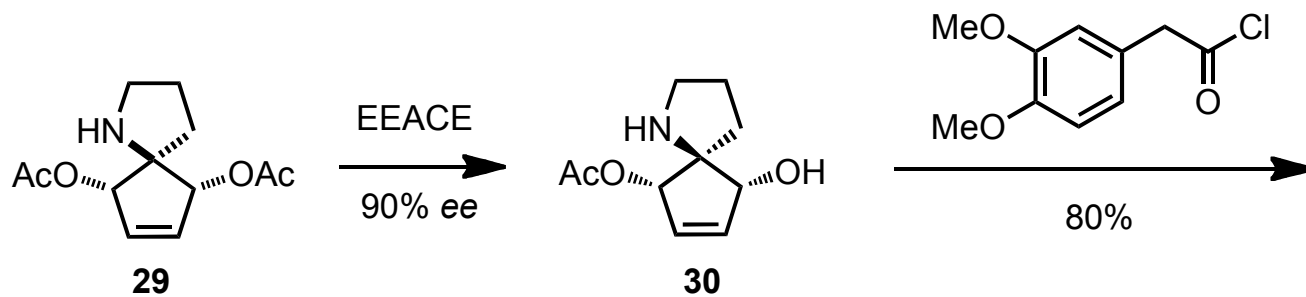
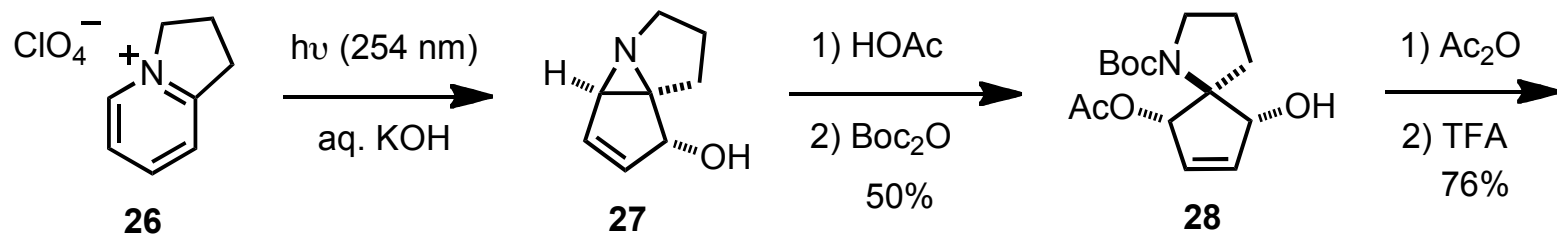


Pyridinium salts 4π – Photocyclization

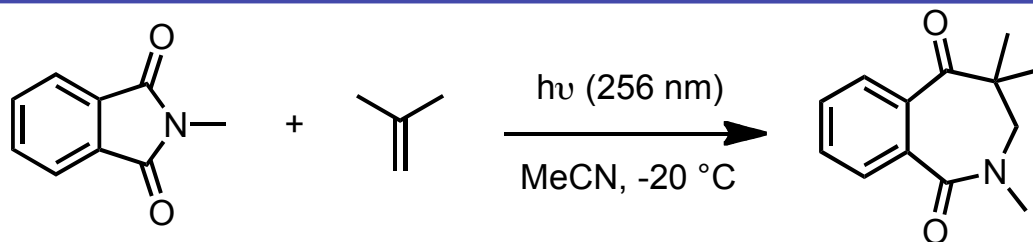


L. Kaplan, J. W. Pavlik, K. E. Wilzbach, *JACS*, **1972**, *94*, 3283-3284
 J. Zou, P. S. Mariano, *Photochem. Photobiol. Sci.*, **2008**, *7*, 393-404
 T. Damiano, D. Morton, A. Nelson, *Org. Biomol. Chem.*, **2007**, *5*, 2735-2752

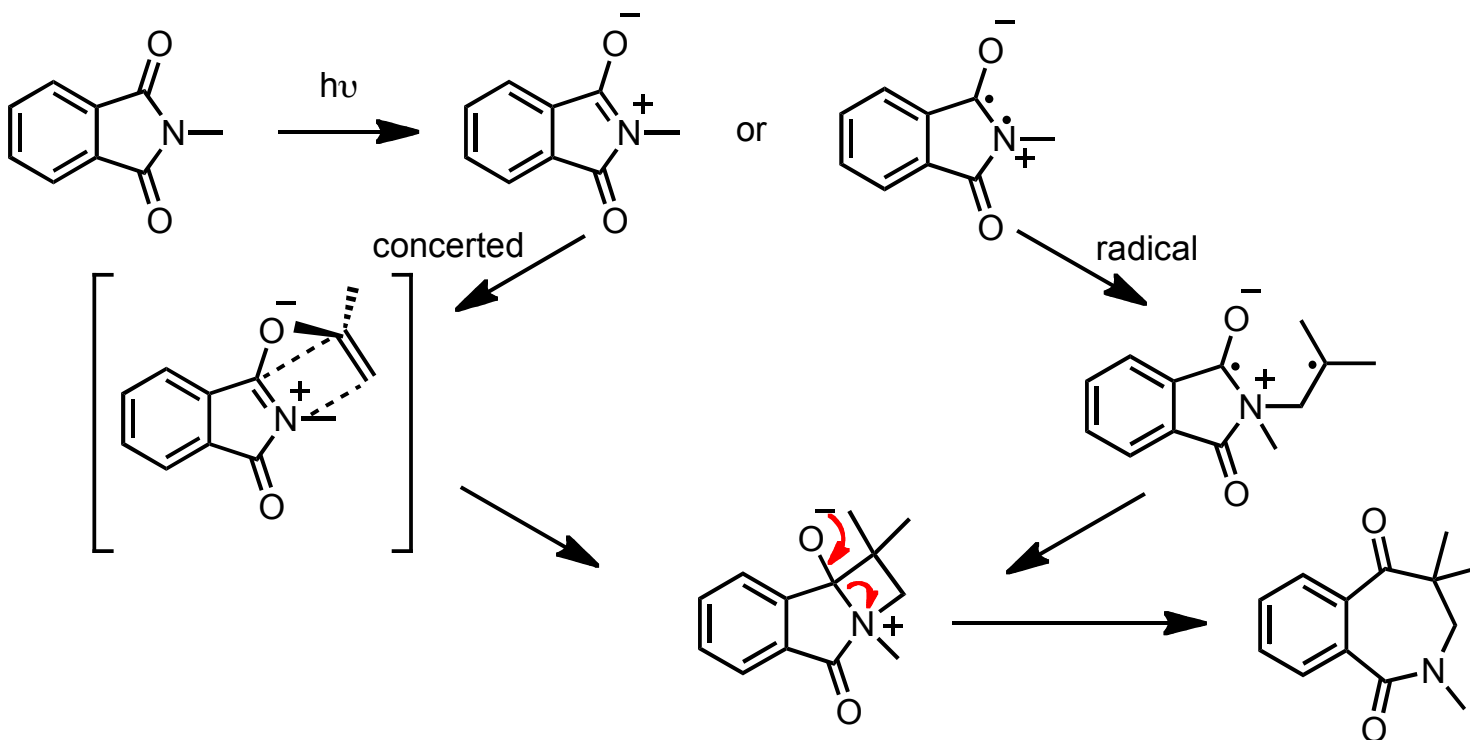
(-) – Cephalotaxine



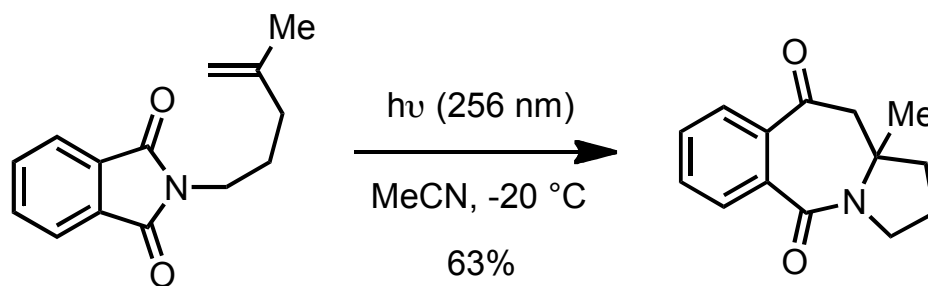
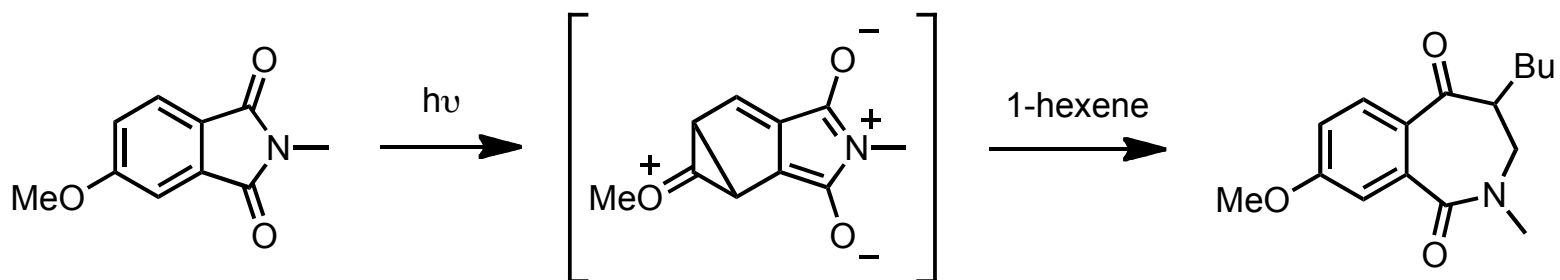
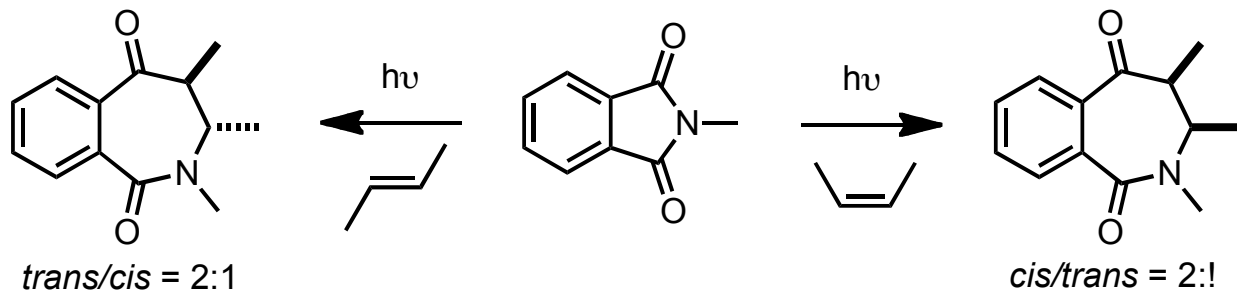
Phthalimide/Maleimide Photochemistry



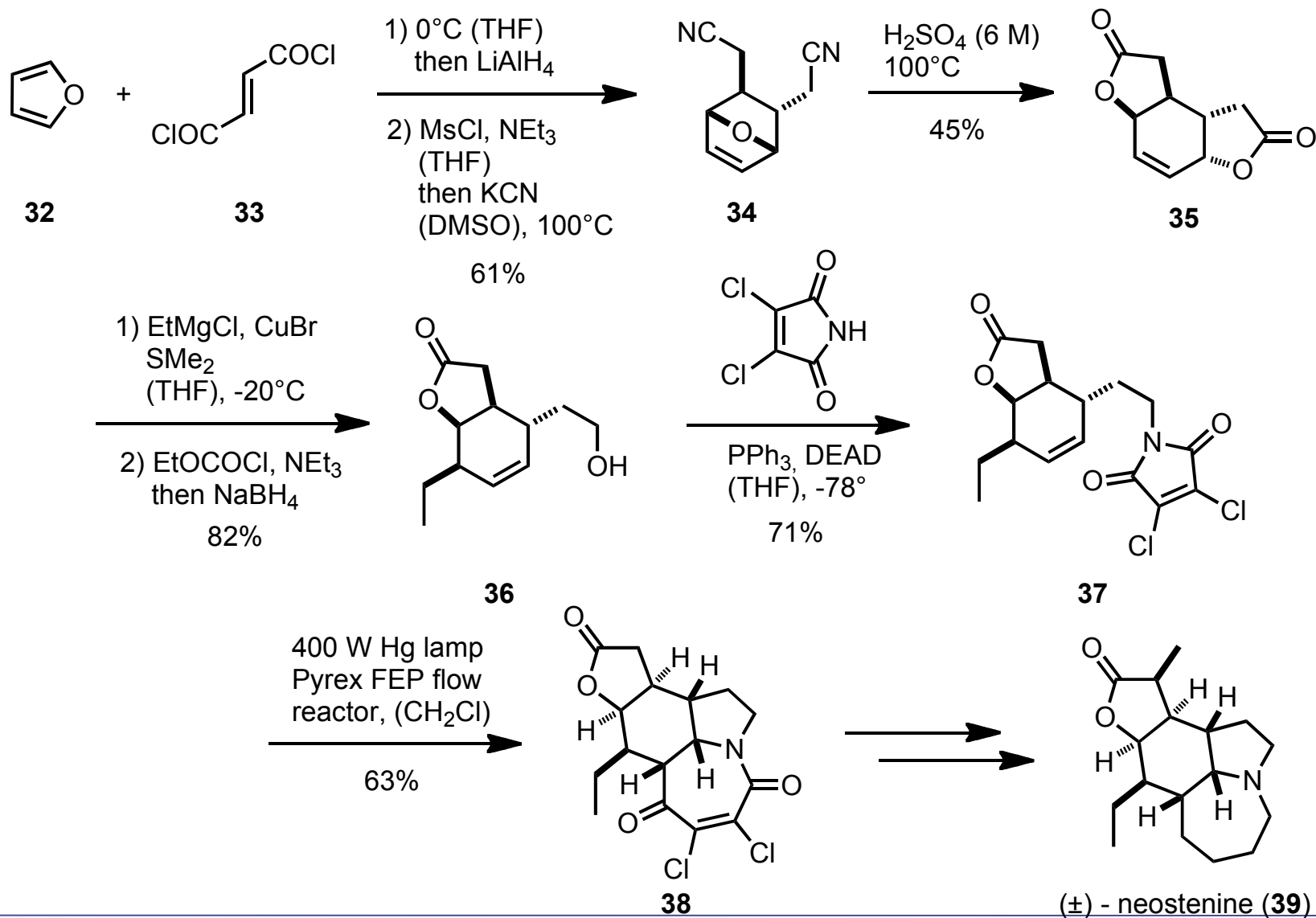
Mechanism:



Phthalimide/Maleimide Photochemistry

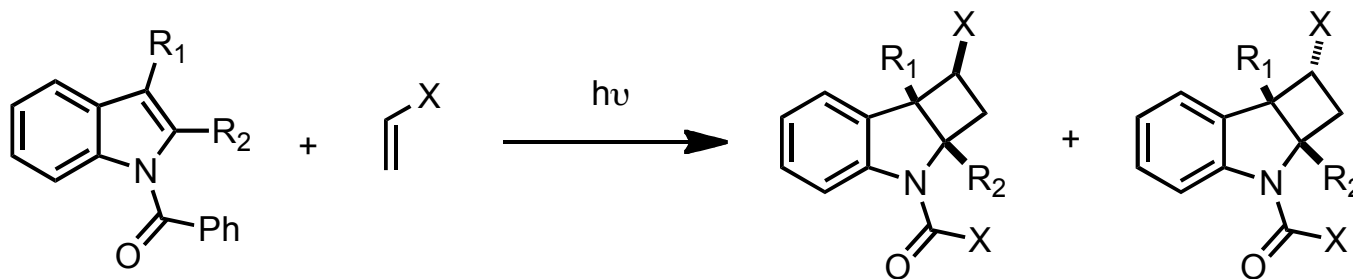


(±) – Neostenine



Indole Photochemistry

2+2 – Cycloaddition:

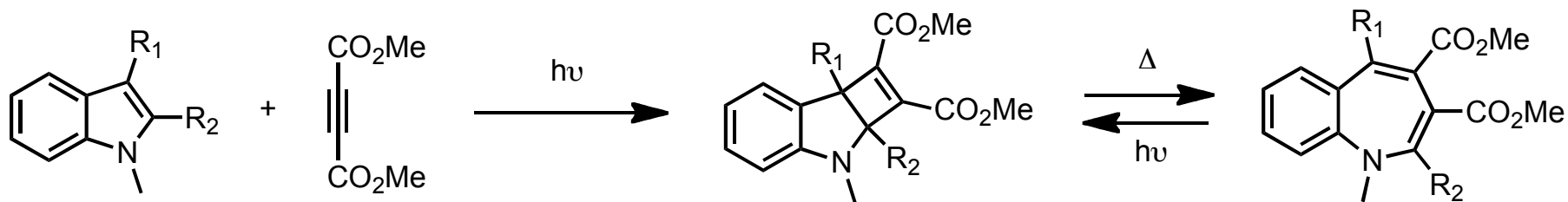


$R_1 = \text{H, Me, CHO, Ac, OAc, SMe, CN, Cl}$

$R_2 = \text{H, Me, CN}$

$X = \text{OAc, CO}_2\text{Me}$

exo-product preferred

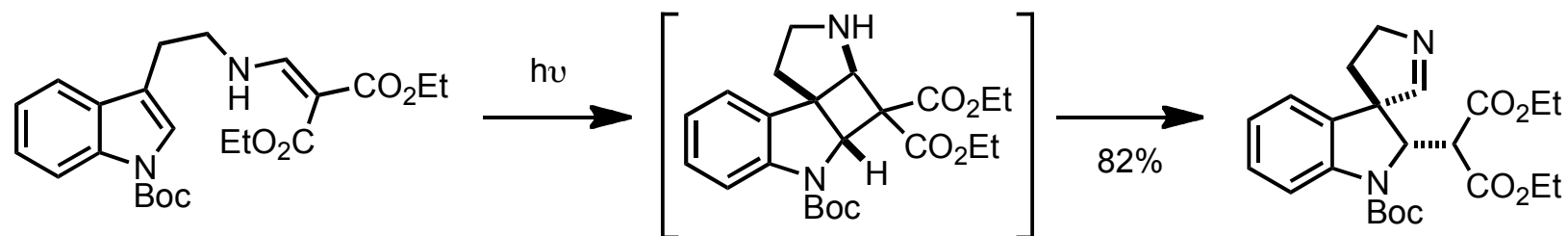
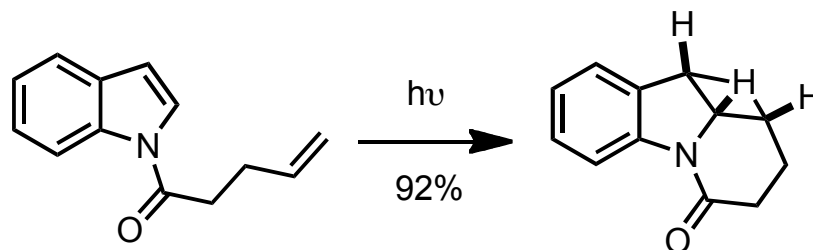


$R_1 = \text{alkyl}$

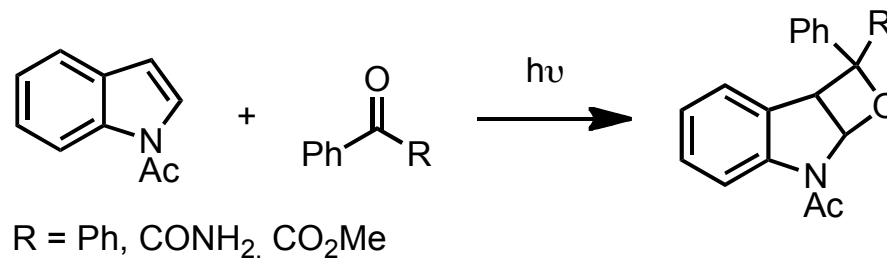
$R_2 = \text{H, alkyl}$

Indole Photochemistry

intramolecular:



Paternó-Büchi:



Vindorosine

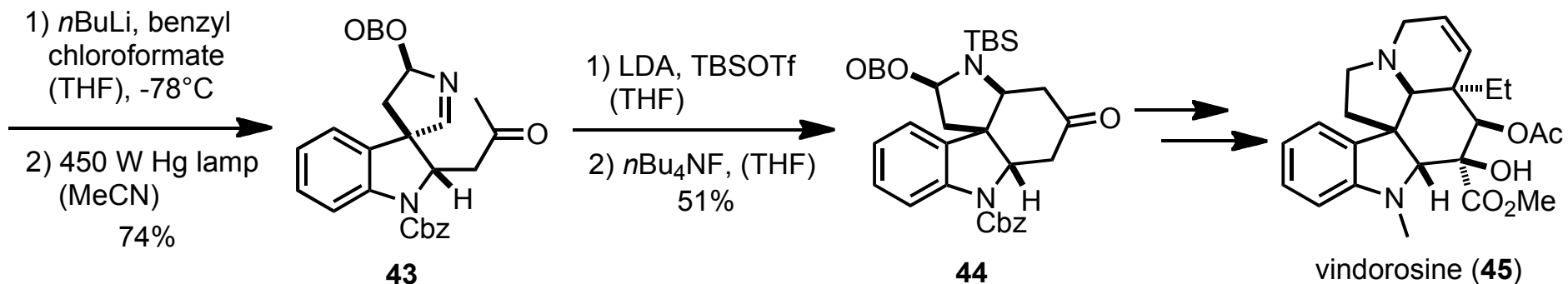
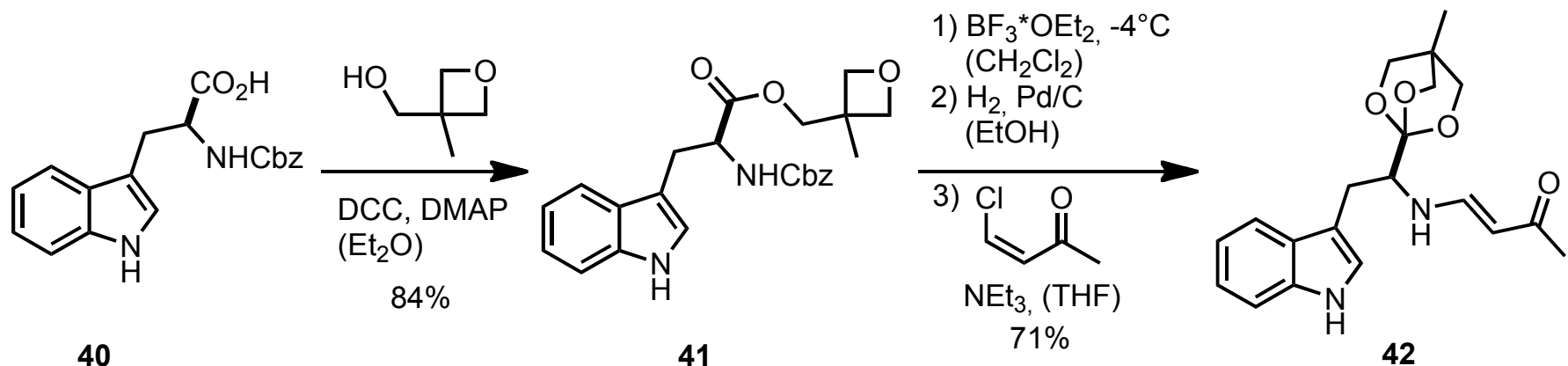


Photo-Fries reaction

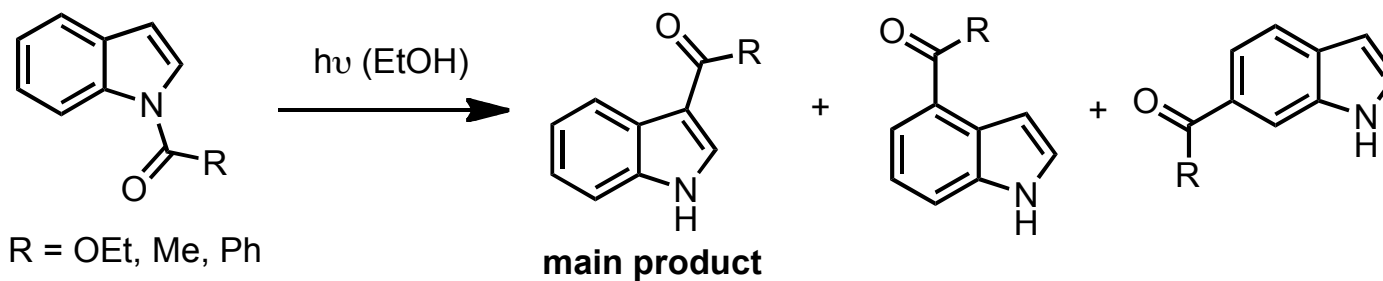
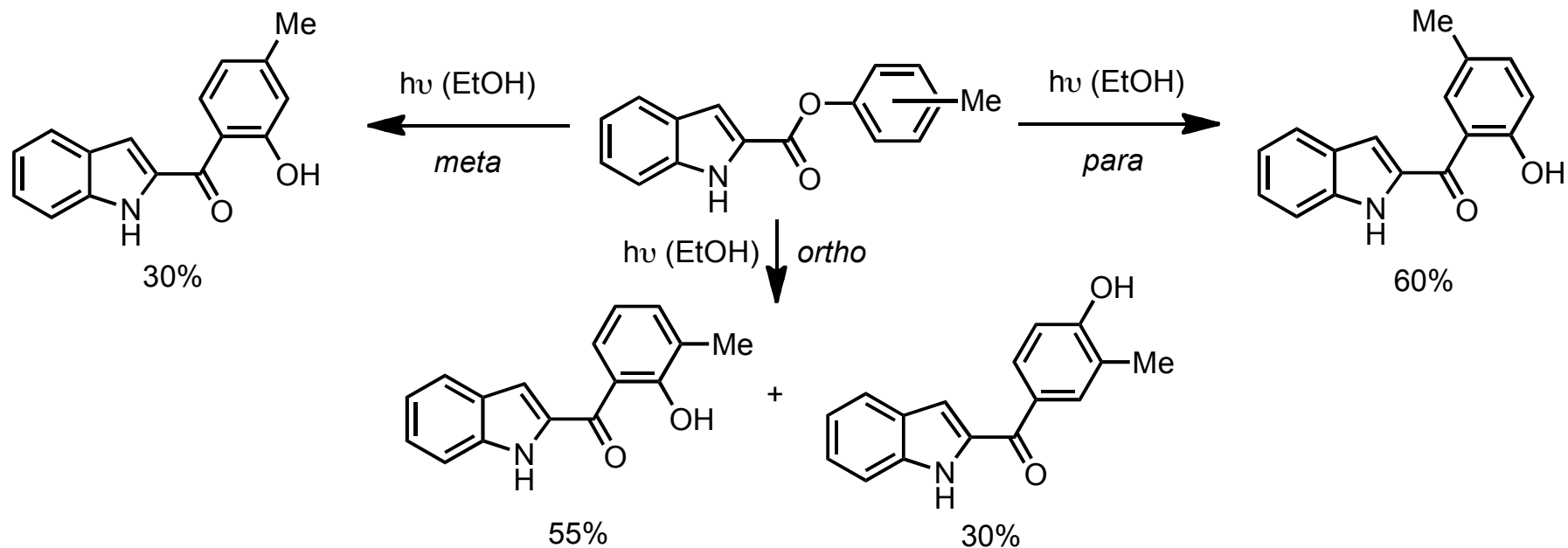
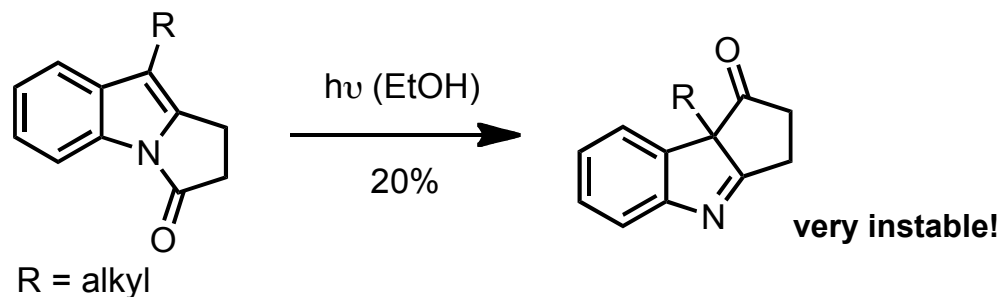
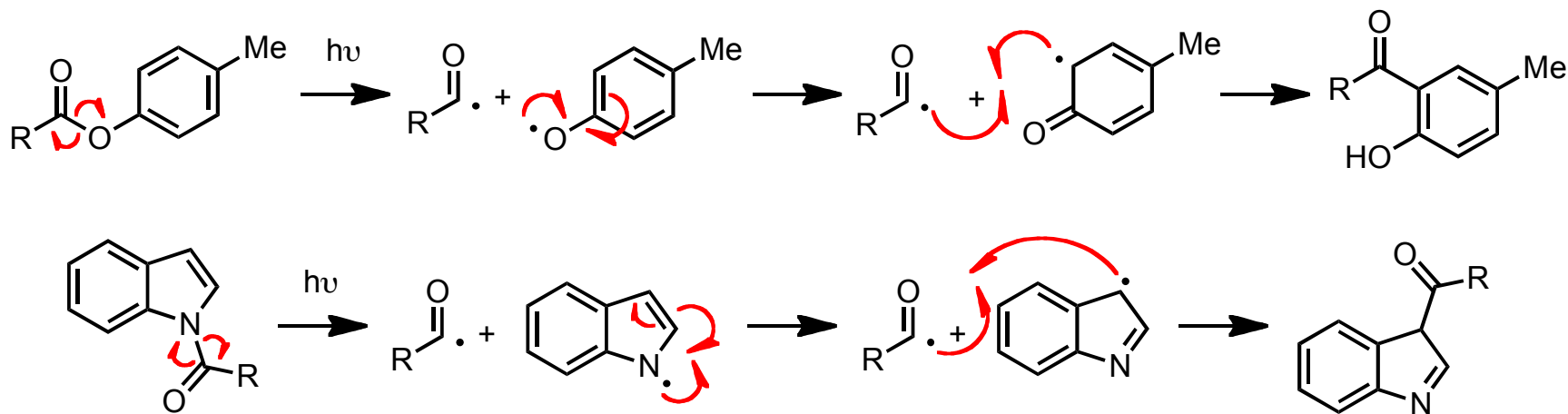


Photo-Fries reaction

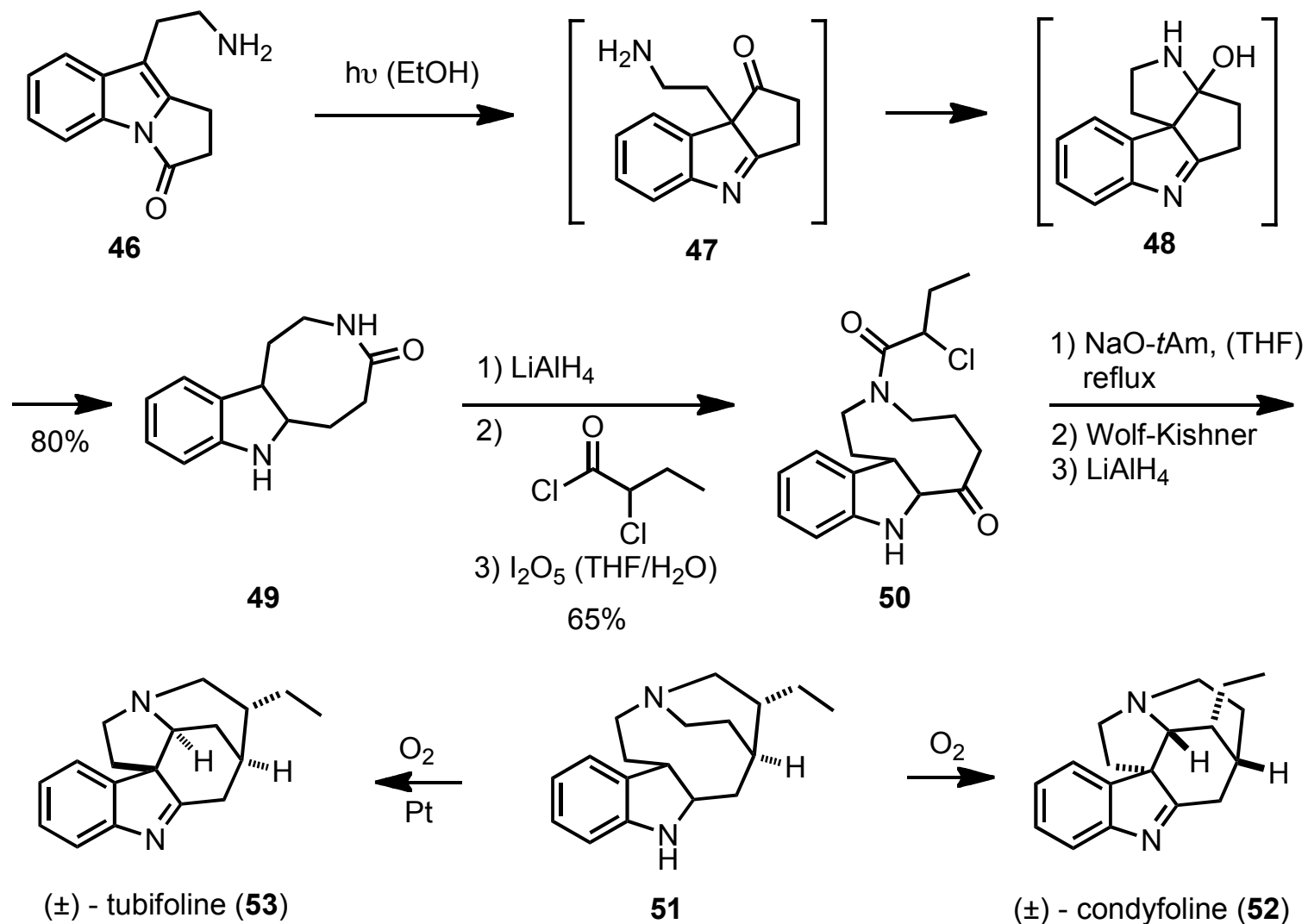
intramolecular:



mechanism:



(±) – Condifoline & (±) – Tubifoline

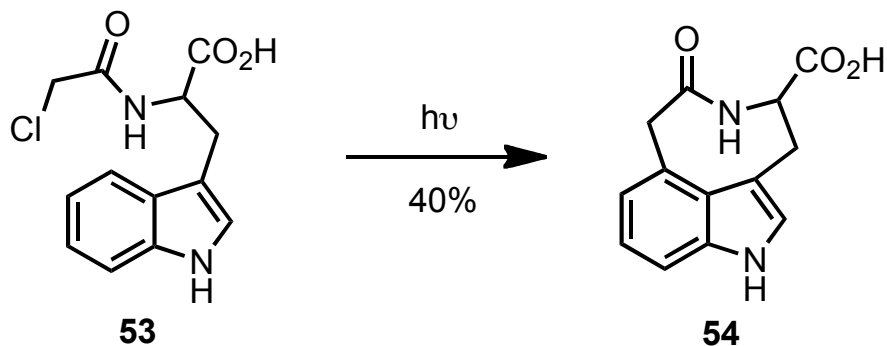


Y. Ban, K. Yoshida, J. Goto, T. Oishi, *JACS*, **1981**, *103*, 6990-6992

D. Schumann, H. Schmid, *Helv. Chim. Acta*, **1963**, *6*, 1996-2003

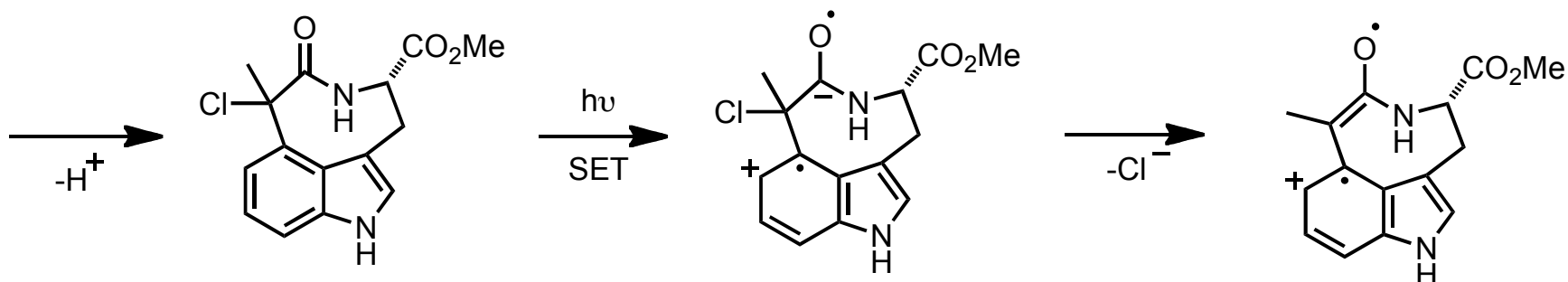
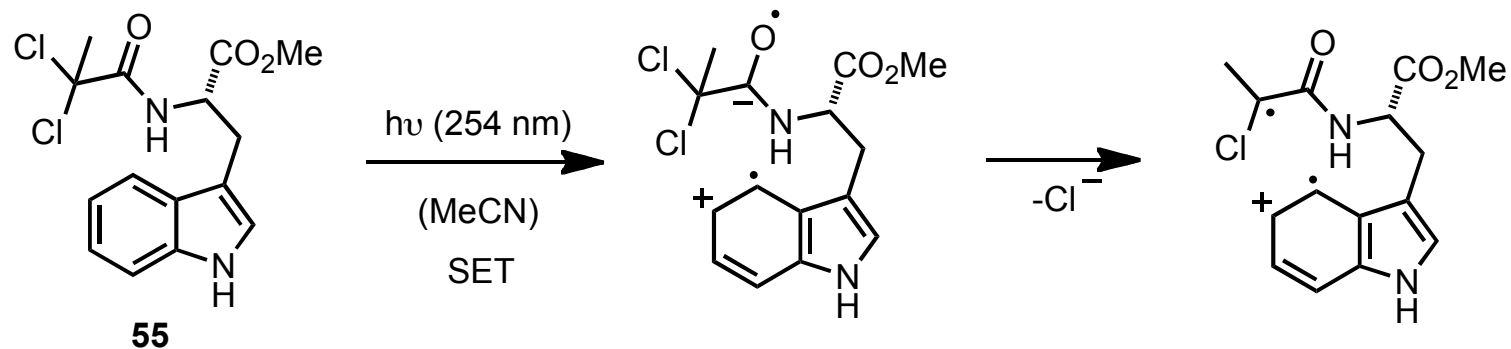
B. A. Dadson, J. Harley-Mason, G. H. Foster, *Chem. Comm.*, **1968**, 1233

Witkop Cyclization

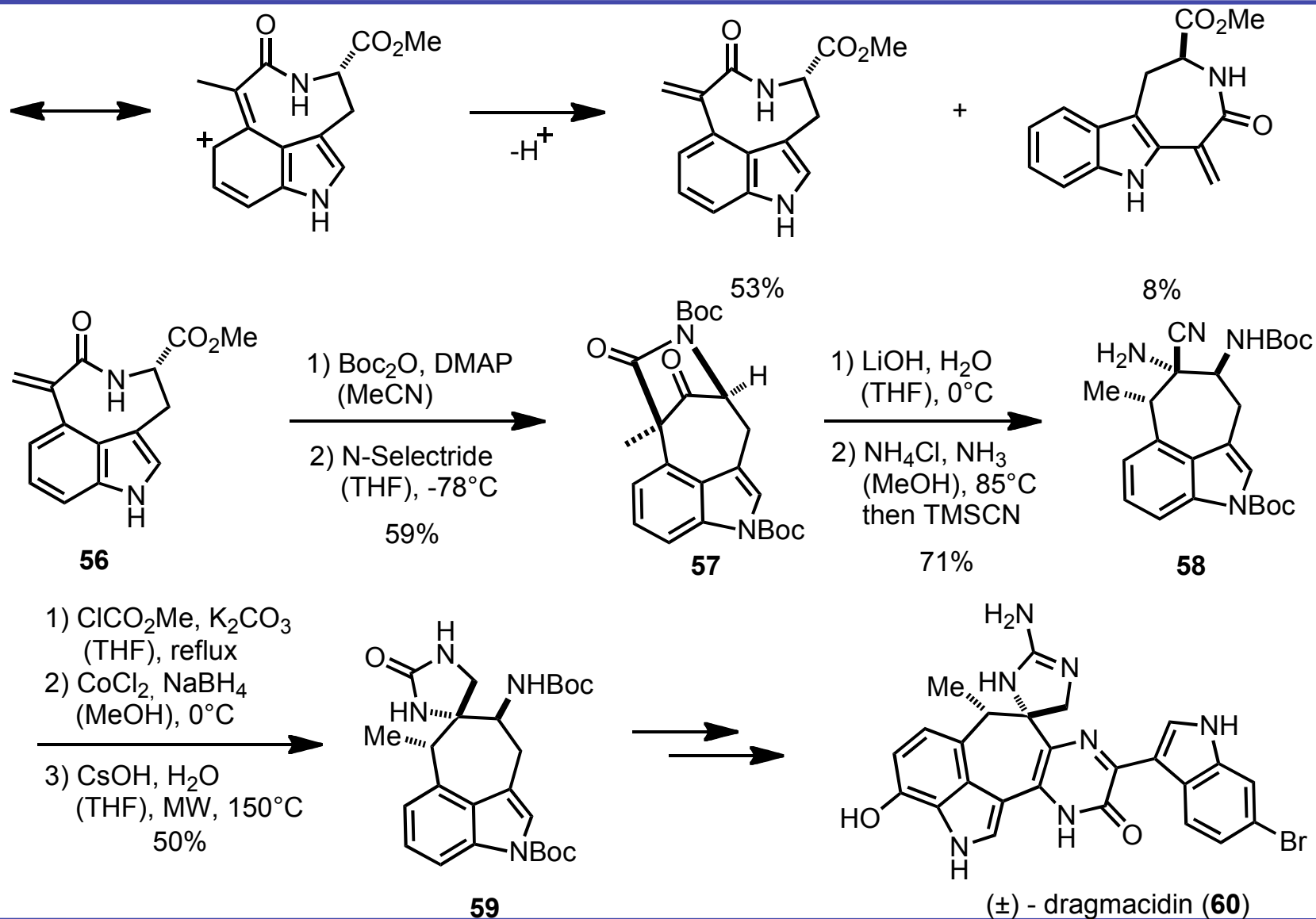


first observed by
Witkop and coworkers
in 1966

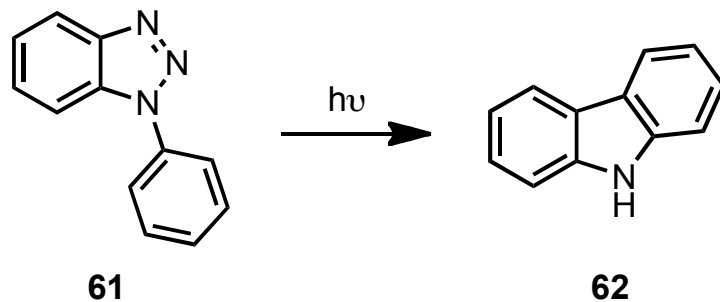
mechanism:



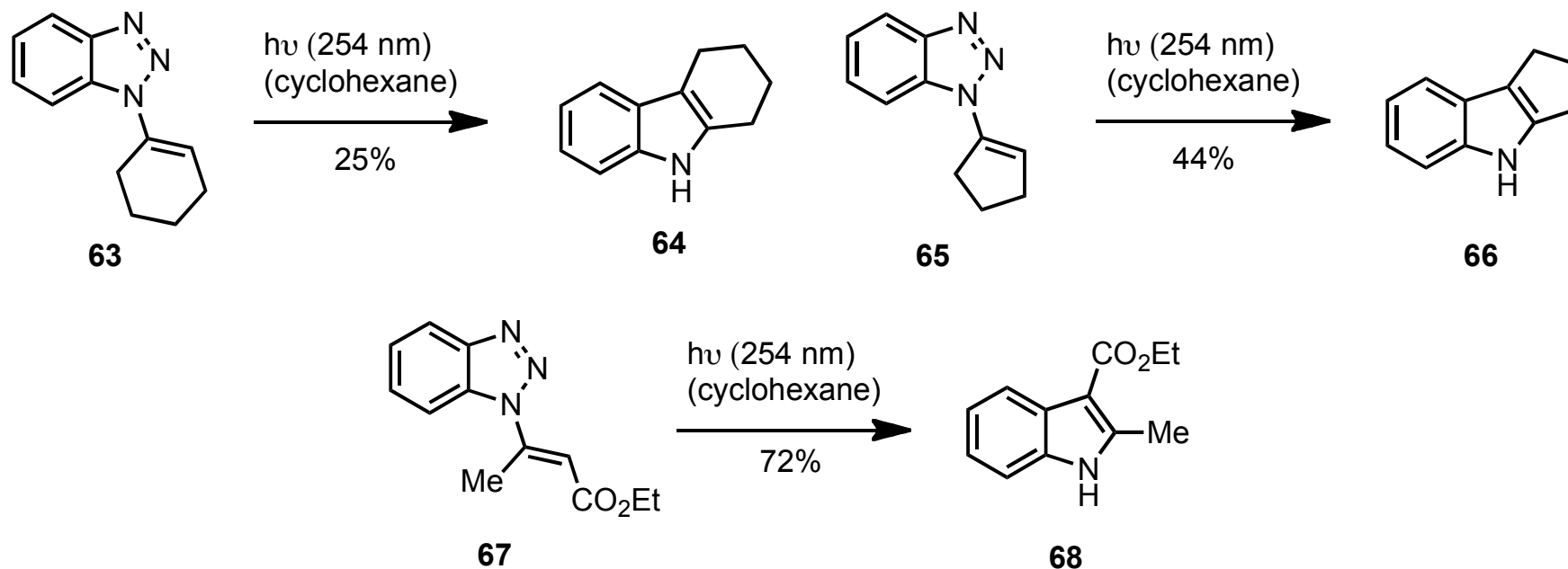
(±) – Dragmacidin E



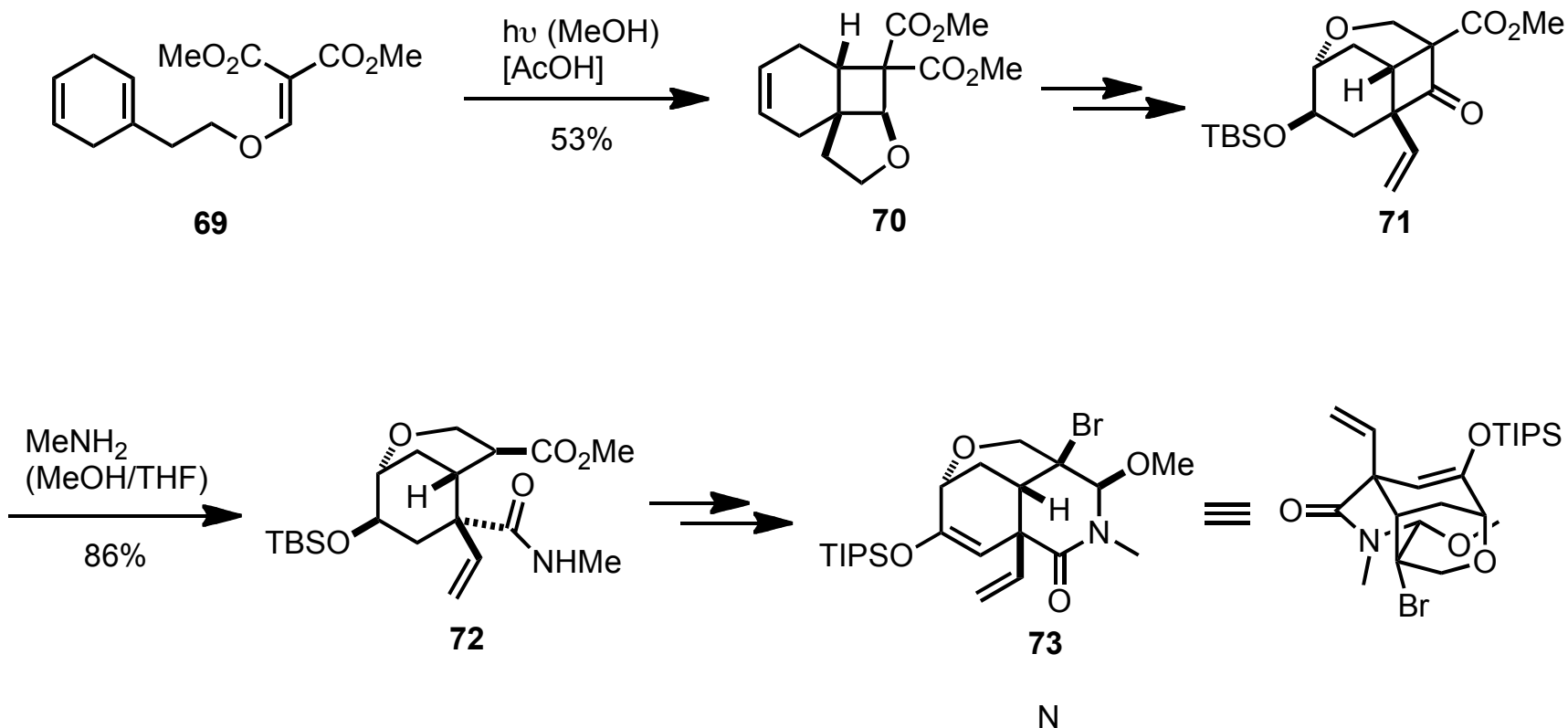
Indole Synthesis



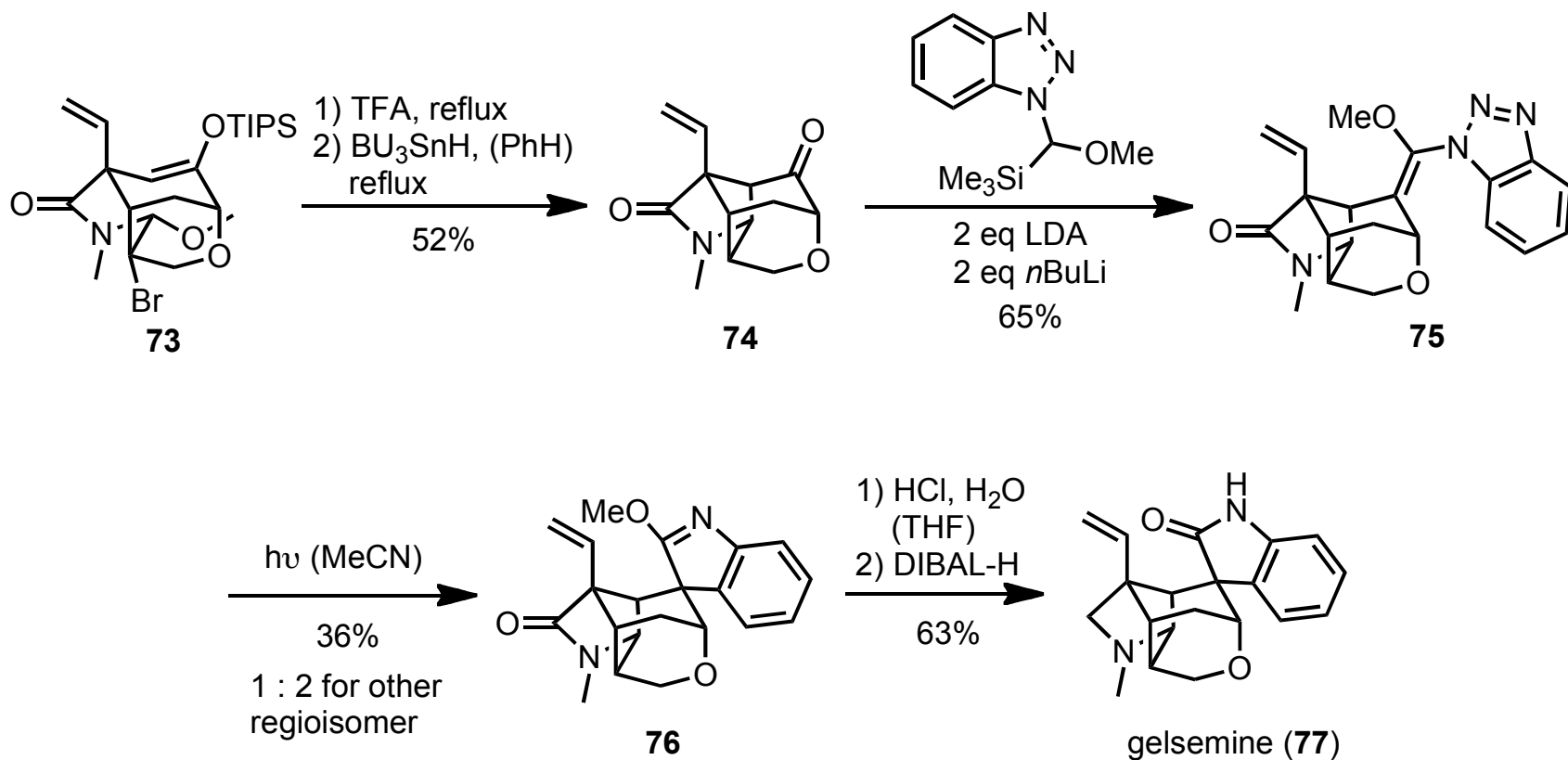
demonstrated by
Burgess and
coworkers in 1968



Gelsemine



Gelsemine



Thank you for your attention!

Questions?