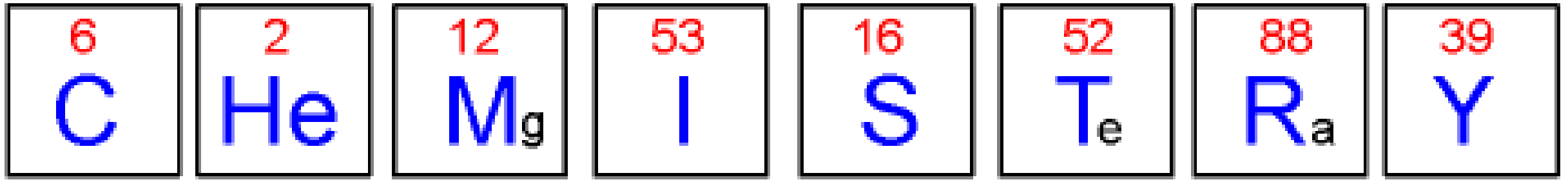

6
C
2
He
12
Mg
53
I
16
S
52
Te
88
Ra
39
Y

Rearreglo de Claisen

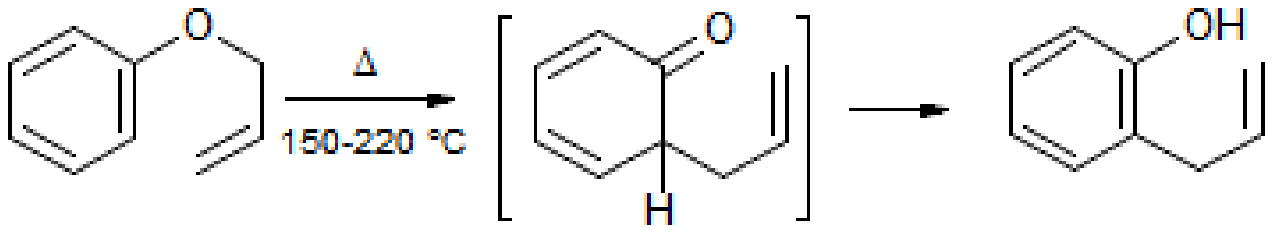
Rainer Ludwig Claisen
(1851-1930)
Químico alemán

Rearreglo de Claisen

The Claisen and Cope Rearrangements,
Rhoads, S. J.; Raulins, R. *Org. React.*, **1975**, *22*, 1.
Stereo- and Regiochemistry of the Claisen Rearrangement - Applications to Natural Product Synthesis,
Ziegler, F. E. *Acc. Chem. Res.* **1977**, *10*, 227.
Claisen Rearrangements in Heteroaromatic Systems,
C. J. Moody, *Advances Heterocycl. Chem.* **1987**, *42*, 203.
The Thermal Aliphatic Claisen Rearrangement,
Ziegler, F. E. *Chem. Rev*. **1988**, *88*, 1423.
The Hetero-Cope Rearrangement in Organic Synthesis,
Blechert, S. *Synthesis* **1989**, 71.
Progress in the Fischer Indole Reaction,
Hughes, D. L. *Org. Prep. Proc. Int.* **1993**, *25*, 607.
Asymmetric [3.3]-Sigmatropic Rearrangements in Organic Synthesis.
Enders, D.; Knopp, M.; Schiffers, R. *Tetrahedron: Asymmetry* **1996**, *7*, 1847-1882.
Asymmetric Claisen Rearrangement,
Ito, H.; Taguchi, T. *Chem. Soc. Rev*. **1999**, *28*, 43-50.
Recent Advances in Asymmetric [3,3]-Sigmatropic Rearrangements,
Nubbemeyer, U. *Synthesis* **2003**, 961-1008.
The Thio-Claisen Rearrangement 1980-2001,
Majumdar, K. C.; Ghosh, S.; Ghosh, M. *Tetrahedron* **2003**, *59*, 7251-71.

https://www.chem.wisc.edu/areas/reich/chem547/4-pericyclic%7B17%7D.htm

Aromatic Claisen Rearrangement

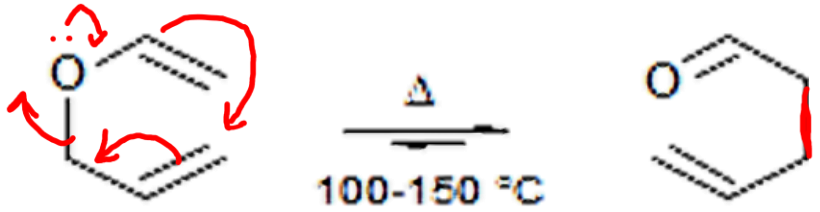


Claisen aromático

orto-Alilfenol

Reordenamiento Claisen Alifático

El reordenamiento de Claisen alifático (oxa-Cope), en contraste con el Cope totalmente de carbono, tiene la ventaja de que la constante de equilibrio es favorable en la dirección del compuesto carbonílico. El propio Claisen descubrió el primer ejemplo de reordenamiento sigmatrópico [3.3] de un alil enol éter: Claisen *Chem. Ber.* **1912**, *42*, 3157



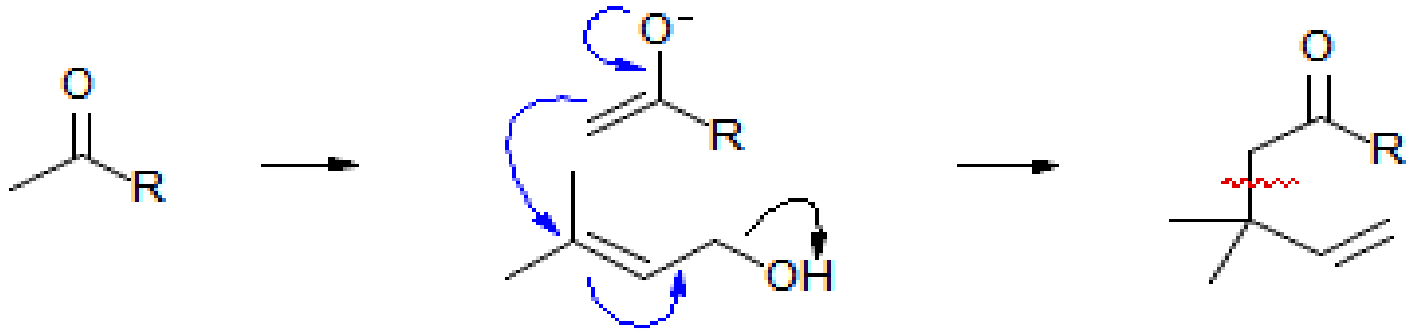
Éter O-alilvinilo
Éter de O-alilenol

Claisen alifático

Carbonilo
γ,δ-insaturado

Equivalencia sintética de los reordenamientos de Claisen

El Reordenamiento de Claisen se puede considerar como la alquilación S_N2' de un enolato por un alcohol alílico. La reacción ocurre con regiocontol completo (la posición del alcohol determina el punto de unión) y, además, tiene valiosas propiedades estereoquímicas que se discutirán a continuación que no están presentes en las alquilaciones de enolato

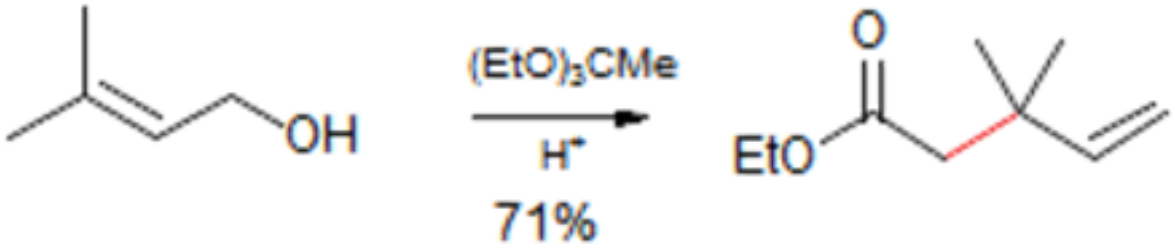


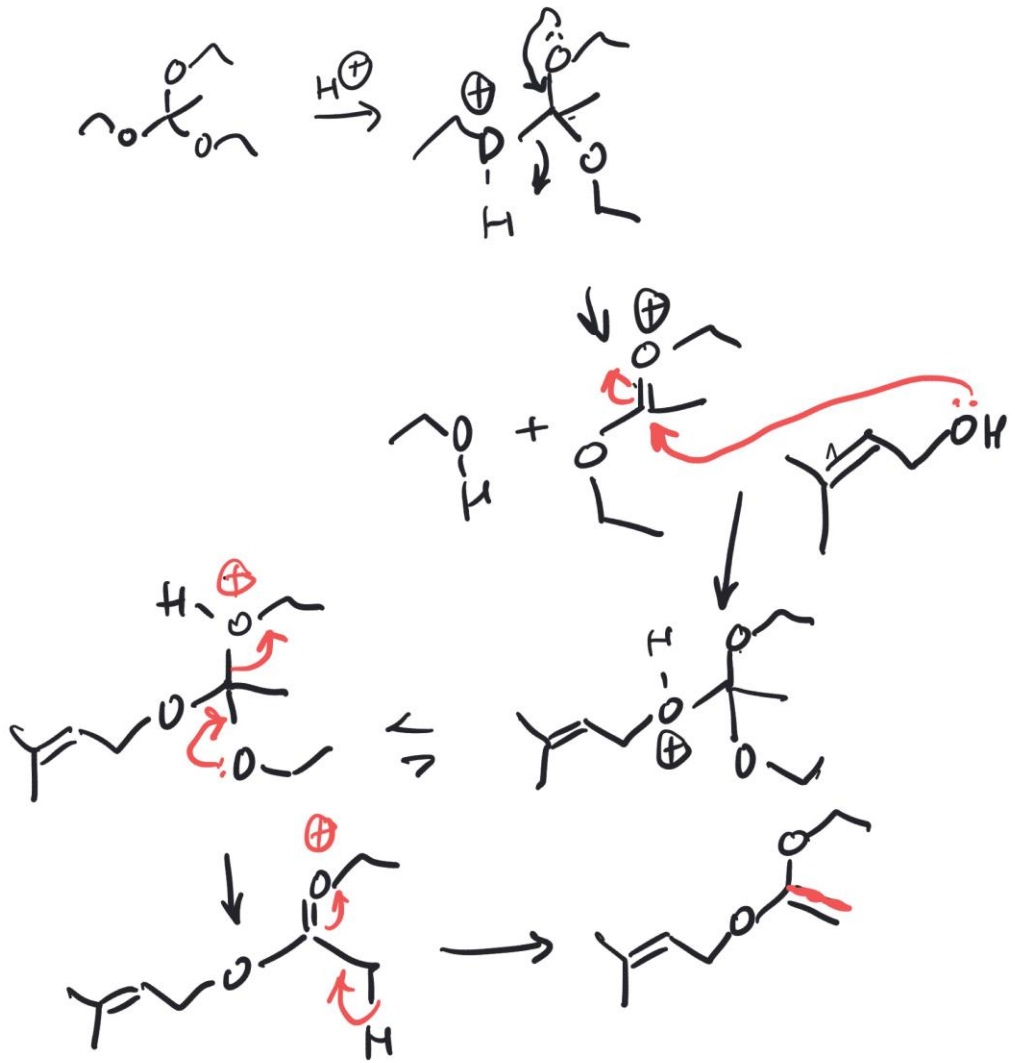
Se debe tener en cuenta que esta alquilación particular no se puede realizar mediante las condiciones químicas de un enolato, bajo ninguna condición, ya que la alquilación de un haluro de prenilo adecuadamente activo, no daría el producto mostrado, sino más bien la alquilación en la posición alílica primaria. De hecho, la introducción de grupos alilo en el extremo más impedido, es uno de los usos importantes de los procesos de Claisen.

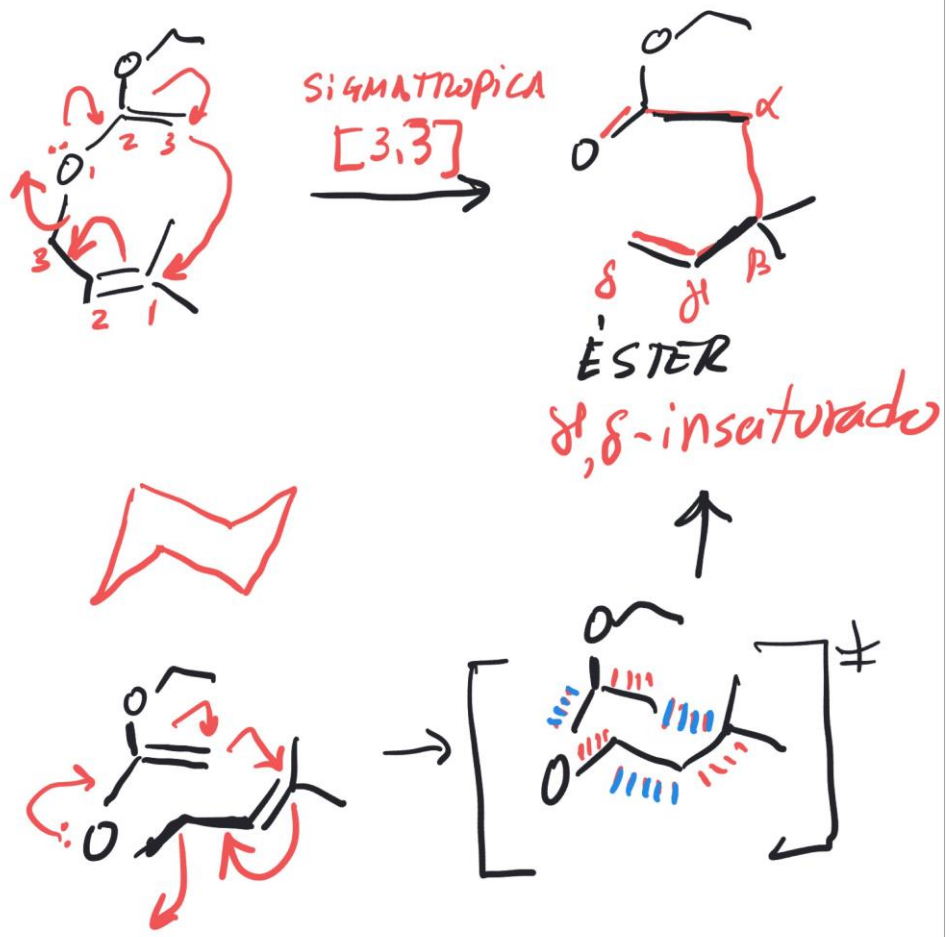
La versión aldehído del reordenamiento de Claisen no tiene un equivalente sintético directo en la química del enolato, ya que los enolatos de aldehído generalmente no son adecuados para reacciones de alquilación, debido a problemas de autocondensación

Chrysanthemic-Acid

Babler, J. H,; Tortorello, A. J. *J. Org. Chem.* **1976**, *41*, 885.



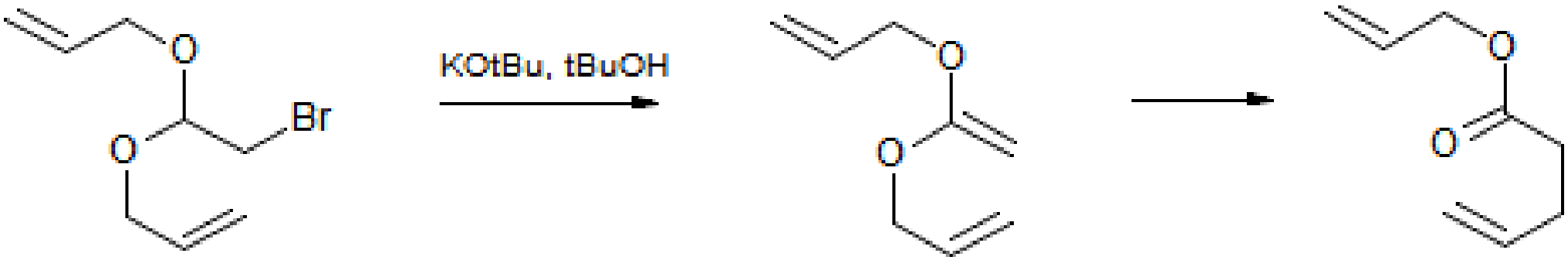



SIGMATRÓPICA
[3,3]
ÉSTER
γ,δ-insaturado

Otros métodos para preparar éteres de alil-enol

Dehydrohalogenation of bromoacetals.

McElvain, S. *J. Am. Chem. Soc.* **1942**, *64*, 2525

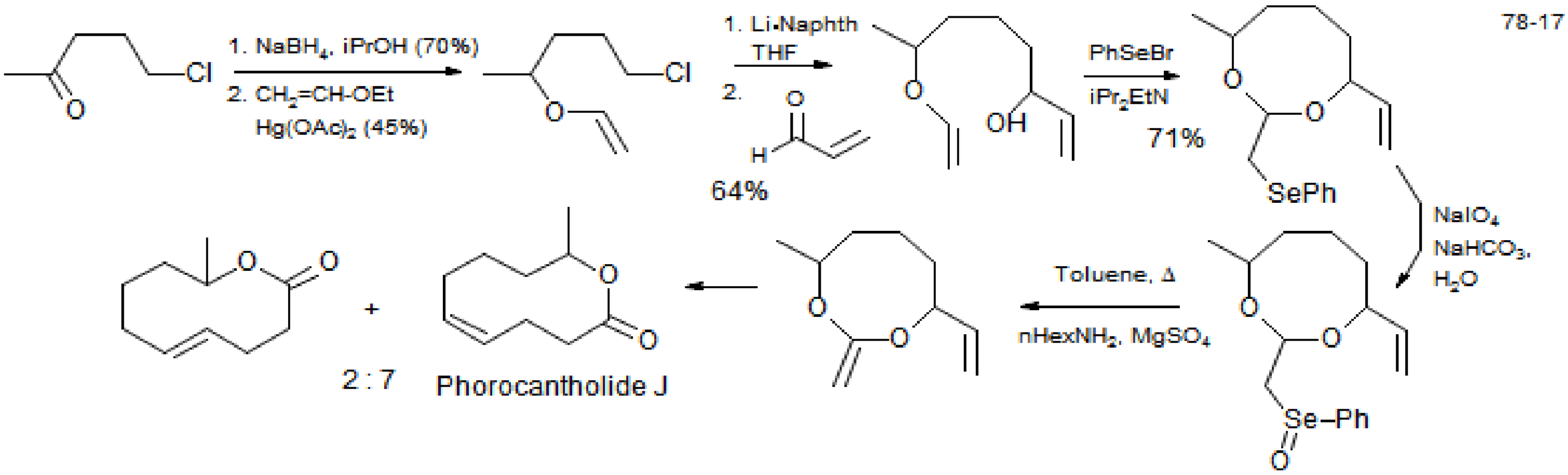


Otros métodos para preparer éteres de alil-enol

Selenoxide elimination

Phorocantholide J

Petrzilka, M. *Helv. Chim. Acta* **1978**, *61*, 3075

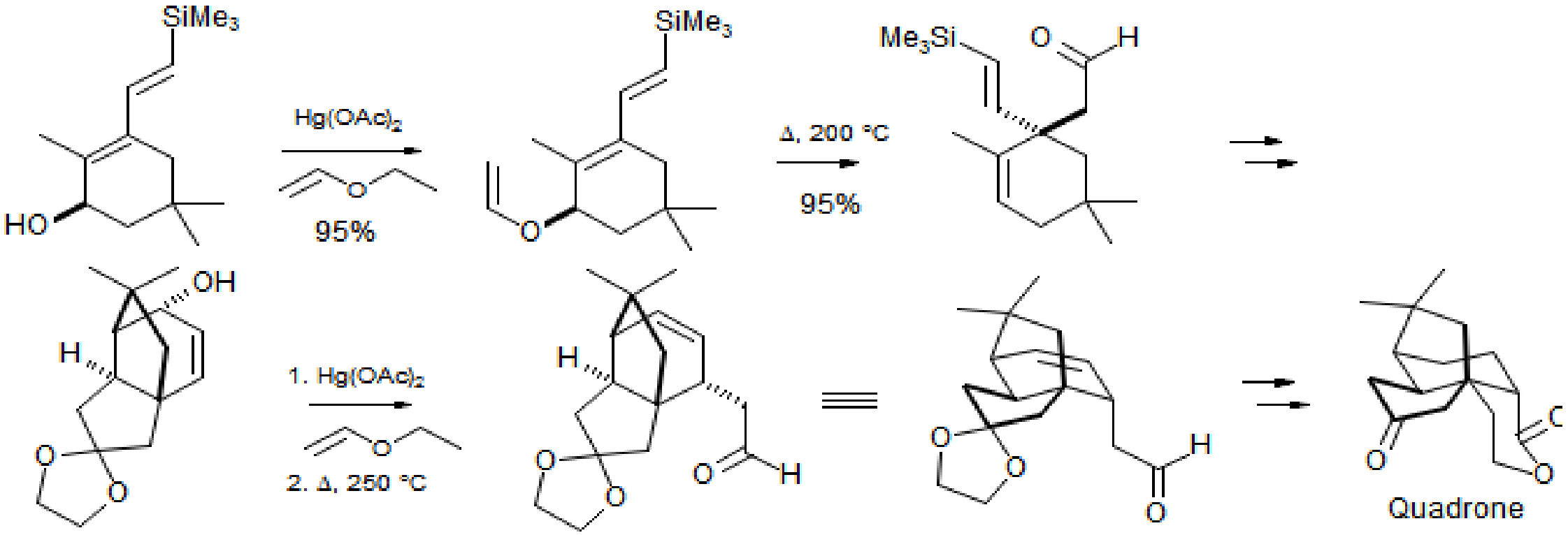


Estereoquímica de la reacción de Claisen: selectividad facial (una cara)

El rearreglo de Claisen es suprafacial en el fragmento del alcohol alílico

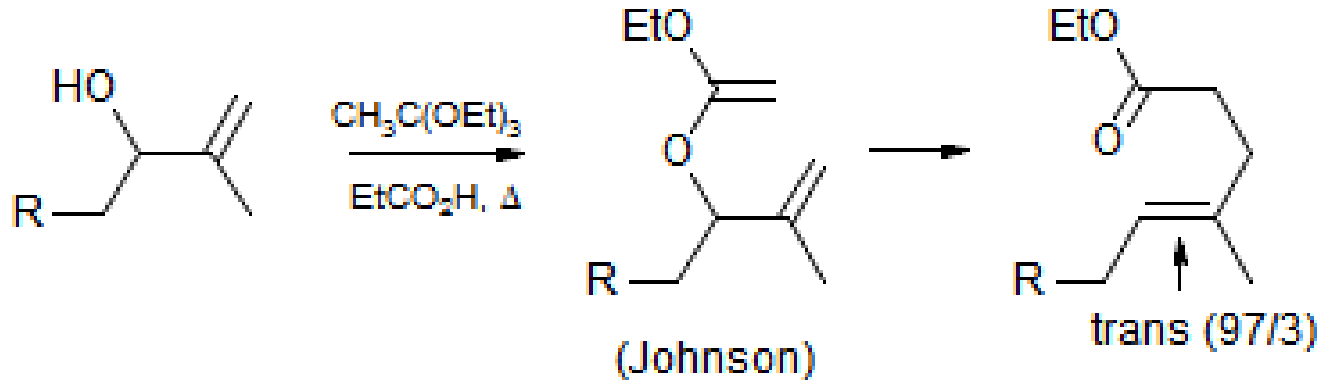
Quadrone

Burke, S. D.; Murtiashaw, C. W.; Saunders, J. O.; Dike, M. S. *J. Am. Chem. Soc.* **1982**, *104*, 872

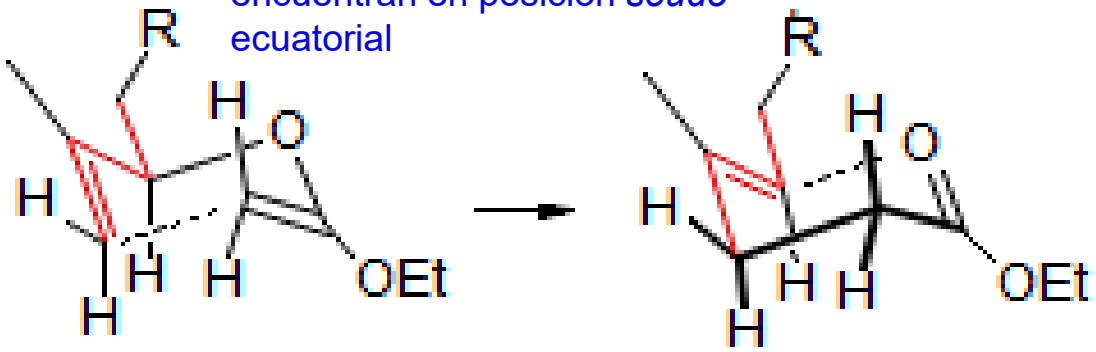


Stereochemistry of Claisen: *E*/*Z* Selectivity

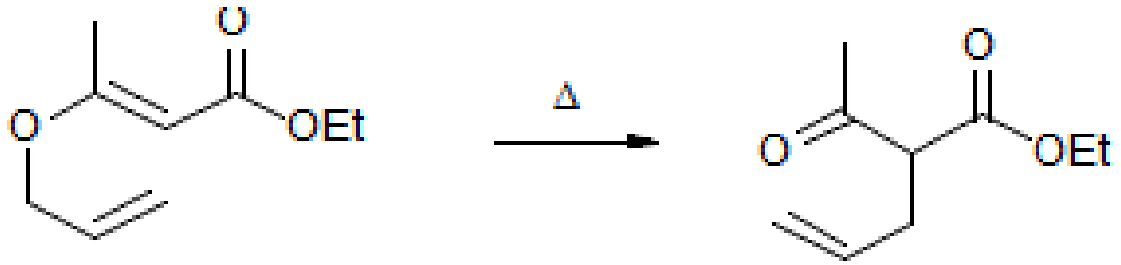
The Claisen rearrangement is *E*-Selective for reactions where di- or trisubstituted bonds are formed:



Los sustituyentes alquilo se encuentran en posición *seudo*-ecuatorial

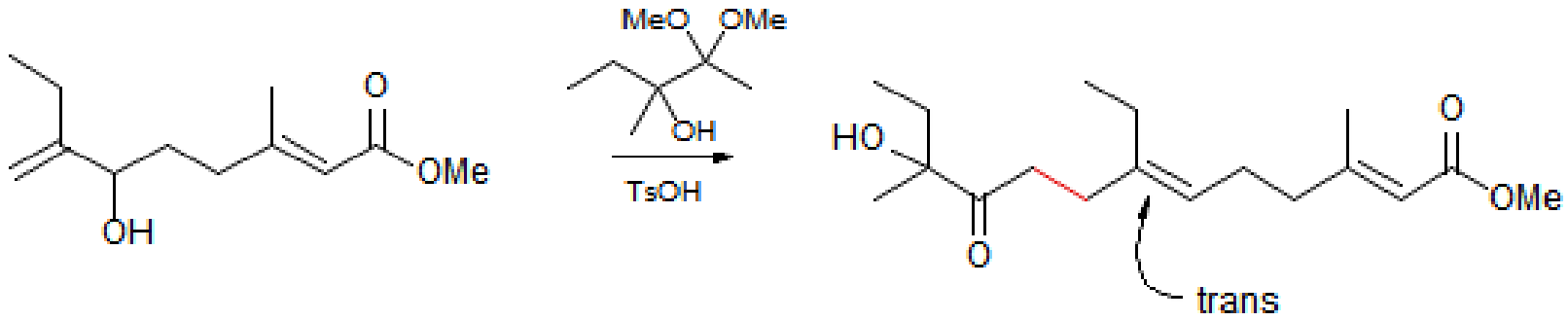


Estado de transición de silla

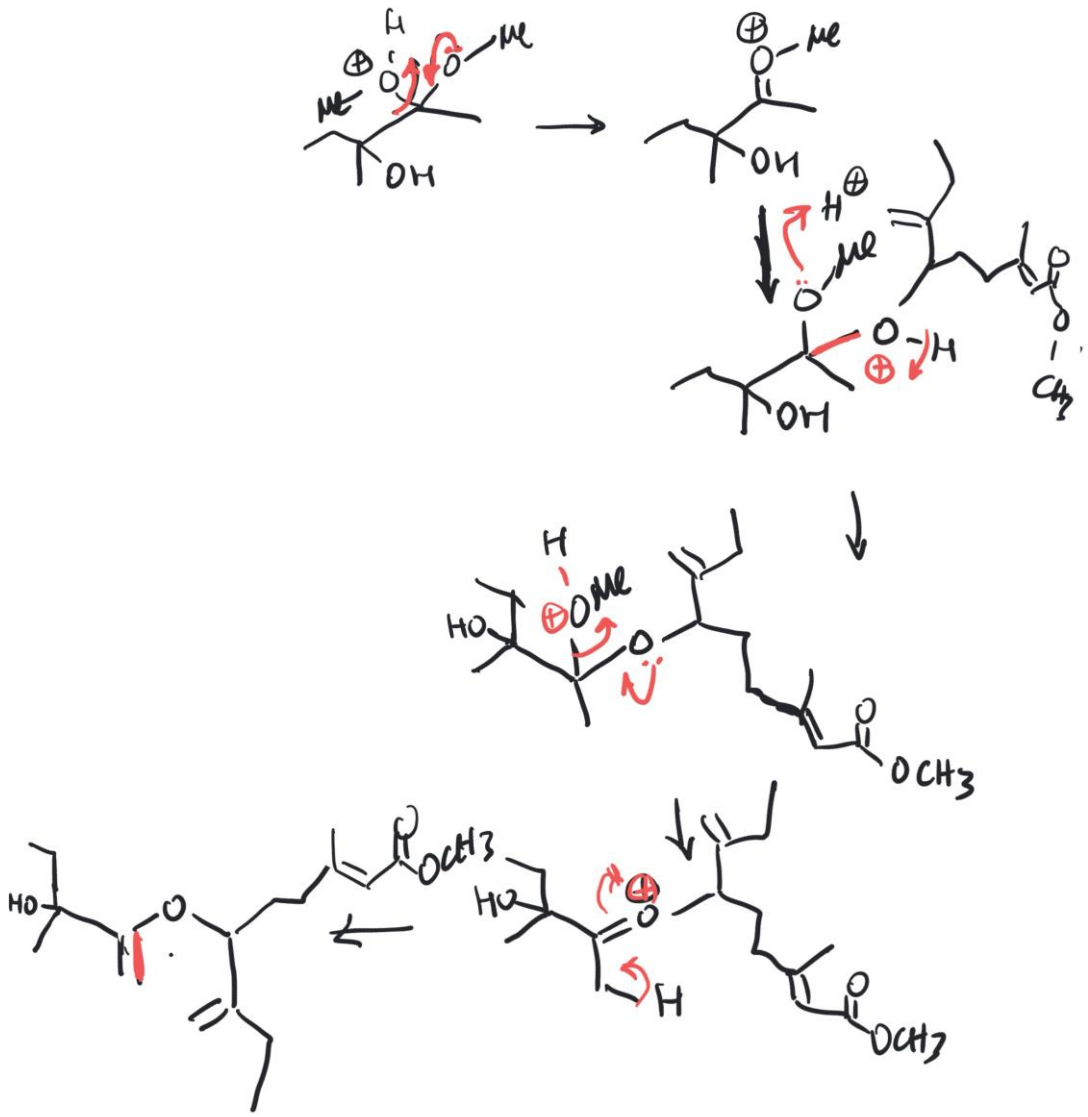


Se han desarrollado varios protocolos efectivos para sintetizar los éteres de alilo enol requeridos: el enol éter Claisen, el ortoéster de Johnson Claisen y el acetal de silileno ceteno Claisen-Ireland

Aunque la aplicación más común de este tipo de reordenamiento de Claisen es para la síntesis de aldehídos usando etil vinil éter, también es posible formar enol éteres derivados de cetonas:



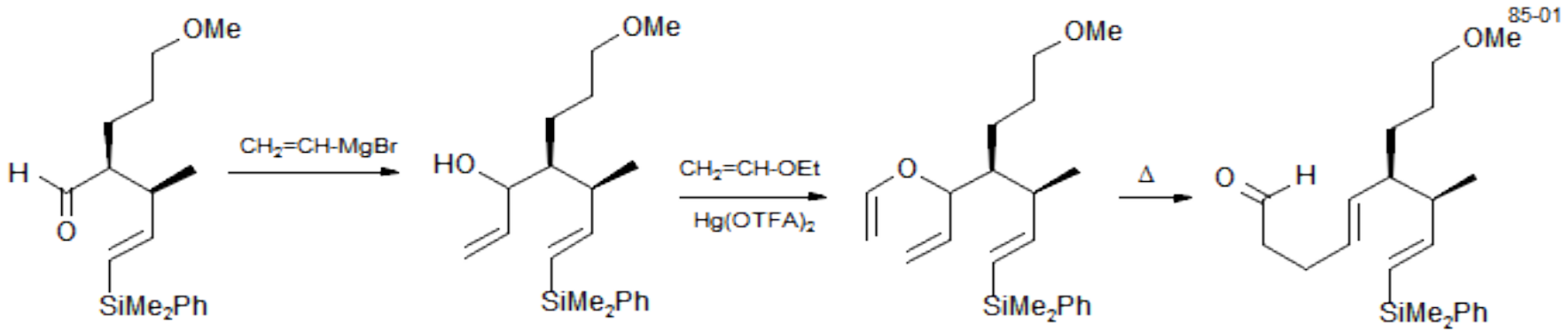
Cecropia Juvenile Hormone : Faulkner, D. J.; Peterson, M. R. *J. Am. Chem. Soc.* **1973**, *95*, 553

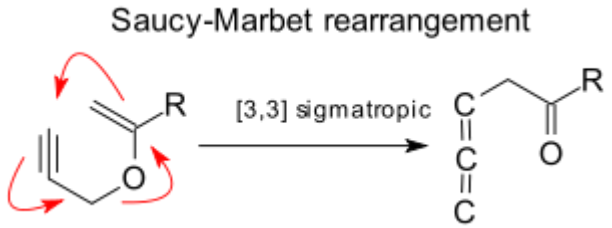


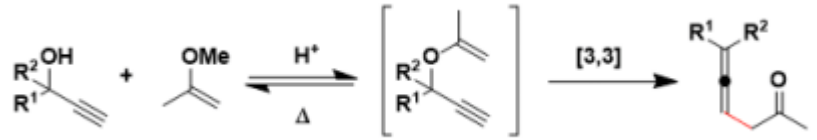
La aplicación más común de este tipo de reordenamiento de Claisen es para la síntesis de aldehídos, usando etil vinil éter

The Enol Ether-Claisen Process (Marbet-Saucy reaction)
4-Carbon chain extension

Burke, S. D., Saunders, J. O.; Oplinger, J. A.; Murtiashaw, C. W. Synthesis of Dihydrocompactin. *Tetrahedron Lett.*, **1985**, *26*, 1131

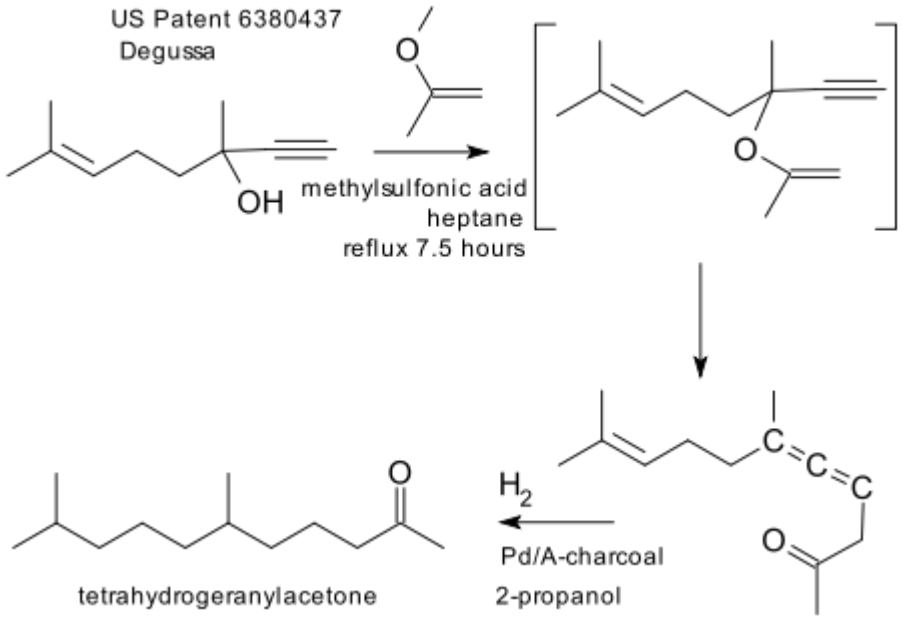






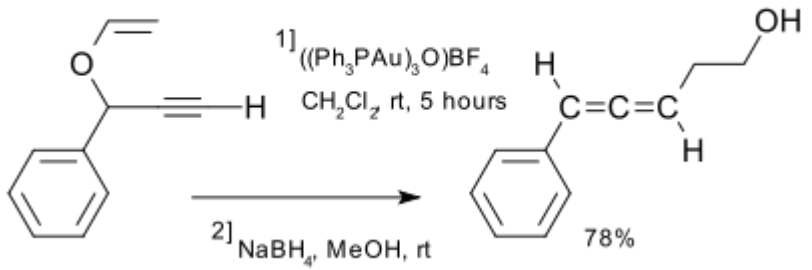
G. Saucy, R. Marbet (Hoffmann-La Roche) 1967

Aplicaciones industriales: se ha llevado a cabo la síntesis de la β-ionona, utilizando como materia prima dehidrolinalool y acetoacetato de etilo



Sherry & Toste 2004

La reacción se puede catalizar con oro:

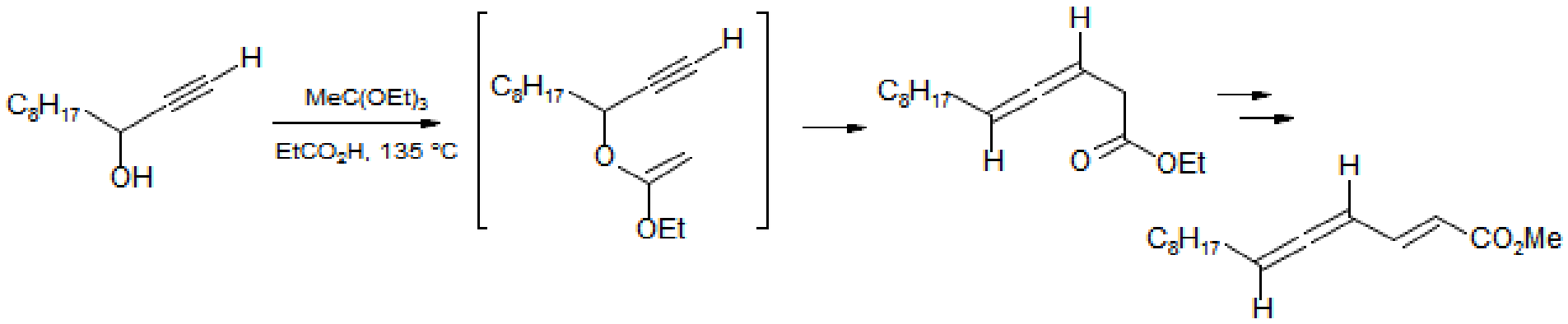


Gold(I)-Catalyzed Propargyl Claisen Rearrangement
Sherry, B.D.; Toste, F.D.; *J. Am. Chem. Soc.* 2004, 126, 49, 15978–15979

Claisen Rearrangment of a Propargyl alcohol

Male Dried Bean Beetle Sex Pheromone.

Kocienski, P.; Cernogliaro, G.; Feldstein, G. *J. Org. Chem.* **1977**, *42*, 353



The Johnson Ortho Ester Claisen Process

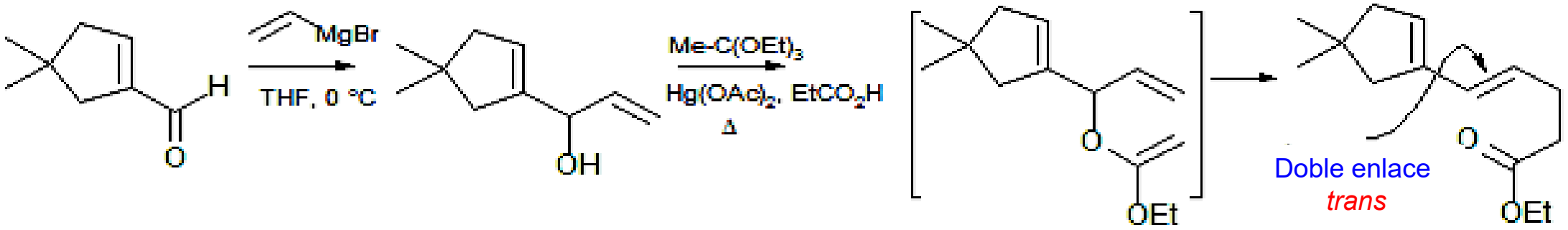
Johnson, W. S. *J. Am. Chem. Soc.* **1970**, *92*, 741

En la modificación de Johnson del Reordenamiento de Claisen, se forma un acetal alil ceteno por reacción catalizada por ácido a alta temperatura de un alcohol alílico con ortoacetato de etilo o metilo.

4-Carbon chain extension

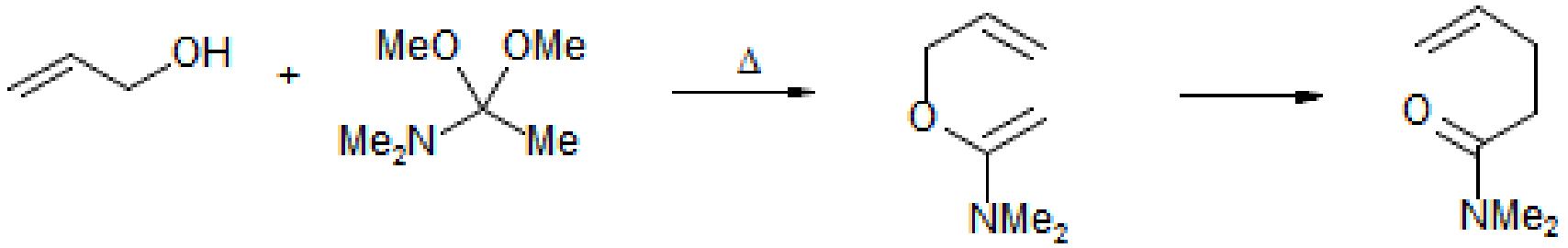
Synthesis of Hirsutene

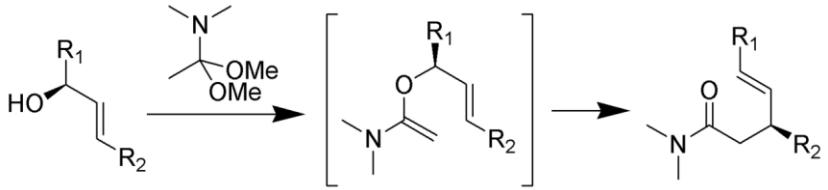
Hudlicky, T.; Kutchan, T. M.; Wilson, S. R.; Mao, D. T. *J. Am. Chem. Soc.* **1980**, *102*, 6351



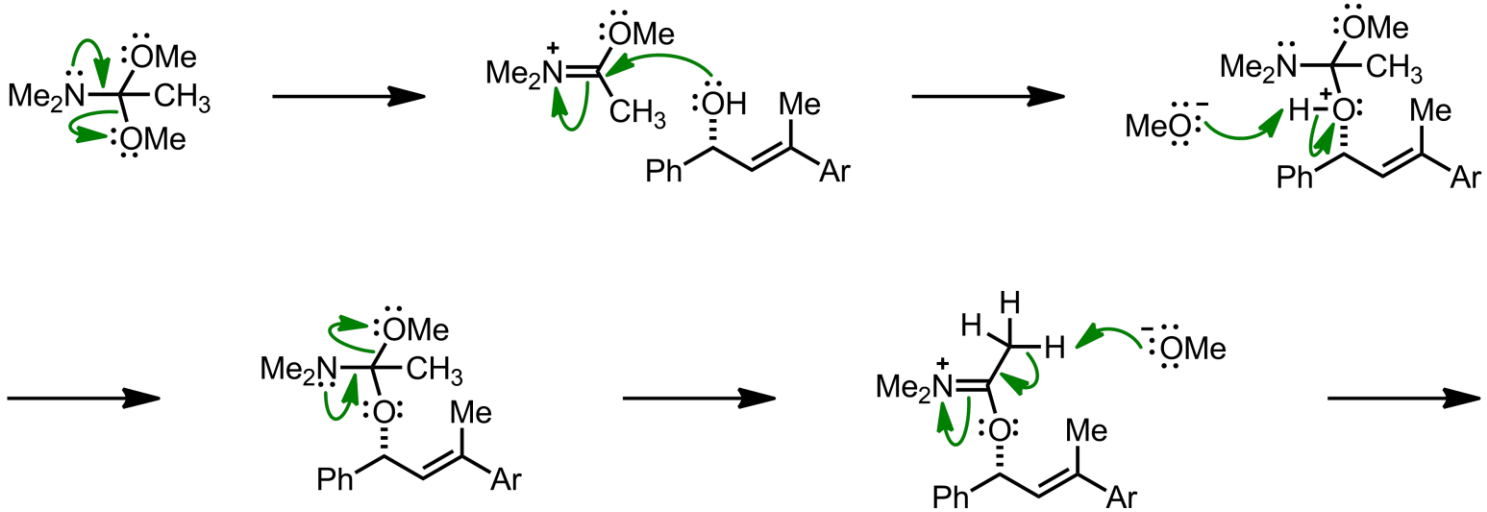
The Eschenmoser Amide Claisen Process

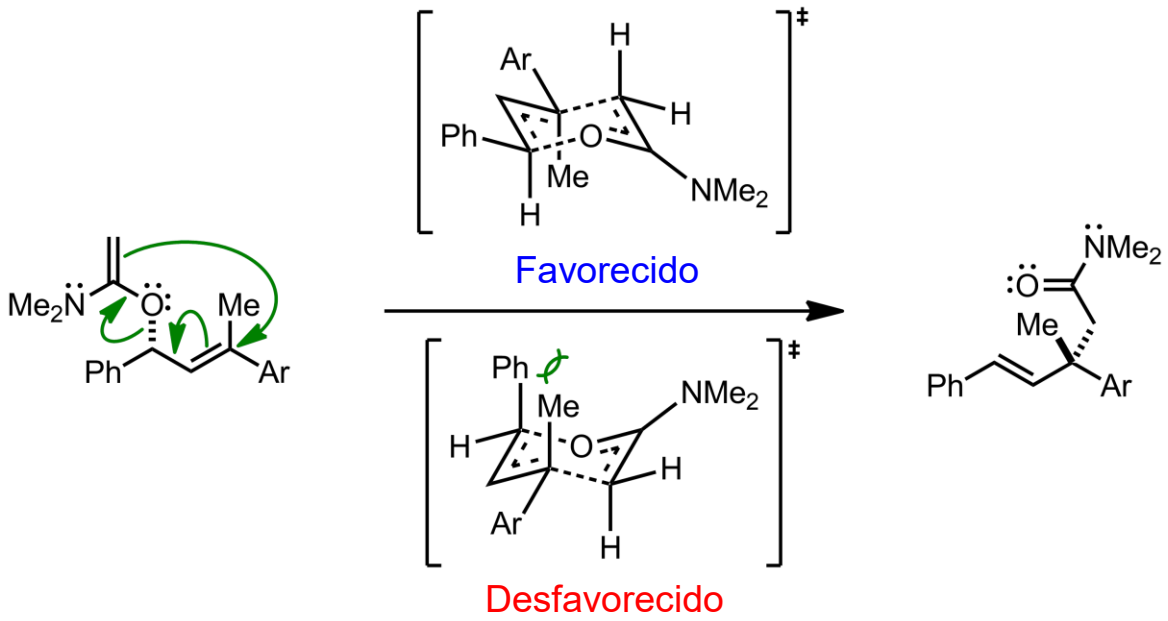
Wick, A. E.; Felix, D.; Steen, K.; Eschenmoser, A. *Helv. Chim. Acta* **1964**, *47*, 2425–2429
Felix, D.; Gschwend-Steen, K.; Wick, A.E.; Eschenmoser, A.; *Helv. Chim. Acta* **1969**, *52*, 1030-1042





https://nl.wikipedia.org/wiki/Eschenmoser-Claisen-omlegging#/media/Bestand:Eschenmoser-Claisen_Rearrangement_Scheme.png



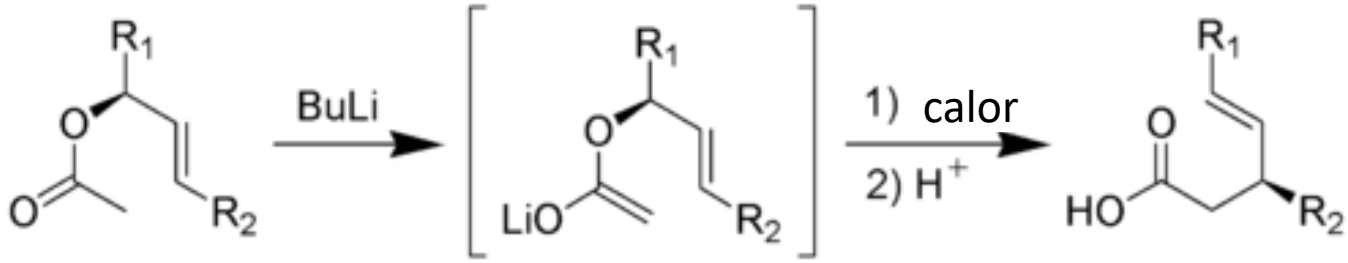


https://www.synarchive.com/named-reactions/eschenmoser-claisen-rearrangement

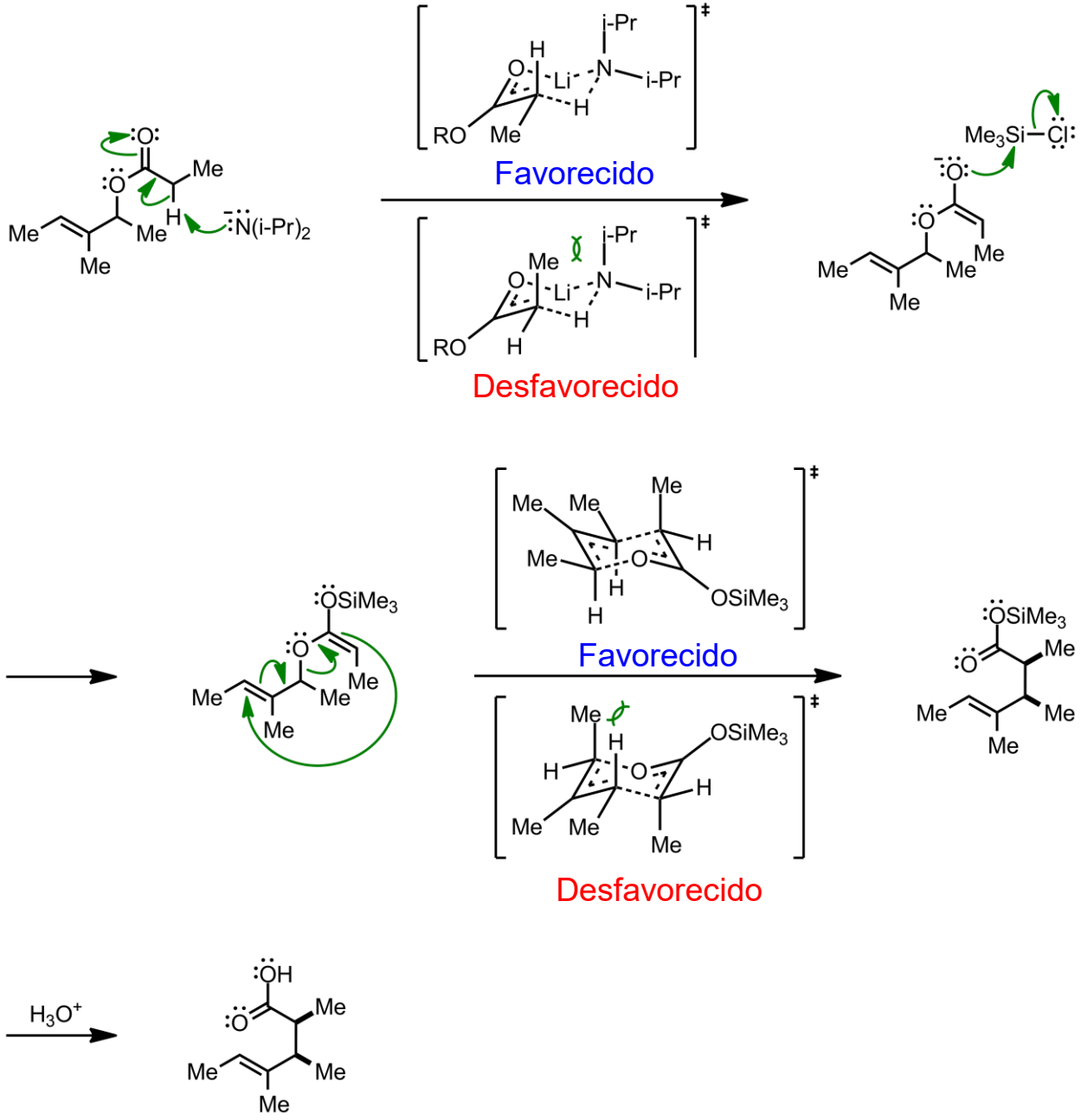
Rearreglo de Ireland-Claisen

Ireland, R. E.; Mueller, R. H. *J. Am. Chem. Soc.* **1972**, *94* (16): 5897

La modificación de Ireland al rearreglo de Claisen es el más suave y más general de los procedimientos disponibles. Un alcohol alílico o propargílico se convierte en un éster, y este éster se desprotona (es usual emplear LiNiPr2) y se silila en el O para formar el acetal cetena, el cual se rearregla bajo condiciones suaves. El proceso de enolización controlada permite un control estéreoquímico mucho mejor del enol éter formado, que el que es posible con otros métodos.



https://en.wikipedia.org/wiki/Ireland%E2%80%93Claisen_rearrangement#/media/File:Ireland-Claisen_Rearrangement_Scheme.png



https://www.synarchive.com/named-reactions/ireland-claisen-rearrangement

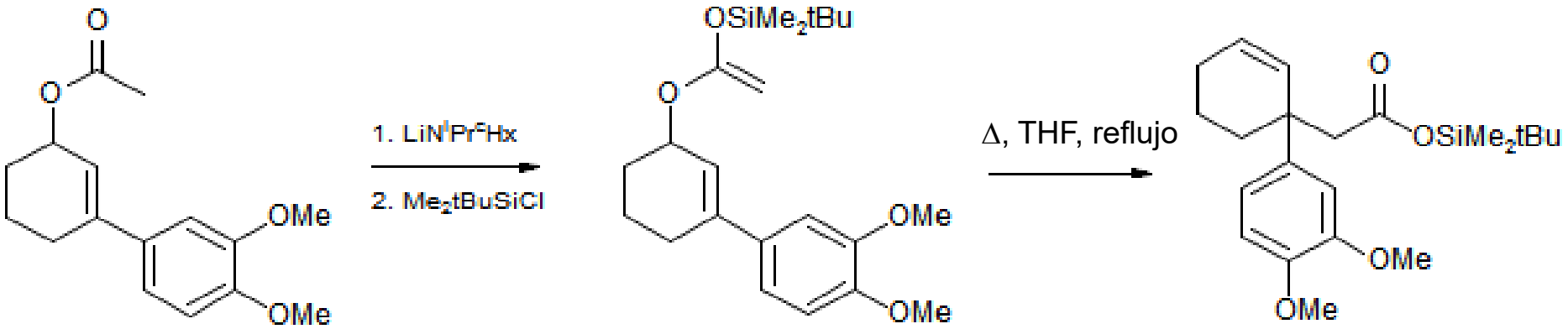
El proceso de Claisen-Ireland acetal silil cetena

New Aspects of the Ireland and Related Claisen Rearrangements

Chai, Y.; Hong, S.-P.; Lindsay, H. A.; McFarland, C.; McIntosh, M. C. *Tetrahedron* **2002**, *58*, 2905-28.

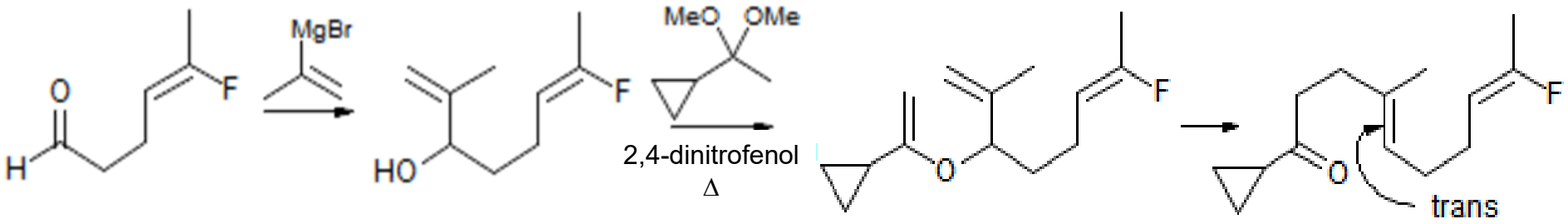
Synthesis of Mesembrine

Keck, G. E.; Webb, R. R. *J. Org. Chem.* **1982**, *47*, 1302



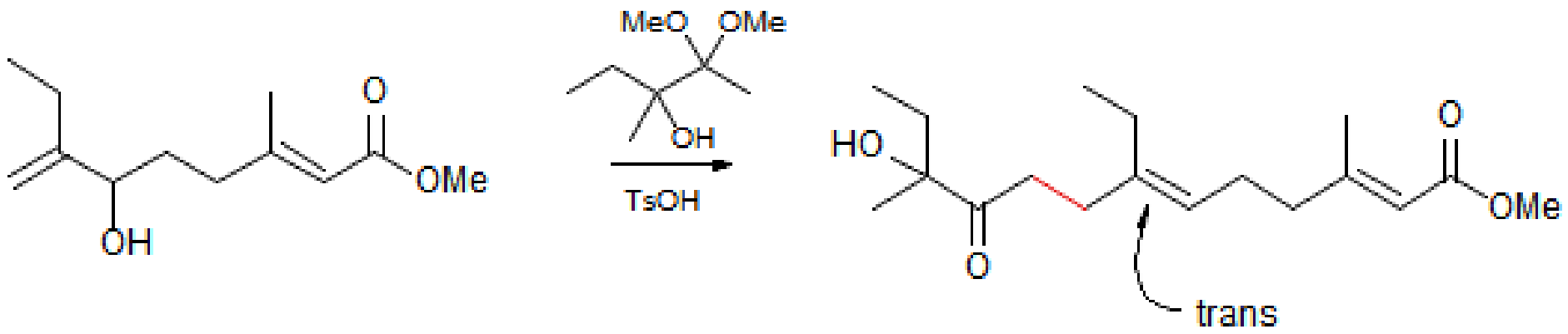
In suitable situations, ketone based Claisen rearrangements can also be carried out

Progesterone synthesis: Johnson *J. Am. Chem. Soc.* **1980**, *102*, 7800



Cecropia Juvenile Hormone

: Faulkner, D. J.; Peterson, M. R. *J. Am. Chem. Soc.* **1973**, *95*, 553

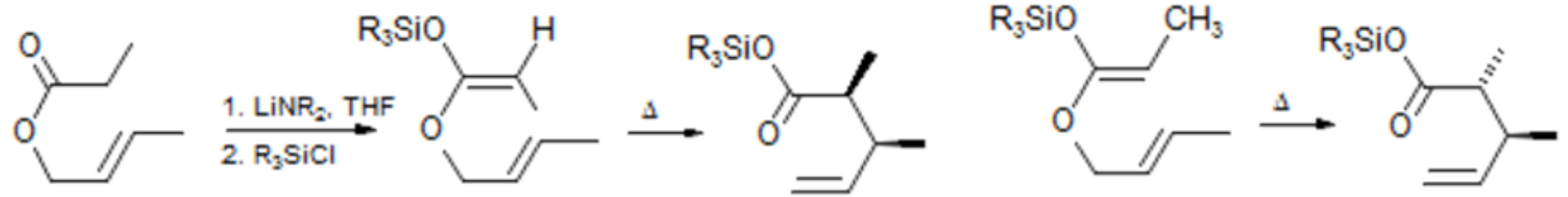


Estereoquímica de Claisen: selectividad *eritro-treo*

Los reordenamientos de Claisen muestran una alta estereoespecificidad para la interconversión de dobles enlaces *cis / trans* y estereoquímica sp^3 (Ireland).

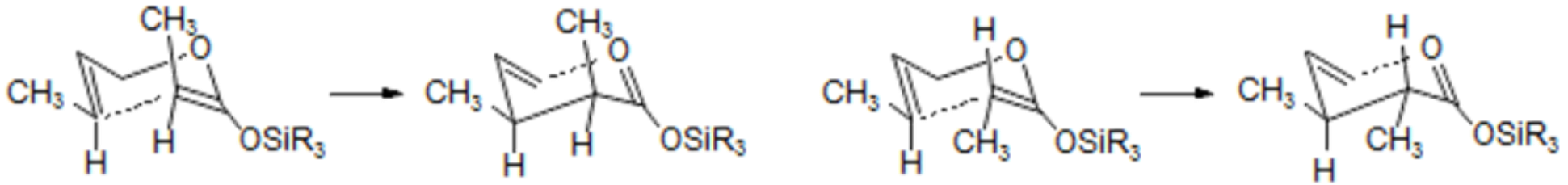
The ester enolate Claisen rearrangement. Stereochemical control through stereoselective enolate formation

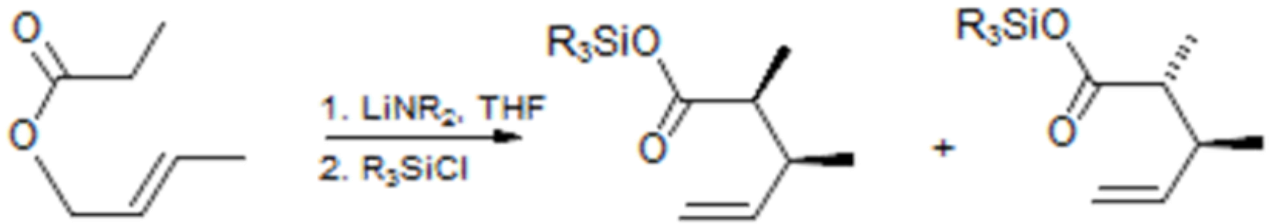
Ireland, R.E.; Mueller, R.H.; Willard, A.K.; *J. Am. Chem. Soc.* 1976, 98, 10, 2868–2877

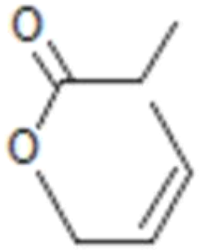


Enolato cinético

Enolato termodinámico (THF/HMPA)







THF	87 / 13
THF / HMPA	19 / 81
THF	11 / 89
THF / HMPA	86 / 14

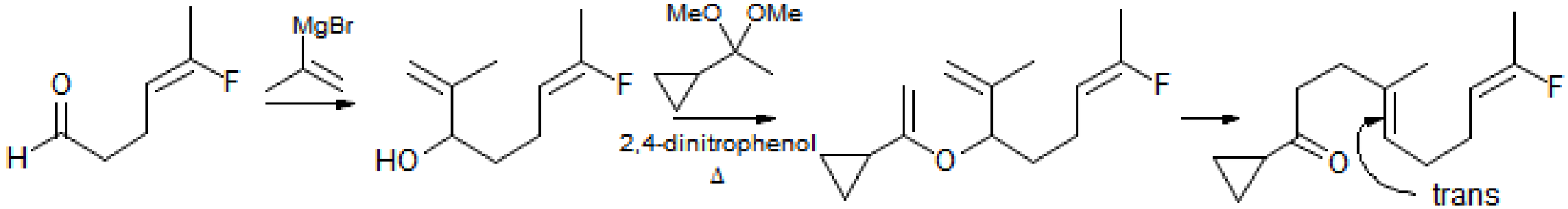
Si se cambia la estereoquímica del alcohol crotílico, se forma el isómero principal

En situaciones apropiadas, se puede formar una cetona con el rearreglo de Claisen

Síntesis de la Progesterona

Vinyl fluoride function as a terminator of biomimetic polyene cyclizations leading to steroids

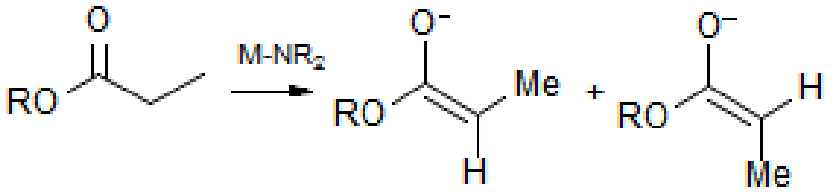
Johnson, W.S.; Daub, G.W.; Lyle, T.A., Niwa, M.; *J. Am. Chem. Soc.* **1980**, *102*, 7800



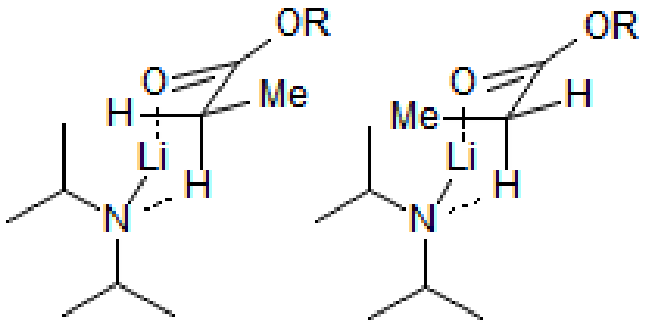
Control de la estereoquímica en el rearreglo de Claisen en el enolato de un éster

Stereoselectivity in silyl ketene acetal formation

Ireland, R. E.; Wipf, P.; Armestrong, J. D., III *J. Org. Chem.* **1991**, *56*, 650.

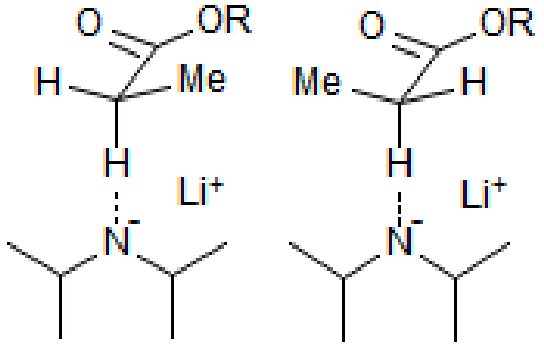


LiN*i*-Pr$_2$, THF. -78°	6 : 94
LiN*i*-Pr$_2$, THF, 23% HMPA, -78°	85 : 15
LiN*i*-Pr$_2$, THF, 48% DMPU, -78°	>98 : 2



Favorecido

Estado de transición cíclico empleando THF



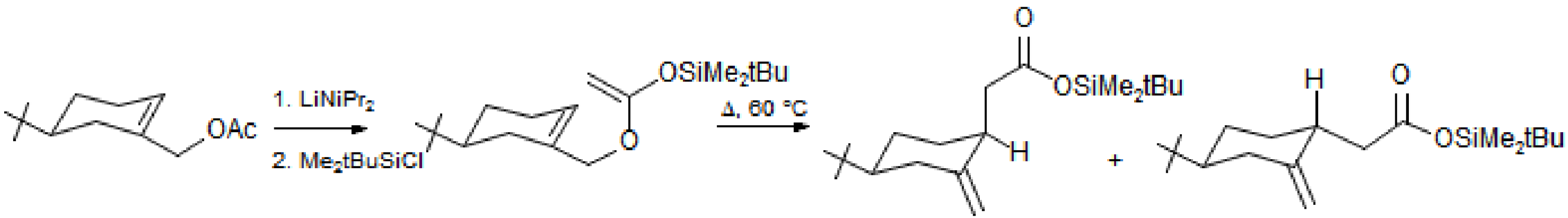
Favorecido

Estado de transición abierto, empleando THF-HMPA

Selectividad hacia una cara en un sistema de ciclohexano.

Stereochemistry of the Claisen rearrangement of derivatives of 5-*tert*-butyl-1-(hydroxymethyl)-1-cyclohexene: preferred axial attachment of the side chain

Ireland, R.E.; Varney, M.D.; *J. Org. Chem.* 1983, 48, 11, 1829–1833

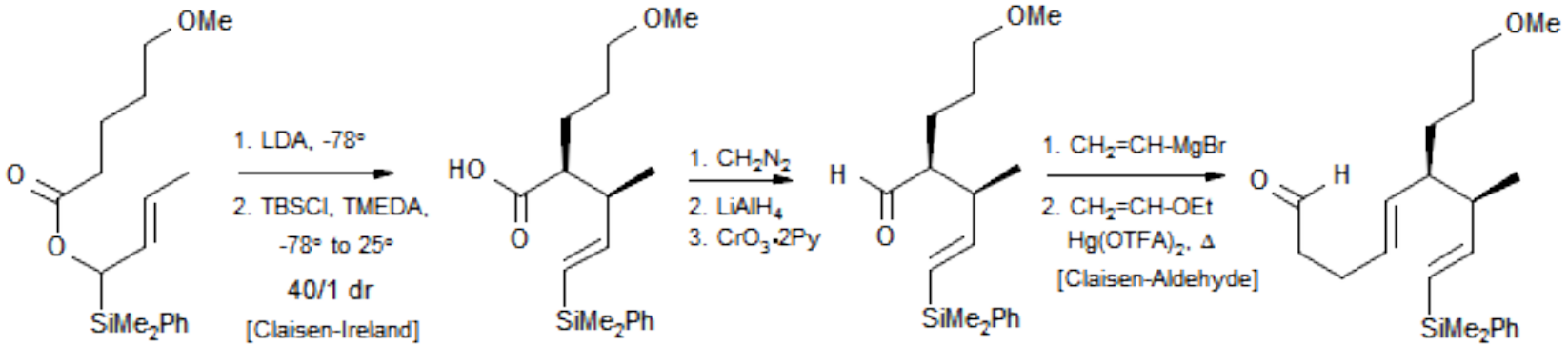


A una temperatura de 166 °C, el proceso de Johnson también dio el isómero axial

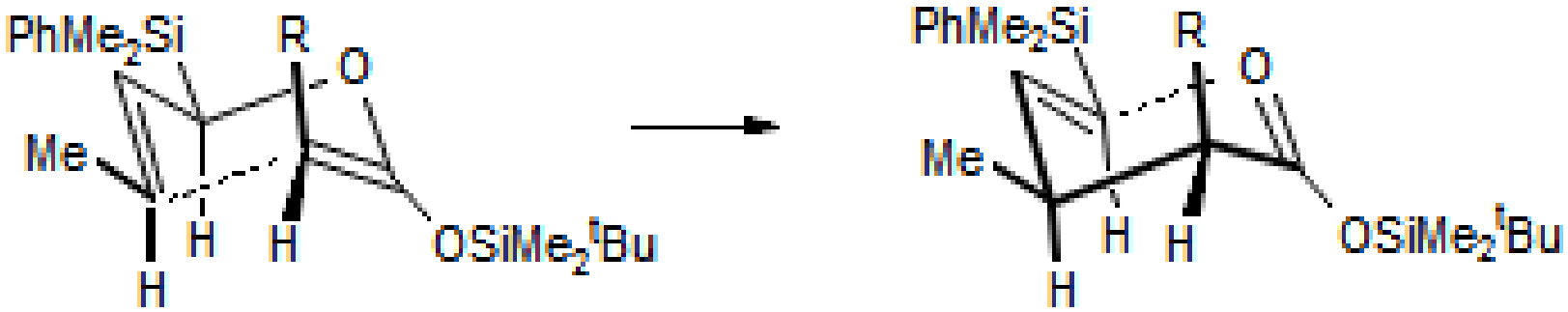
Control de la estereoquímica *Eritro-Treo*

Dihydrocompactin

Burke, S. D., Saunders, J. O.; Oplinger, J. A.; Murtiashaw, C. W. *Tet. Lett.*, **1985**, *26*, 1131



Estereoquímica de la reacción de Claisen

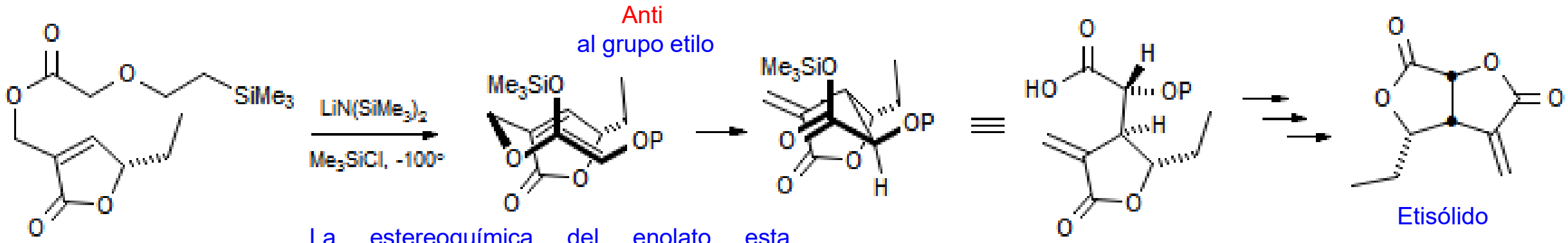


Enolato *E*

Control de la estereoquímica *Eritro-Treo*

Synthesis of ethisolide, isoavenaciolide, and avenaciolide

Burke, S.D.; Pacofsky, G.J.; Piscopio, A.D.; *J. Org. Chem.* **1992**, *57*, 2228-2235



Anti
al grupo etilo

Etisólido

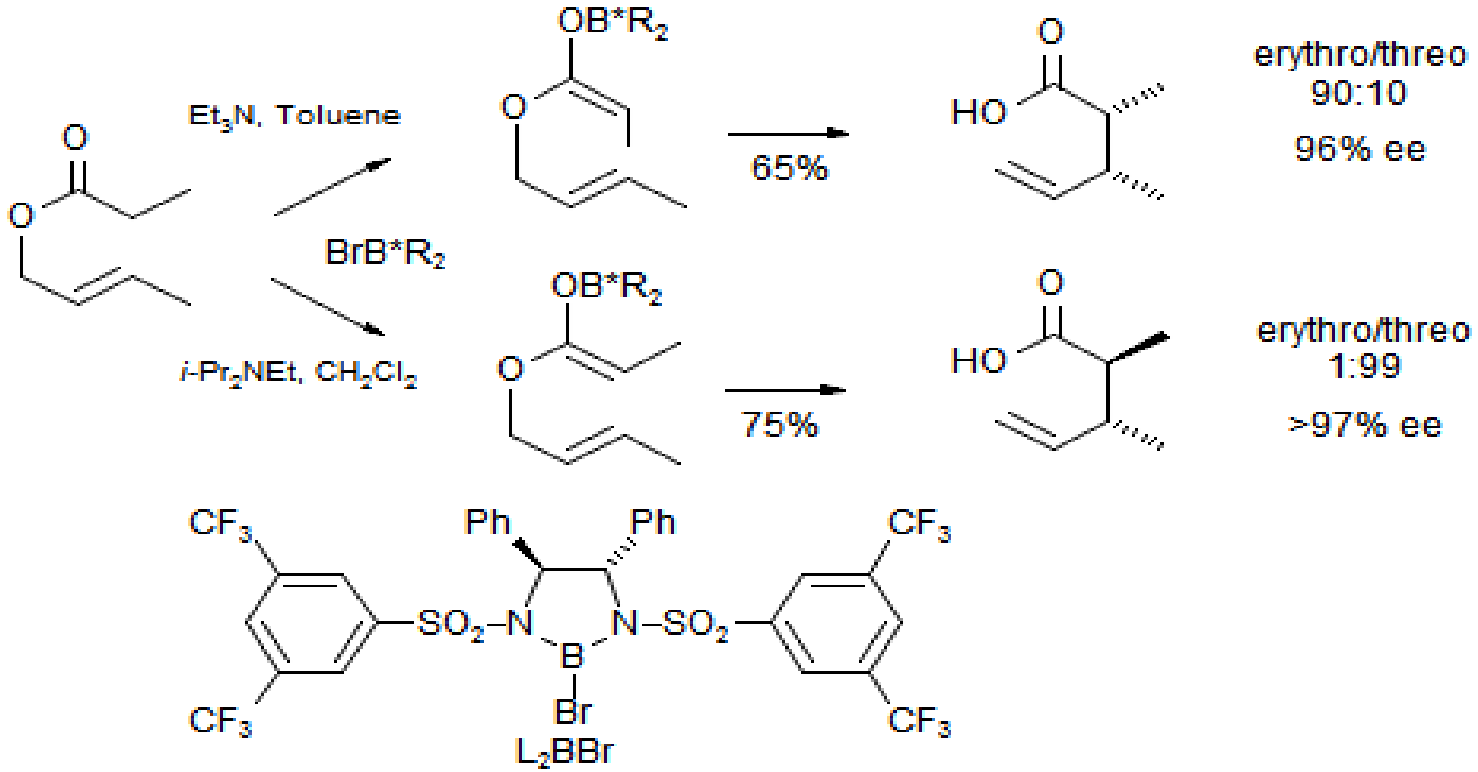
La estereoquímica del enolato esta controlada por la formación de un quelato. Hay una selectividad hacia una de las caras, anti al grupo etilo

Estereoquímica del rearreglo de Caisen: *enantioselectividad*

Boro como ácido de Lewis quiral

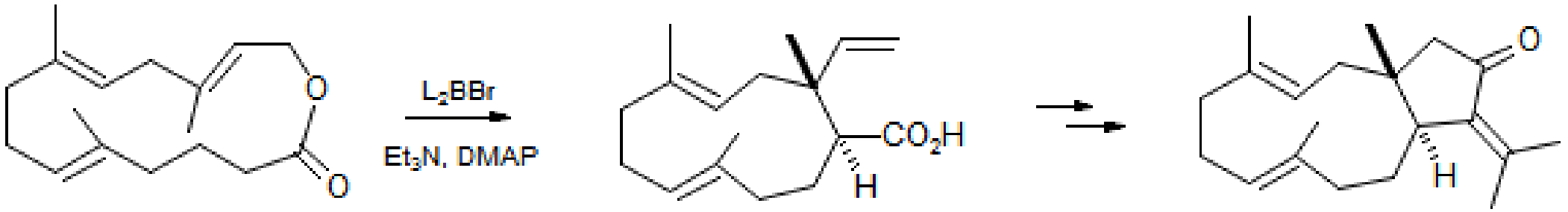
Highly enantioselective and diastereoselective Chiral Ireland-Claisen rearrangement of achiral allylic esters

Corey, E.J.; Lee, D.H.; *J. Am. Chem. Soc.* **1991**, *113*, 4026.



Dolabellatrienone

Corey, E. J.; Kania, R. S. *J. Am. Chem. Soc.* **1996**, *118*, 1230



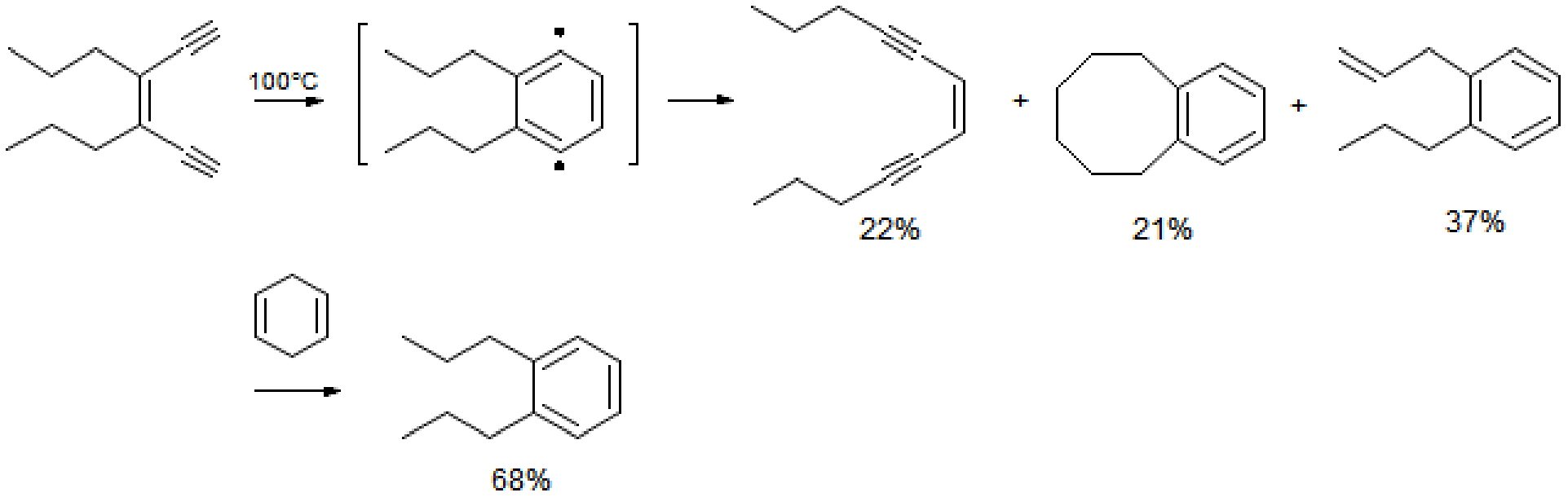
98:2 ds, 98% ee

Dolabellatrienone

Ciclización de Bergman o Reacción de Bergman o cicloaromatización de Bergman

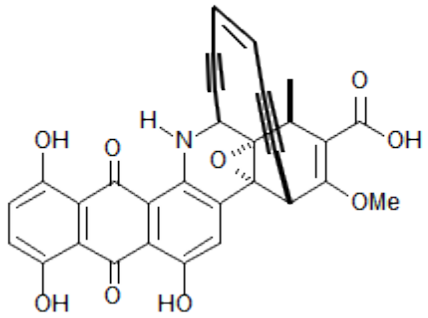
Kinetic evidence for the formation of discrete 1,4-dehydrobenzene intermediates. Trapping by inter- and intramolecular hydrogen atom transfer and observation of high-temperature CIDNP

Lockhart, T. P.; Comita, P. B.; Bergman, R. G. J. Am. Chem. Soc. 1981,. 103,4082.

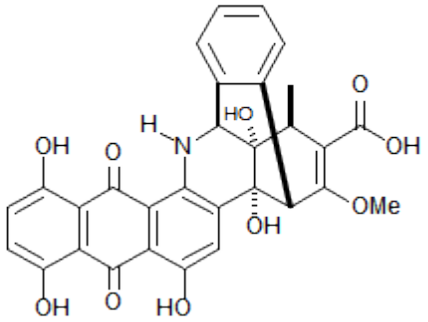


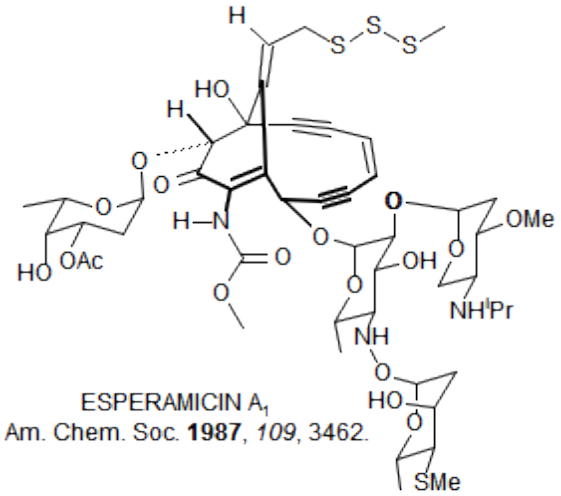
Enediyne antibiotics

M. D. Lee, G. A. Ellestad, D. B. Borders *Acc. Chem. Res.* **1991**, *24*, 235.

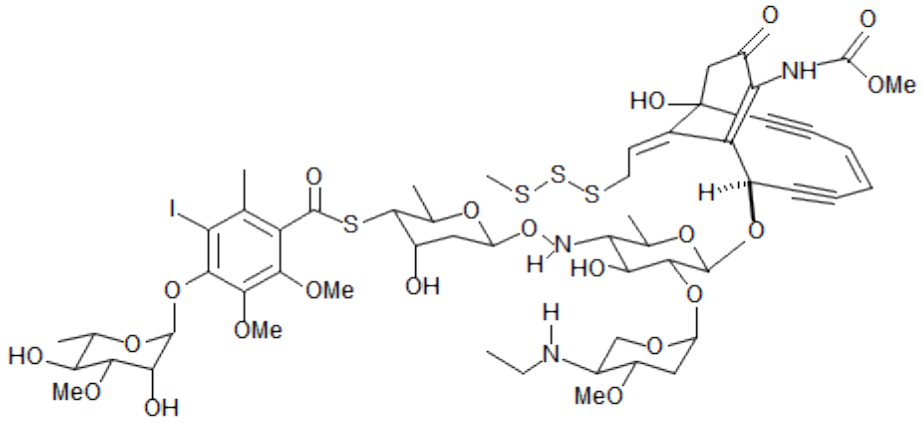


DYNEMYCIN A
J. Am. Chem. Soc. **1990**, *102*, 3715.

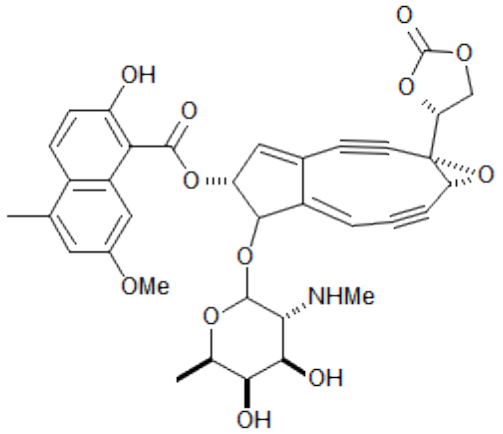




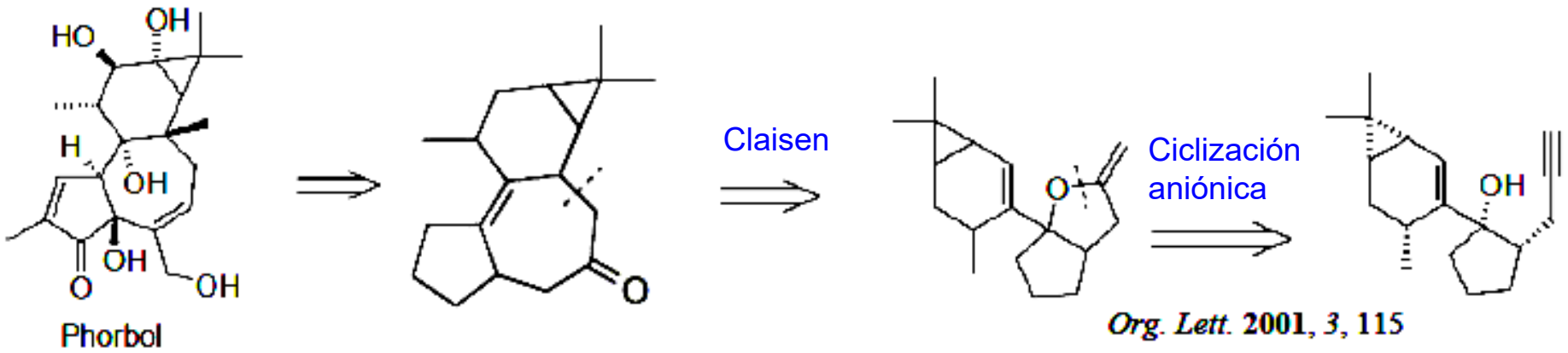
ESPERAMICIN A_1
J. Am. Chem. Soc. **1987**, *109*, 3462.



CALICHEMYCIN γ_1
J. Am. Chem. Soc. **1987**, *109*, 3466.



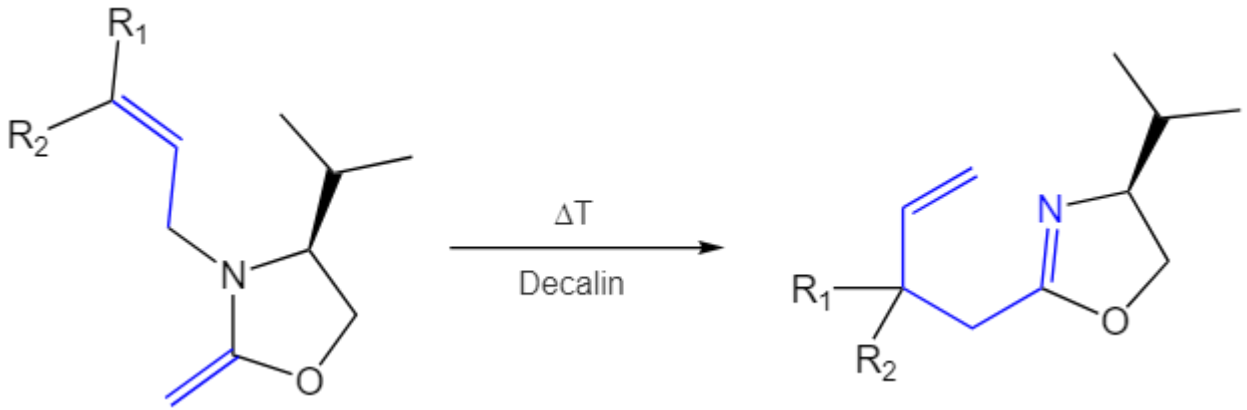
NEOCARZINOSTATIN
CHROMOPHORE
J. Am. Chem. Soc. **1988** *110*, 7212.

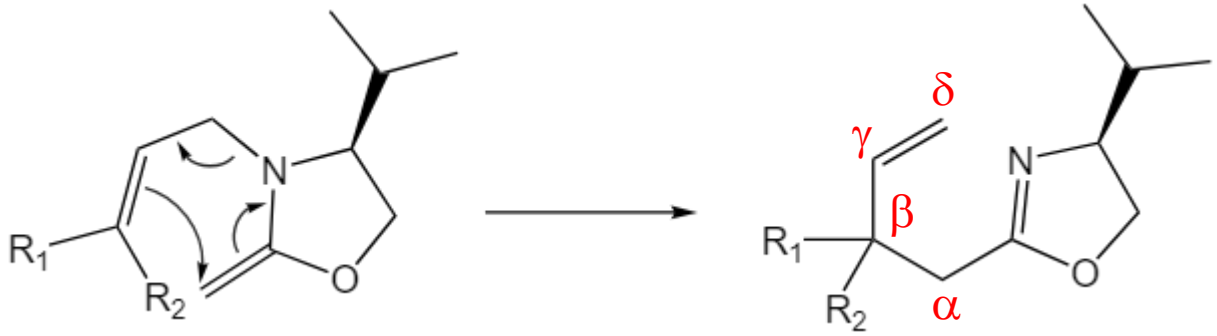


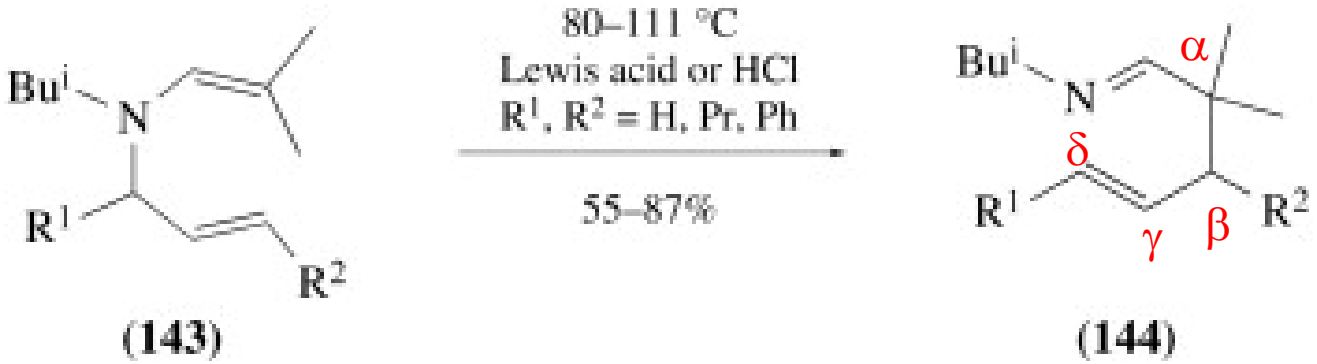
Org. Lett. **2001**, *3*, 115

Timo V. Ovaska,* Sarah E. Reisman, and Meghan A. Flynn

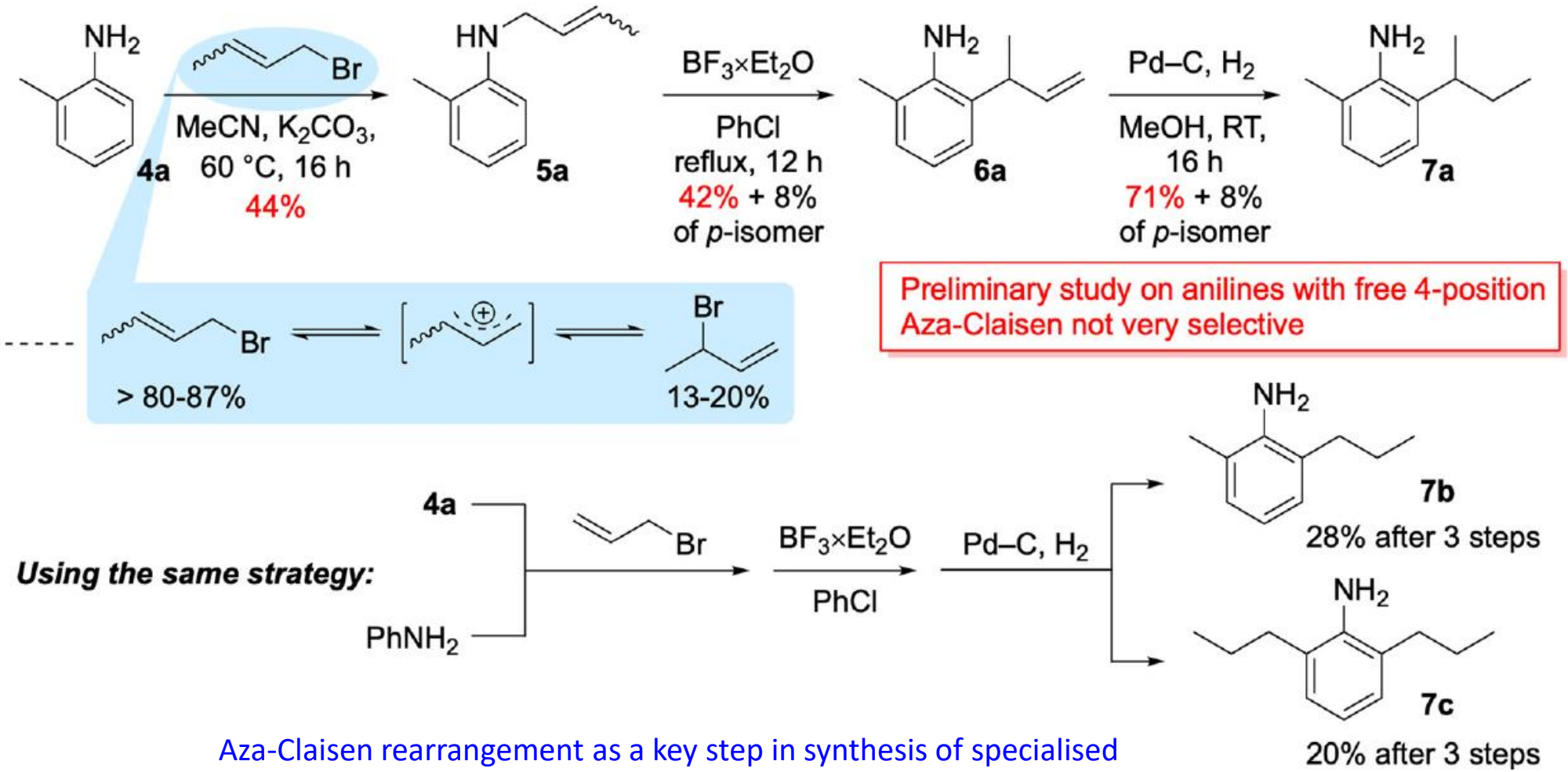
Rearreglo aza-Claisen
Rearreglo térmico sigmatrópico-[3.3] de N-alil enaminas






Bu^i
N
R^1
R^2
80–111 °C
Lewis acid or HCl
R^1, R^2 = H, Pr, Ph
55–87%
Bu^i
N
α
δ
R^1
γ
β
R^2

(143) **(144)**



Aza-Claisen rearrangement as a key step in synthesis of specialised anilines used in the production of efficient ethenolysis catalysts

Adrian Sytniczuk, Karol Grela Filip Struzik, Vishal Purohit, and AnnaKajetanowicz

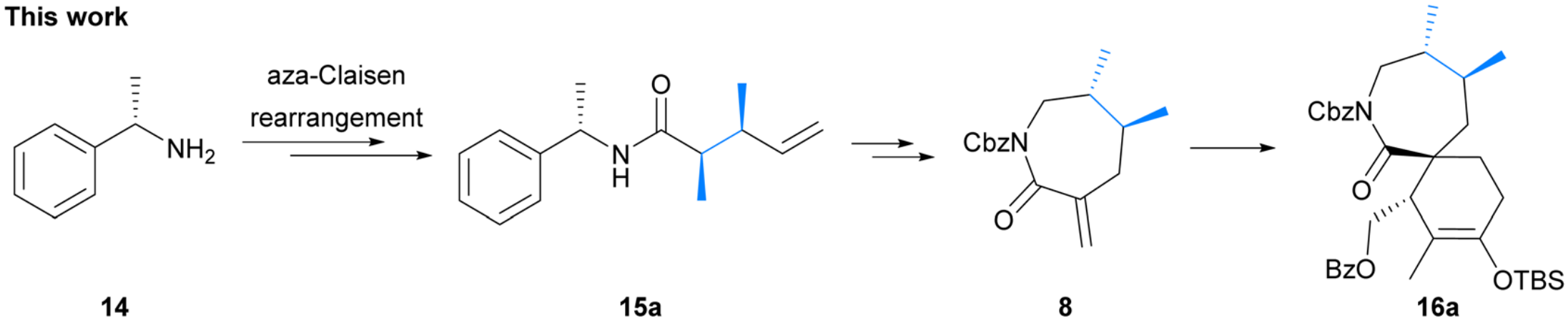
Catal. Sci. Technol.,**2023**, *13*,3682

Stereoselective synthesis of the spirocyclic core of 13-desmethyl spirolide C using an aza-Claisen rearrangement and an exo-selective Diels–Alder cycloaddition

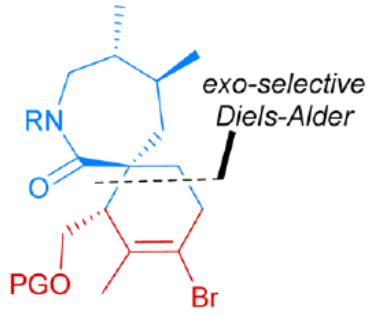
Andrew D. W. Earl, Freda F. Li, Chao Ma, Daniel P. Furkert and Margaret A. Brimble

Org. Biomol. Chem., **2023**, *21*, 1222

This work

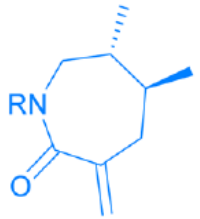


14 **15a** **8** **16a**

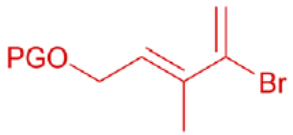


exo-selective
Diels-Alder

17
spirocyclic ring fragment of
13-desmethyl spirolide C

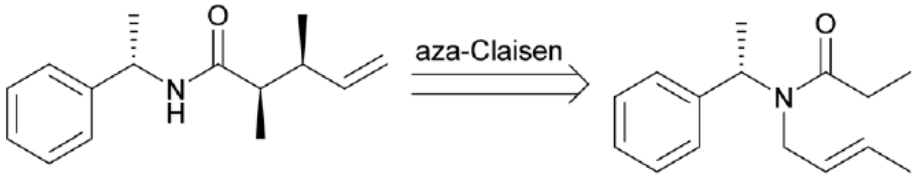


+



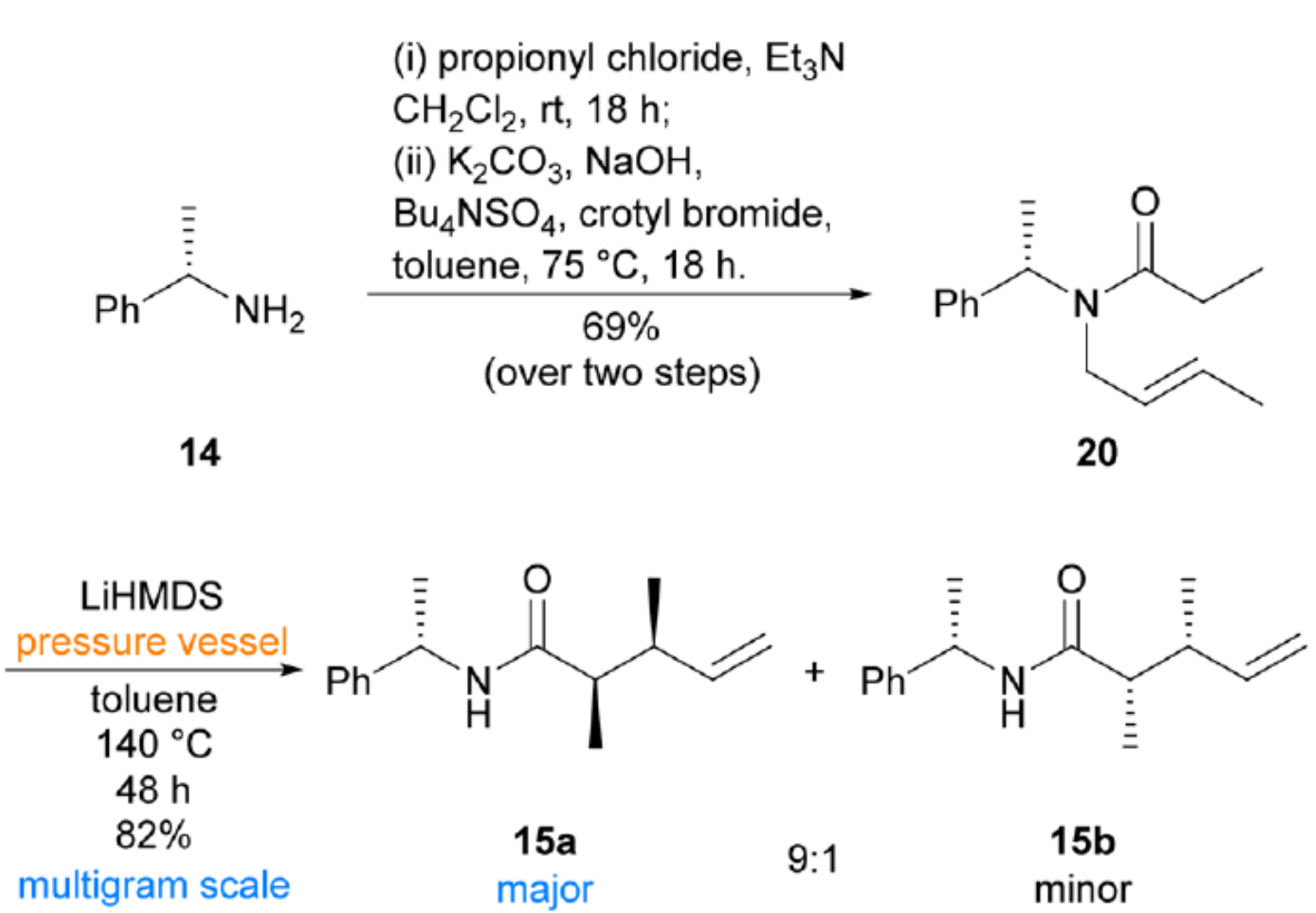
18
lactam dienophile

19
bromodiene

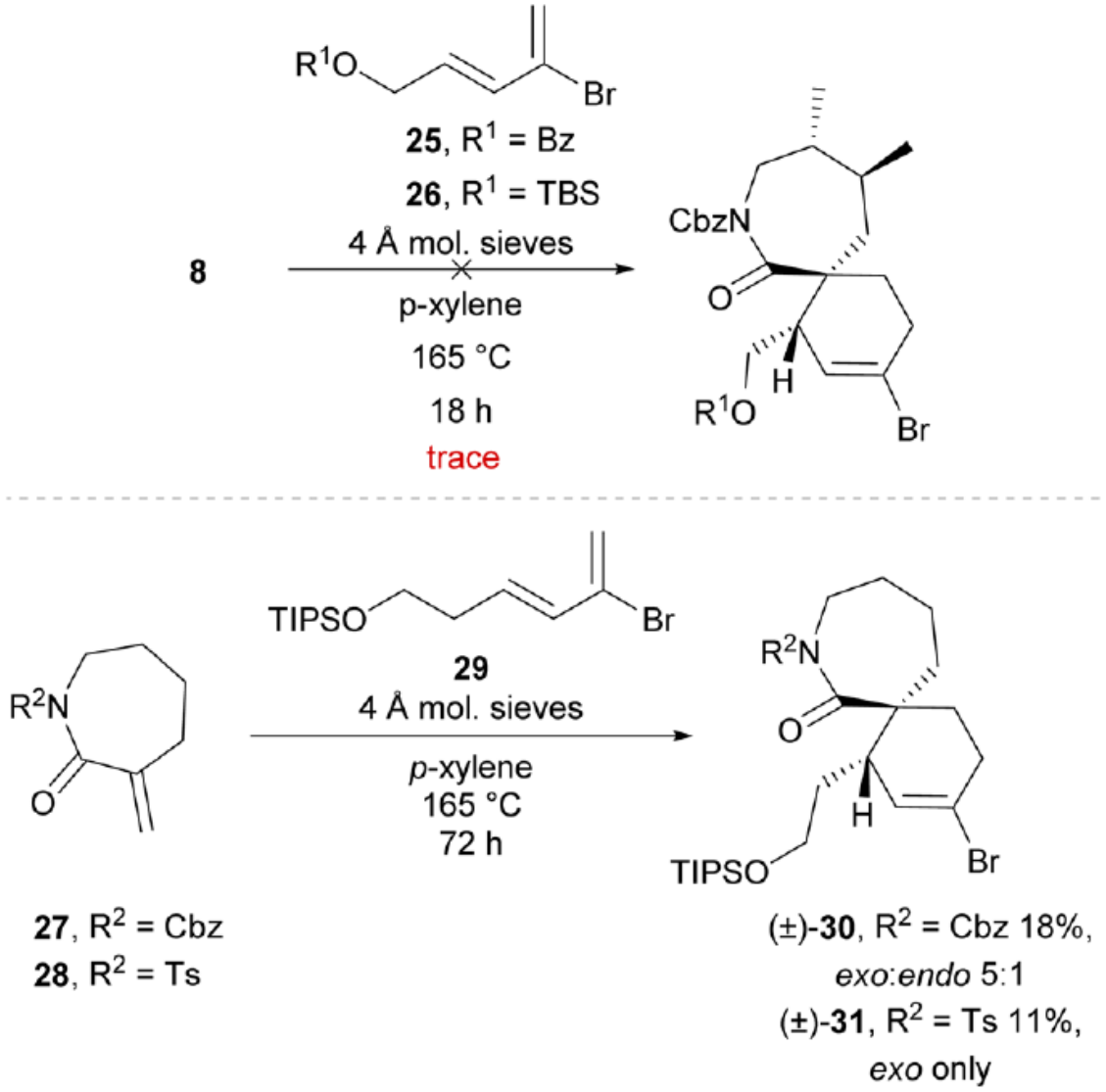


15a
vicinal dimethyl intermediate

20
aza-Claisen precursor

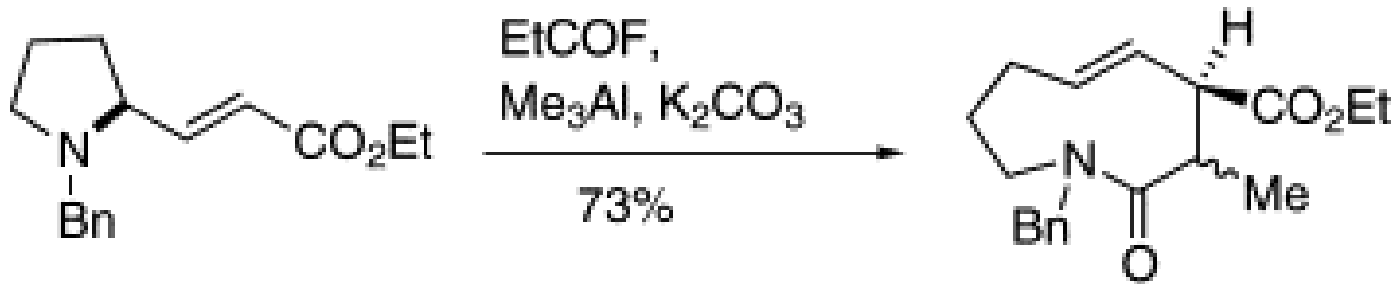


Scheme 3 Construction of the *syn*-dimethyl moiety of amide **15a** using an aza-Claisen rearrangement.



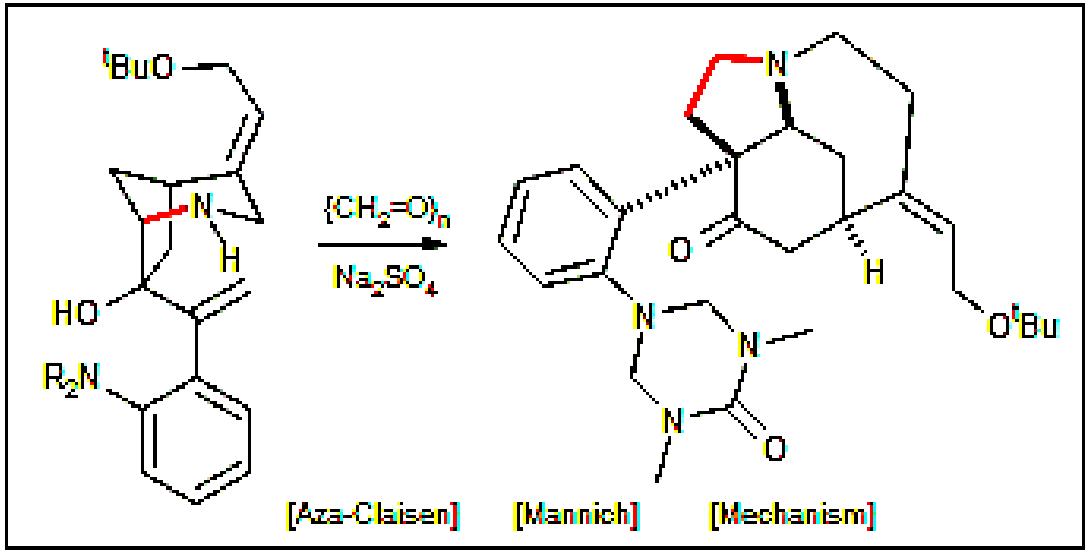
Scheme 5 Diels–Alder cycloadditions of α-*exo*-methylene lactams with bromodienes.

Synthesis: Carbon With No Attached Heteroatoms
M.T. Molina, J.L. Marco-Contelles,
in Comprehensive Organic Functional Group Transformations II, **2005**



6:1 dr

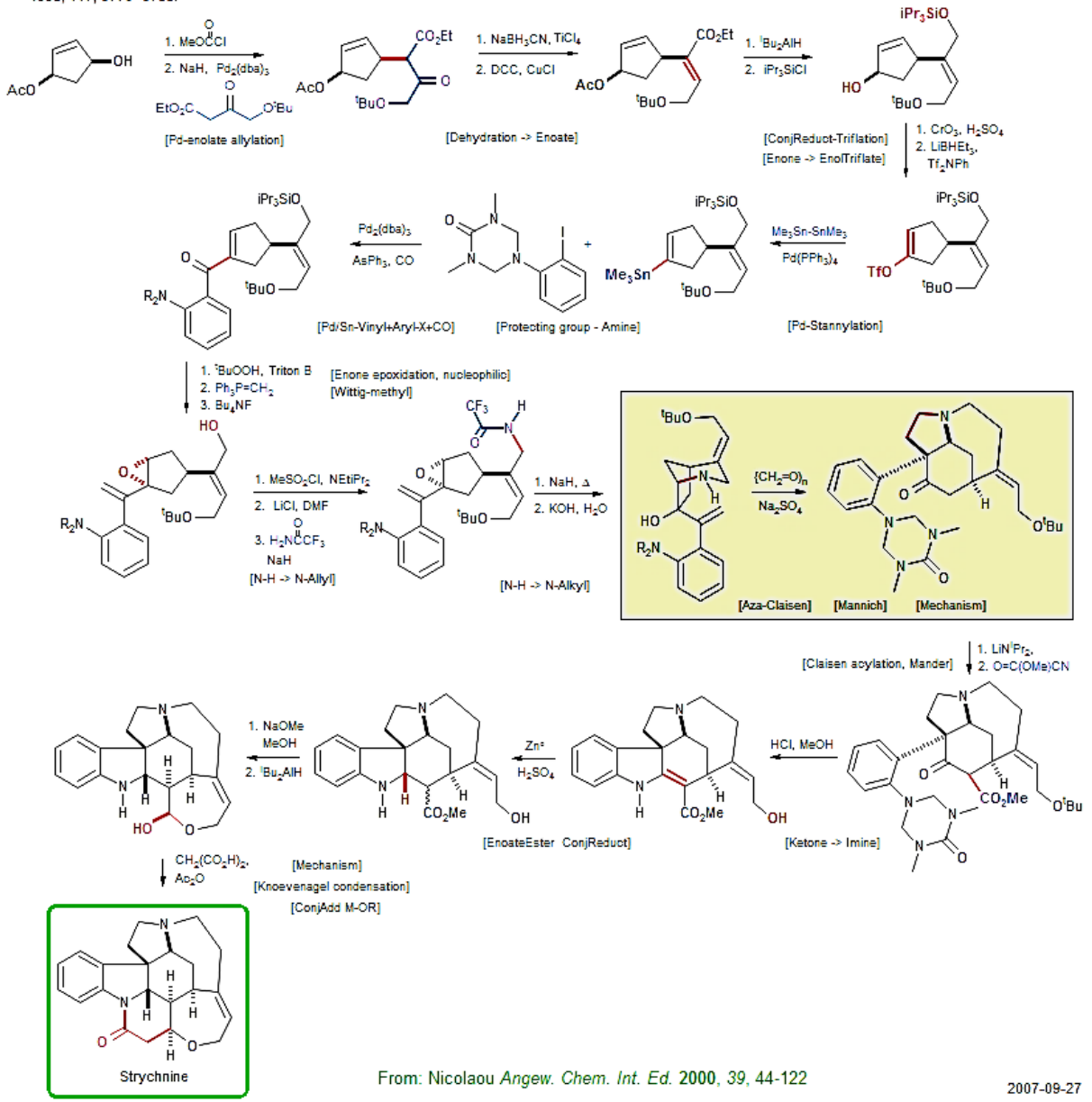
Rearreglo aza-Claisen



Strychnine

93-05

Knight, S. D.; Overman, L. E.; Pairaudeau, G. *J. Am. Chem. Soc.* **1993**, *115*, 9293-9294; ; Knight, S. D.; Overman, L. E.; Pairaudeau, G. *J. Am. Chem. Soc.* **1995**, *117*, 5776- 5788.

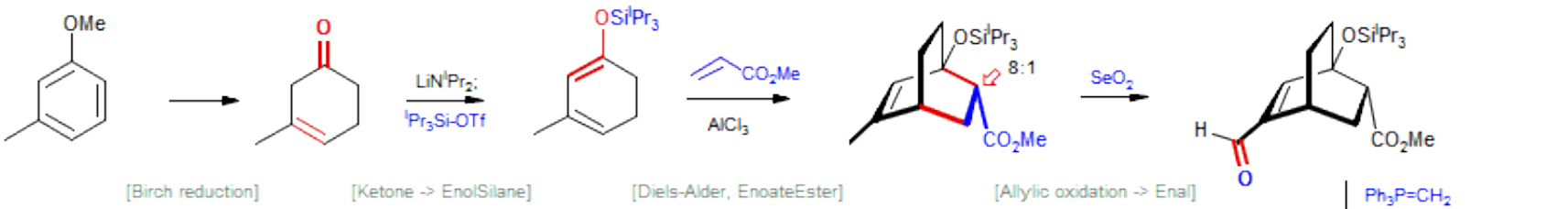


From: Nicolaou *Angew. Chem. Int. Ed.* **2000**, *39*, 44-122

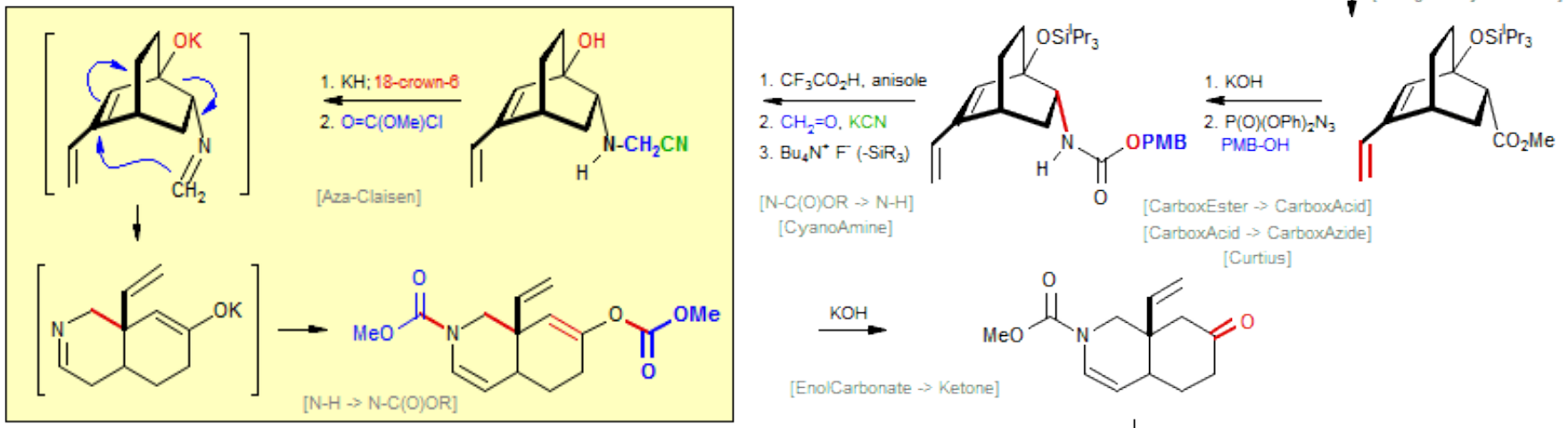
2007-09-27

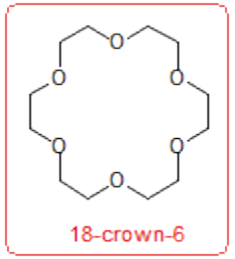
Gelsemine (Part 1) (Overman)

Earley, W. G.; Jacobsen, J. E.; Madin, A.; Meier, J. P.; O'Donnell, C. J.; Oh, T.; Old, D. W.; Overman, L. E.; Sharp, M. J. *J. Am. Chem. Soc.* **2005**, *1127*, 18046.



$Ph_3P=CH_2$
[Wittig-methyl -> Diene]



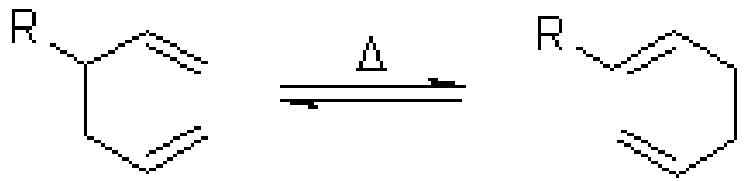


2009-02-09

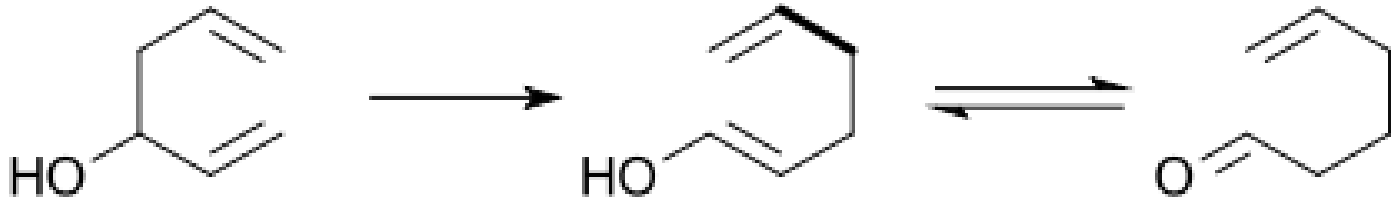
REARREGLO DE COPE

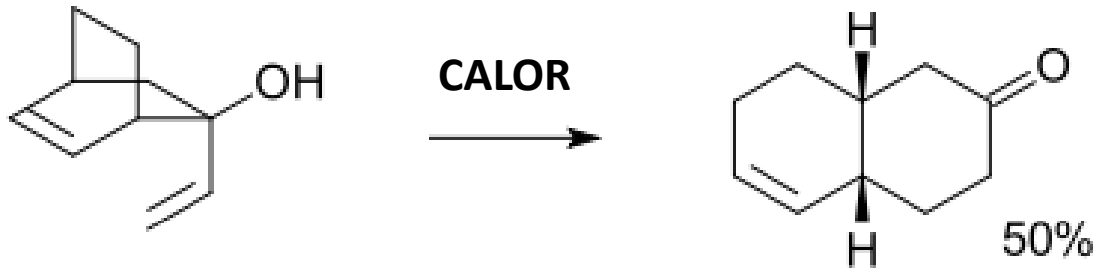
Arthur Clay Cope
(1909 - 1966)

Cope



Oxi-Cope

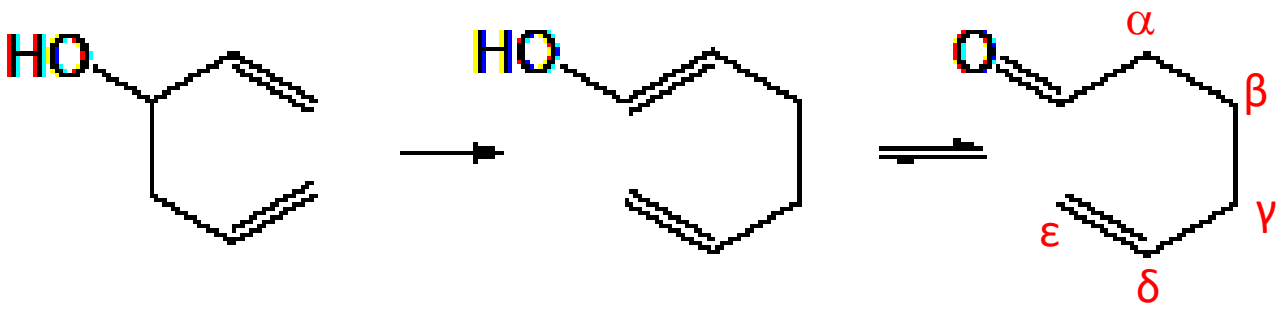


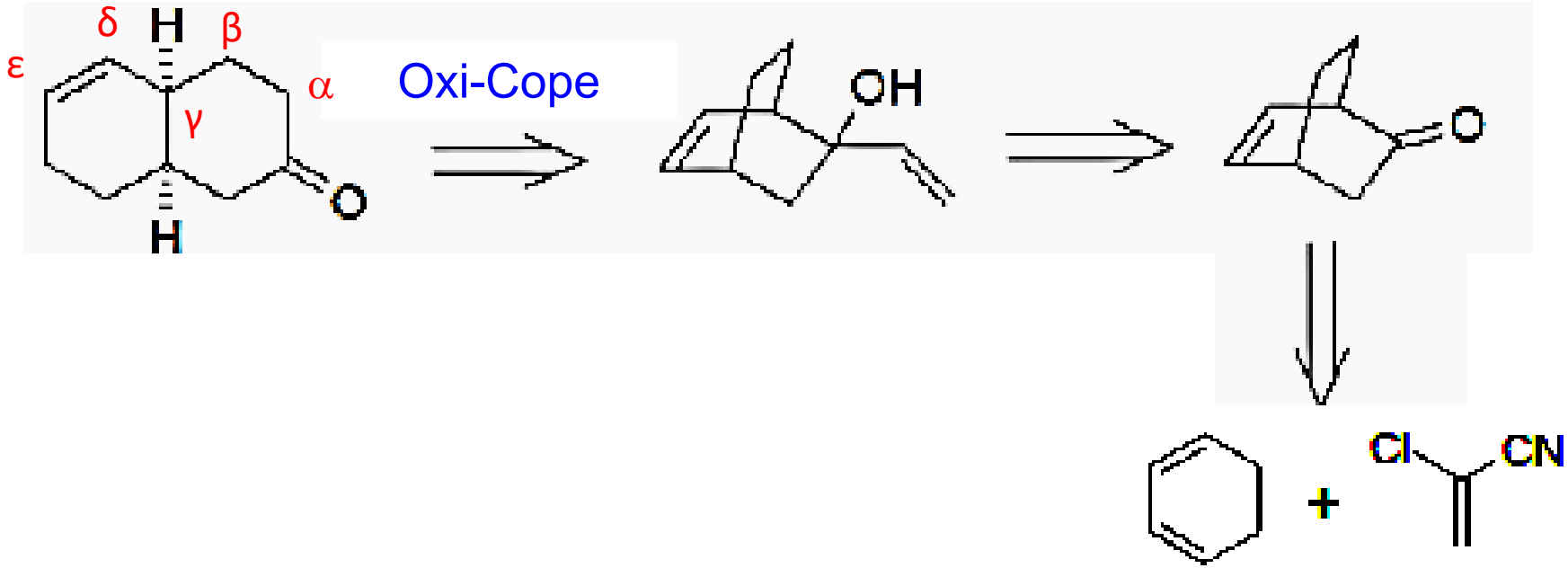


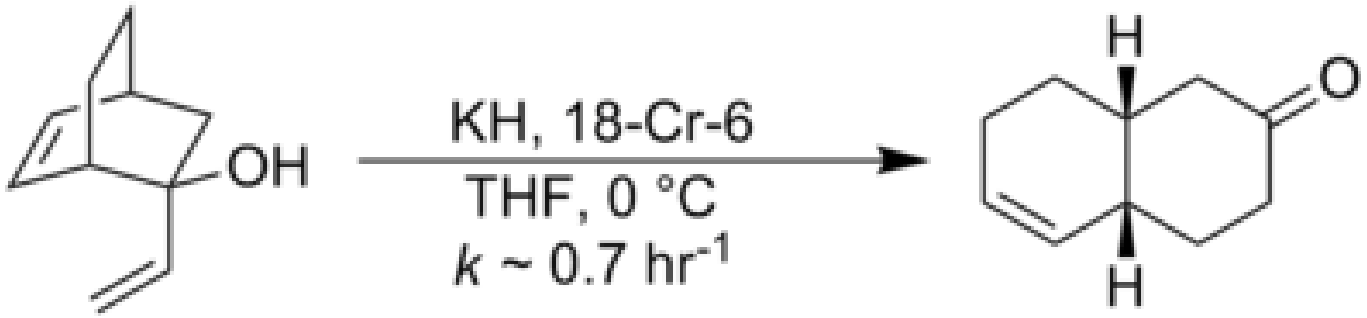
CLASE DEL 27-05-2021

J. Am. Chem. Soc. **1964,** 86(22); 5017 – 5018
J. Am. Chem. Soc. **1964**; 86(22); 5019–5020

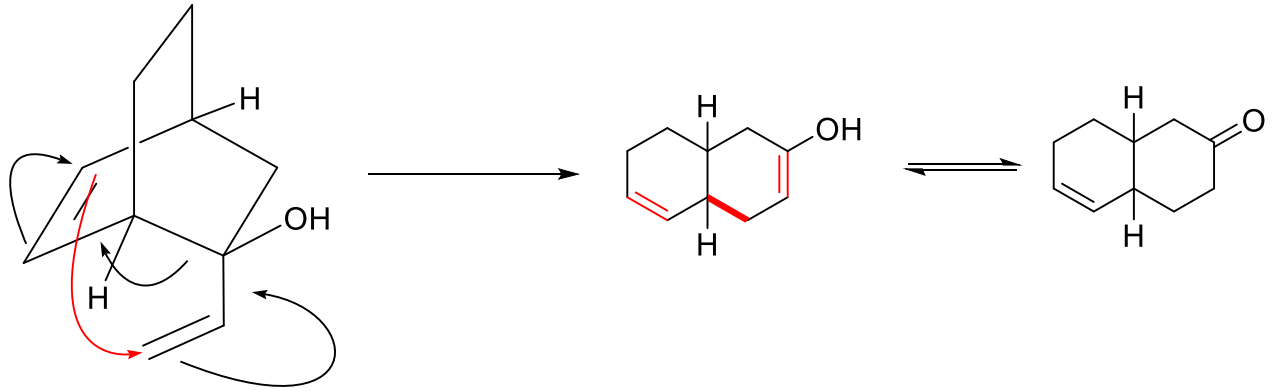
Oxi-Cope





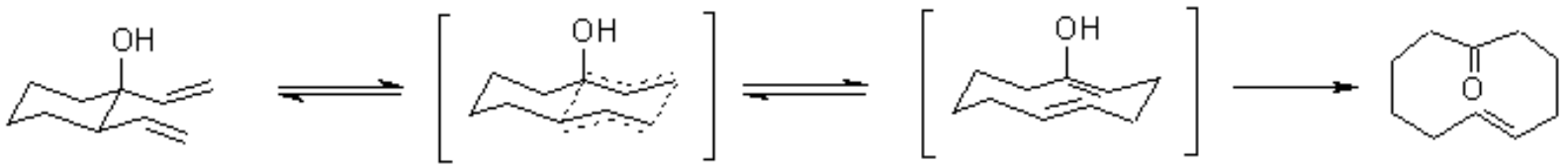


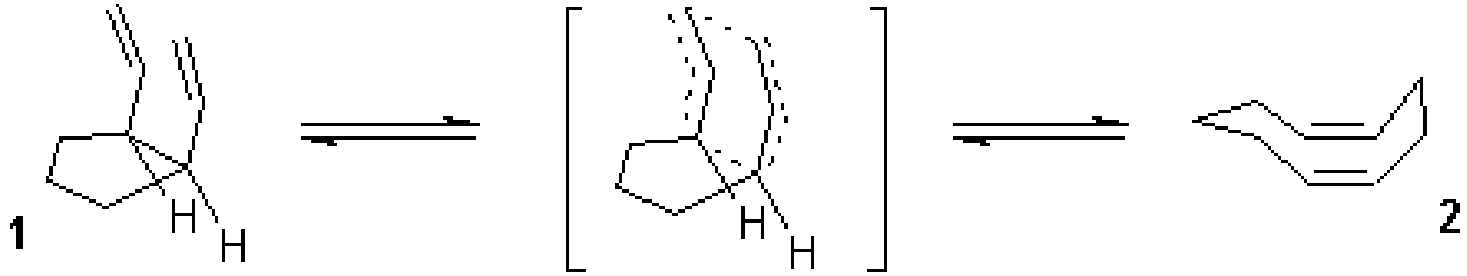
Mecanismo

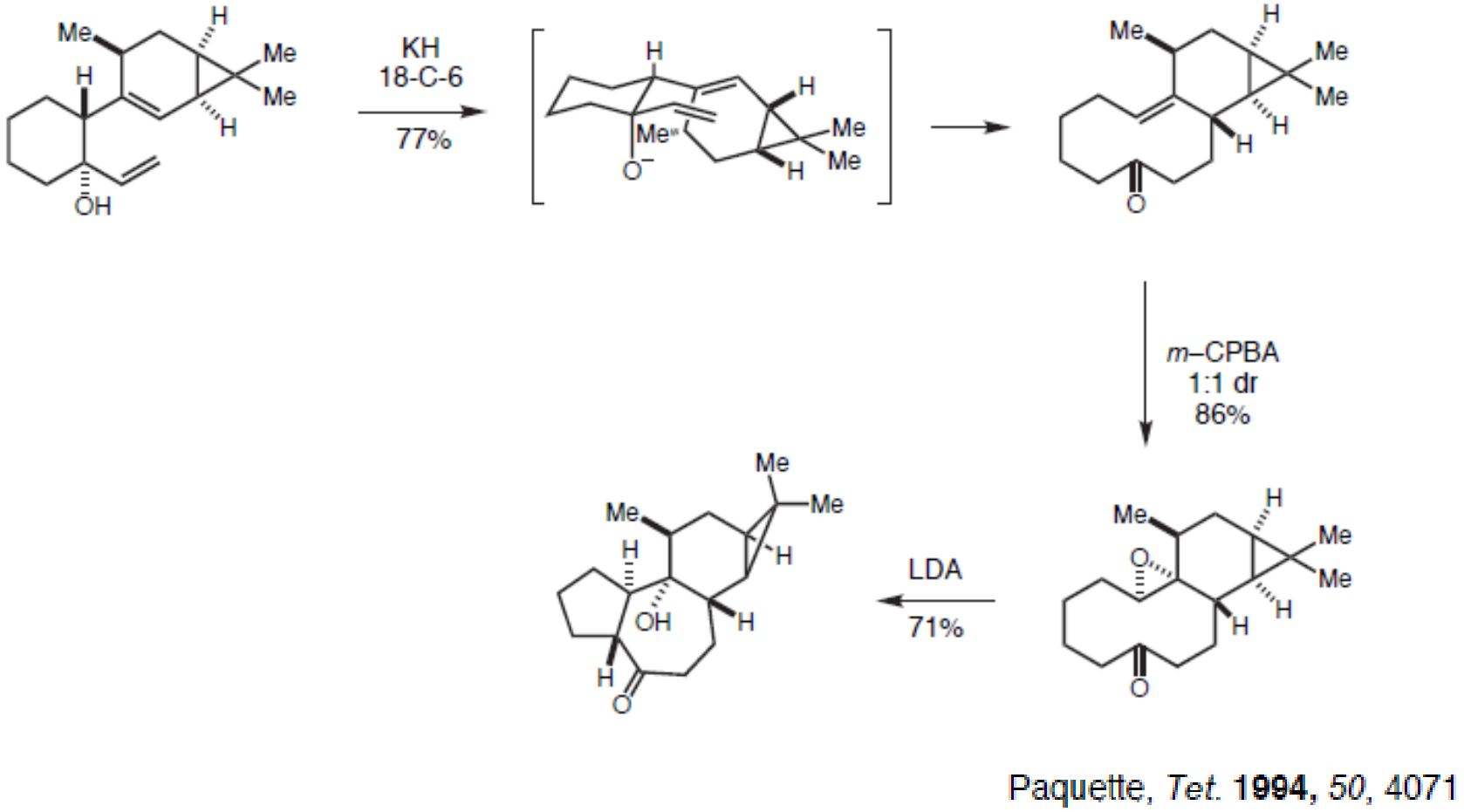


Evans, D.A.; Golob, A.M. *J. Am. Chem. Soc.* **1975**, *97*, 4765–4766

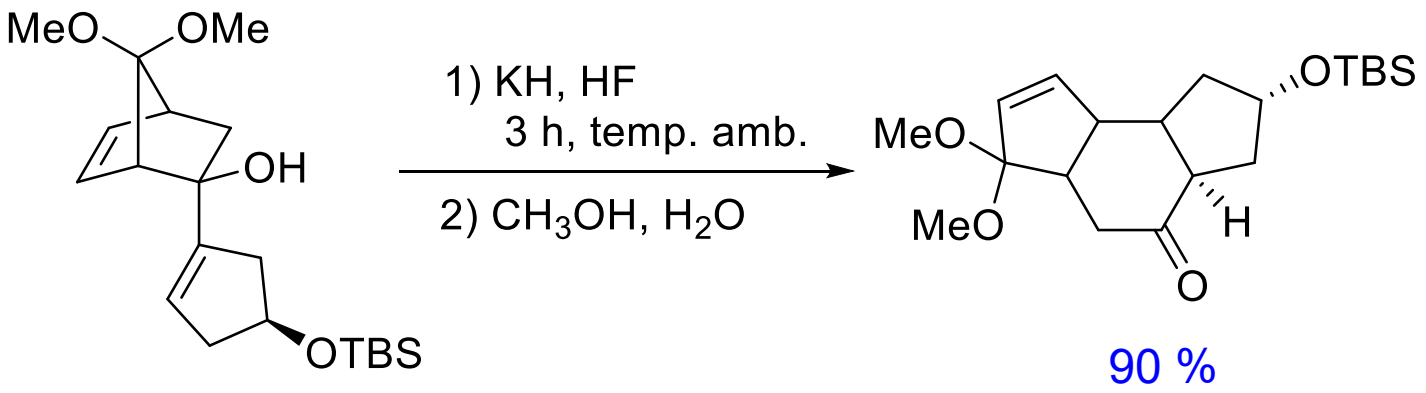
Dos estados de transición son posibles y el resultado de la reacción se puede predecir sobre la base de la superposición más favorable de los orbitales del doble enlace, la cuales influenciada por factores estereoelectrónicos :





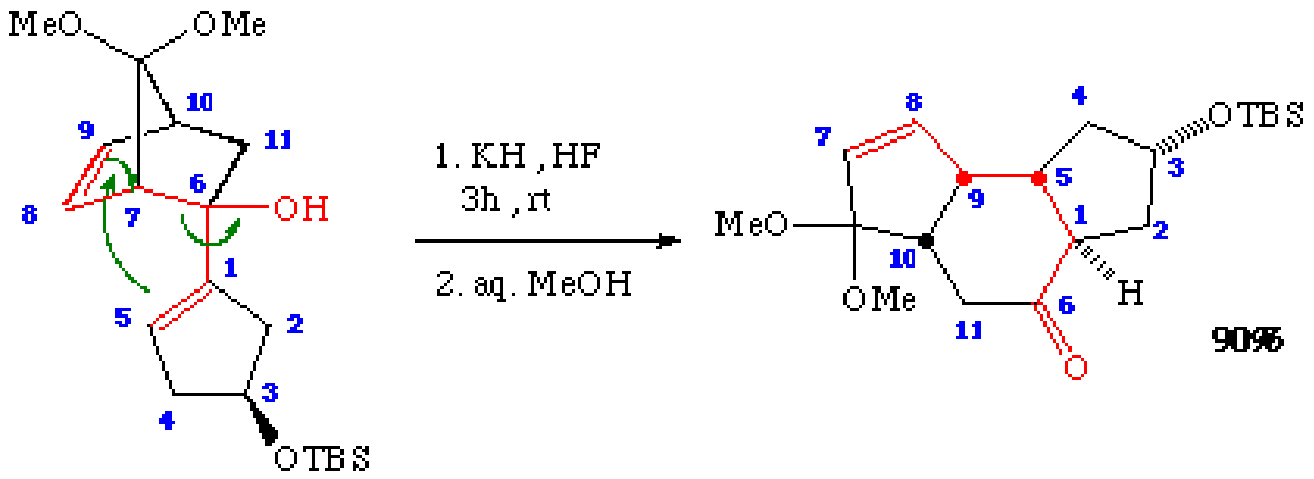


Paquette, *Tet.* **1994**, *50*, 4071

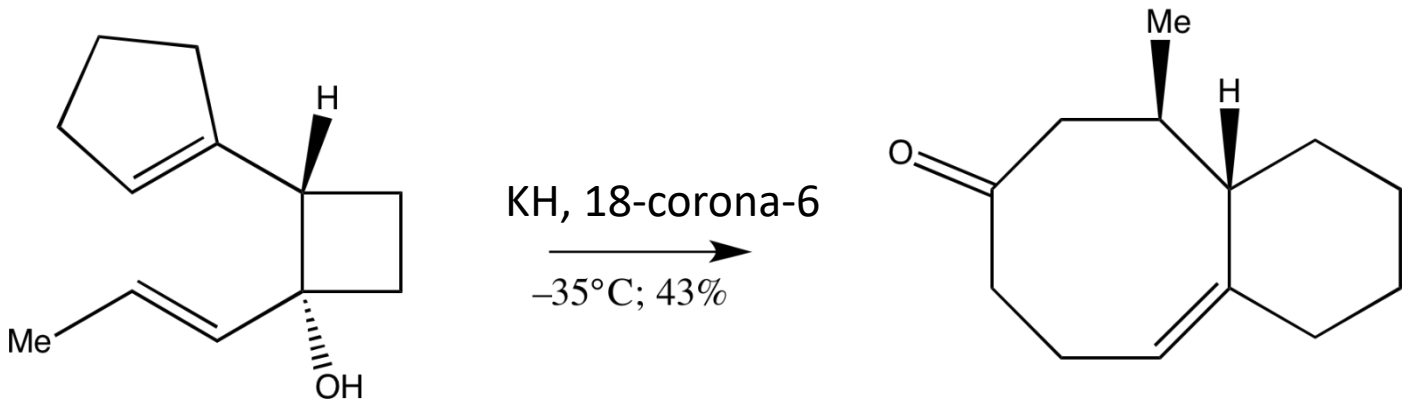


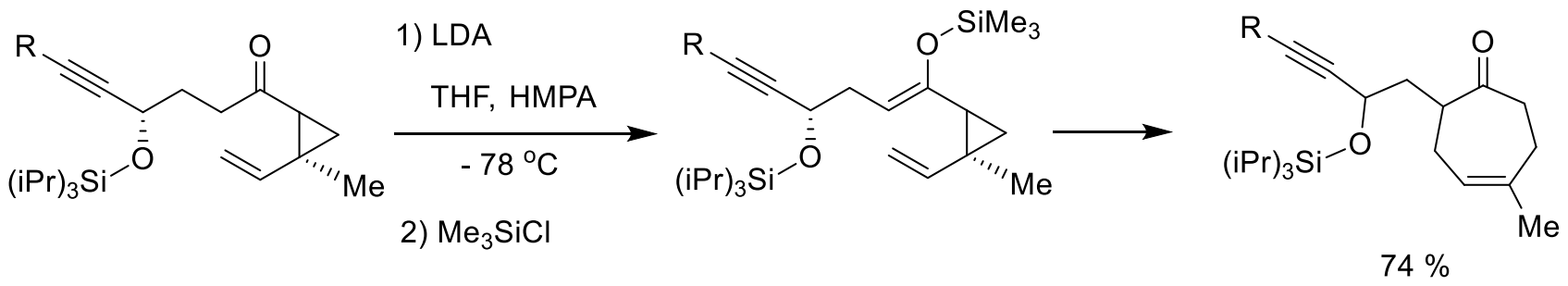
90 %

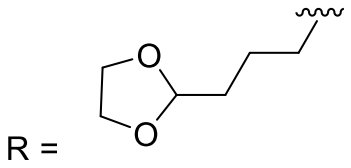
Mecanismo

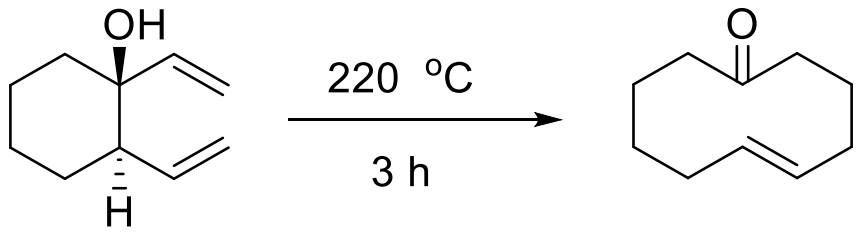


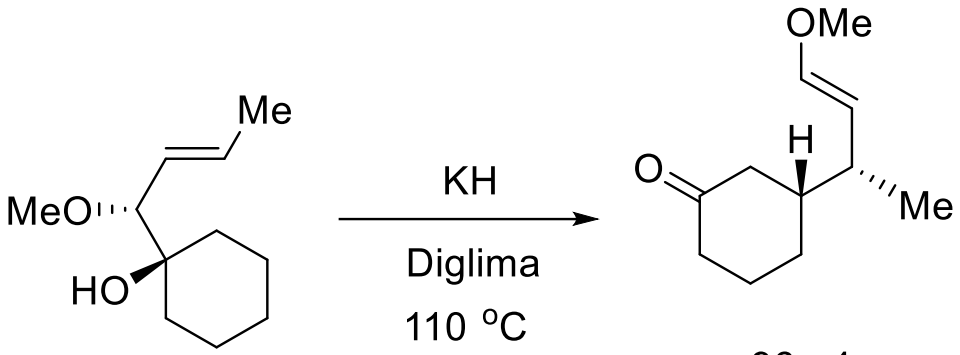
Paquette, L.A.;* Gao, Z.; Ni, Z.; Smith, G.F. *J. Am. Chem. Soc.*, **1998**, *120*, 2543-2552.


H
Me
OH
KH, 18-corona-6
–35°C; 43%
Me
H
O


R
O
(iPr)3Si
O
Me
1) LDA
THF, HMPA
- 78 °C
2) Me3SiCl
SiMe3
74 %

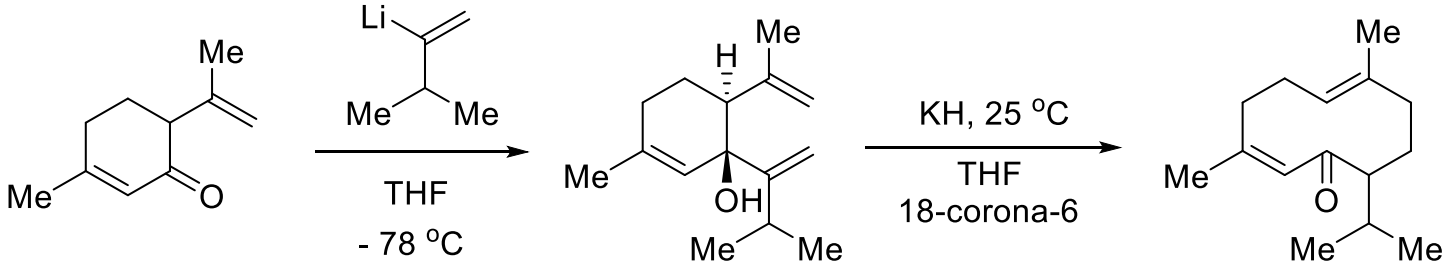

R =
O
O


OH
H
220 °C
3 h
O


Me
MeO
HO
KH
Diglima
110 °C
OMe
H
O
Me

96 : 4

77 %

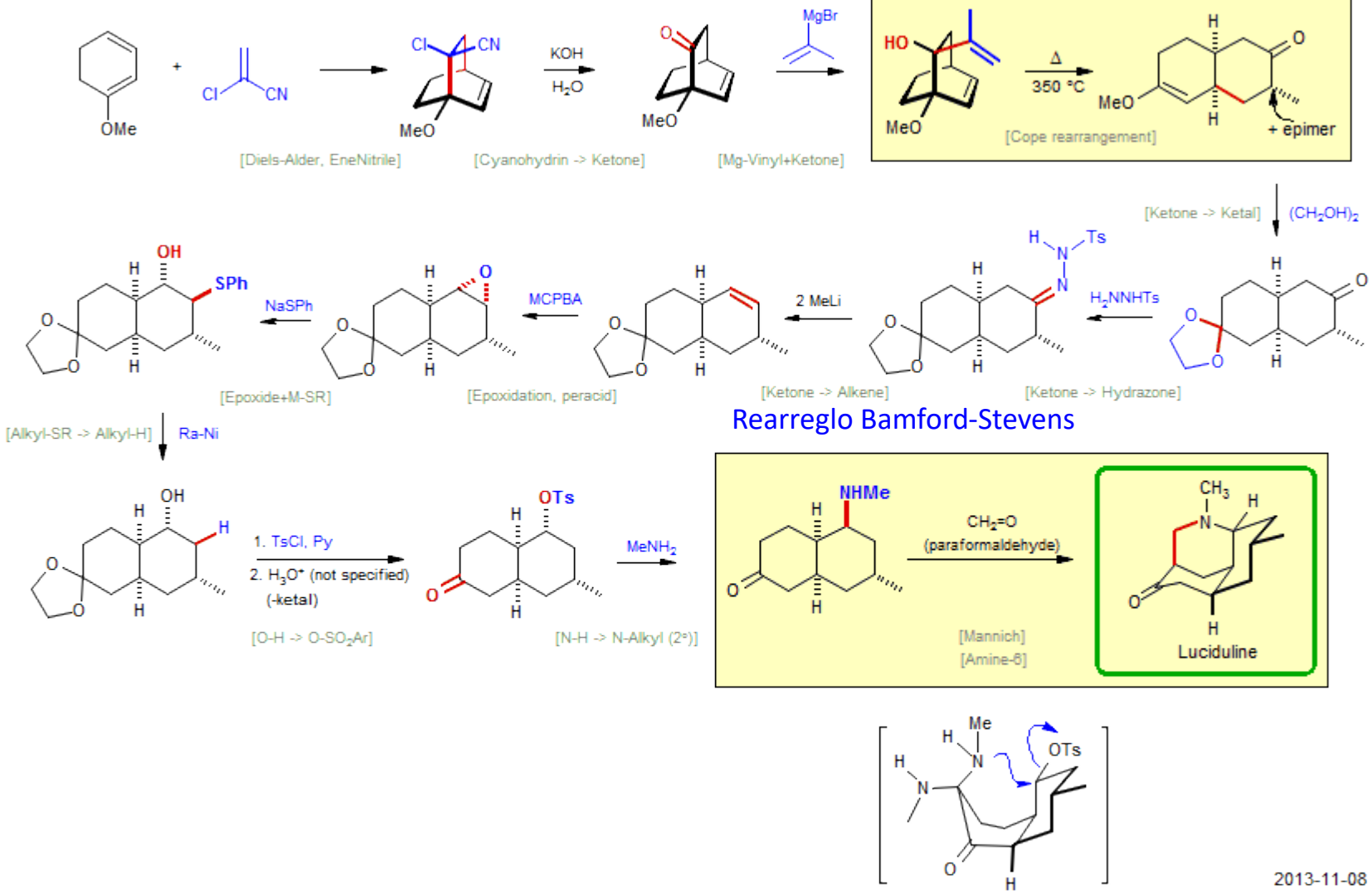

Me
Me
O
Li
Me
Me
THF
- 78 °C
Me
H
Me
OH
Me
Me
KH, 25 °C
THF
18-corona-6
Me
Me
O
Me
Me

73 %

Luciduline (Evans)

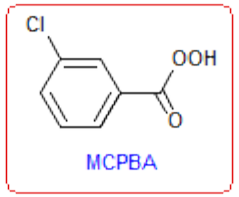
72-16

Scott, W. I.; Evans, D. A. *J. Am. Chem. Soc.* **1972**, *94*, 4779-4780.

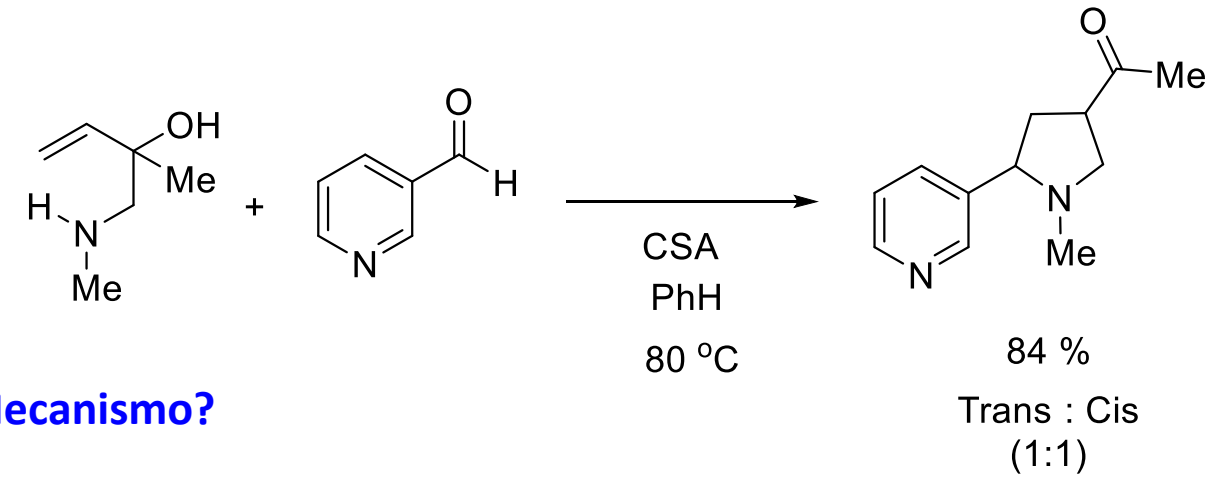


Rearreglo Bamford-Stevens

2013-11-08



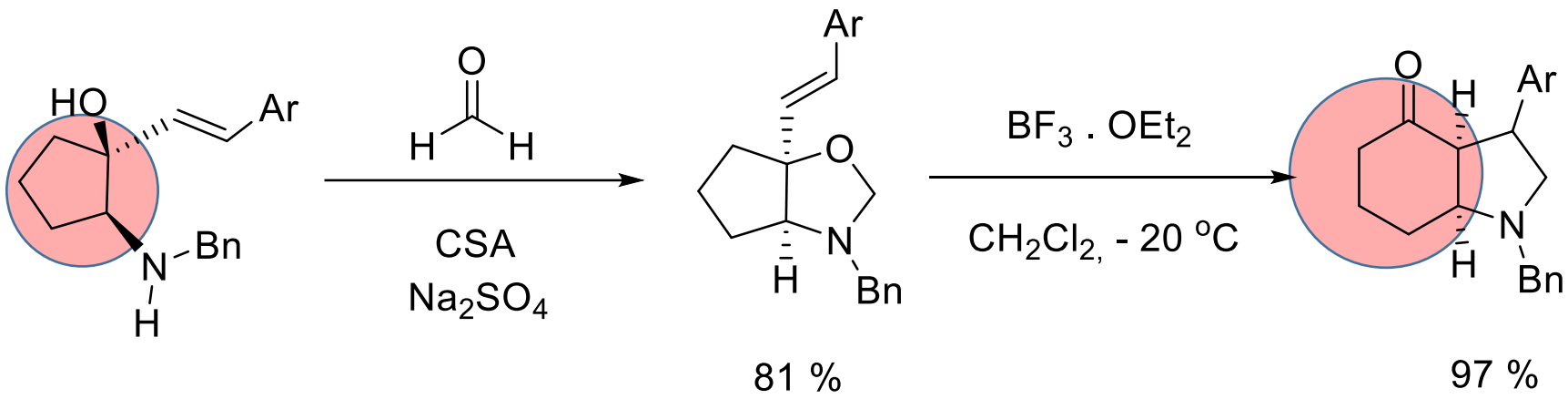
Aza Cope

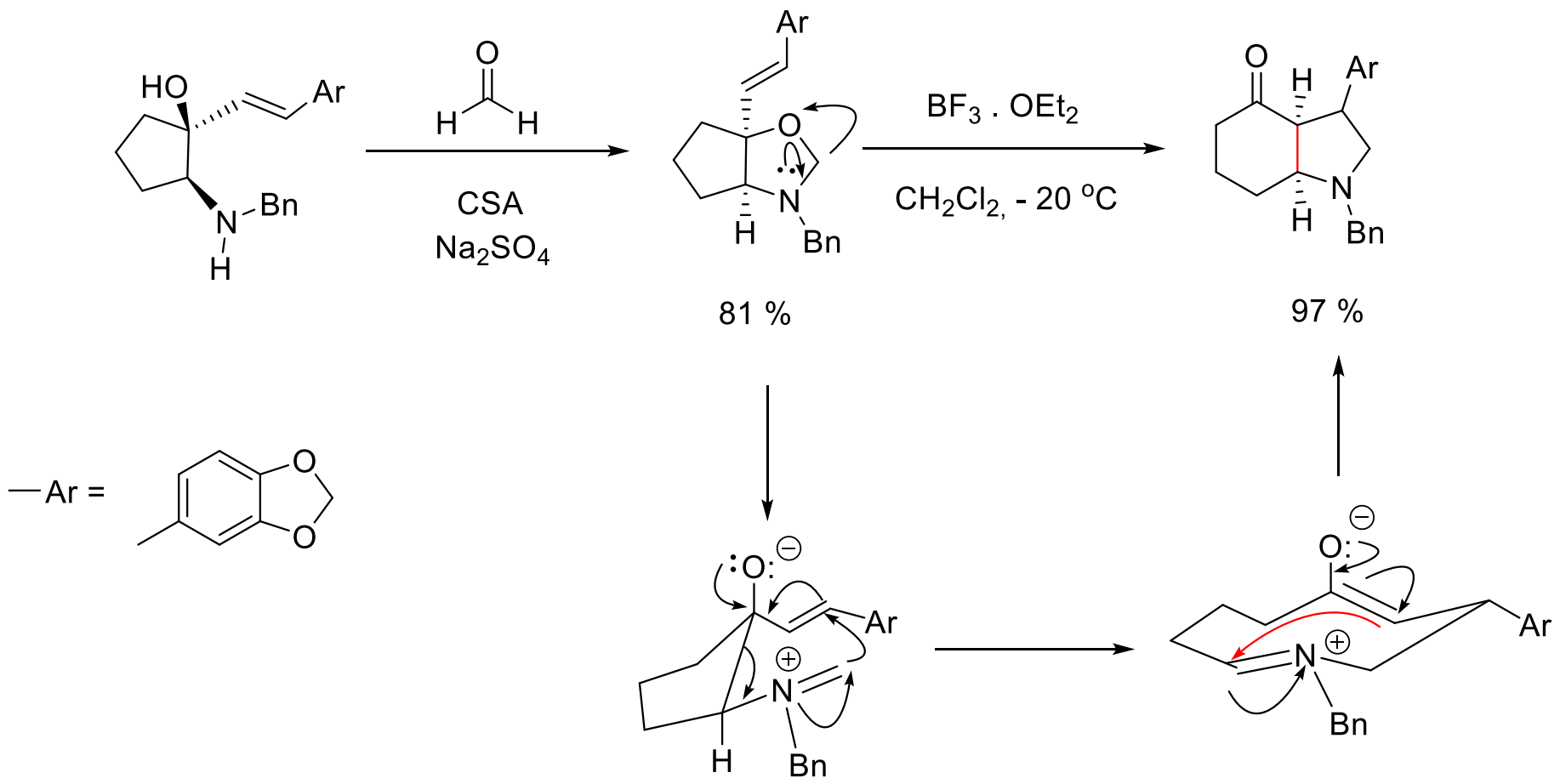


84 %

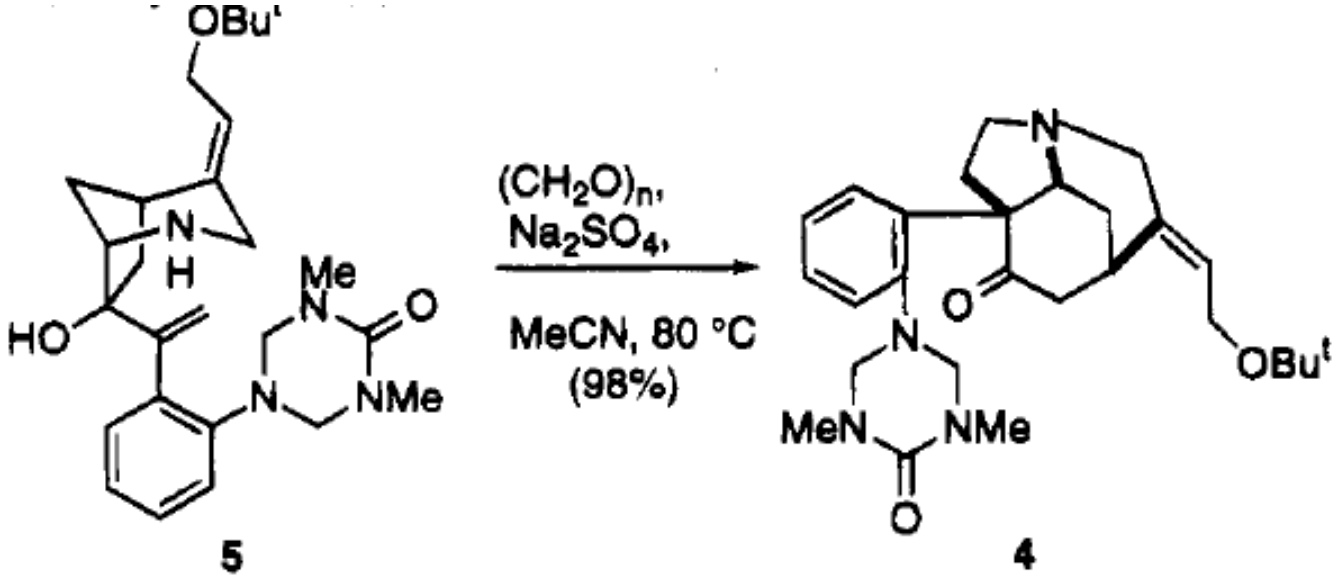
Trans : Cis
(1:1)

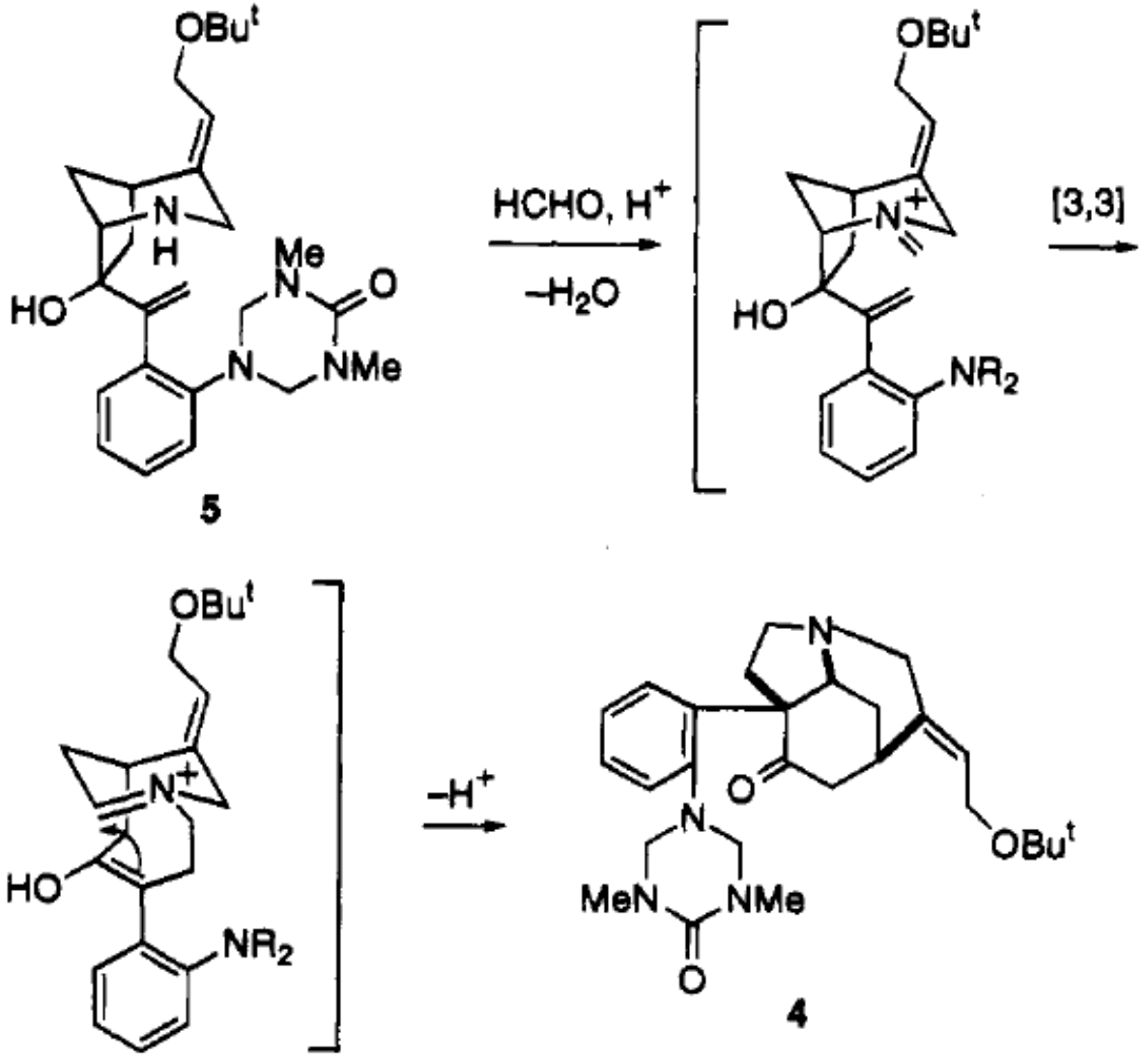
¿Mecanismo?


HO
Ar
N
Bn
H
O
H
H
CSA
Na2SO4
Ar
O
N
H
Bn
81 %
BF3 . OEt2
CH2Cl2, - 20 °C
O
H
Ar
N
H
Bn
97 %

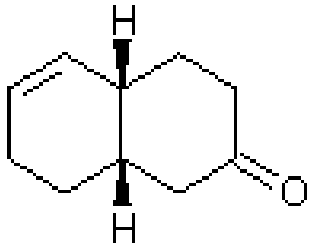

HO
Ar
N
Bn
H
O
H
H
CSA
Na2SO4
Ar
O
N
H
Bn
81 %
BF3 . OEt2
CH2Cl2, - 20 °C
O
H
Ar
N
H
Bn
97 %
—Ar =
O
O
:O:
Ar
N
H
Bn
:O:
Ar
N
Bn

AZA-COPE MANNICH

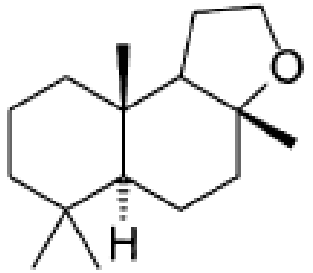



OBu^t
N
H
HO
Me
N
O
N
NMe
5
HCHO, H$^+$
–H$_2$O
OBu^t
N$^+$
HO
NR$_2$
[3,3]
OBu^t
N$^+$
HO
NR$_2$
–H$^+$
N
O
N
MeN
NMe
O
OBu^t
4

Ejemplo de una poderosa combinación táctica

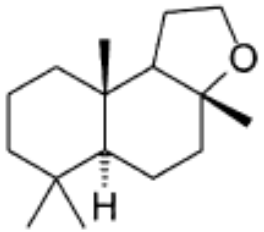


Productos naturales obtenidos por medio de la reacción de Oxi-Cope

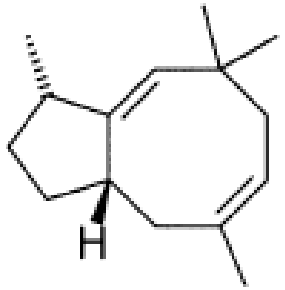


Éter tipo ambár gris

Maleczka, R. E.; Paquette, L. A. Adaptation of oxyanionic sigmatropy to the convergent enantioselective synthesis of ambergris-type odorants. *J. Org. Chem.* **1991**, *56*, 6538–6546.

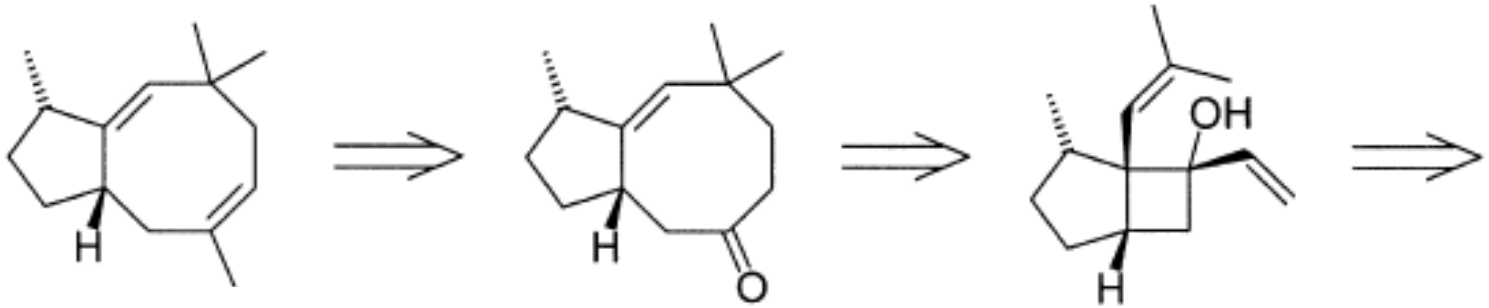


Introducción de grupos funcionales auxiliares (Retrón Oxi-Cope)

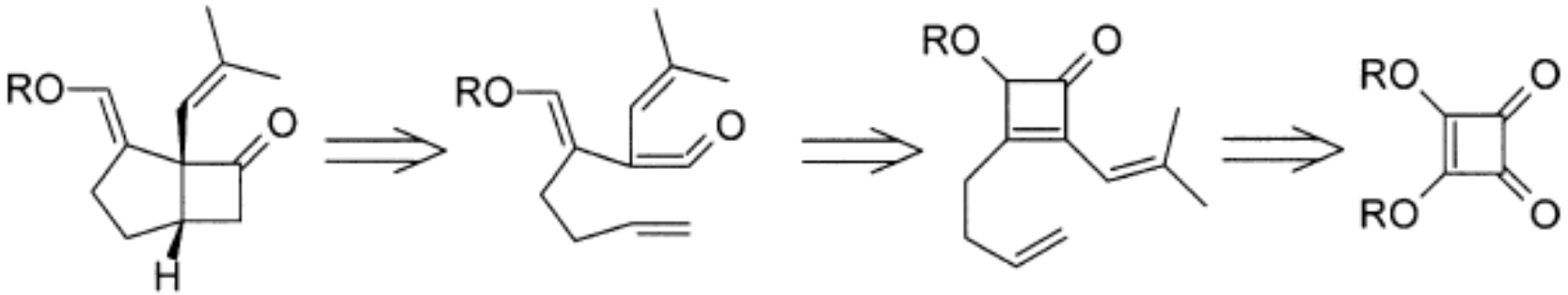


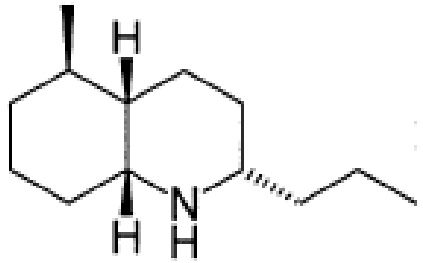
Precapneladieno

MacDougall, J. M.; Santora, V. J.; Verma, S. K Turnbull, P.; Hernandez, C. R.; Moore, H. W. Cyclobutenone-based syntheses of polyquinanes and bicyclo[6.3.0]undecanes by tandem anionic oxy-Cope reactions. Total synthesis of (±)-precapnelladiene. *J. Org. Chem.* 1998, *63*, 6905–6913.

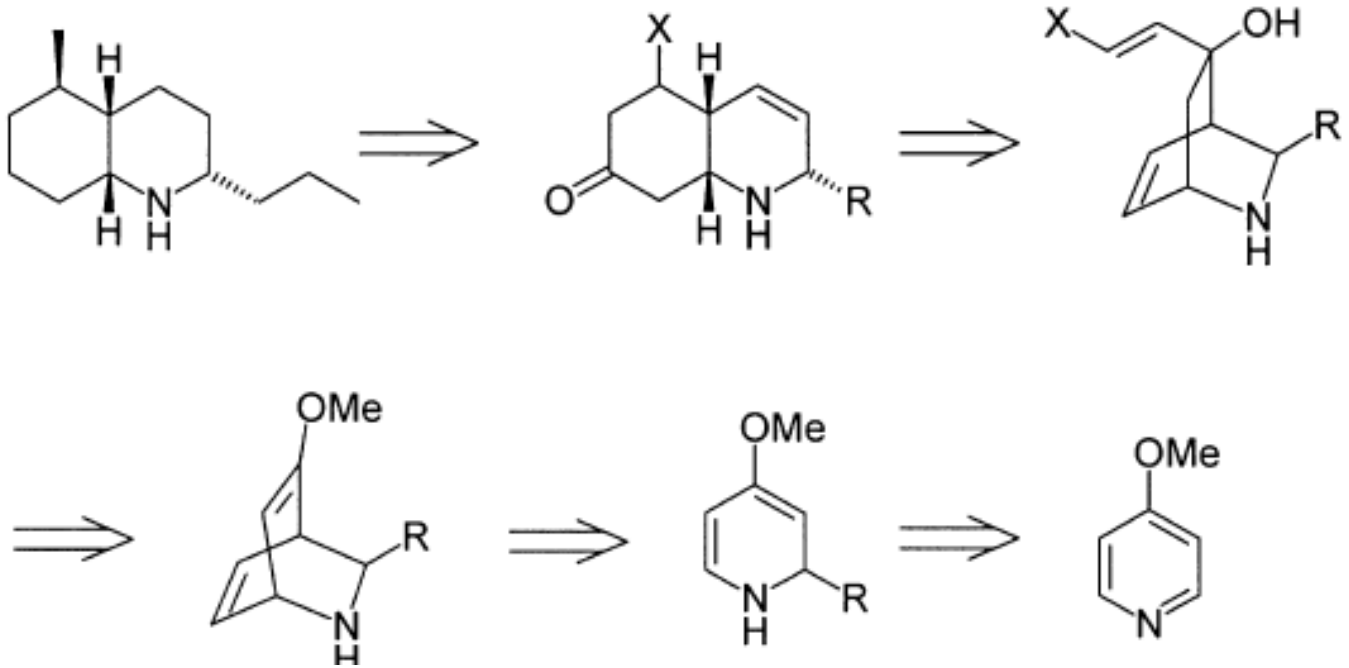


Precapneladieno



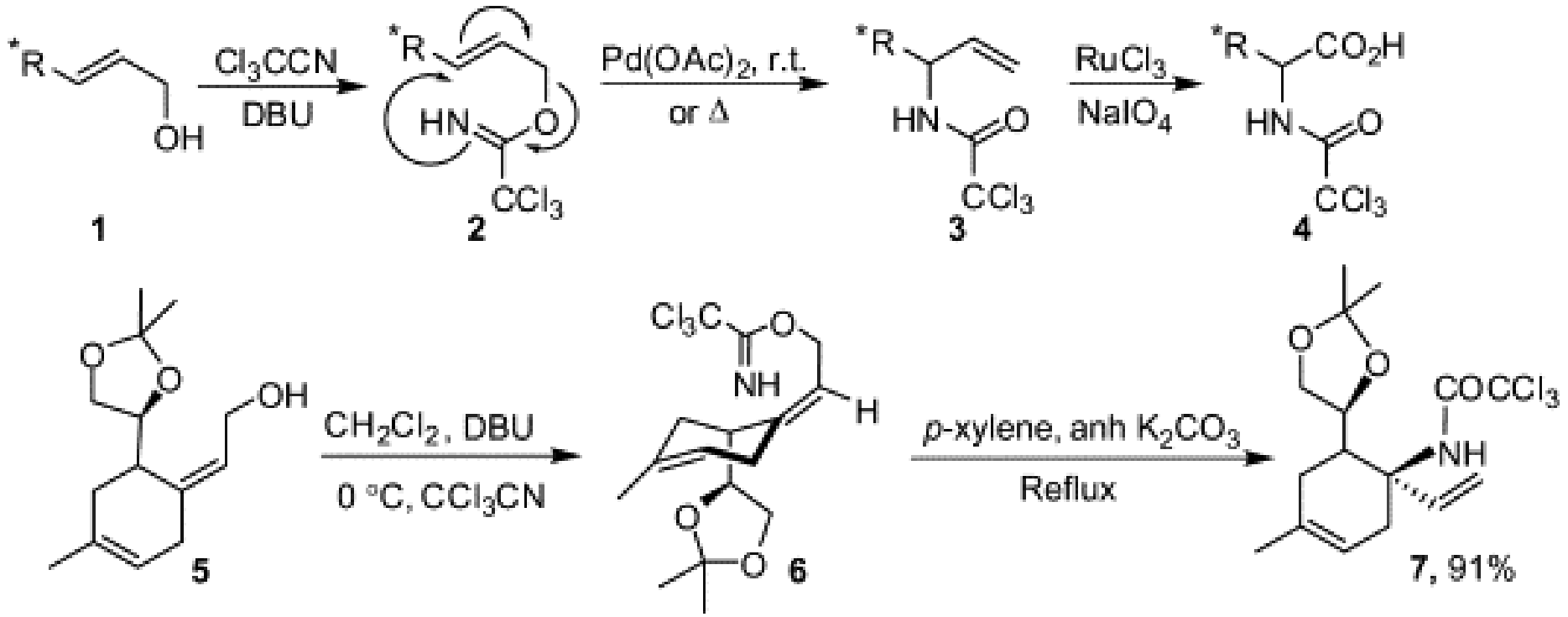


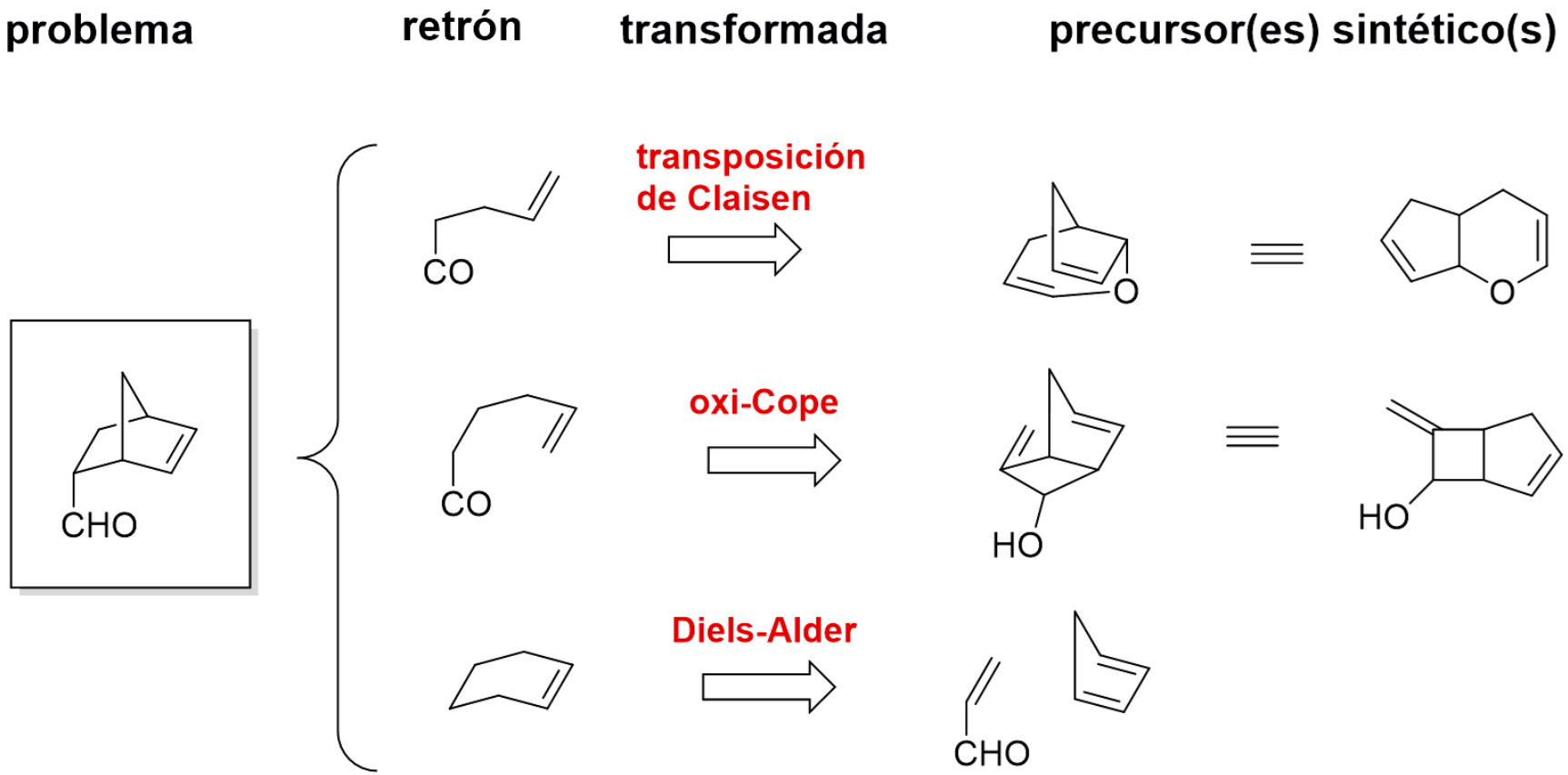
Polniaszek, R. P.; Dillard, L. W. Stereospecific total synthesis of decahydroquinoline alkaloid (±)-195A and (±)-2-*epi*-195A. *J. Org. Chem.* 1992, *57*, 4103–4110.



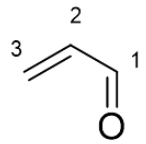
O'DONNELL Amino Acid Synthesis to Oxy-COPE Hydroxydiene Rearrangement

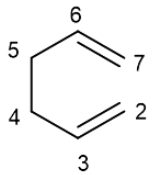
A. Hassner, I. Namboothiri, in Organic Syntheses Based on Name Reactions (Third Edition), 2012

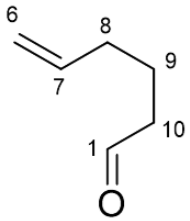



problema
retrón
transformada
precursor(es) sintético(s)
CHO
CO
transposición
de Claisen
O
O
CO
oxi-Cope
HO
HO
Diels-Alder
CHO

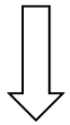
retrones identificados



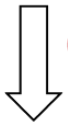




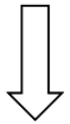
transformadas



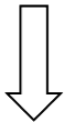
Hörner-Emmons



Cope

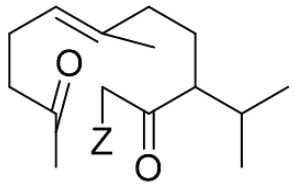


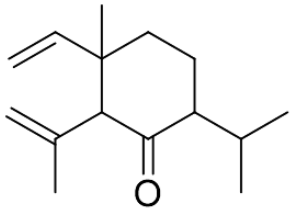
metátesis

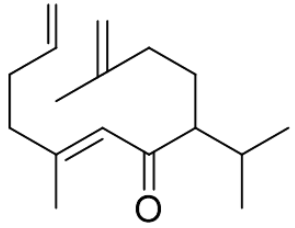


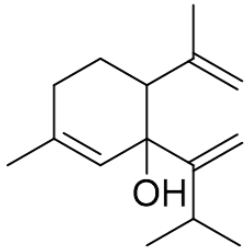
oxi-Cope

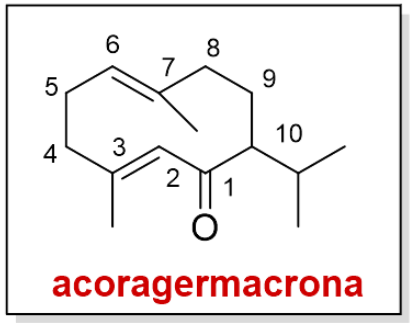
precursores sintéticos

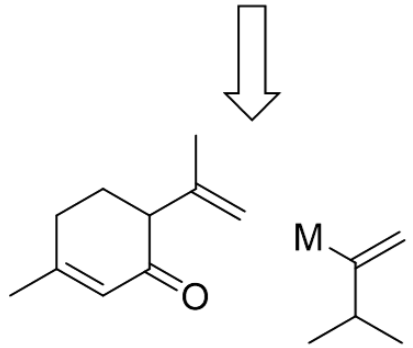


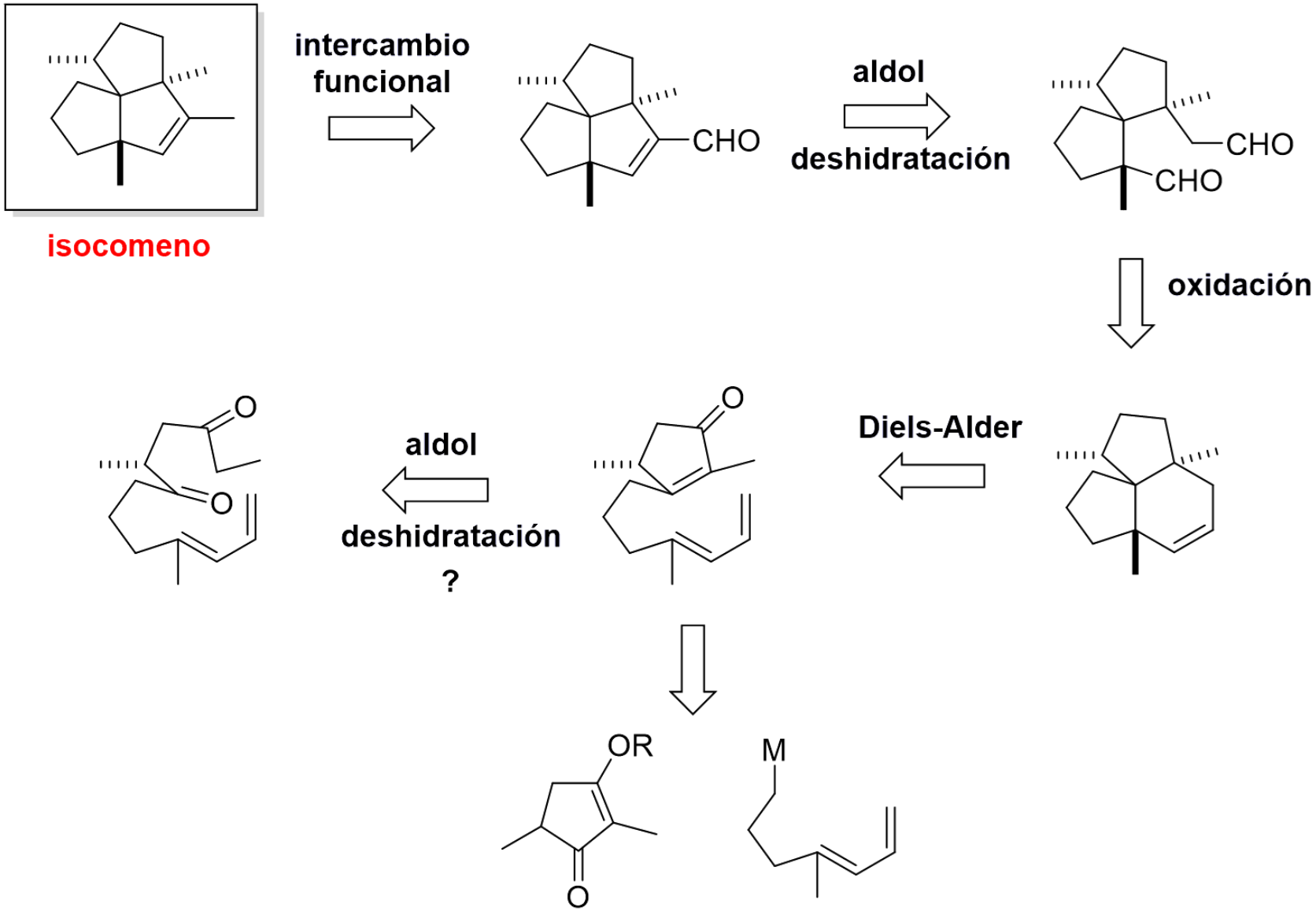






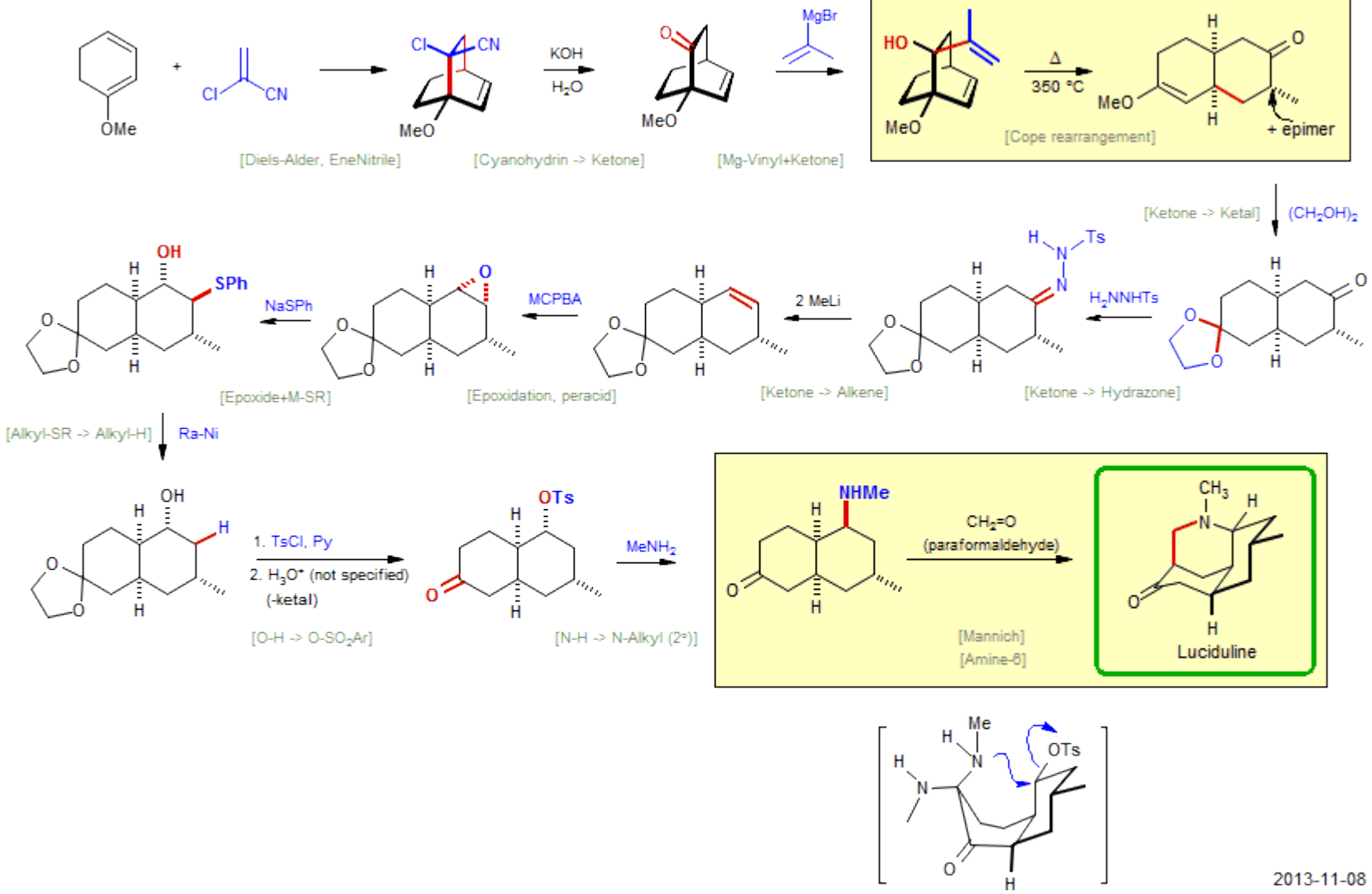


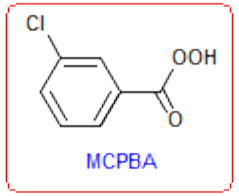



isocomeno
intercambio
funcional
CHO
aldol
deshidratación
CHO
CHO
oxidación
Diels-Alder
aldol
deshidratación
?
O
O
O
OR
O
M

Luciduline (Evans)

Scott, W. I.; Evans, D. A. *J. Am. Chem. Soc.* **1972**, *94*, 4779-4780.

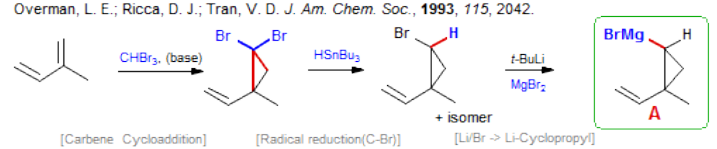




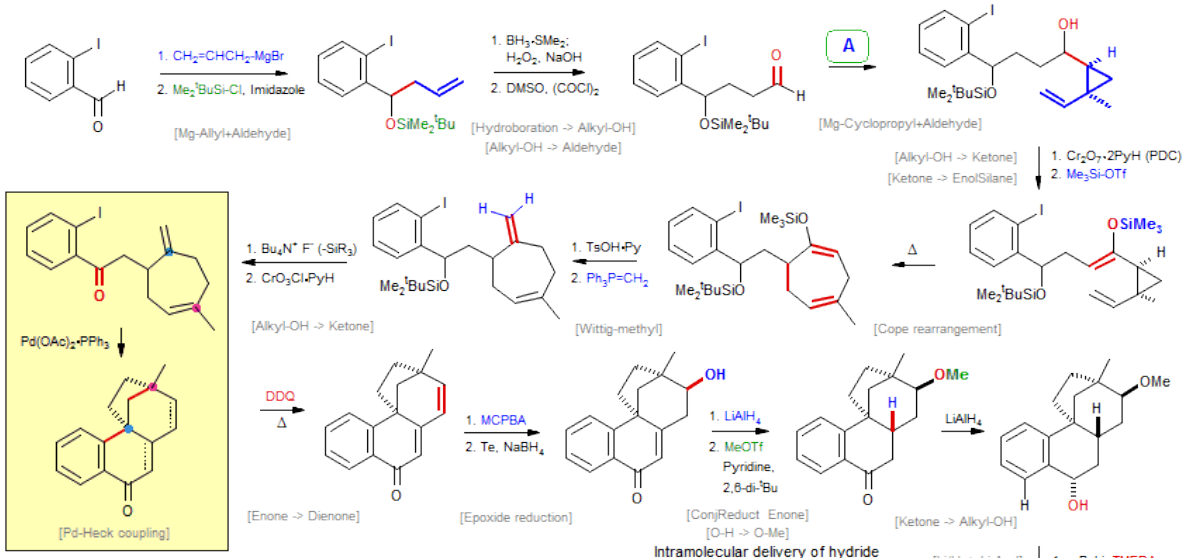
Scopadulcic Acid B

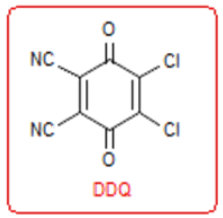
93-07

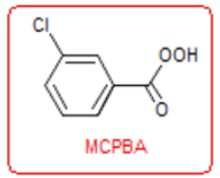
Overman, L. E.; Ricca, D. J.; Tran, V. D. *J. Am. Chem. Soc.*, **1993**, *115*, 2042.

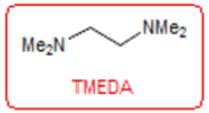


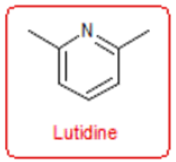
The cyclopropyllithium reagent cannot be used directly because of competing Li/I exchange.











Georg Wittig
(1897 – 1987)
Químico alemán

Compartió el Premio Nobel de Química con Herbert C. Brown en 1979

The [2,3]-Wittig Rearrangement

[2,3]-Wittig Sigmatropic Rearrangements in Organic Synthesis
Nakai, *Chem. Rev*. **1986**, *86*, 885-902.

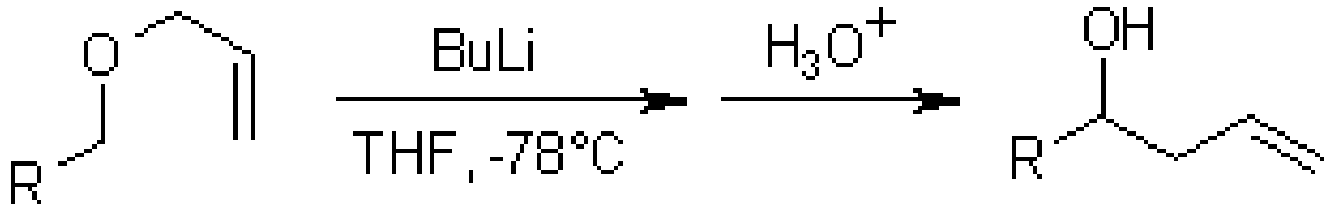
Acyclic Stereocontrol via [2,3]-Wittig Sigmatropic Rearrangement,
Mikami, K.; Nakai, T. *Synthesis* **1991**, 594.

The [2,3]-Wittig Reaction,
Nakai, T.; Mikami, K. *Org. React*. **1995**, *46*, 105-210.

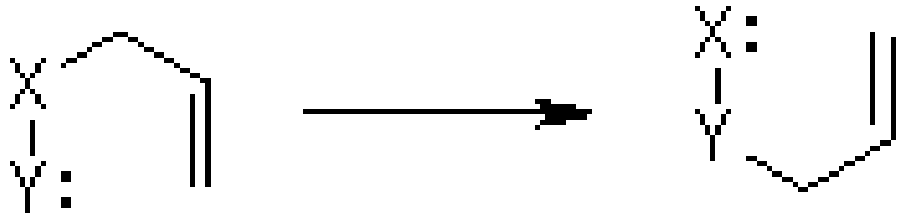
Asymmetric [2,3]-Wittig Rearrangement as a General Tool for Asymmetric Synthesis,
Nakai, T.; Tomooka, K. *Pure Appl. Chem*. **1997**, *69*, 595-600.

The Aza-Wittig Rearrangement,
Vogel, C. *Synthesis* **1997**, 497-505.

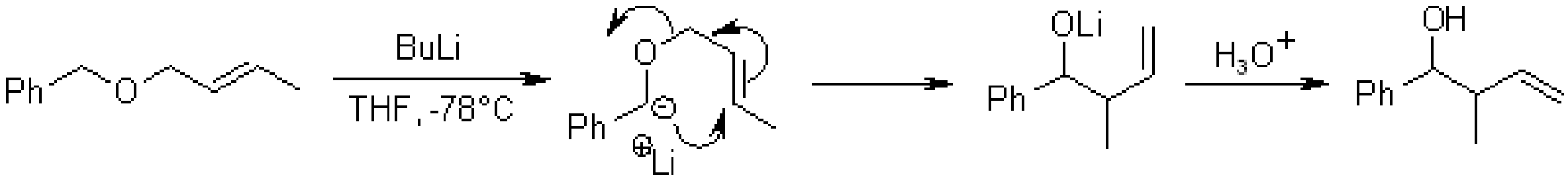
Rearreglo [2,3]-Wittig



Reacción [2,3]-sigmatrópica

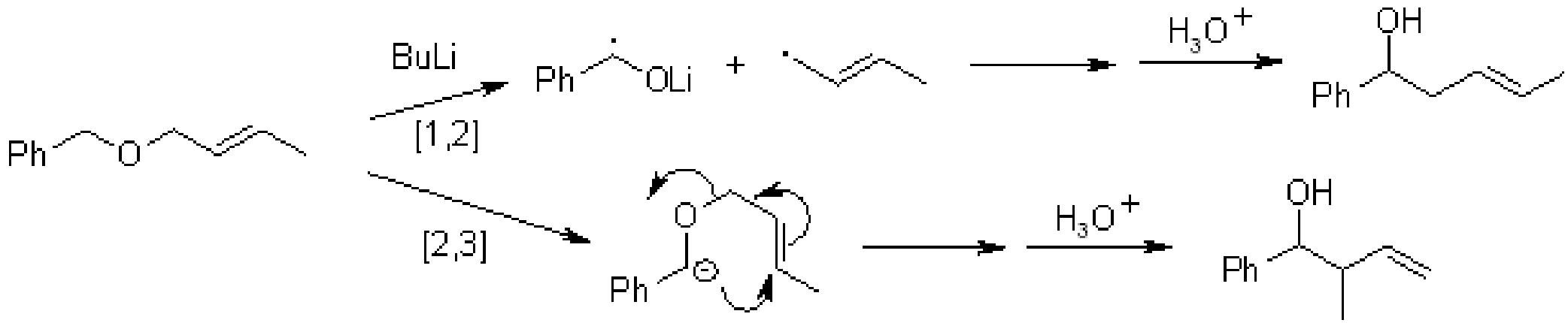


La transformación de alil-éteres en alcoholes homoalílicos es la version [2,3]-sigmatrópica de un rearreglo [1,2]-Wittig

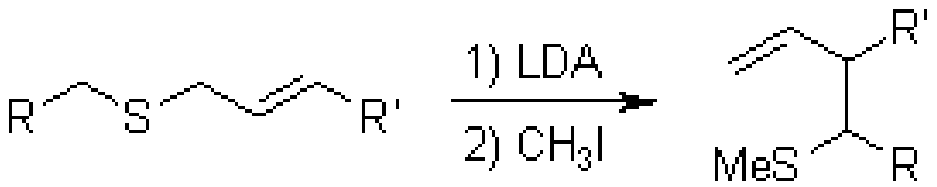


En muchos casos el desplazamiento concertado-[2,3] compite con del desplazamiento concertado-[1,2]

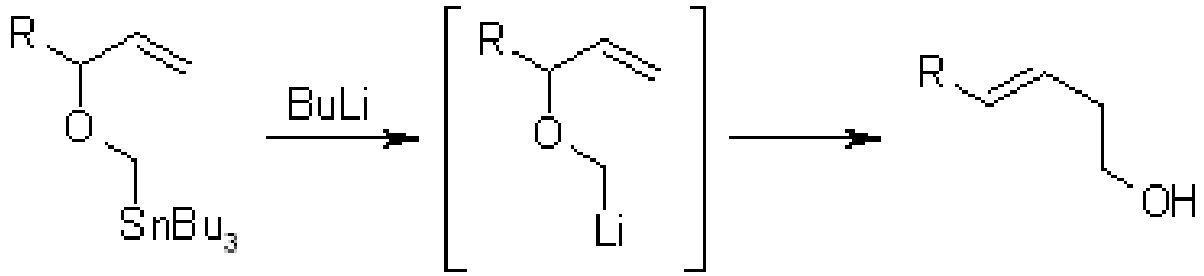
La relación de producto varía como una función de la temperatura y el ambiente estructural (ver también Rearreglo de Wittig-[1,2]). El Rearreglo de Wittig-[2,3] se debe llevar a cabo a una temperatura baja para evitar la contaminación por el producto [1,2].



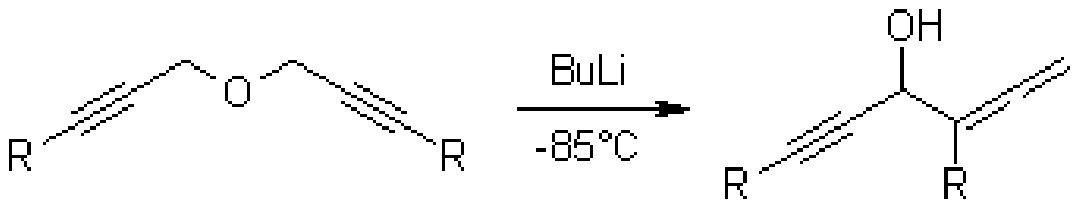
La rapidez de la reacción depende de la diferencia de energia gap (band gap) entre los orbitales HOMO (anión) y LUMO (alilo). Hablando en una manera burda, si el carbanion es menos estable, más rápido es el rearreglo



El alcance del rearreglo [2,3]–Wittig esta definido por la disponibilidad de métodos para generar carbaniones a temperaturas lo suficientemente bajas para minimizar la aparición del rearreglo [1,2]-Wittig.
Por ejemplo, el intercambio estaño-litio permite la preparación selectiva de carbaniones extremadamente inestables en una reacción conocida como rearreglo [2,3]-Wittig-Still

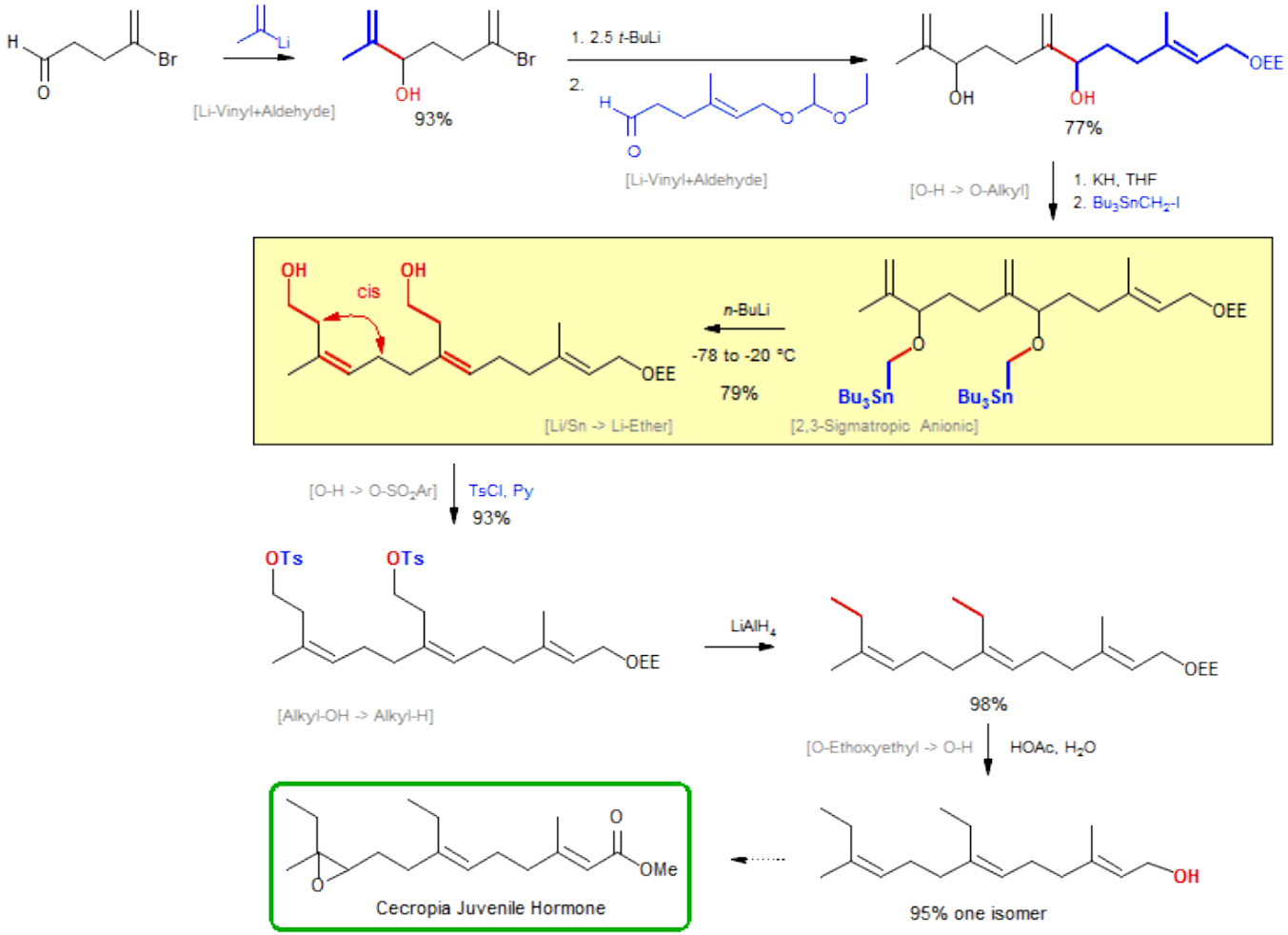


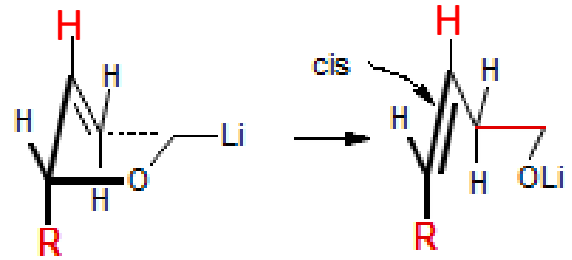
En los éteres propargilicos los rearreglos [2,3]-Wittig se pueden formar alcoholes aleno, pero el alcance es relativamente limitado y el proceso no es general.



CECROPIA JUVENILE HORMONE (Still)

Still, W.C.; McDonald, J.H.; Collum, D.B.; Mitra, A.; *Tet. Lett*, 1979, 593



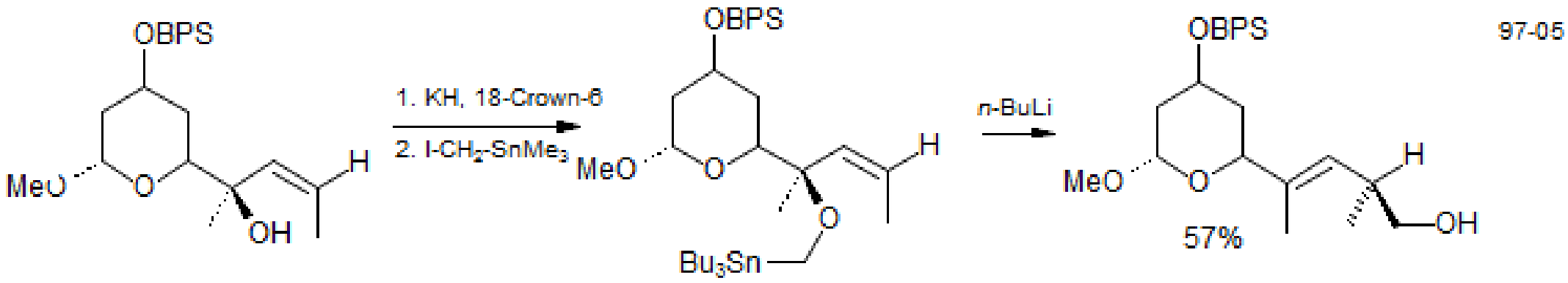


Este rearreglo sigmatrópico, es insual, ya que da como resultado un doble enlace *cis* (*Z*)

La reacción consiste en un proceso suprafacial

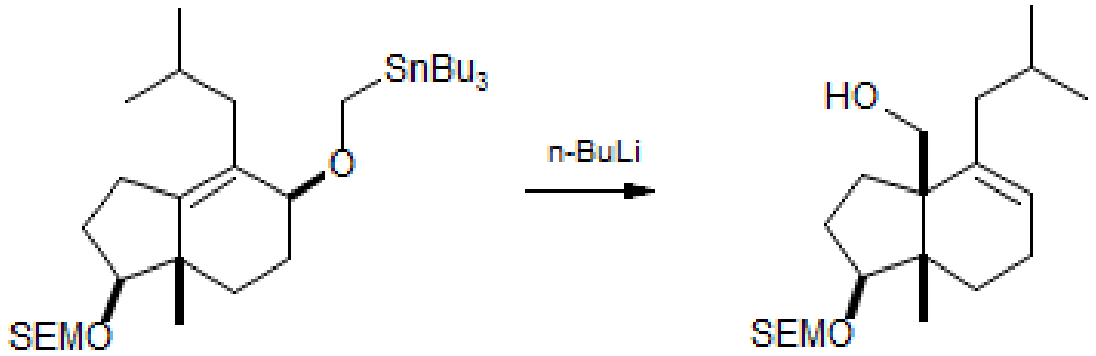
Acutiphycin

Smith, A. B.; Chen, S. S.-Y.; Nelsom, F.; Reichert, J. M.; Salvatore, B. A. *J. Am. Chem. Soc.* **1997**, *119*, 10935



Punctatin A

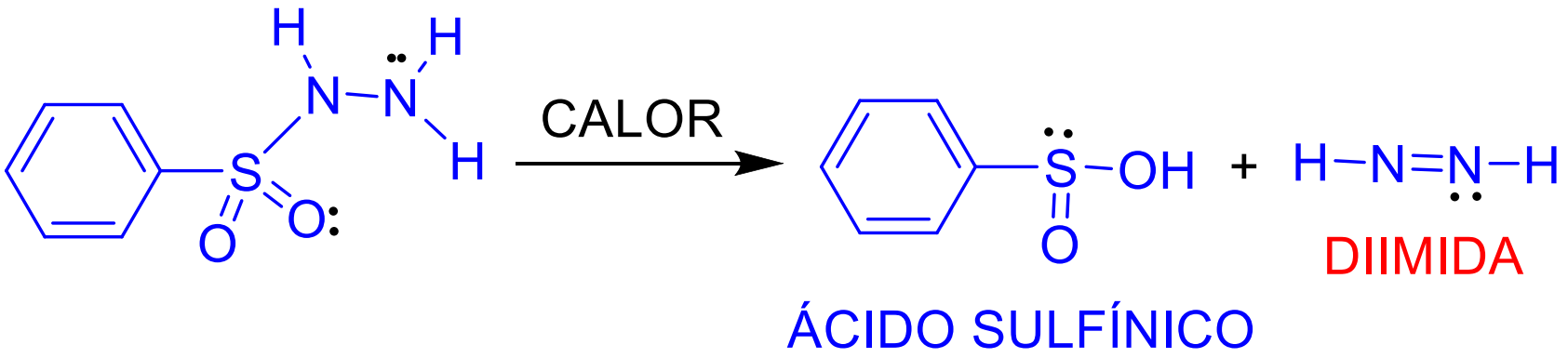
Paquette, L. A.; Sugomura, T. *J. Am. Chem. Soc.* **1987**, *109*, 3017

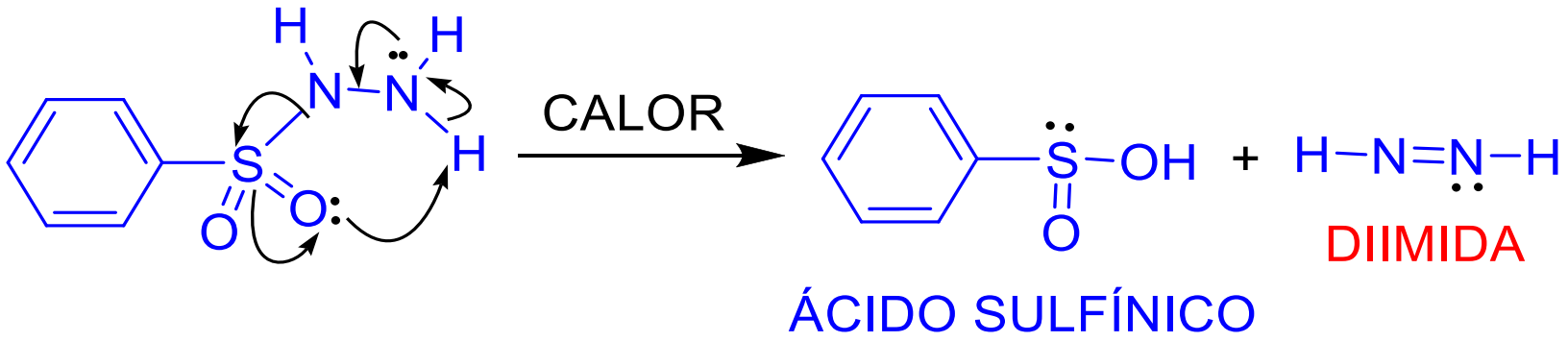


Esta reacción es apropiada
para introducir los sustituyentes
en los centros cuaternarios con
control estereoquímico

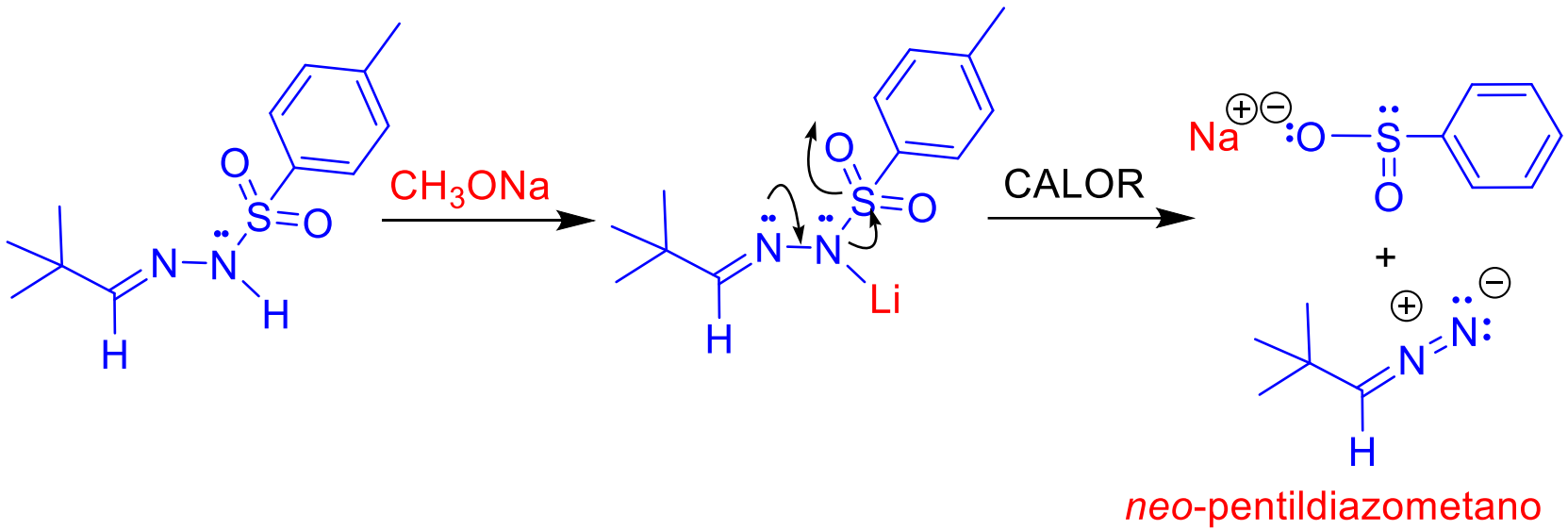
REACCIONES BASADAS EN LAS SULFONILHIDRAZINAS

DESCOMPOSICIÓN TÉRMICA





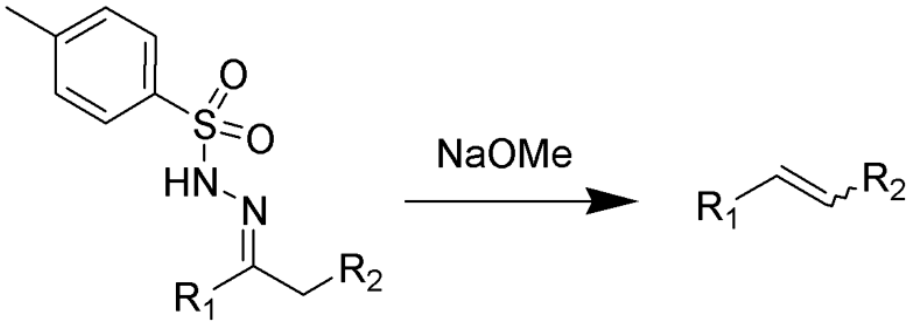
REACCIÓN DE BAMFORD-STEVENS



neo-pentildiazometano

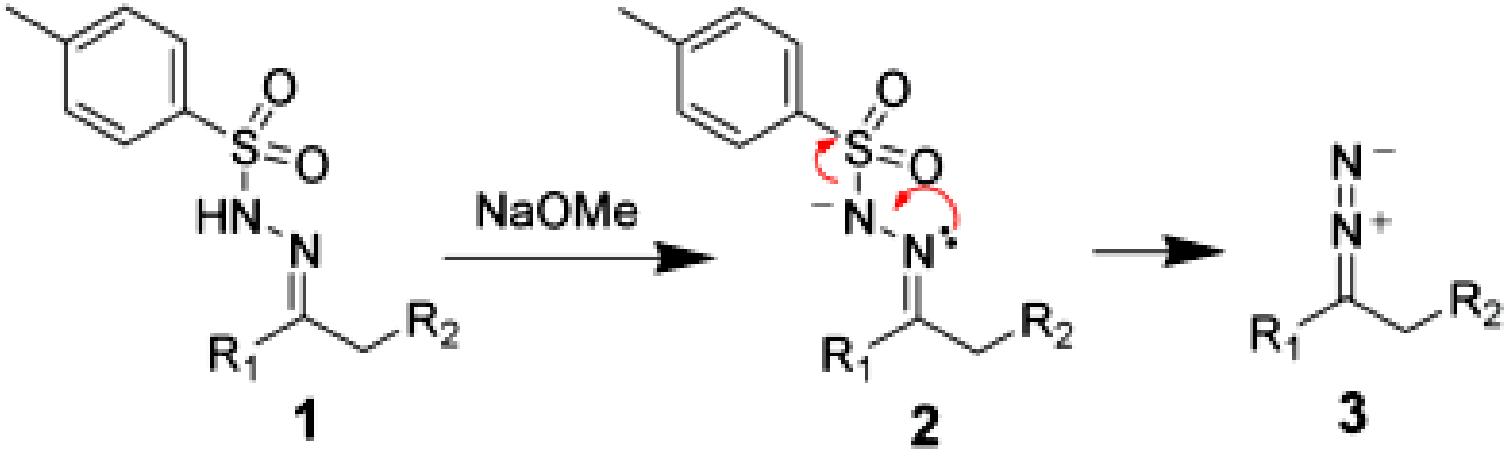
Reacción de Bamford-Stevens

William Randall Bamford **Thomas Stevens Stevens**



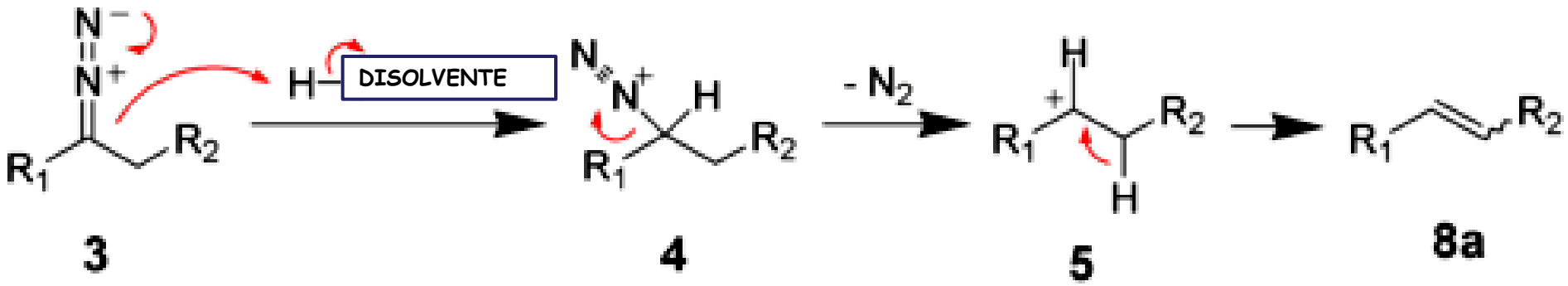
SE USA UNA BASE SUAVE

MECANISMO: EL PRIMER PASO CONSISTE EN LA FORMACIÓN DEL DIAZO COMPUESTO **3**.

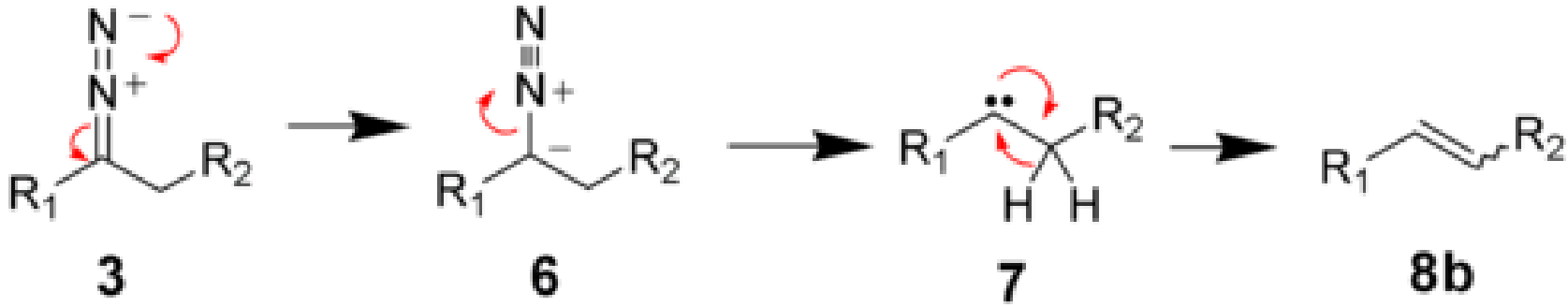


Bamford, W. R.; Stevens, T. S."The decomposition of toluene-*p*-sulfonylhydrazones by alkali". *J. Chem. Soc.*, **1952**, 4735–4740. doi:10.1039/JR9520004735.

EN DISOLVENTES PRÓTICOS, EL DIAZO COMPUESTO **3** SE DESCOMPONE EN EL CARBOCATIÓN **5**.

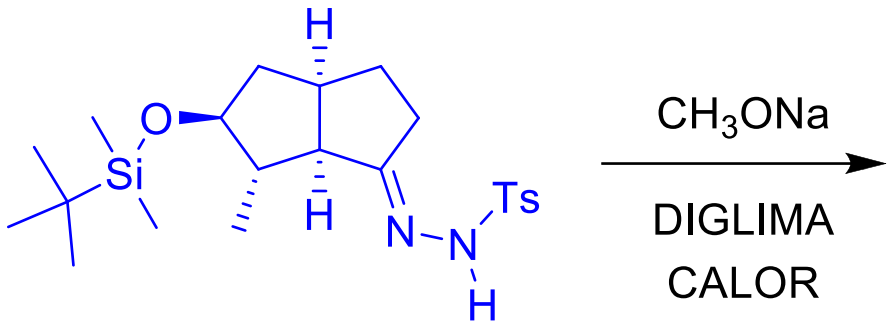


EN DISOLVENTES APRÓTICOS, EL DIAZOCOMPUESTO **3** SE DESCOMPONE EL CARBENO **7**



REGLA DE BREDT

EJEMPLO

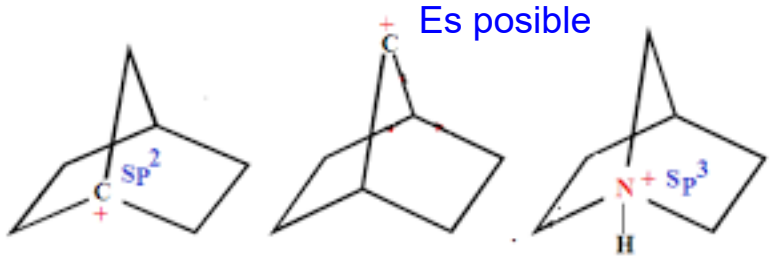


CH_3ONa

DIGLIMA

CALOR

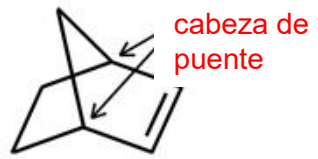
La regla de Bredt es una observación empírica en química orgánica que establece que no se puede colocar un doble enlace en la cabeza de puente de un sistema de anillos con puente, a menos que los anillos sean lo suficientemente grandes. La regla lleva el nombre de Julius Bredt, quien la discutió por primera vez en 1902 y la codificó en 1924.



No es posible

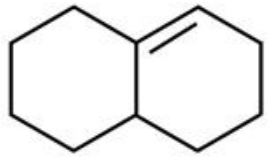
Es posible

Es posible



Carbonos cabeza de puente

Biciclo[2.2.1]hept-2-eno



Biciclo[4.4.0] dec-1-eno

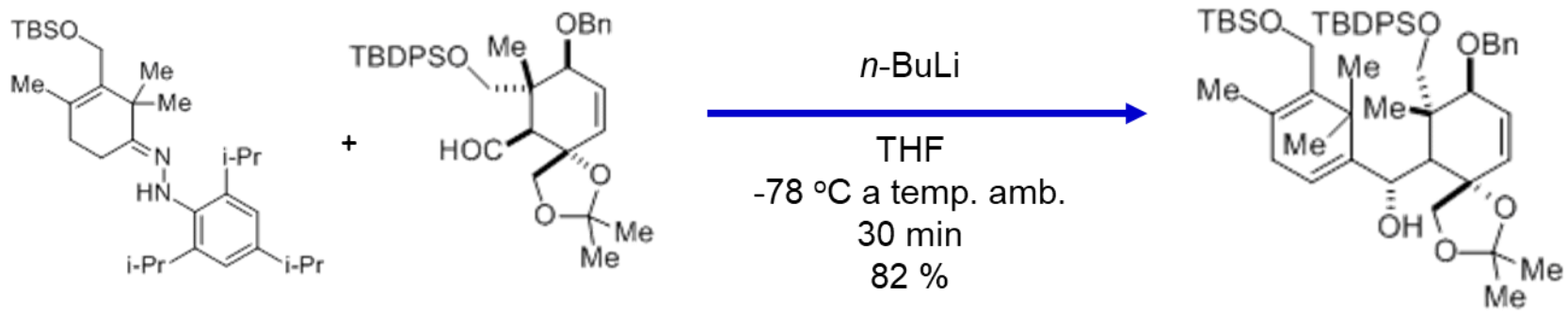
Biciclo[4.2.10] non-1-eno

No es posible

Biciclo[2.2.1] hept-1-eno

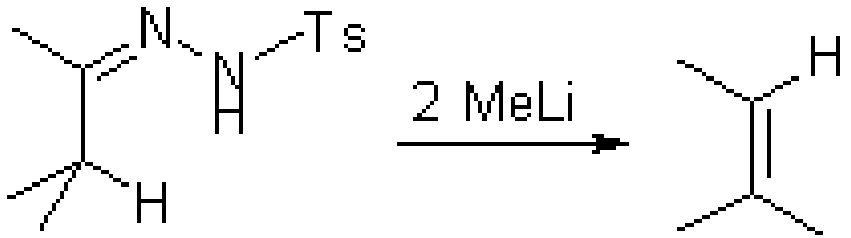
Biciclo[2.2.1] hept-1(7)eno

Biciclo[2.2.2] oct-1-eno


TBSO
Me
Me
Me
N
HN
i-Pr
i-Pr
i-Pr
+
TBDPSO
Me
OBn
HOC
O
O
Me
Me
n-BuLi
THF
-78 °C a temp. amb.
30 min
82 %
TBSO
TBDPSO
OBn
Me
Me
Me
Me
OH
O
O
Me
Me

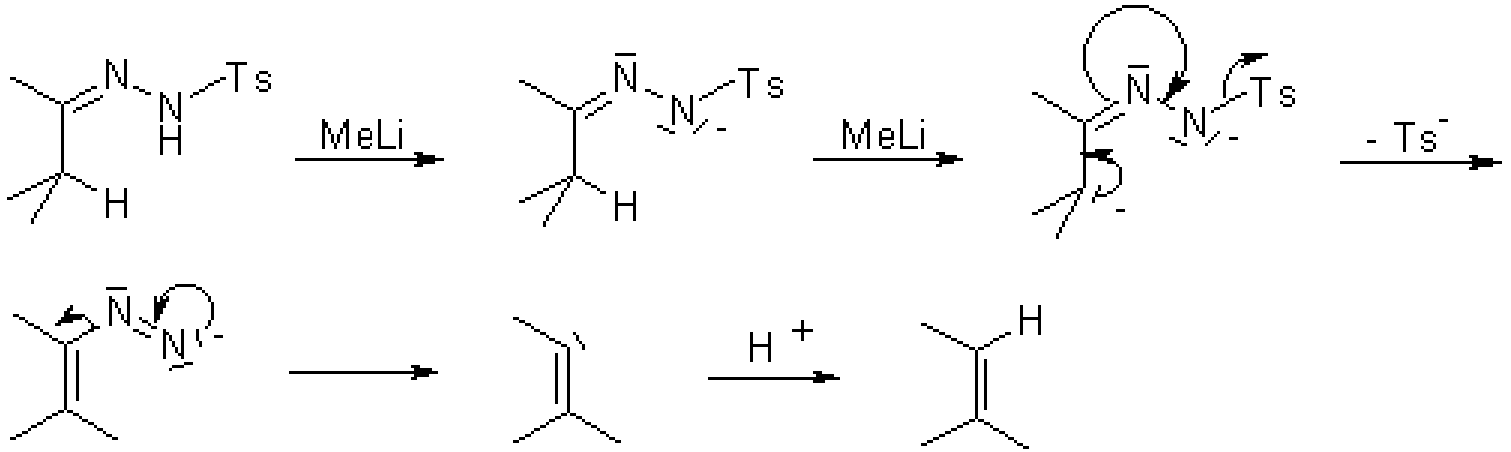
REACCIÓN DE SHAPIRO

Robert H. Shapiro

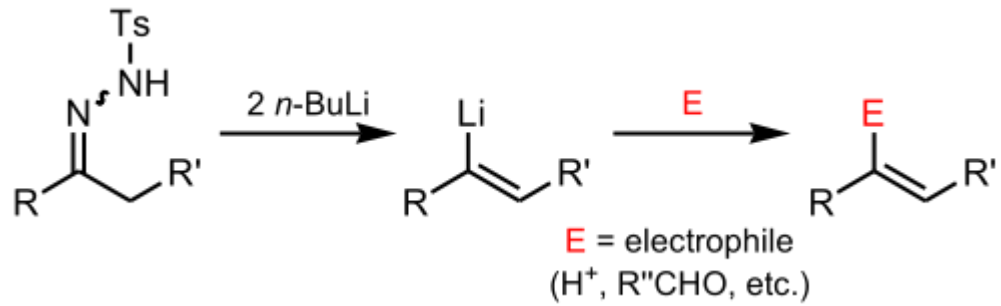


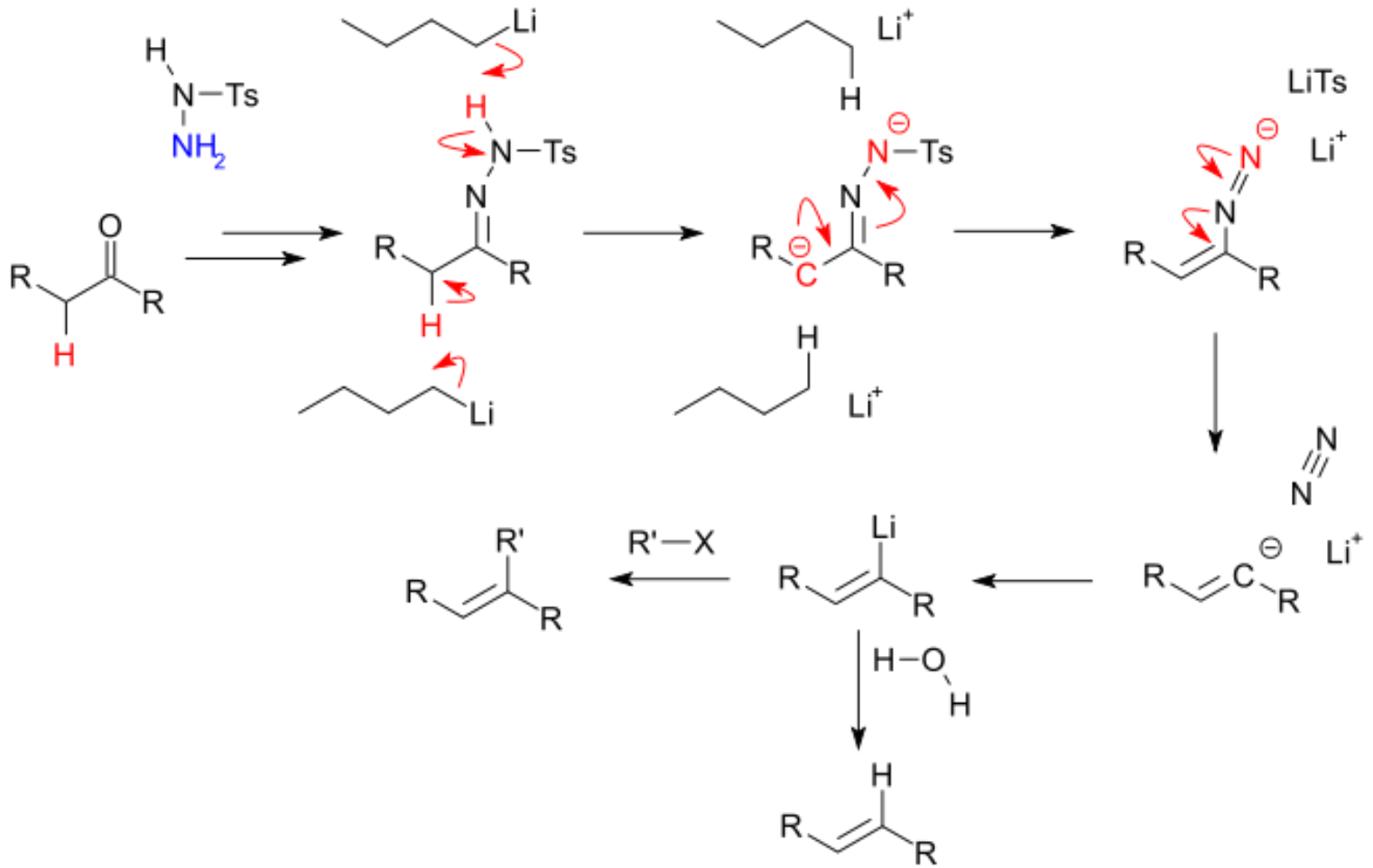
Robert H. Shapiro
(1935 – 2011)
Químico norteamericano

CAMBIO:
SE USA UNA BASE FUERTE

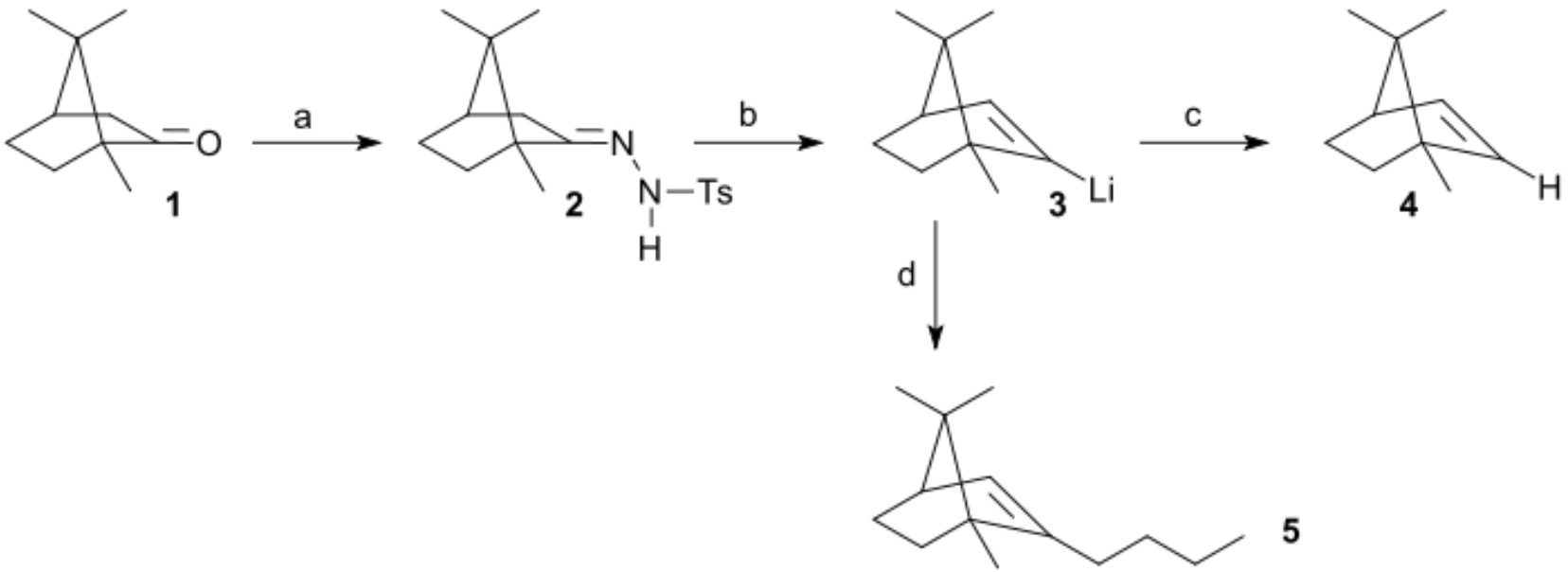


Shapiro, R. H. (March 1976). "Alkenes from Tosylhydrazones", *Organic Reactions*, 405–507. ISBN 0-471-19624-X.


Ts
NH
N
R
R'
2 n-BuLi
Li
E
E = electrophile
(H+, R''CHO, etc.)


H
N—Ts
NH2
O
R
H
Li
Li+
LiTs
N
C
R'—X
H—O
H

EJEMPLO

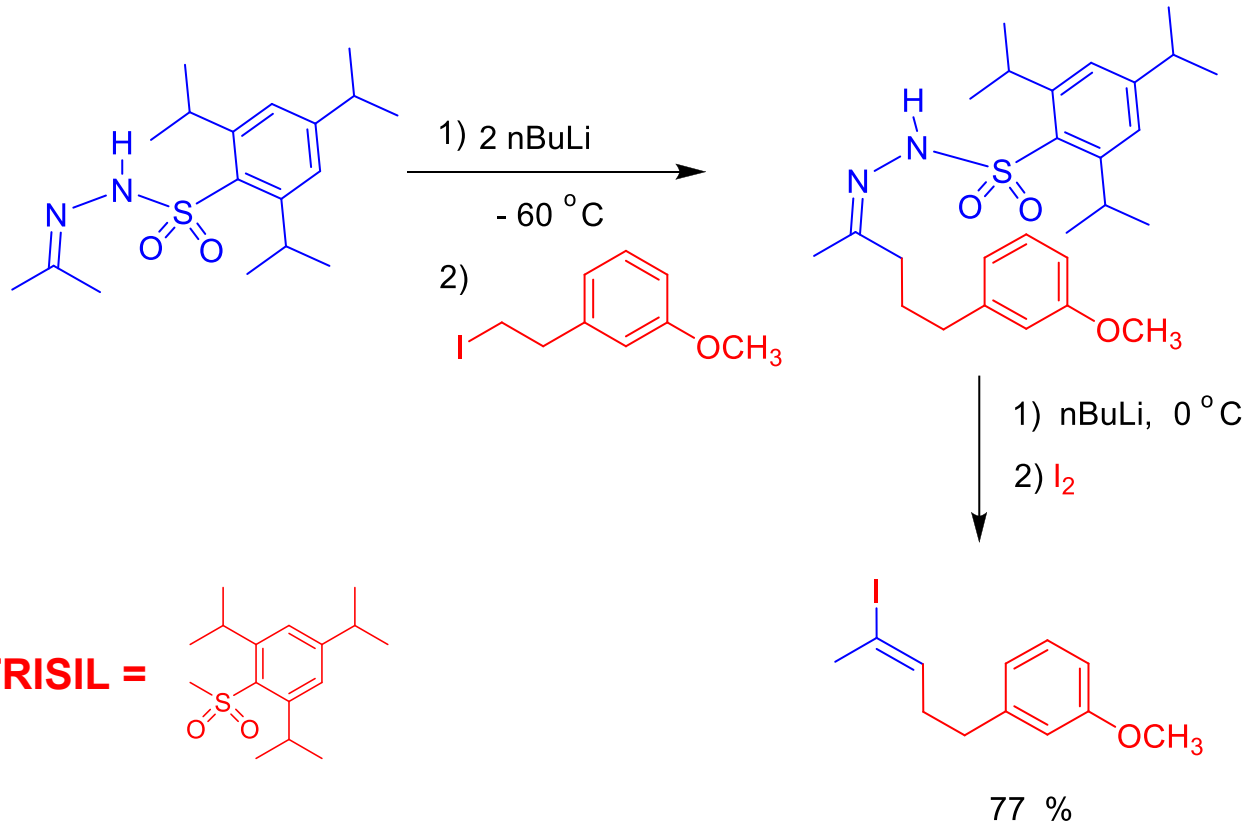


REACCIÓN DE SHAPIRO:

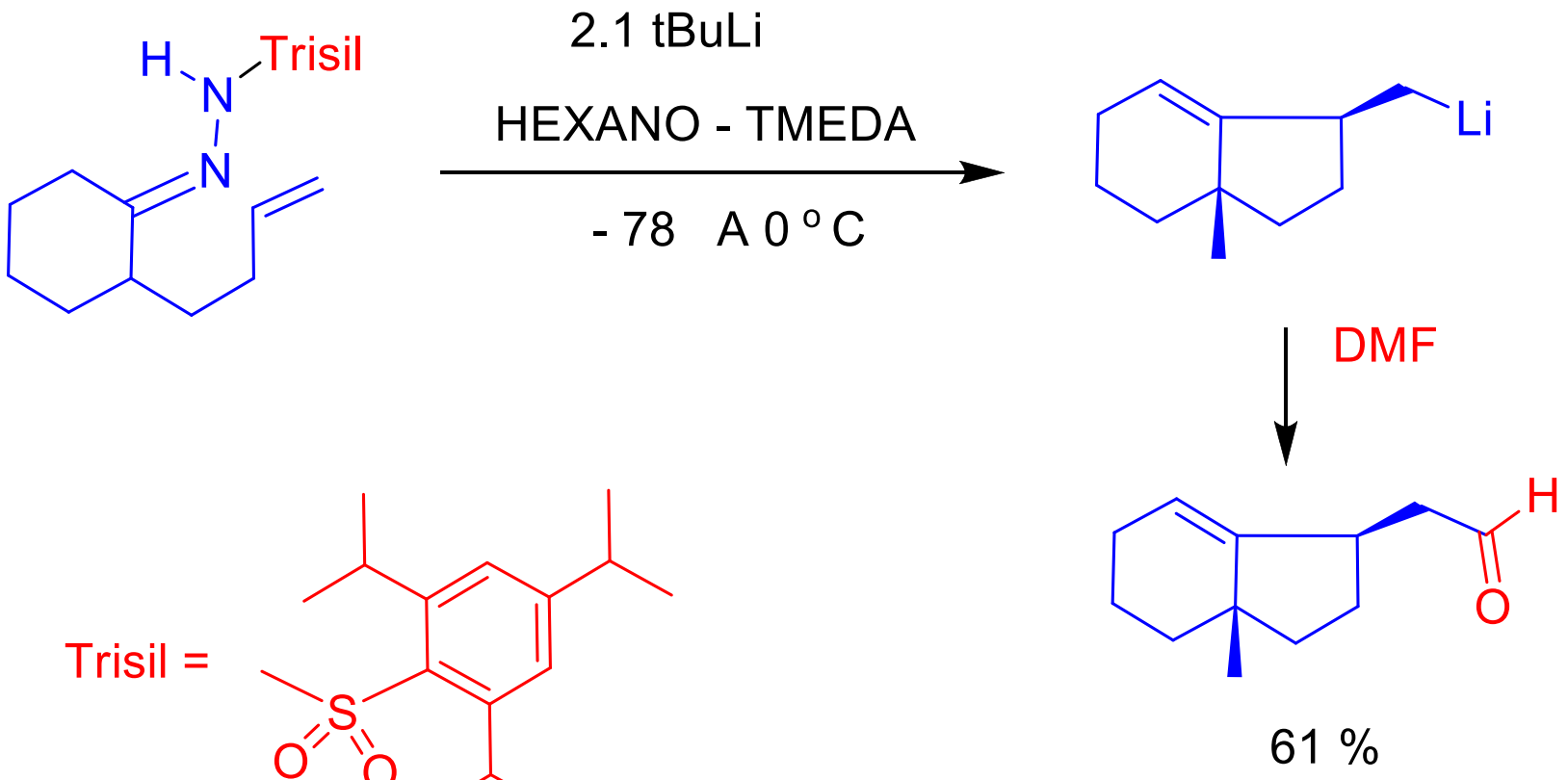
- SE INICIA CON EL ALCANFOR (1)
- SE FORMA UNA TOSILHIDRAZONA (2)
- AL HACERLA REACCIONAR CON METILITIO (b) EN EXCESO SE FORMA EL VINILITIO (3).
- LA ADICIÓN DE AGUA (c) PERMITE OBTENER EL 2-BORNENO (4)
- POR EL OTRO LADO SI SE ADICIONA UN BROMURO DE ALQUILO AL VINILLITIO (d) SE OBTIENE 5

EJEMPLO

2,4,6-TRI-(*ISO*-PROPIL)BENCENSULFONILHIDRAZONAS, TRISILHIDRAZONAS

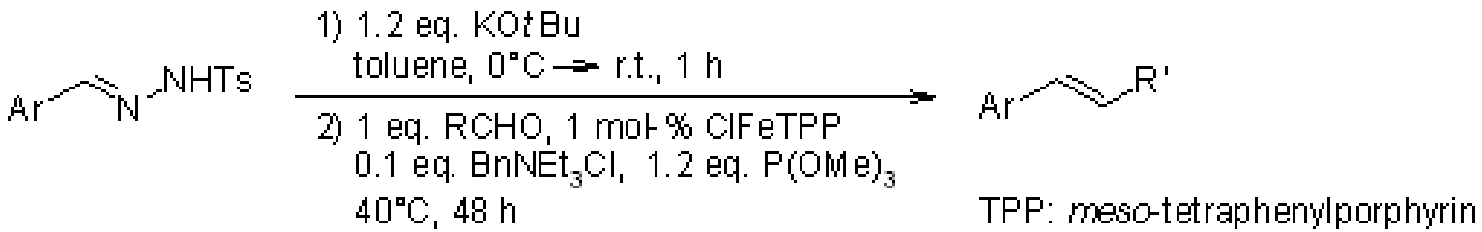


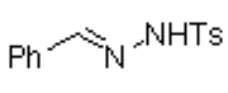
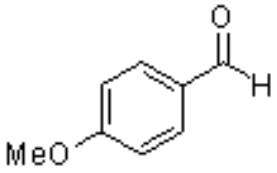
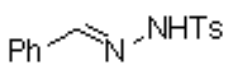
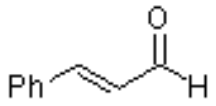
EJEMPLO

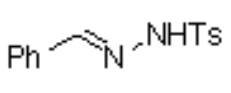
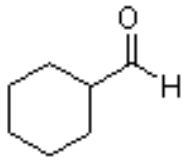
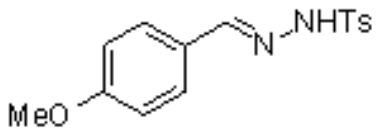
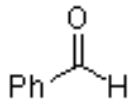

H
N
Trisil
N
2.1 tBuLi
HEXANO - TMEDA
- 78 A 0 º C
Li
DMF
H
O
61 %
Trisil =
S
O
O

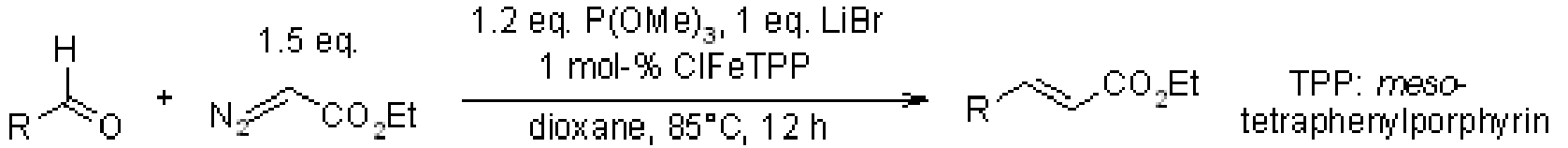
Generation of Phosphoranes Derived from Phosphites. A New Class of Phosphorus Ylides Leading to High *E* Selectivity with Semi-stabilizing Groups in Wittig Olefinations

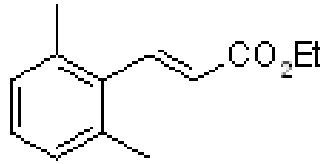
V. K. Aggarwal, J. R. Fulton, C. G. Sheldon, J. de Vicente, *J. Am. Chem. Soc.*, **2003**, *125*, 6034-6035.

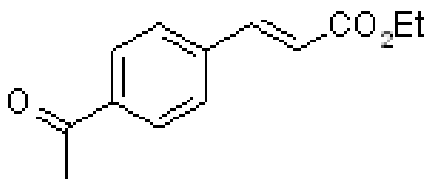


hydrazone	aldehyde	yield (%, isol.)	*E*:*Z*
		95	97:3
		88	86:14

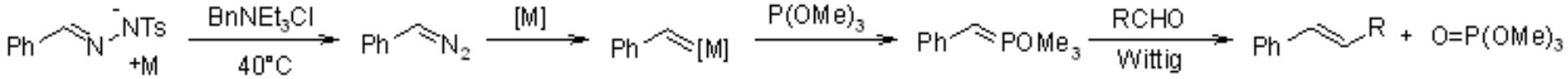
hydrazone	aldehyde	yield (%, isol.)	*E*:*Z*
		91	93:7
		79	98:2



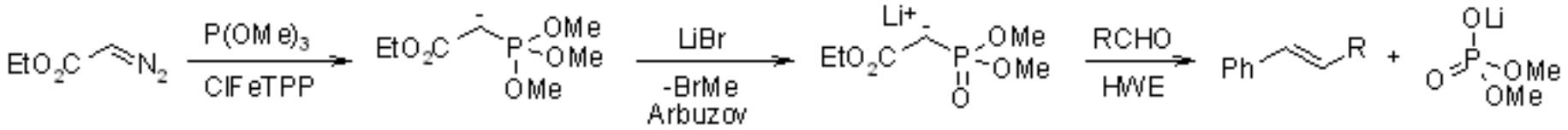
product	yield (%, isol.)	E:Z
	86	96:4
	45	94:6

product	yield (%, isol.)	E:Z
	75	95:5
	92	90:10

proposed reaction pathway

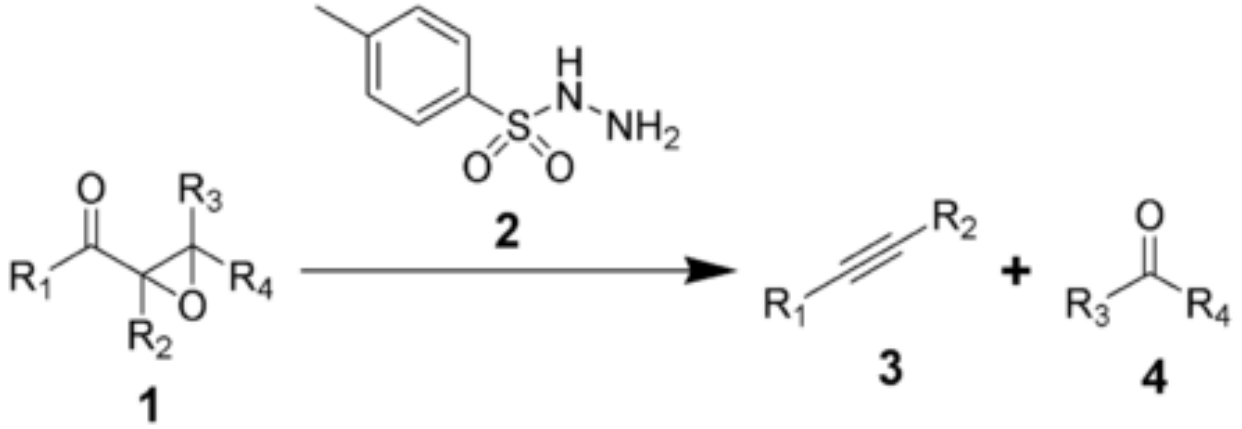


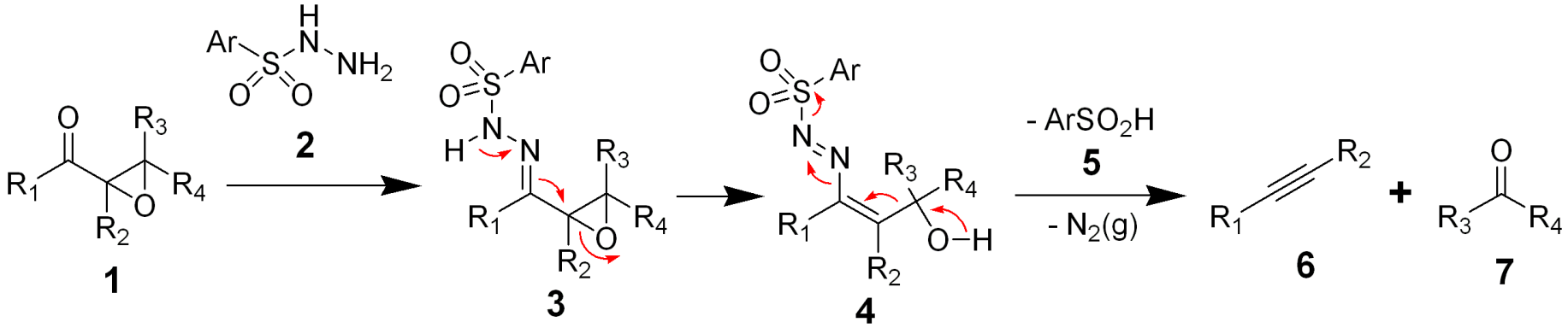
proposed reaction pathway



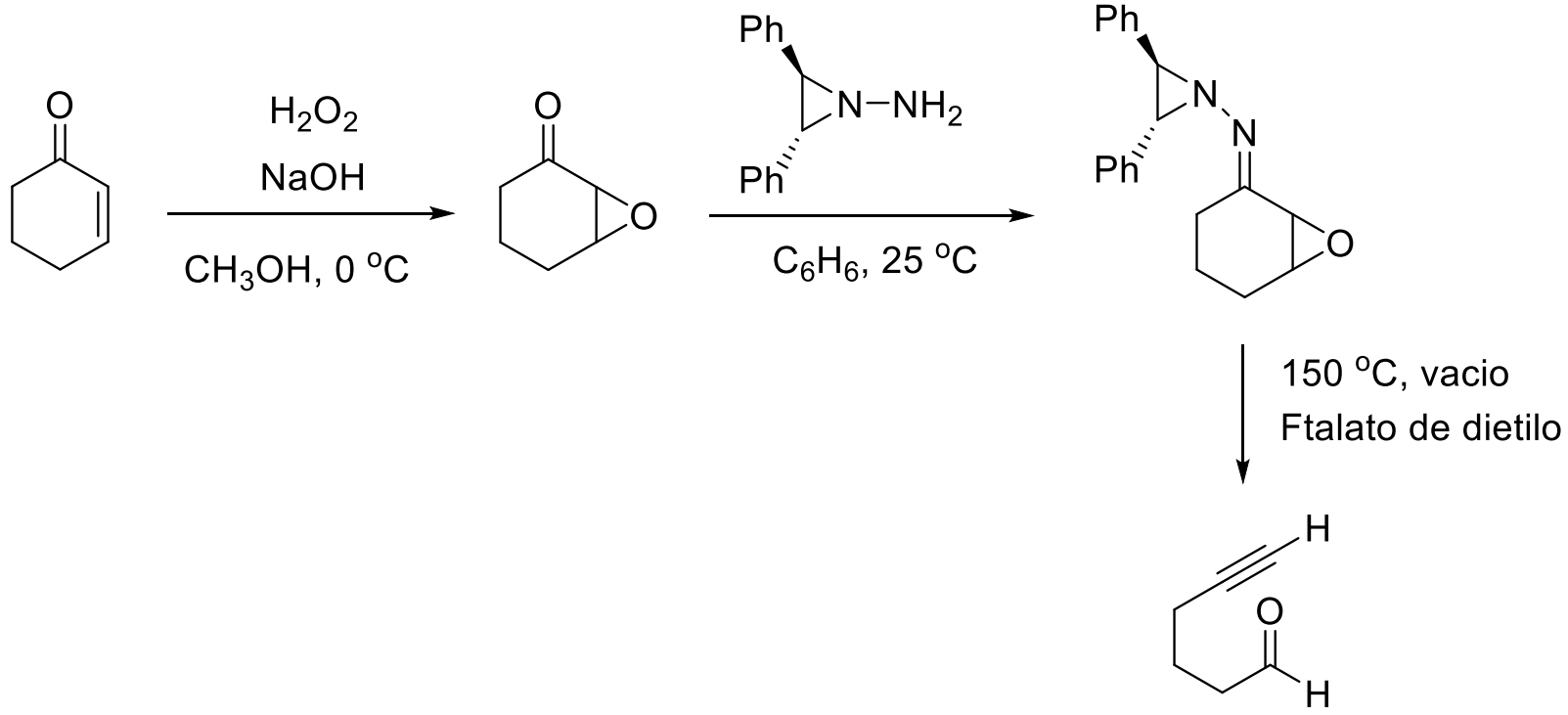
Albert Jakob Eschenmoser
(1925 -)
Químico orgánico

REACCIÓN DE ESCHENMOSER



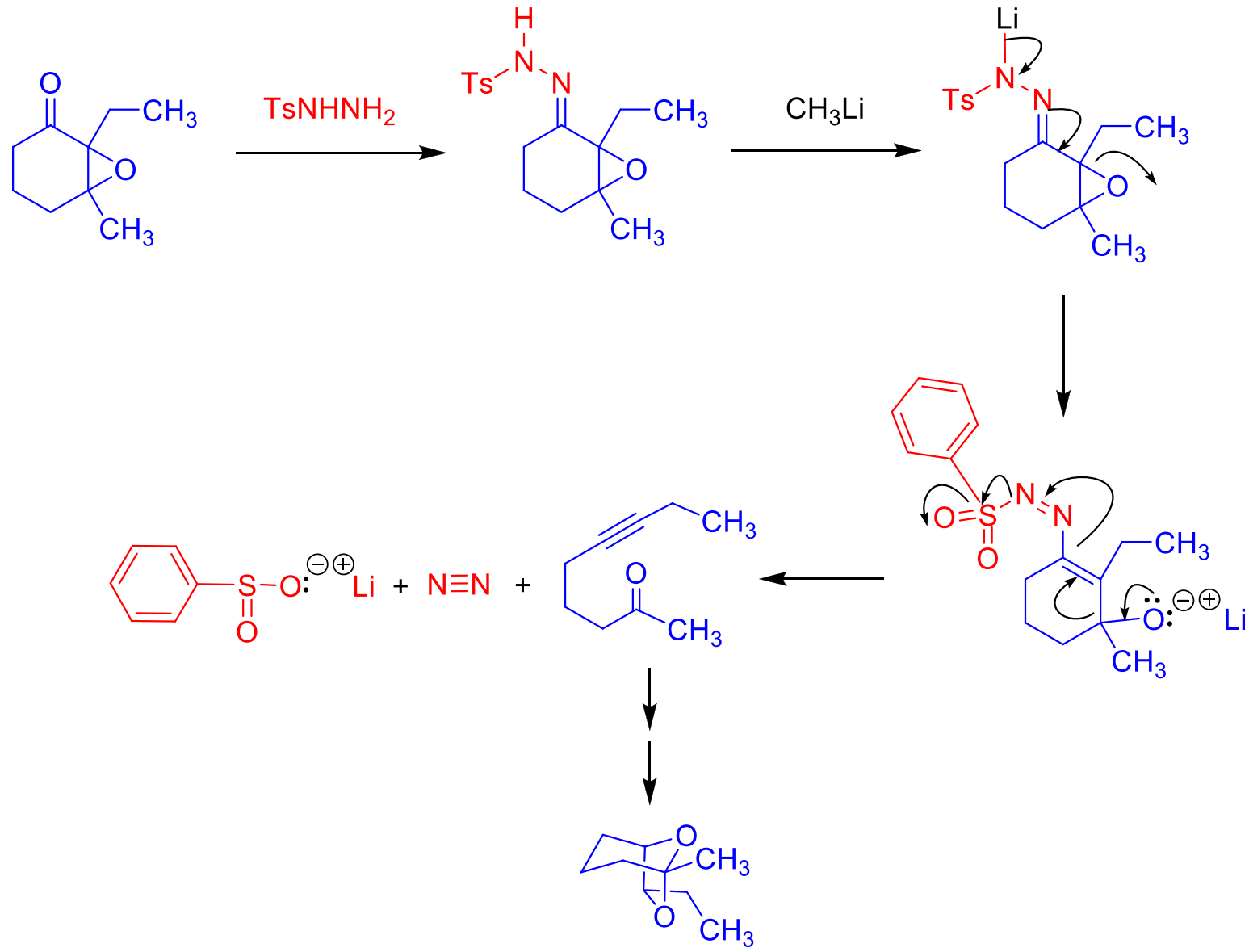


Eschenmoser, A.; Felix, D.; and Ohloff, Helvetica Chimica Acta.,**1967**,*50*(2),708–713.
Schreiber, J.; Felix, D.; Eschenmoser, A.; Winter, M.; Gautschi, F.; Schulte-Elte, K.H.; Sundt, E.; Ohloff, G.; Kalovoda, J.; Kaufmann, H.; Wieland, P.; and Anner, G.; Helvetica Chimica Acta, **1967**,*50*(7),2101–2108.

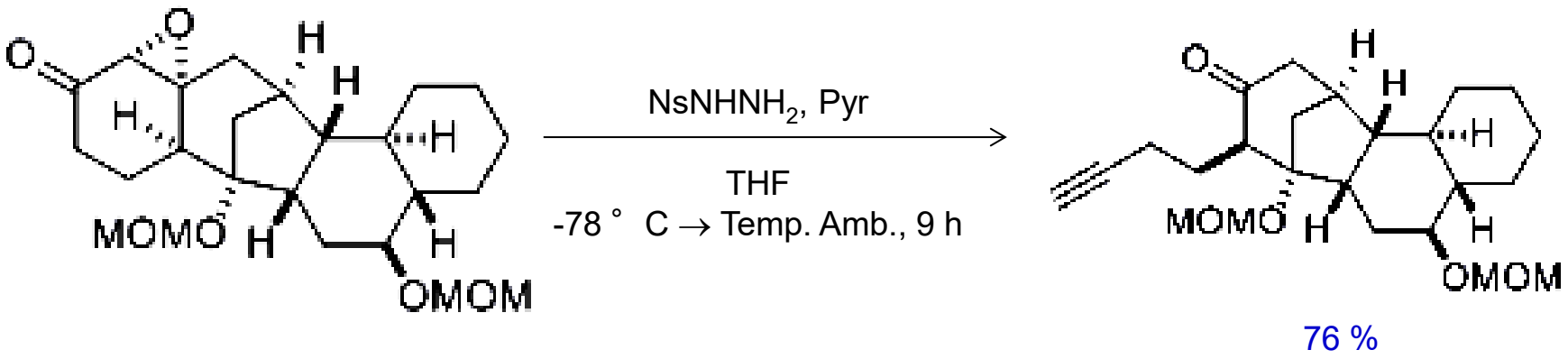


Org. Synth. 1976, *55*, 52. DOI: 10.15227/orgsyn.055.0052

EJEMPLO



The Total Synthesis of the Galbulimima Alkaloid GB 13



76 %

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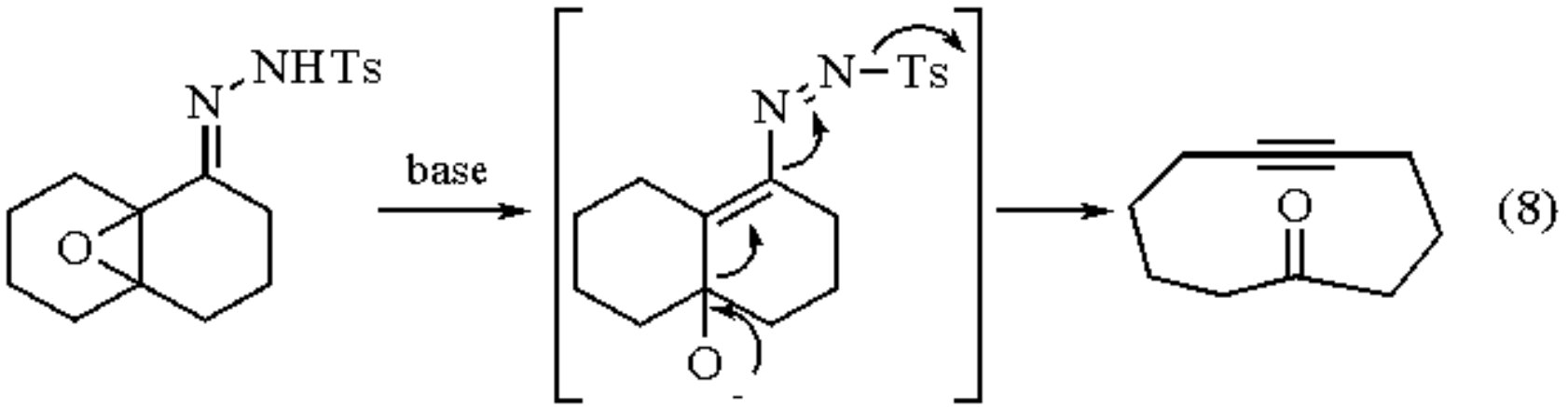

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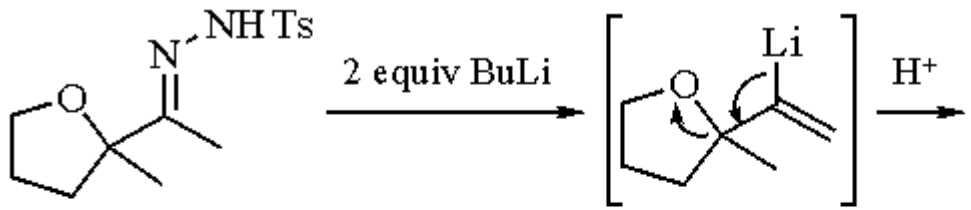

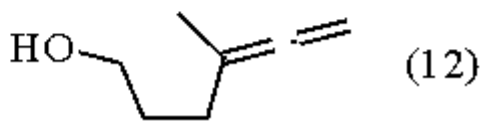

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