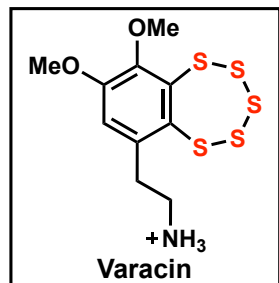
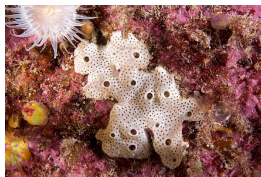


## Sulfur-containing Natural Products

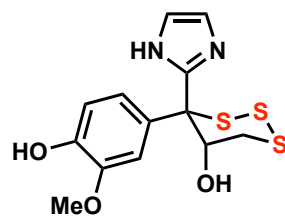


- Isolated from the marine ascidian *Lissoclinum vareau* in 1991 by Ireland and coworkers  
- Potent antifungal activity and strong antitumor activity against human colon tumor cell line HCT-116 (IC<sub>90</sub> = 0.05 μg/mL)

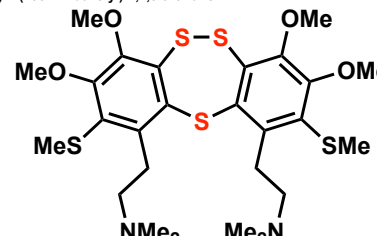


isolation: *J. Am. Chem. Soc.* **1991**, *113*, 4709.  
review: *Chem. Rev.* **2012**, *112*, 4, 2179.

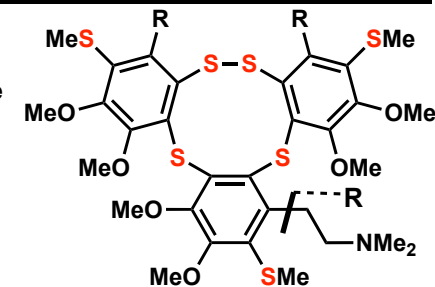
\*cis-5-Hydroxy-4-(40-hydroxy-30-methoxyphenyl)-4-(200-imi-dazoly)-1,2,3-trithiane



imidazole alkaloid isolated from an unidentified species of New Zealand ascidians *Aplidium* sp. *Tetrahedron Lett.* **1989**, *30*, 3703  
*J. Org. Chem.* **2001**, *66*, 8257

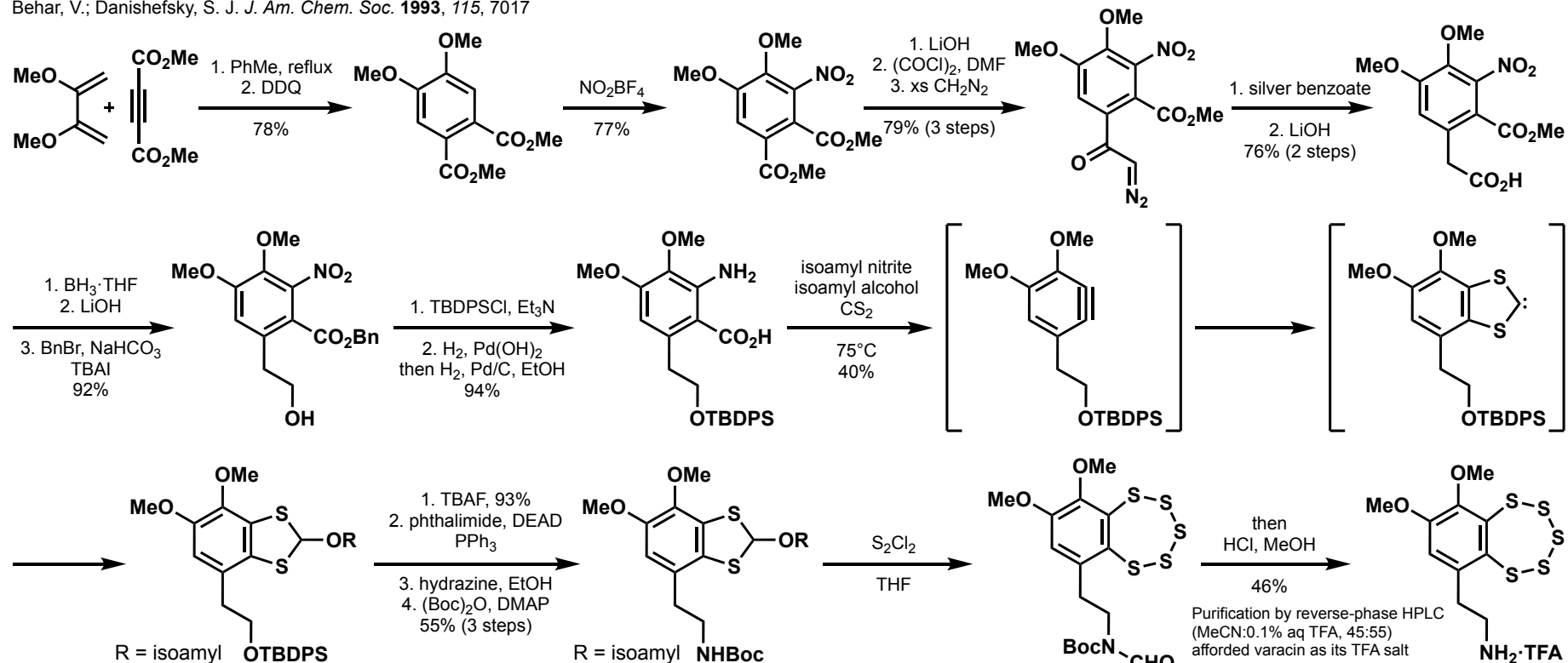


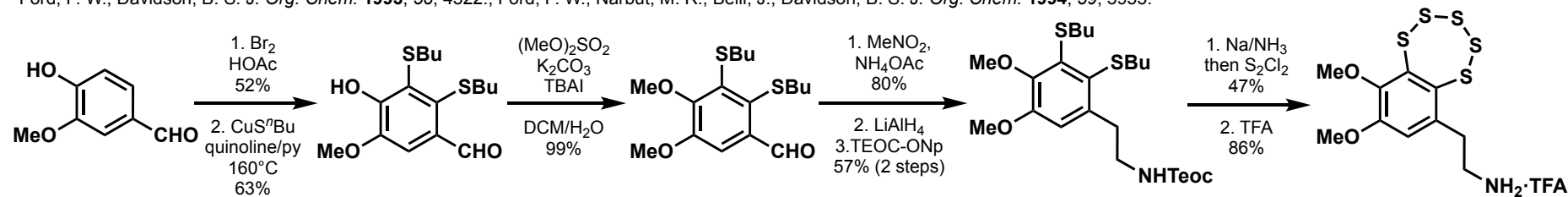
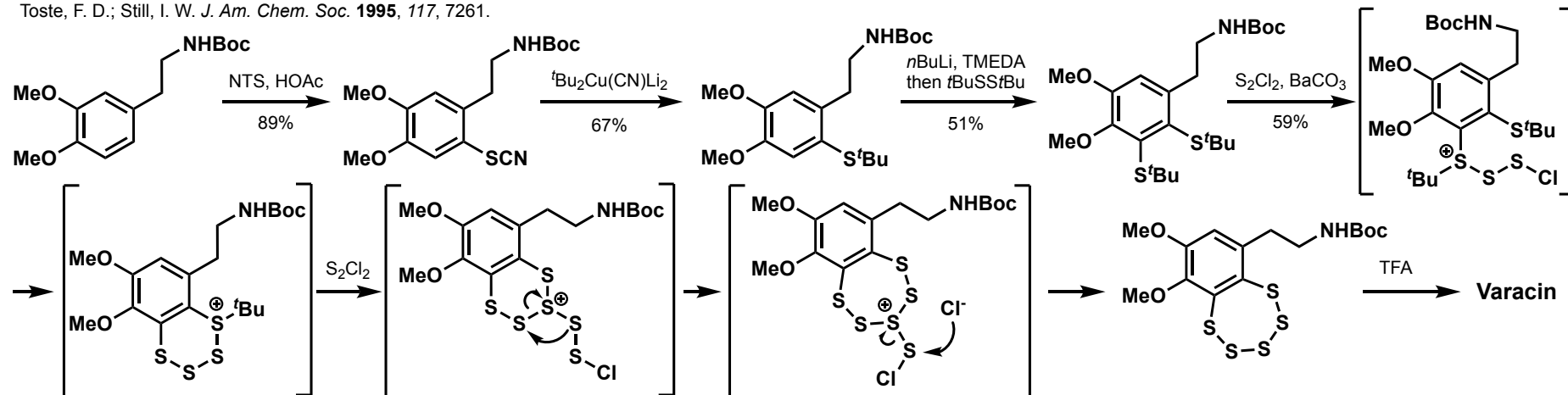
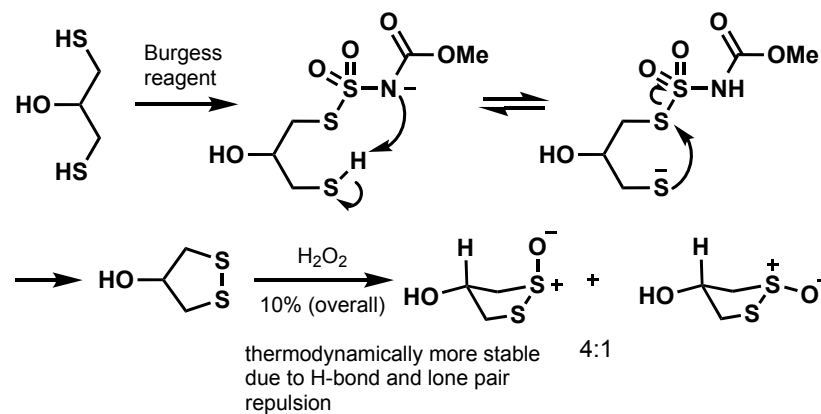
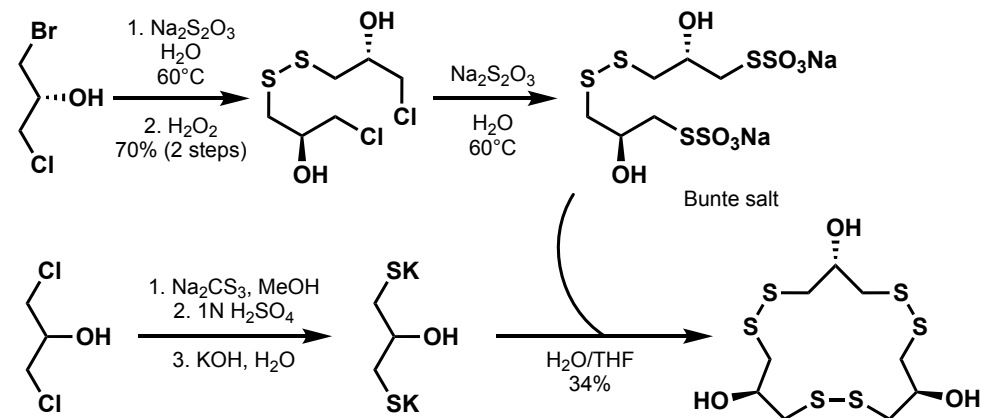
dimeric lissoclinotoxin isolated from a Philippine didemnid ascidian with an IC<sub>50</sub> value of 1.5 μg/mL towards cell line MDA-MB-468  
*Tetrahedron* **2003**, *59*, 2855



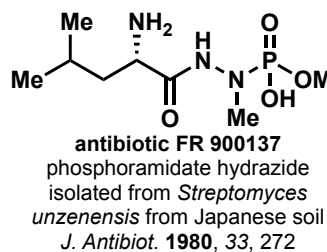
tribenzotetraphiepin alkaloid isolated from the ascidian *Lissoclinum* sp. *Tetrahedron Lett.* **2004**, *45*, 7015

Behar, V.; Danishefsky, S. J. *J. Am. Chem. Soc.* **1993**, *115*, 7017

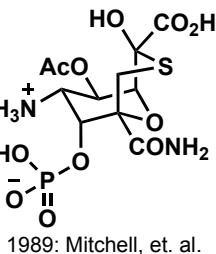
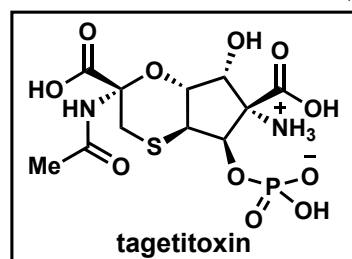
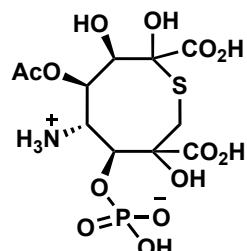
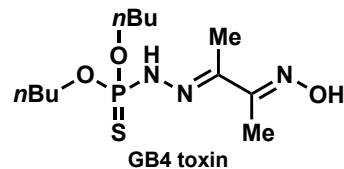
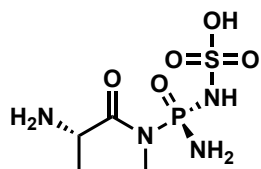


Ford, P. W.; Davidson, B. S. *J. Org. Chem.* **1993**, *58*, 4522.; Ford, P. W.; Narbut, M. R.; Belli, J.; Davidson, B. S. *J. Org. Chem.* **1994**, *59*, 5955.Toste, F. D.; Still, I. W. *J. Am. Chem. Soc.* **1995**, *117*, 7261.Brugierol isolation: *Tetrahedron Lett.* **1972**, *13*, 203*Tetrahedron Lett.* **1972**, *13*, 2959Gymnorrhizol isolation: *Tetrahedron Lett.* **2004**, *45*, 5533*Org. Lett.* **2007**, *9*, 1715

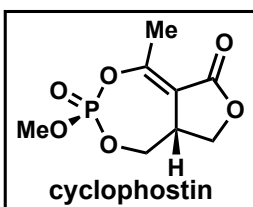
## Phosphorus-containing Natural Products



review:  
*Nat. Prod. Rep.*, **2022**, *39*, 1066  
*Tetrahedron* **1999**, *55*, 12237  
*Molecules* **2019**, *24*, 866  
*J. Nat. Prod.* **2018**, *81*, 423

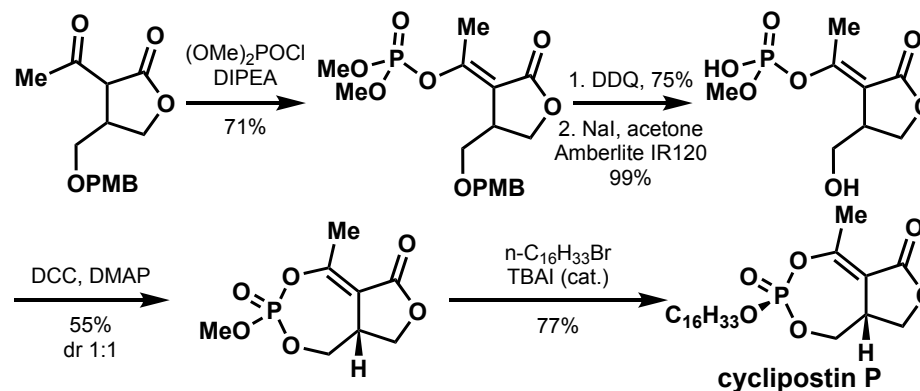
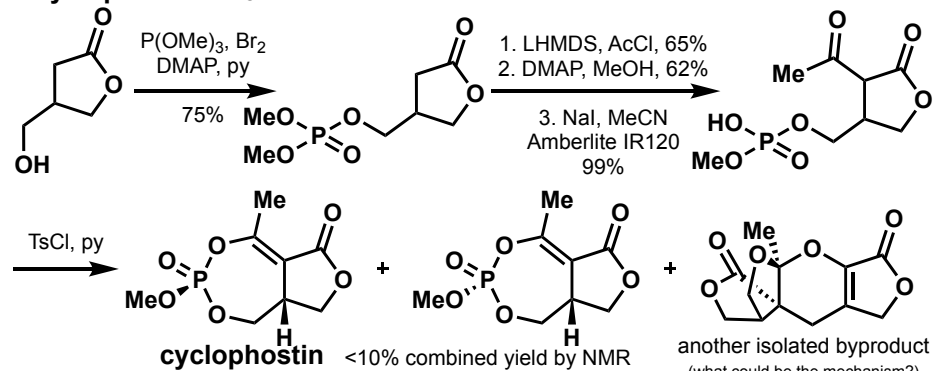


- first isolated from the plant pathogenic bacterium *Pseudomonas syringae* pv. *tagetis*
- first structure was proposed in 1983 by Mitchell and coworkers then revised in 1989
- Aliev and coworkers reported a new structure in 2016 based on detailed NMR analysis
- the exact structure was confirmed by our group's synthesis in 2020  
*J. Am. Chem. Soc.* **2020**, *142*, 32, 13683

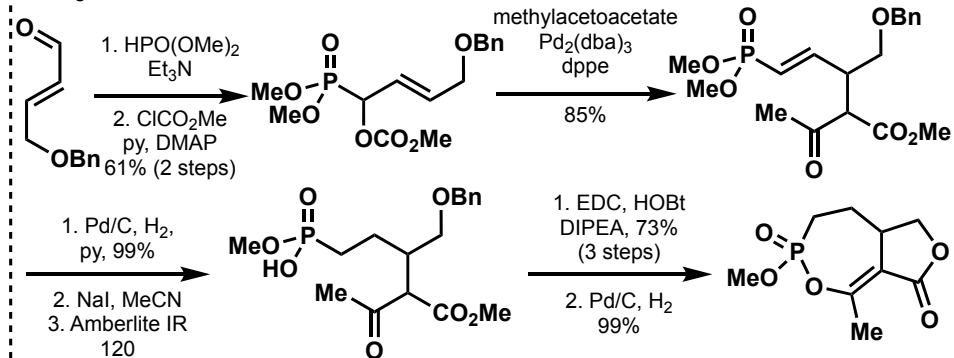


isolation: *N. J. Antibiot.* **1993**, *46*, 1315  
mycobacterial-related: *Int. J. Antimicrob. Agents* **2018**, *51*, 651

- isolated from a fermentation solution of *Streptomyces lavendulae* (strain NK901093)
- potent inhibition of acetyl cholinesterase (AChE) from the housefly (CSMA strain)
- biosynthetically related to A-factor, virginiae butanolides, and the PLA<sub>2</sub> inhibitor
- cyclophostin and cyclipostins analogues (CyCs) is recently reported to act as a new potent antimycobacterial agents

Cyclophostin *Org. Lett.* **2011**, *13*, 3094

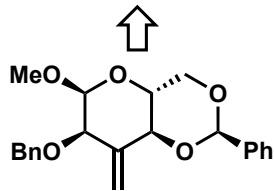
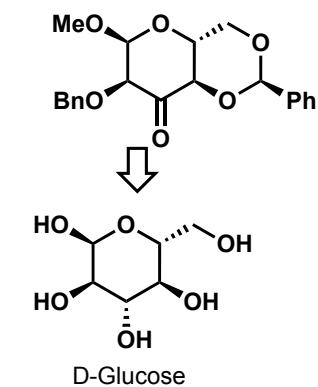
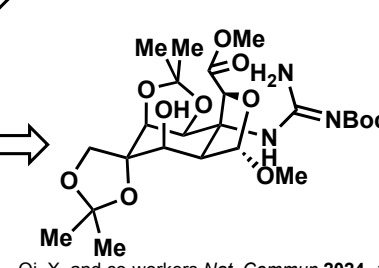
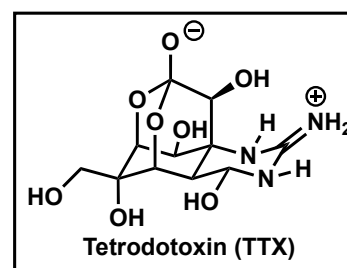
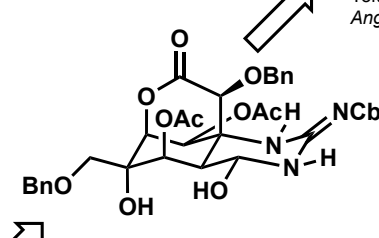
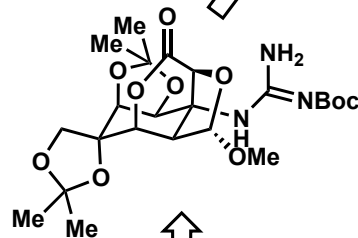
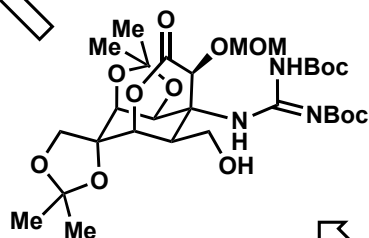
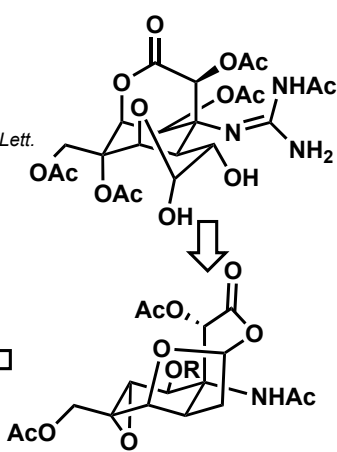
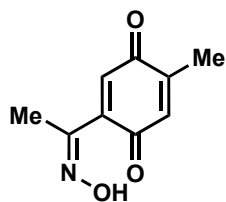
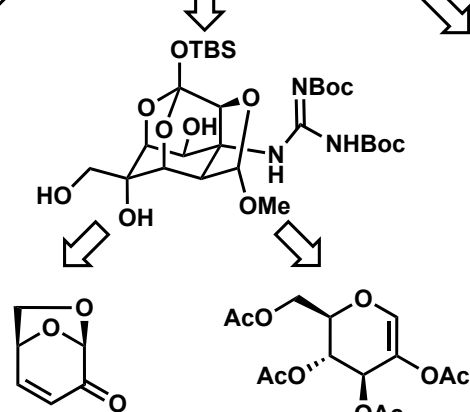
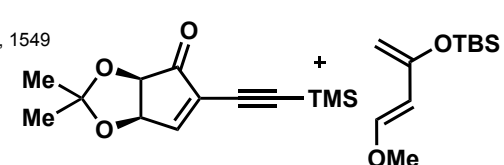
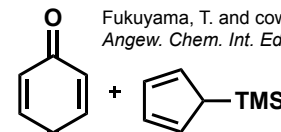
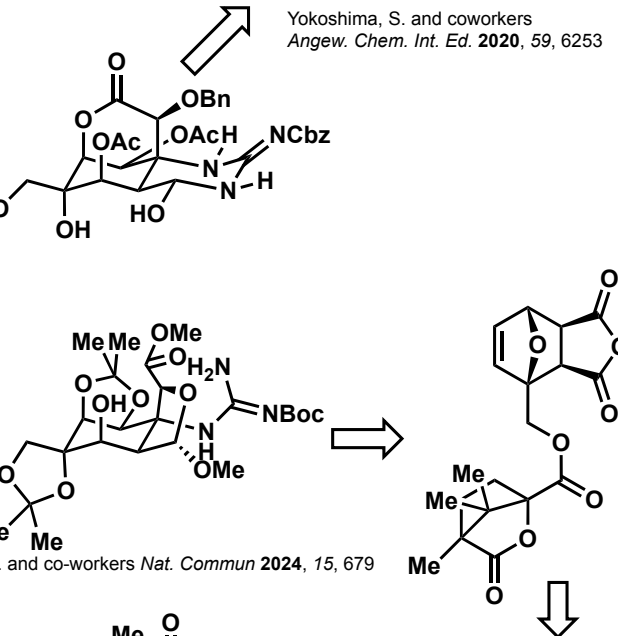
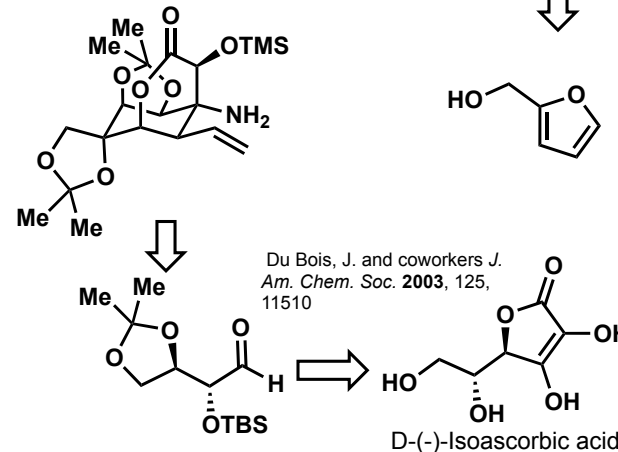
*J. Org. Chem.* **2008**, *73*, 8386

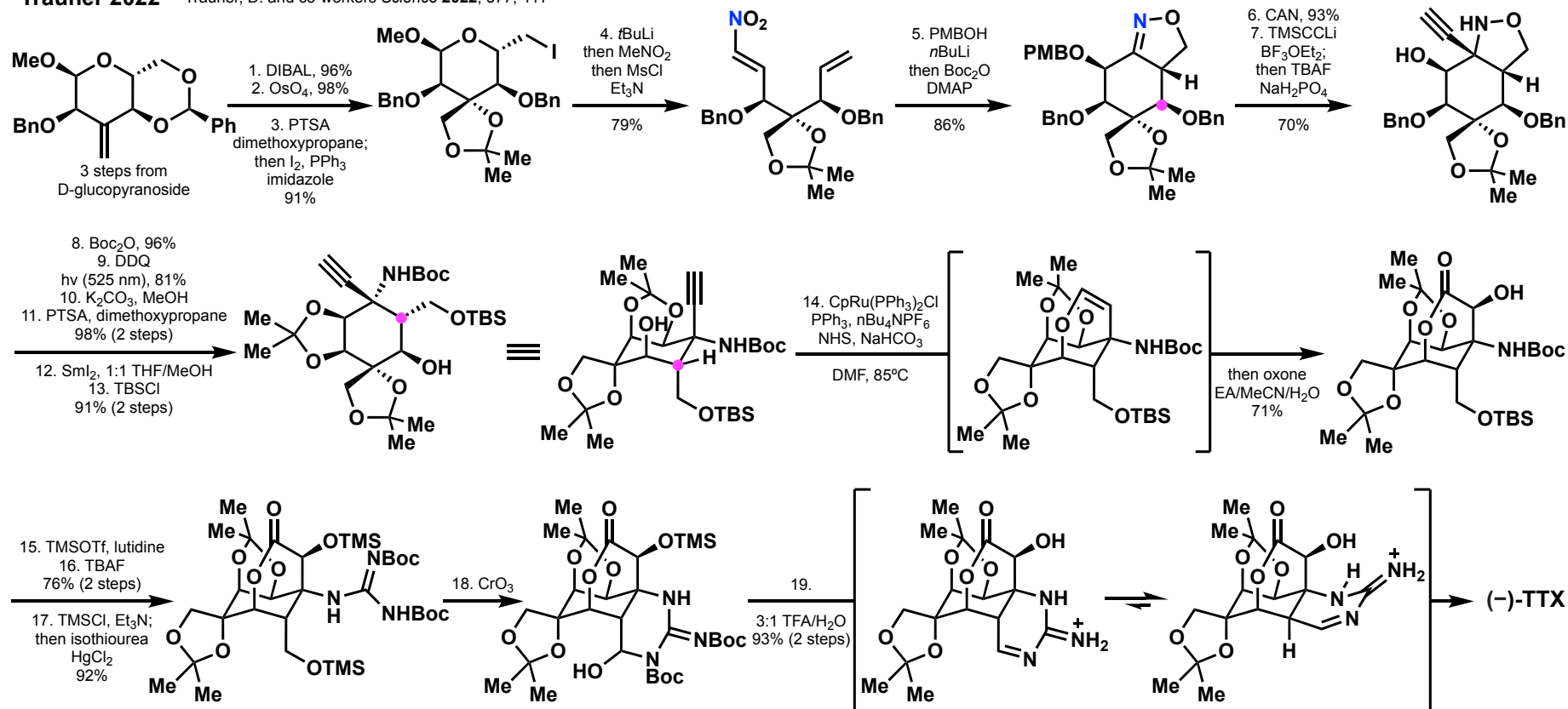


## Guanidine-containing Natural Products

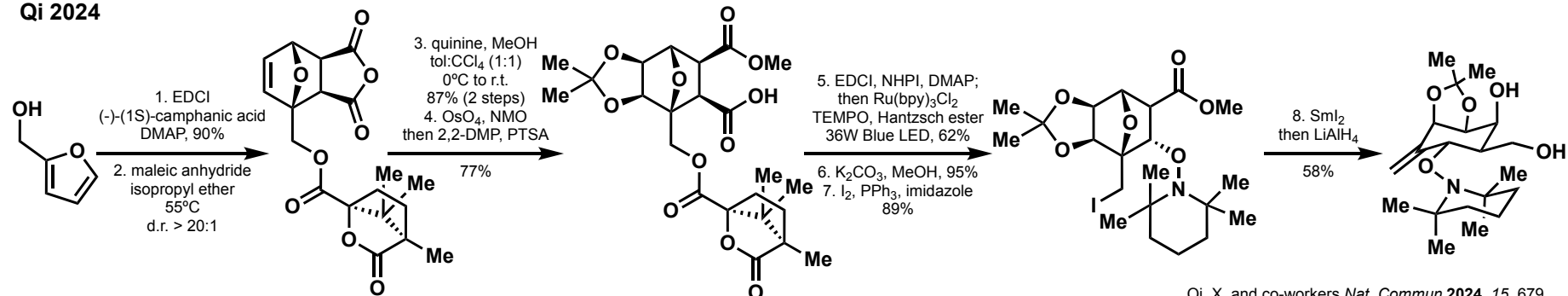
isolation: *J. Pharm. Soc. Jpn* 1909, 29, 587

## Tetrodotoxin 2.0

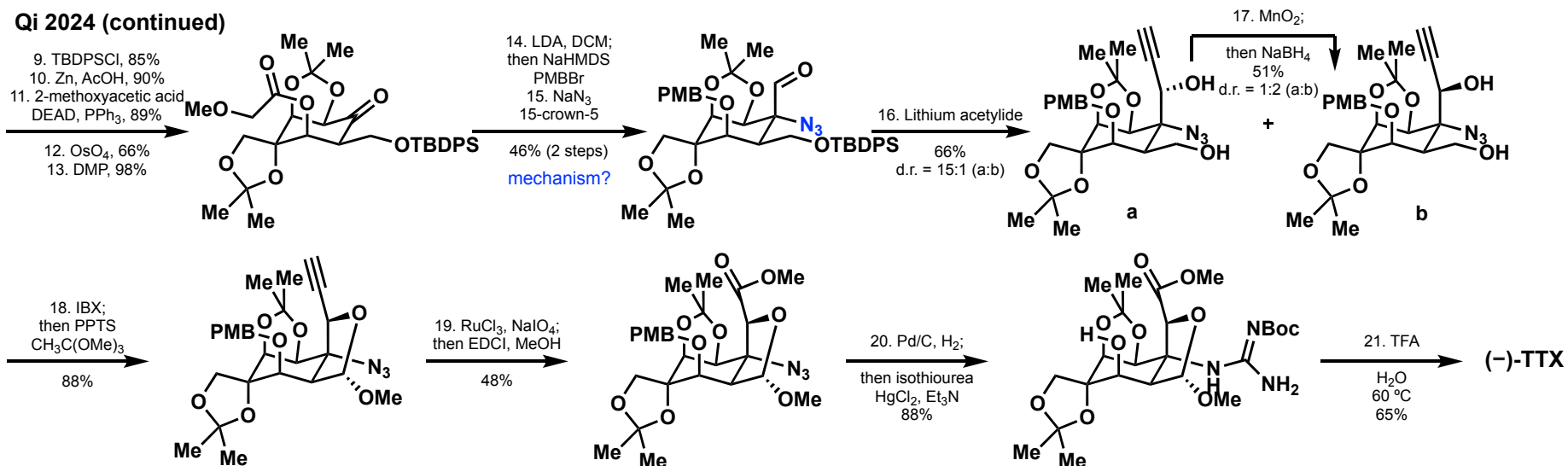
Sato, K. and coworkers  
*J. Org. Chem.* 2005, 70, 7496  
*J. Org. Chem.* 2008, 73, 1234  
*Bull. Chem. Soc. Jpn.* 2010, 83, 279Trauner, D. and co-workers *Science* 2022, 377, 411Qi, X. and co-workers *Nat. Commun* 2024, 15, 679Kishi, Y. and coworkers *Tetrahedron Lett.* 1970, 59, 5127  
*Tetrahedron Lett.* 1970, 59, 5129  
*J. Am. Chem. Soc.* 1972, 94, 9217  
*J. Am. Chem. Soc.* 1972, 94, 9219Isobe, M. and coworkers *J. Am. Chem. Soc.* 2003, 125, 8798  
*Angew. Chem. Int. Ed.* 2004, 43, 4782Fukuyama, T. and coworkers  
*Angew. Chem. Int. Ed.* 2017, 56, 1549Yokoshima, S. and coworkers  
*Angew. Chem. Int. Ed.* 2020, 59, 6253Du Bois, J. and coworkers *J. Am. Chem. Soc.* 2003, 125, 11510

Trauner 2022 Trauner, D. and co-workers *Science* 2022, 377, 411

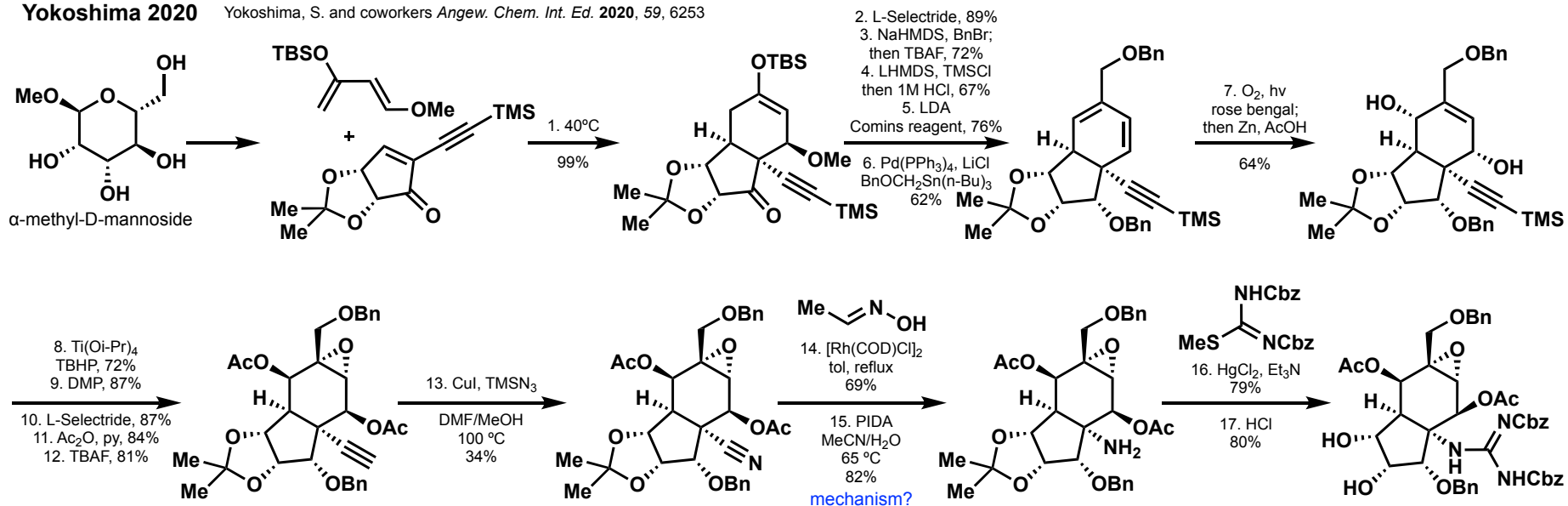
Qi 2024

Qi, X. and co-workers *Nat. Commun* 2024, 15, 679

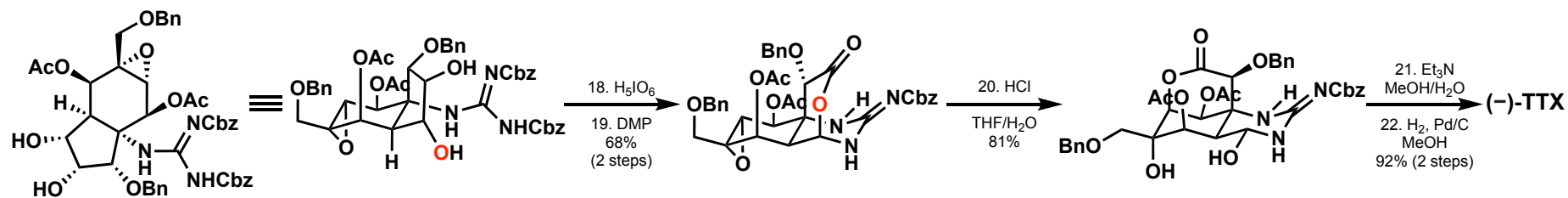
## Qi 2024 (continued)



## Yokoshima 2020

Yokoshima, S. and coworkers *Angew. Chem. Int. Ed.* 2020, 59, 6253

## Yokoshima 2020 (continued)



## Fukuyama 2017

