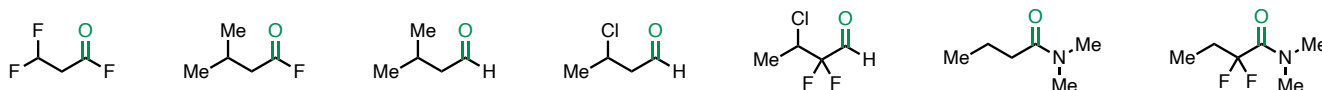
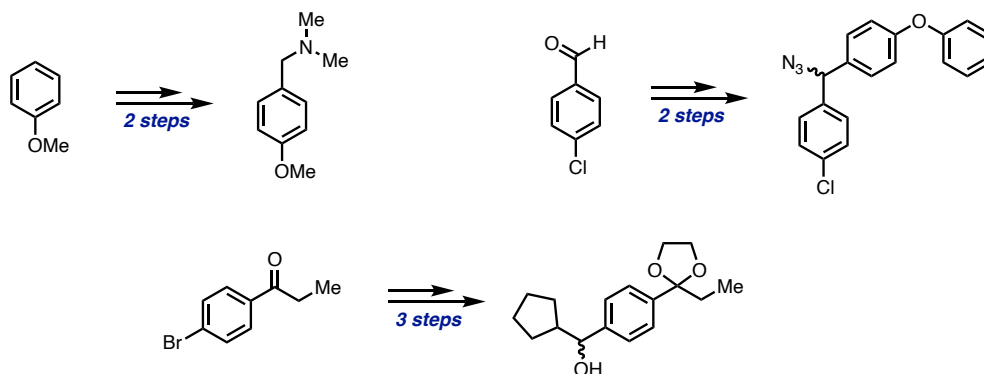


1. Order the following carbonyl compounds according to increasing electrophilicity [★]

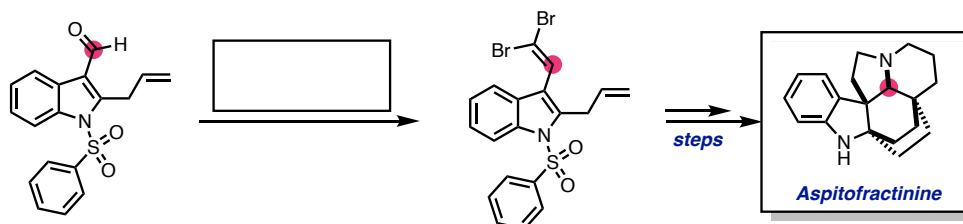


2. Suggest a synthetic strategy based on carbonyl compounds for each of the following molecules. [★★]

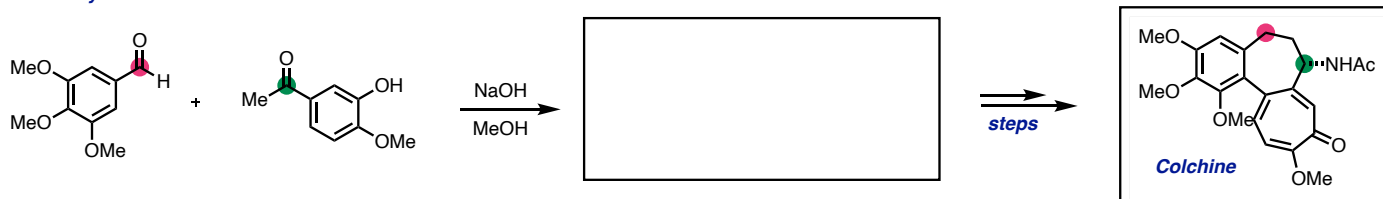


3. Complete the following reaction schemes concerning the total synthesis of aspidofractinine (*J. Org. Chem.* **2009**, *74*, 16, 6035–6041), colchicine (*Pure & Appl. Chem.* **1996**, *68*, 539–542), and leuconoxine (*Chem. Eur. J.* **2015**, *21*, 6355–6357). [★★]

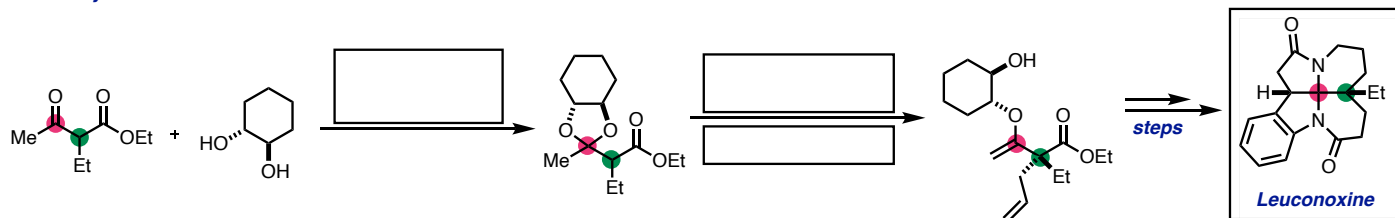
a. Total synthesis of aspidofractinine



b. Total synthesis of colchicine

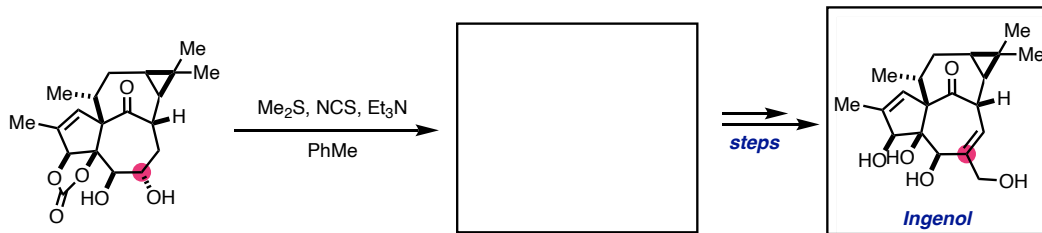


c. Total synthesis of leuconoxine

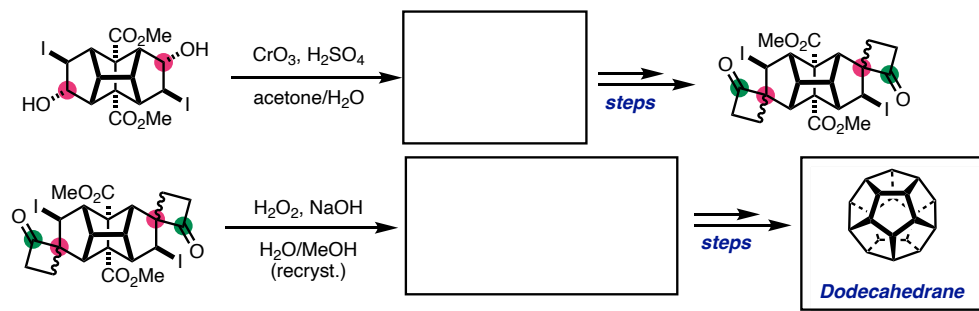


4. Complete the reaction schemes. Regarding the total synthesis of ingenol (*J. Am. Chem. Soc.* **2003**, *125*, 1498–1500): (a) propose a mechanism for the Corey-Kim oxidation reaction; (b) suggest a reason for the selectivity. Regarding the total synthesis of dodecahedrane (*J. Org. Chem.* **1979**, *44*, 3616–3630): (a) rationalize the selectivity in the migration step of the Baeyer-Villiger oxidation. Regarding the total synthesis of echinopine A (*Org. Lett.* **2013**, *15*, 1978–1981): (a) suggest a mechanism for the cascade reaction; (b) what is the name reaction involved? [★★] [NCS, *N*-chlorosuccinimide]

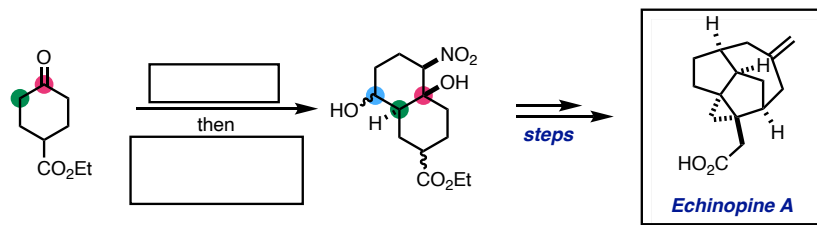
a. Total synthesis of ingenol



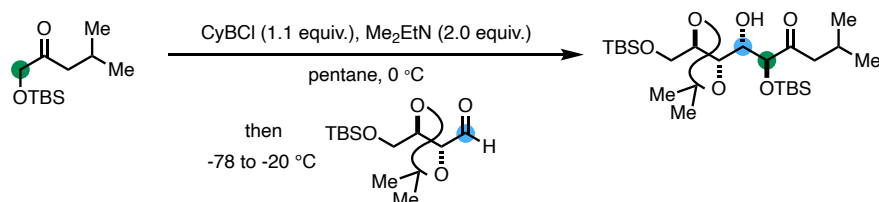
b. Total synthesis of dodecahedrane



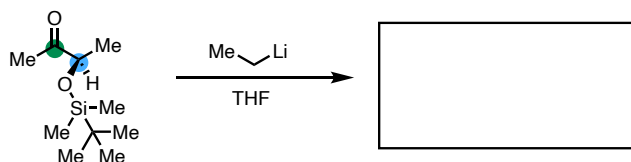
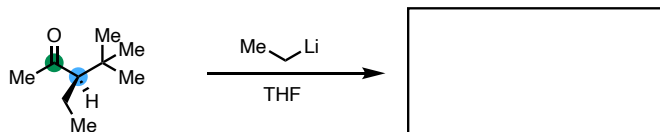
c. Total synthesis of echinopine A



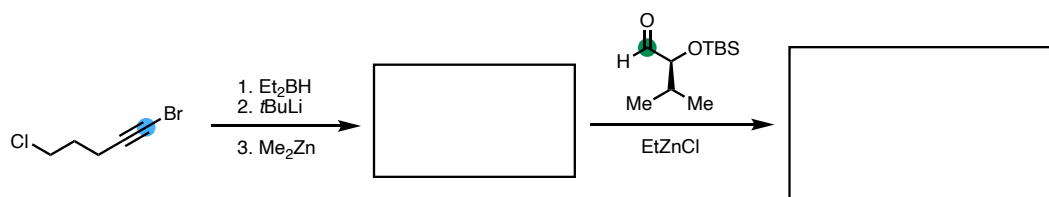
5. In the context of the total synthesis of aflastatin A (*J. Am. Chem. Soc.* **2022**, *144*, 19953–19972), Beiger and co-workers observed the following stereoselectivity in the following aldol reaction. Rationalize the stereochemical outcome. [★★★] [Suggestion: the reaction proceeds *via* (*E*)-enolate.] [TBS, *tert*-butyldimethylsilyl]



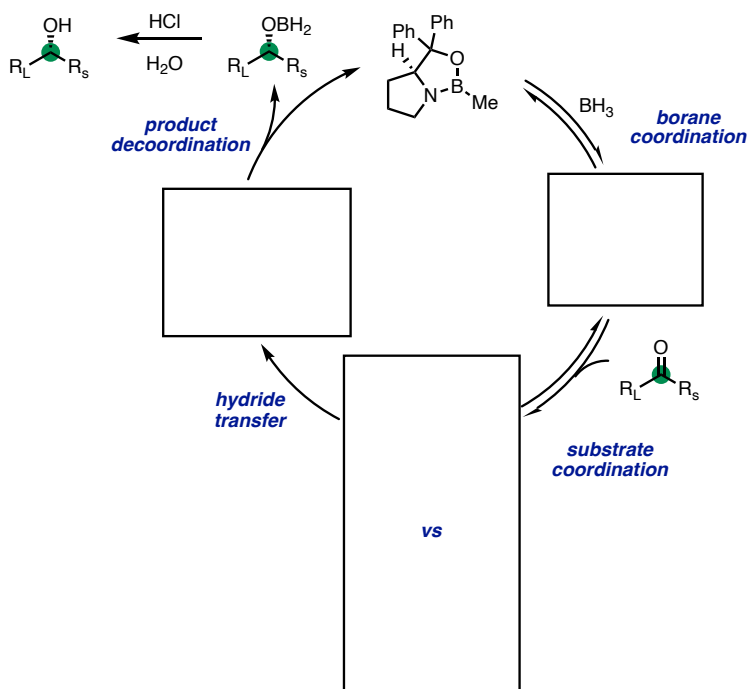
6. Predict the major diastereoisomer of the following carbonyl addition reactions and rationalize it according to the Felkin-Ahn model. [★★]



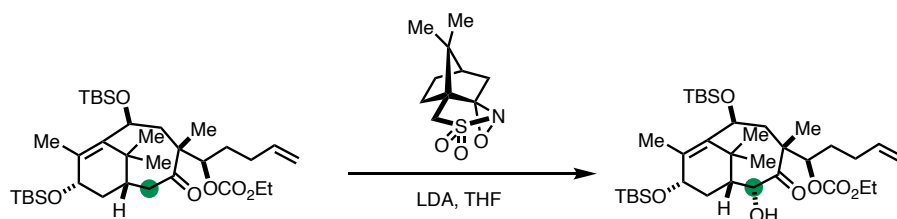
7. Walsh and co-workers reported the following carbonyl addition (*J. Am. Chem. Soc.* **2010**, *132*, 4399-4408). Complete the reaction scheme and rationalize the stereoselection. [★★] [TBS, *tert*-butyldimethylsilyl]



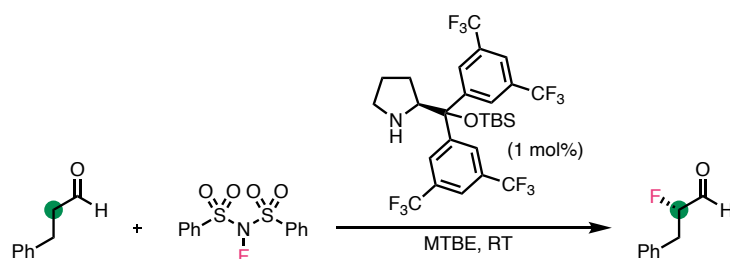
8. Complete the stereoselection model for the Corey-Bakshi-Shibata reduction and suggests which step is decisive for enantioinduction (*J. Am. Chem. Soc.* **1987**, *109*, 5551-5553). [★★] [R_L , large substituent; R_S , small substituent]



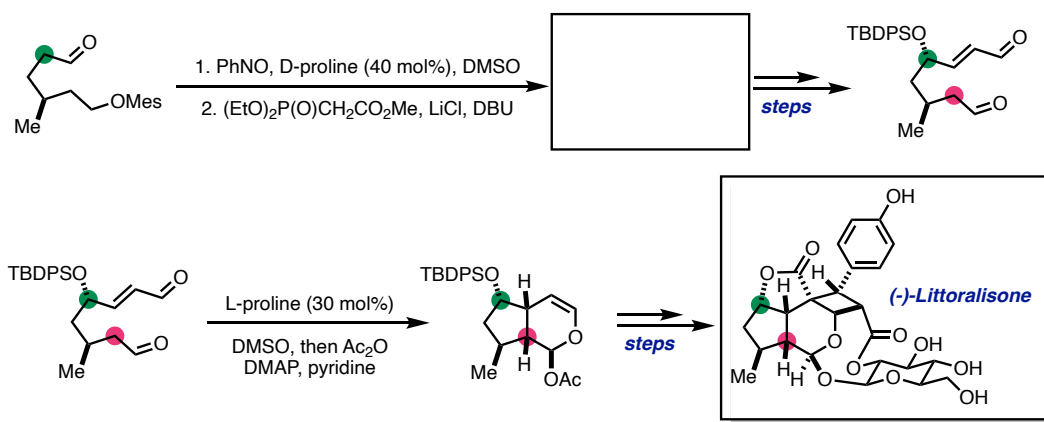
9. Suggest a mechanism for the following transformation (*J. Am. Chem. Soc.* **1994**, *116*, 1597-1598). What is the name of the transformation? [★★]



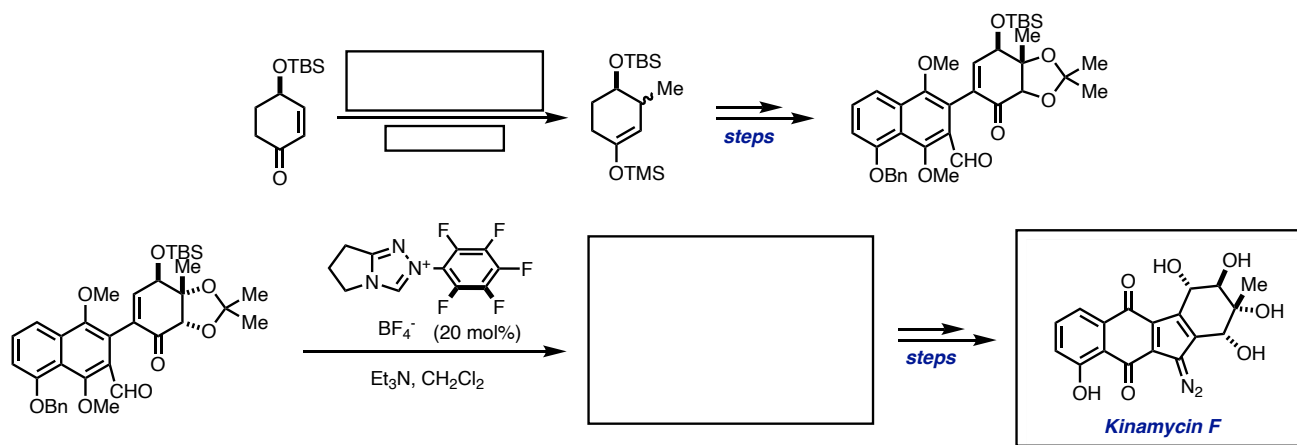
10. In 2005, Jørgensen and co-workers (*Angew. Chem. Int. Ed.* **2005**, *44*, 3703-3706). published the following enantioselective fluorination of aldehydes. Propose a mechanism and the origin of enantioselectivity. [TBS, *tert*-butyl-dimethylsilyl; MTBE, methyl-*tert*-butyl ether] [★★]



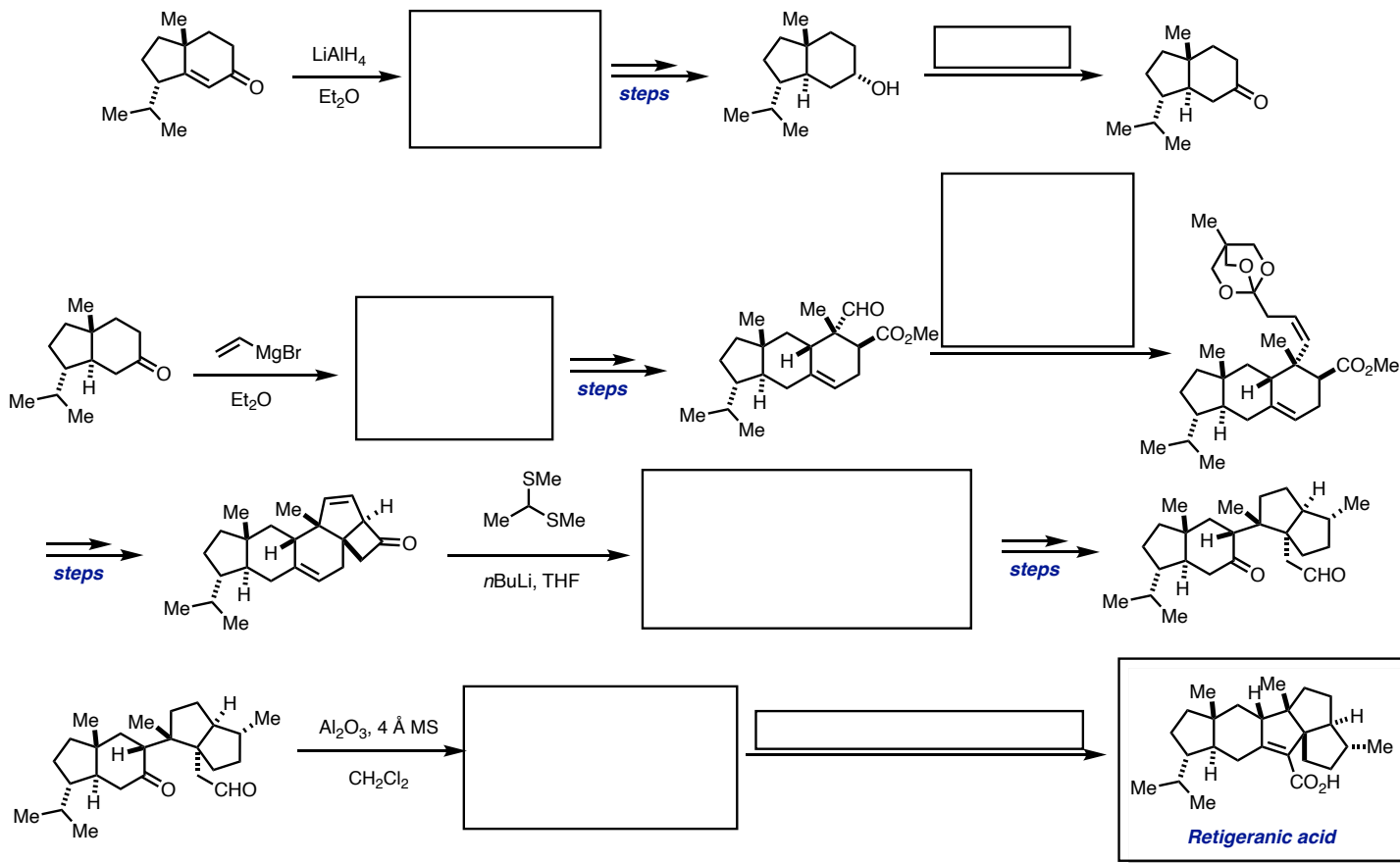
11. MacMillan and co-workers reported the total synthesis of littoralene (*J. Am. Chem. Soc.* **2005**, *127*, 3696-3697) using multiple organocatalyzed transformations. Complete the reaction scheme and provide a mechanistic hypothesis for the second reaction. [TBDPS, *tert*-butyl-diphenylsilyl; DBU, 1,8-diazabicyclo[5.4.0]undec-7-ene, DMAP, *N,N*-dimethylaminopyridine] [★★]



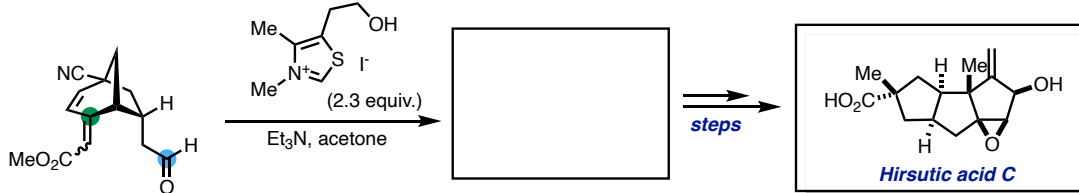
12. Complete the following reaction scheme, part of the total synthesis approach towards Kinamycin F by Nicolaou and co-workers (*J. Am. Chem. Soc.* **2007**, 129, 10356-10357). [TBS, *tert*-butyl-dimethylsilyl; TMS, trimethylsilyl] [★★]



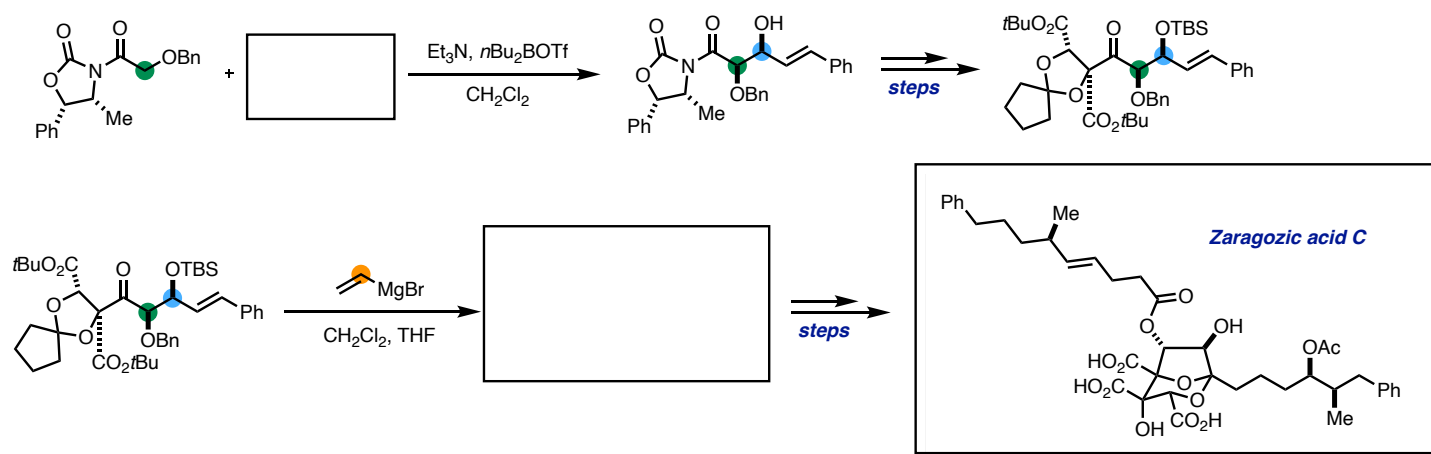
13. Complete the following scheme, which summarizes some steps of the total synthesis of retigeranic acid by Corey and co-workers (*J. Am. Chem. Soc.* **1985**, 107, 4339-4341). What is the name of the last reaction? [★★★]



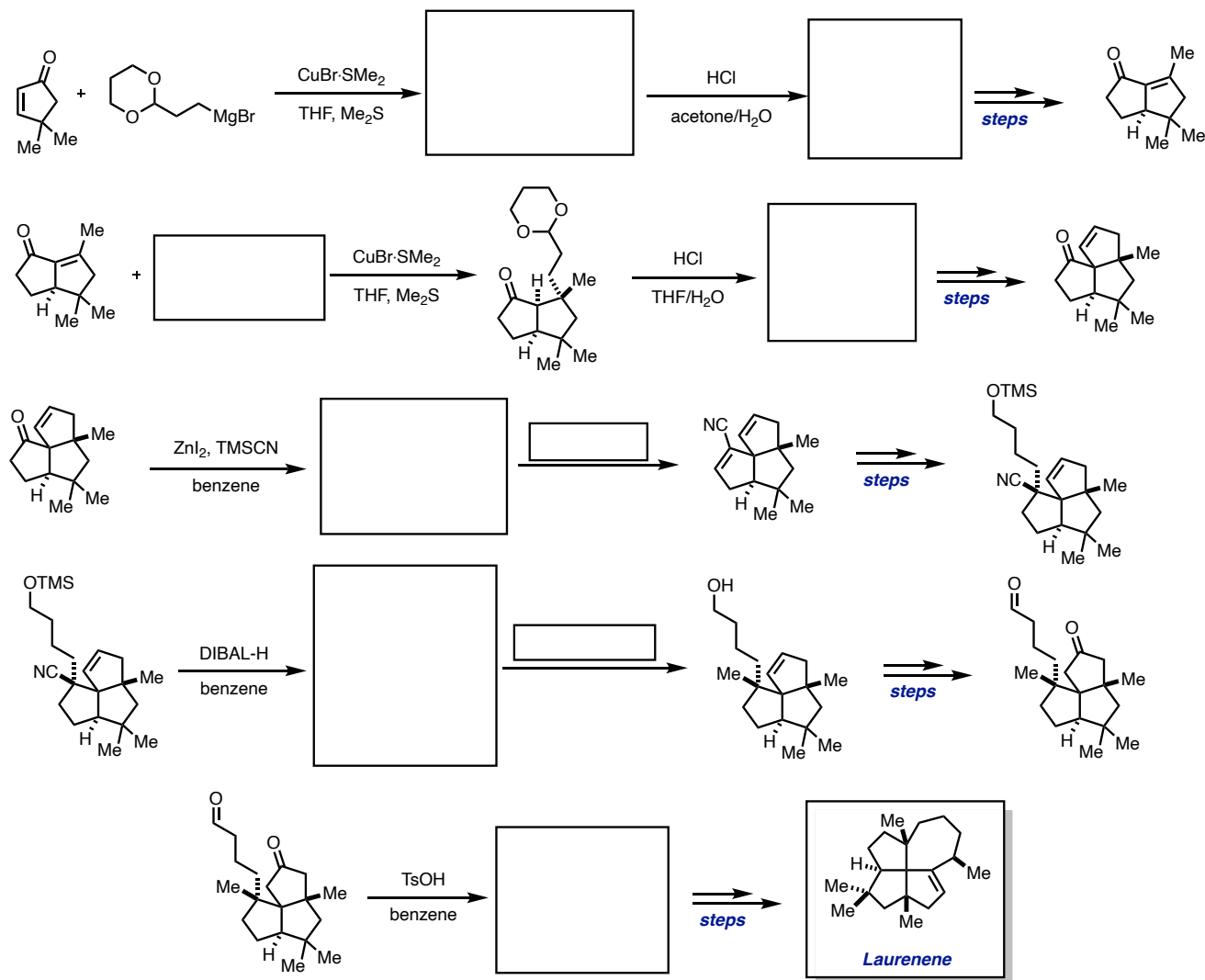
14. Complete the following scheme, part of the racemic total synthesis of hirsutic acid C by Trost and co-workers (*J. Am. Chem. Soc.* **1979**, *101*, 1284-1285) and propose the reaction mechanism. [★★]



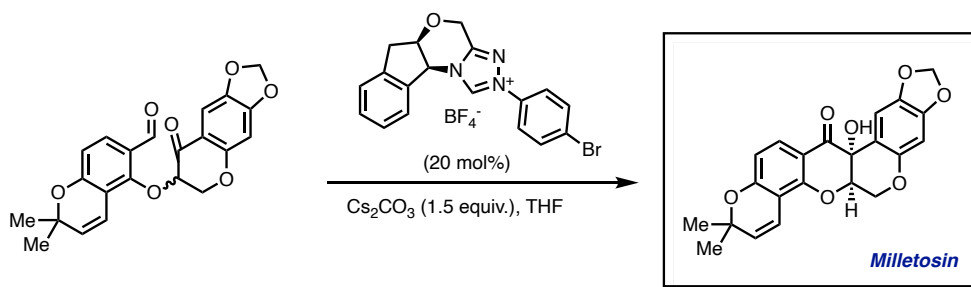
15. In 1994, Evans and co-workers achieved the total synthesis of zaragozic acid C (*J. Am. Chem. Soc.* **1994**, *116*, 12111-12112). Please complete the following scheme and propose two models for the diastereoselection observed at each step. [★★★]



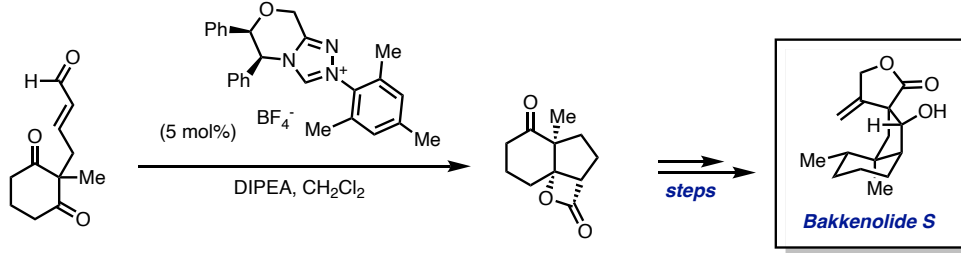
16. Complete the following formal total synthesis of laurenene by Paquette and co-workers (*J. Org. Chem.* **1988**, *53*, 477-481). [★★★★] [DIBAL-H, diisobutylaluminum hydride; TMS, trimethylsilyl]



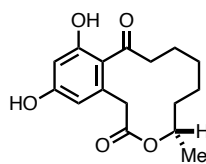
17. Fang and co-workers reported the total synthesis of milletosin (*Commun. Chem.* **2019**, *2*, 8). Propose a mechanism for the transformation. Explain why the yield of the transformation is higher than 50% (60%). [★★]



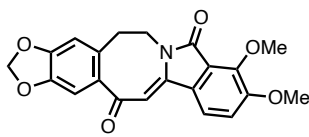
18. Scheidt and co-workers reported the total synthesis of bakkenolide S (*Org. Lett.* **2010**, 12, 2830-2833). Propose a mechanism for the transformation. [★★] [DIPEA, diisopropylethylamine]



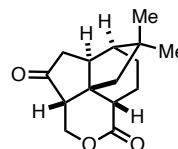
19. Highlight the carbonyl group that is the most susceptible to nucleophilic addition in the following molecules. [★★]



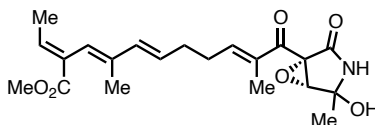
Curvularine



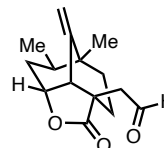
Magallanesine



Quadrone



Epolactaene



Upial