A Concise, Efficient and Scalable Total Synthesis of Thapsigargin and Nortilobide
Dezhi Chen and P. Andrew Evans, J. Am. Chem. Soc. 2017, 139, 6046 - 6049

1) tBuOCl
2) DIBAL-H then TBSCI
3) Pd₂dba)_3•CHCl₃, (S)-BINAP, LiCl, then B, LiHMDS

4) O₃, PPh₃, then piperidinium acetate
5) VCl₃(THF)₃, Zn, HMPA

6) Co(acac)₂, PhSiH₃, O₂
7) Ac₂O, DMAP
8) Pd(OH)₂/C, H₂, then IBX, then NaBH₄

Name of A?
Mechanism of step 3?
Mechanism of step 4?
Mechanism of step 5? How do you explain the stereoselectivity?
Mechanism of step 6?
How would you synthesize this ketoester?
9) (PrCO)₂O, DMAP, then CrO₃
10) Mn(OAc)₃, C₇H₁₅CO₂H

Mechanism of step 10?
What other conditions could accomplish the same transformation?

11) Zn(BH₄)₂
12) G, NaHCO₃

**Bonus question - 'Thapsigargin Wars' Edition:**
Some great chemistry from Baran and Massanet is featured in a competing short, scalable synthesis of (−)-thapsigargin (*ACS Cent. Sci.* 2017, 3, 47-51). What are the conditions and mechanism?