Enantioselective Total Synthesis of (+) and (–)-Nigellamine A$_2$
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1) MeMgBr (3.3 eq.)
2) TBSCI (1.0 eq.), imidazole
3) n-BuLi, CICOCH(CH$_3$)$_2$
4) HF・py
5) I$_2$, PPh$_3$, imidazole
6) NaCH(CO$_2$Et)$_2$

7) LiHMDS, Pd$_2$(dba)$_3$, S-1
8) I$_2$
9) (i-Pr)$_3$SiCCSO$_2$CF$_3$, λ = 300 nm, (Bu$_3$Sn)$_2$
10) Bu$_4$NF
11) DIBAL-H
12) NaBH$_4$
13) Cp$_2$ZrCl$_2$, AlMe$_3$, H$_2$O, –18 °C (36 h) to –5 °C (12 h) then I$_2$ at –20 °C
14) 2,6-lutidine, (t-Bu)$_2$Si(OTf)$_2$

7) conceptualize the reaction, can you explain the regiochemistry? *hint: not sterics*

13) Note: water forms a thermodynamically unstable but highly catalytically active species
15) PdCl$_2$(dpf) cat., 2
16) Bu$_4$NF
17) Cp$_2$ZrCl$_2$, Al$_3$Me, H$_2$O, then I$_2$
18) PCC, 4 Å MS
19) CrCl$_2$, Ni(acac)$_2$ cat., sonication
20) DMP
21) LiAlH(i-Bu)$_2$ t-Bu
22) LAH
23) NEt$_3$, BzCl
24) 3, oxone, K$_2$CO$_3$, Bu$_4$NHSO$_4$, MeCN/DMM
25) Nicotinic acid, DCC, DMAP

ent-Nigellamine A$_2$

19) Please draw the mechanism.

24) what is the catalyst derived from? what is the mechanism? Do you know the Name?