Our research program is focused on designing chiral reagents and catalysts for applications in asymmetric synthesis. The targets have structural features that may result in complementary reactivity and/or improvements in stereoselectivity over known reagents, but have been difficult to synthesize by previous methods. Our intention is to develop viable routes to these materials to allow their systematic evaluation in asymmetric synthesis. To date we have developed routes to phenanthroline-derived N-heterocyclic carbene (NHC) ligands as in complex 1, L-proline derived imidazolones (e.g., 2), tertiary aminoferrocenes (e.g., 3), and planar chiral N-ferrocenyl imidazolones (4). Stereoselective synthesis of the latter molecules has resulted in iridium complexes bearing unusual NHCs (e.g., 5) that catalyze asymmetric hydrogenation of quinolines at low hydrogen pressures (1-5 atm). A survey of results in all of these areas will be presented.