The synthesis of chiral, optically pure compounds still remains the challenging field of organic chemistry. Developing methods of obtaining desired stereoisomer is an essential task in pharmaceutical and cosmetics, where many commonly used compounds have enantiomers (or diastereoisomers) exhibiting different organoleptic properties or biological activities. Among the variety of approaches to synthesize chiral molecules, the asymmetric synthesis is one of the most effective in terms of yield and economy.

The aim of presented research was to obtain chiral, enantiomerically pure organophosphorus aziridines: previously synthesized phosphine oxides and newly obtained phosphines and also to prove their high catalytic activity in the following asymmetric transformations:

1) Mannich reaction with benzaldehyde derivatives, *p*-anisidine and hydroxyacetone (organocatalysis)

2) Friedel-Crafts alkylation of indoles by *trans*-β-nitrostyrene, leading to important building blocks to synthesis of potential drugs (cooperation between ligands and copper (I) triflate)

3) Zinc-mediated reactions with chiral ligands:

a) addition of diethylzinc to aromatic and aliphatic aldehydes,

b) Simmons-Smith cyclopropanation.

4) Morita-Baylis-Hillman reaction with such substrates as: benzaldehyde derivatives, methyl vinyl ketone and methyl acrylate.

5) Intramolecular Rauhut-Currier, leading to chiral dihydrocoumarins.

In the second part of the thesis, the results of biological research are collected. The investigations on phosphinoyl- and phosphinoaziridines were performed in terms of antibacterial and cytotoxic activity.