CHAPTER 7

ECONOMIC SIGNIFICANCE OF ASYMMETRIC CATALYSIS

INTRODUCTION

The commercial significance of asymmetric synthesis is enormous, not only are questions of economy involved but the necessity of obtaining enantiomerically pure compounds for the pharmaceutical industry is no longer a matter of convenience, it is a matter of law. The classic example of thalidomide has not gone unnoticed; the S-enantiomer causes malformations, the R-enantiomer does not. The racemic mixture was sold. There are numerous, less tragic, examples of this kind which makes asymmetric catalysis the method which is likely to dominate synthetic strategies in the drug and food industries in the 1990's.

This Chapter deals with those aspects of asymmetric catalysis which are relevant to industry. We include a number of purely organic examples of asymmetric catalysis which we have not dealt with previously. Notable among these is the use of alkaloid bases and amino acids in asymmetric catalysis. We also give a list of chirois i.e. chiral starting materials, which are precursors for a number of important industrial products.

1. Economic Advantages of Asymmetric Synthesis

Dependence of the odor, flavor, nutritional efficacy, physiological, pheromonal and pharmacological activities, and the toxicity on the absolute configuration of the effector molecules has made the preparation of chiral compounds in enantiomerically pure forms a virtual necessity. To accomplish this goal synthetic chemists have two methods at their disposal, resolution and asymmetric synthesis. Resolution is an inefficient method for the preparation of optically pure compounds even when it is carried out early in the synthetic sequence and the recovery of the resolving agent is effective, unless both enantiomers of the product molecule are usable or an effective recycling of the undesired enantiomer is available. Therefore, asymmetric synthesis is the method of choice since, in the case of a high degree of asymmetric induction, it permits the conversion of up to 100% of the prochiral substrate to a single enantiomer of the product.

The most effective asymmetric syntheses are those using
asymmetric catalysts or enzymes, although there are notable exceptions. This art, however, is in a formative stage with few catalytic asymmetric processes giving the products with an enantio­meric excess above 90%. Such processes would be ideal for industrial applications.