XI. MECHANISM OF ENZYMATIC REACTIONS*

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RESEARCH OBJECTIVES

In recent years, considerable effort has been expended in the elucidation of biochemical mechanisms utilizing physical chemical techniques. This project, while still making use of general physical chemical techniques, is primarily concerned with kinetic studies of chemical reactions of biochemical interest. A number of techniques have recently been developed which permit the study of chemical reactions with half-times as short as 5×10^{-10} sec.[1] The advantage of being able to carry out kinetic studies over an extended time range is that the entire course of a chemical reaction can be observed. Since reaction intermediates are directly detected, detailed chemical mechanisms can be obtained.

The work that is being done can be roughly divided into two classes: the study of model systems, and the study of biological systems themselves. By studying relatively simple model systems, complex biological processes can be better understood. In this connection, studies of the interaction of metal ions with amino acids, peptides, phosphates, and polymers have been carried out[2] in an effort to understand the role of metal ions in enzymatic catalysis. Since macromolecules are necessary for almost all biological processes, chemical relaxation processes of simple polymers, polypeptides, proteins, and polynucleotides are being examined, particularly with regard to the possibility of fast conformational changes. "Stacking" interactions of small molecules (e.g., acridine orange) with macromolecules are also being investigated.

In addition to model systems, several enzymatic systems are being studied. Results are already available in two cases, aspartic aminotransferase and ribonuclease.[3,4] Some detailed information about the nature and number of reaction intermediates has been obtained. As a result, considerable insight into the elementary steps in enzyme mechanisms has been gained. Since the structural determination of macromolecules is now feasible, it should ultimately be possible to understand enzymatic mechanisms on a molecular basis.

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References

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