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LABORATORY OF PHYSICAL CHEMISTRY OF ENZYMES

Head: Dr. Tatsuo Ooi

In 1966, when nineteen research sections were set up in this Institute on the basis of the Ordinance No. 4 of the Ministry of Education, Dr. Keiichi Sisido, who had been the Head of Sisido Laboratory in this Institute since 1946, moved to this section, and continued his research works besides his principal responsibility of the Department of Industrial Chemistry, Faculty of Engineering of Kyoto University until his retirement in 1971. With the collaboration of the staff members of the Industrial Chemistry, the activities of his laboratory to cover the chemistry of natural products and organometallic compounds as a part of Organic Chemistry had been focused mainly on the synthesis of fragrant materials and related compounds as well as organotin. Also, the fundamental aspects of organic reactions were investigated. Papers published after 1967 till the end of his laboratory are given in the end of this description.

The Institute moved to Uji campus in 1968, when Dr. Tatsuo Ooi was appointed as professor of Kyoto University and established his own laboratory of Physical Chemistry of Enzymes in this Institute. The research projects since then have been to elucidate the mechanism of protein functions on the molecular basis, or how specific functions of protein molecules could be explained by the three dimensional structures. There are several approaches to this important problem in one of the research fields of Molecular Biology and Biophysics, and the problem has been studied experimentally and theoretically with various methods.

One of the projects is concerned with the folding of a polypeptide chain into the native structure which is definitely determined by the primary structure encoded from the genetic code in DNA. Renaturation experiments on ribonuclease A and T_1 have been performed to look for the folding pathway in addition to the physico-chemical studies on the stability of the tertiary structures of these proteins. Theoretical works on conformational analyses by utilizing the known atomic coordinates of proteins determined by X-ray crystallography have been another approach to the problem. The postulate that the native three dimensional structure of a protein is thermodynamically stable will be examined by computations of the sum of atomic interactions.

Second, architecture of assemblies of protein molecules is an interesting problem related to the generation of higher functions such as regulation of the enzymatic activity. Since the contractile system of muscle proteins is a good example, the research project on this aspect has been concentrated to one of the muscle proteins, tropomyosin which is a rod-like molecule of 400 A in length. Studies have been done on the stability of this molecule and the binding to actin and troponin, other muscle proteins capable to interact specifically with tropomyosin. Efforts are now paid to identify the location of the interacting sites in the molecules.

Finally, studies on synthetic polypeptides, the basic materials of proteins, have been carried out, since the importance of such studies has been illustrated by the formation of specific secondary structures, α-helix and β-structure depending on the species of amino acids. The synthesis of regular copolypeptides of L-alanine and glycine and the characterization of the polymers have been achieved. Recently the synthesis was in success on copolymers of a given polymerization degree, physico-chemical investigations of which are now in progress.

Publications in this laboratory during the period from 1968 to 1976 are listed below.

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