Meetings

Organization of Energy-Transducing Membranes: Report of a Joint Japan–United States Seminar

The interest of participants of this seminar (held in Tokyo, 22 to 26 May 1972) quickly focused on the adenosine triphosphatase ion carrier protein that is now thought to reside in the membrane, and on the growing arsenal of methods by which to get at the properties of this protein. Historically, the basis for understanding this sort of system originated in the study of the Na^+,K^+–dependent adenosine triphosphatase of erythrocyte membrane, and such knowledge was updated in papers by M. Nakao (Tokyo Medical and Dental University), R. Post (Vanderbilt University School of Medicine), R. Blostein (Royal Victoria Hospital, Montreal), J. Hoffman (Yale University), and D. C. Tosteson (Duke University). Valuable uses of various chemical probes for study of the Na^+,-K^+–adenosine triphosphatase mechanism were reported by K. Nagano (Tokyo Medical and Dental University), H. Matsui (Kyorin University Medical School), and M. Fugita (Tokyo Medical and Dental University). However, the fast strides made by those studying the Ca^{2+} pump in sarcoplasmic reticulum (SR) were illustrated in two highly original papers. In one, Y. Tonomura (Osaka University) gave a complete account of the pump reversal, that is, the synthesis of adenosine triphosphate (ATP) by dissipation of the Ca^{2+} gradient; and G. Inesi (University of the Pacific) reported several new features of the pump and its environment as revealed by fast kinetic and magnetic resonance spectroscopy, and also reported the discovery of a peptide complex capable of conducting Ca^{2+} across the membrane. In addition, B. Harigaya (Tanabe Seiyaku Company, Saitama, Japan) and Y. Ogawa (University of Tokyo) reported on the properties of the SR transport system. The report by D. R. Sanadi (Boston Biomedical Research Institute) of the isolation of "ATP synthetase" appeared to be a major advance in understanding mitochondrial function, and stimulating new concepts of mitochondrial membrane organization were developed by L. Packer (University of California, Berkeley) with evidence obtained by freeze-fracture electron microscopy and the use of nitroxide hydrocarbon spin labels as probes of the role of lipids in membrane structure. Present knowledge about the analogous adenosine triphosphatase and pyrophosphate energy transduction in bacterial chromatophore membranes was summarized by T. Horio (Osaka University); and B. Hagihara (Osaka University) and S. Muraoka (University of Tokushima) described important in situ studies of energized cytochrome b of the respiratory chain. New results on thermal chloroplast functions were presented by Y. Mukohata (Osaka University). Important studies on the permeability of artificial membranes (Tosteson) and natural membranes of mitochondria (K. Utsumi, O. Hatase, and T. Oda, all of Okayama University Medical School) and chloroplasts (S. Murakami, University of Tokyo) were reported. A promising characterization of the synaptic membrane by fluorescense probes was made by K. Nagai (Osaka University). Contraction and translocation appear to differ from ion transport in chemical mechanism (especially in the nature of the intermediate); nevertheless, membrane studies may be enriched by the paper by J. Duke and M. F. Morales (both of the University of California School of Medicine, San Francisco) on ATP analogs and other probes of the contractile system. Work by G. R. Schonbaum, J. Tavares de Sousa (both of the University of California, Berkeley), Packer, and Utsumi on thiophosphate may prove reciprocally important. In the same vein, F. Morita and K. Yagi (both of Hokkaido University, Sapparo) gave a progress report on their pioneering work on tryptophan in the "moving part" of the contractile machine. The account by I. Kajiro (University of Tokyo) of the sequence of chemical events in guanosine triphosphate–dependent translocation in initiation of ribosomal protein synthesis was so lucid that the sequence could well be compared to the energy cycle in membrane and muscle systems.

A unique feature of complexity of control functions is the highly specific adenine nucleotide translocation mechanism of the inner mitochondrial membrane, reported on by Packer. The relation of this mechanism to the ATP synthetase–adenosine triphosphatase complex is still obscure.

A consensus was developed on the underlying catalytic mechanisms of energy transduction involving the reversible ATP synthetase system. This system functions in different directions in different membranes, a fact that points out the importance of the membrane asymmetry problem. Better knowledge of the structural organization of the adenosine triphosphatase complex is needed.

The experiments on phosphorylation and conformational change, reported at the meeting, point to common mechanisms of energy transduction. These presentations made clear that a better understanding of lipid and protein structure in the membrane is necessary for the clarification of energy transduction.

In this report it is only possible to single out a few highlights, and not necessarily the papers of most lasting impact. The program consisted of 28 papers, and it was punctuated by lively and profitable discussions. The seminar was sponsored by the National Science Foundation and the Japan Society for Promotion of Science under the Joint United States–Japan cooperative science program and was organized by the authors of this report, who will edit the published proceedings.

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