Meetings

Biological Membrane Structure and Function

A workshop on functional aspects of the interrelations between lipids and protein components of biological membranes was held in Honolulu, Hawaii, 11 to 15 February 1974, at the East-West Centre for Cultural and Technical Exchange of the University of Hawaii. J. K. Raison, A. D. Keith, and J. A. Mann coordinated the workshop under the auspices of the United States/Australia Agreement for Scientific and Technical Cooperation, and financial support was provided by the U.S. National Science Foundation and the Australian Department of Science. Scientists attending the workshop presented papers in several areas relevant to biological membranes. The areas, speakers, and topics are summarized below.

The relation of membrane lipid phase transition to membrane function was discussed by C. F. Fox, J. A. Mann, E. J. McMurchie, and J. K. Raison. It was generally agreed that there is a coincidence between temperature-dependent lipid phase transitions in membranes and alterations in membrane-related functions. Examples include certain enzyme activities, membrane transport, and oxygen utilization. This suggests that even complex physiological activity may be rate-limited by a single protein species functioning in specific membranes. There remain the questions of whether the lipid phase transition involves order-disorder or phase separation and how the phase transition is communicated to the protein moiety.

Application of nuclear magnetic resonance, electron paramagnetic resonance, and fluorescent probes to membrane studies was the subject of a session dealing with the state of development of these methods in approaching membrane-related problems. O. H. Griffith, T. Gunter, P. Jost, A. D. Keith, L. Piette, and J. Vanderkooi presented papers. Several investigators reported using spin-labeling techniques to provide information about the physical properties of highly localized environments within the cell. For example, it was shown that water has a very high viscosity within cells containing large quantities of membranous material, compared to prokaryotic cells or aqueous solutions. Other reports dealt with membrane profiles obtained by localized lipid viscosity and dielectric measurements with spin-labeling methods. Pyrene, a fluorescent probe, was shown to provide information about diffusion within membrane lipid phases.

K. Blaisie, D. Deamer, and L. Packer discussed the application of x-ray diffraction and electron microscopy to the analysis of membrane structure. Direct evidence for asymmetry in membrane profiles, probably due to asymmetric placement of protein within lipid bilayers, was obtained by x-ray diffraction techniques. X-ray methods were also used to localize water within lipid bilayer structures. In a few relatively simple systems, freeze-etch microscopy demonstrates functional proteins embedded within the lipid matrix of membranes. Future studies will be directed toward assigning function to particles found in more complex membranes, such as mitochondria and chloroplasts, and understanding the significance of particle distribution. One step in this direction is the application of computer techniques to the analysis of particle grouping within freeze-fracture planes.

Chloroplast membranes were discussed by D. G. Bishop, N. K. Boardman, D. J. Goodchild, and L. Packer. Considerable attention was given to the particles revealed within chloroplast membranes by freeze-etch microscopy. The significance of the particles is still unknown. There is some evidence that under laboratory conditions the particles may aggregate and disperse during dark-light cycles, but there is no corollary of this in leaf tissue. In other work reported, it was shown that polyene antibiotics inhibit electron transfer in chloroplasts, probably mediated by loss of plastocyanin from the membranes.

G. B. Cox, W. H. Elliot, C. Schnaitmann, W. Snipes, and A. J. Wicken reported on bacterial membranes. Efforts to relate molecular organization in these membranes to development and membrane function have progressed, as have studies of the nitrate reductase system of *Escherichia coli*. Problems related to the molecular events that take place in the virus PM2 as it undergoes membrane assembly were described, and progress in this system was reported. The membrane structure of respiratory-deficient mutants of *E. coli* has been studied. Vectorial transport of ribonuclease was reported in *Bacterium amyloliquefaciens*; the protein primary sequence is constructed on the cell interior, and the protein is then apparently extruded through the cell membrane and folds into its three-dimensional structure on the cell exterior.

Mitochondrial membranes were discussed by F. Bygrave, R. J. Guillory, A. W. Linnane, J. K. Pollak, and H. Tinberg. A method for producing yeast mitochondria with controlled unsaturated fatty acid composition was reported. These mitochondria provided additional evidence that temperature-induced phase changes in membrane lipid affect such processes as mitochondrial DNA replication, protein synthesis, and adenine nucleotide transport. A method for localizing polypeptide in mitochondrial membranes was described; it involves chemical labeling followed by gel electrophoresis. A developmental study compared enzyme function in fetal rat liver. It was shown that the inner membrane of fetal liver mitochondria was permeable to sucrose and had relatively low respiratory control. During the perinatal period a maturation process occurs which decreases permeability and increases respiratory control.

F. Hird and A. Ruoho discussed other membrane systems. The possible relation of hyperpyrexia in humans to abnormal muscle cell membranes has been studied. The adenylate cyclase of avian red cell membranes was studied in regard to its molecular interactions with hormone receptors.

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