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SELECTIVE TRANSPORT OF IONS THROUGH BIMOLECULAR PHOSPHOLIPID MEMBRANES

E. A. LIBERMAN AND V. P. TOPALY

Institute of the Problems of Information Transmission of the U.S.S.R. Academy of Sciences, Moscow (U.S.S.R.)

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SUMMARY

1. The mechanism of ion transport through bimolecular phospholipid membranes in the presence of a number of lipid-soluble substances was studied.

2. Membrane conductance sharply increases on adding these substances to a lipid solution in heptane, or to aqueous solutions separated by a membrane, if transported ions are present in these solutions. The conductance increases linearly, or with the square of the concentration of carriers.

3. At constant concentration of the carrier, the bimolecular membrane conductance depends non-linearly on the concentration of the transported ion. Conductance reaches a maximum in the region of concentrations of transported ion corresponding to the binding of approximately one-half of the carriers on the membrane surface.

4. Current–voltage curves of bimolecular phospholipid membranes in the presence of the carriers are non-linear. In solutions of low buffer capacity effects connected with the diffusion overpotential near the membrane surface are observed.

5. In the presence of certain carriers the current–voltage curves show a region with negative resistance.

6. A potential difference arises from a transmembrane concentration gradient of penetrating ions or from the carrier-charged species. This potential difference has its maximum in the same region of concentration of transported ions as the conductance.

7. Direct passage of the charged form of the carrier through the membrane and the comparatively slow increase of conductance with the concentration of carrier indicate that the ions do not pass through the "pores" in bimolecular phospholipid membrane or by "relay-race" mechanism, but are transported by mobile carriers.

8. When an osmotic pressure gradient is created by sucrose in the presence of tetrachloro-2-trifluoromethylbenzimidazole, a potential difference arises which corresponds to the charged form being carried along by water flow.

9. The conductance of thick layers of non-polar solvent is changed insignificantly on adding the carrier to aqueous solution. This is connected with the rise of spacial charge. The presence in aqueous solutions of two carriers—one of which is charged

Abbreviations: TTFB, tetrachloro-2-trifluoromethylbenzimidazole; FCCP, carbonylcyanide-*p*-trifluoromethoxyphenylhydrazone; CCCP, carbonylcyanide-*m*-chlorophenylhydrazone.