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CHARGED AND NEUTRAL ION CARRIERS THROUGH BIMOLECULAR PHOSPHOLIPID MEMBRANES

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SUMMARY

1. In order to clarify the influence of configuration of molecules on their motion within bimolecular phospholipid membranes the electrical properties of these membranes in the presence of "spherical" lipid-soluble molecules of 1,2-dicarbododecaborane (barene) derivatives were investigated. Decachlorobarene in the pH region 2-13 is an effective carrier of H^+ through bimolecular membranes, and as well as other proton carriers, is an uncoupler of oxidative phosphorylation. The mercury derivatives of barene are carriers of the halogen and rhodanide anions. Phenyldecaborane anions easily penetrate bimolecular membranes.

2. In the presence of decachlorobarene at pH higher than the pK'_2 of decachlorobarene ($pH > 12$), and at sufficiently high concentrations of I^- , Br^- and Cl^- in the presence of dibarenylmercury, the bimolecular membranes have stationary current-voltage characteristics with negative resistance. This confirms the supposition that such characteristics should be observed when the two forms of ion carrier have a charge of the same sign.

3. The N-type current-voltage curves of bimolecular membranes in the presence of tetrachloro-2-trifluoromethylbenzimidazole, copper ions and hydroxyammonium may also be accounted for within the framework of this hypothesis.

4. On the curves of dependence of current on the time after the rapid change of the fixed membrane voltage the carrier current is observed which is followed by the time dependent current of penetrating ions. The ratio of these currents depends on the concentration of the carriers and penetrating ions, the initial membrane potential difference, and the value of the potential change. In the presence of a transmembrane concentration gradient of penetrating ions the time course of these currents also depends on the direction of the electric field applied and the charge sign of the carriers and ions carried. This dependence can be accounted for by the assumption that the direction of the field determines the side of the membrane to which the charged carriers are "pressed" before the change of the fixed voltage.

5. When the carriers are introduced only into the bimolecular membranes, the current-voltage curves change with time owing to carrier leaving the membrane for the solutions. This process is accelerated by the mixing of the water solutions. When only one solution is mixed, the time course of current-voltage curves depends on the value and direction of the electric field. Such experiments enable the charge sign of the carriers in the membrane to be determined. With decachlorobarene at $pH > 12$ the