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ELECTROOPTICAL PHENOMENA IN BIMOLECULAR PHOSPHOLIPID MEMBRANES

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SUMMARY

1. Electrooptic phenomena were investigated both on unmodified bimolecular membranes and on bimolecular membranes with two different carriers.

2. On unmodified bimolecular membranes any optic effects under 100-mV voltage were not detected. In these experiments it was possible to detect the optic signal which was 30 times less than that revealed in axon membrane during action potential (under the same changes of electric field).

3. Under 200-mV voltage on the same membranes a decrease of the phase difference between ordinary and extraordinary rays by 0.1″ was detected which was 12 times less than the effect on the axon membrane in the peak of action potential (1.25″).

4. The electrooptic effect on the membrane with diphenylbarenylmercury (carrier of I^-) was the same as on unmodified bimolecular membrane; under 300-mV voltage it was 0.15″. In the presence of this carrier the conductivity of the membrane was 1500 $\Omega \cdot cm^2$ and the current–voltage characteristic of the membrane was practically linear.

5. In the presence of dibarenylmercury (carrier of I^-) providing the initial conductivity 1500 $\Omega \cdot cm^2$ and the current–voltage characteristic of N-type ("excitable" membrane) a decrease of phase difference up to 1″ under 300 mV voltage was revealed. The effect appeared only in the falling region of the current–voltage characteristic and increased approximately linearly with the field. Besides, a decrease of reflected light was detected.

Electrooptic effects on "excitable" bimolecular membranes had the same sign as similar effects on membranes of nerve fibres during the action potential and were close to the latter in value. It allowed us to suggest that optic effects during the action potential were due to the mechanism controlling the membrane conductivity.

7. The assumption was made that both in bimolecular membranes and in the axon membrane, optic effects resulted from the movement of like-charged carriers in membrane under the action of an electric field.

INTRODUCTION

Changes in birefringence of the nerve fibre were found during action potential[1–5]. This effect arose in the membranes of nerve fibres under the action of an electrical field[2].