male meiotic phenomena in the male gonads of *D. melanogaster* are strikingly similar to the reduction divisions in known hybrids, whether plants or animals. The abnormalities of the maturation division in this species, so much investigated by too purely experimental means, seem to show beyond any reasonable doubt that it is of hybrid origin. This is the more obvious because meiosis in certain other species of Drosophila to judge from the published descriptions is quite normal. It seems unfortunate that the experimentalists *pur sang* should in the main choose for investigation such freaks as the Boston fern, species of Oenothera and above all *Drosophila melanogaster*. The results of experimental work would apparently be much more permanent and convincing were the subject material less abnormal than in the cases mentioned above.

E. C. JEFFREY
LABORATORIES OF PLANT MORPHOLOGY,
HARVARD UNIVERSITY

HIGH AND LOW FREQUENCY MEASUREMENTS WITH LAMINARIA

AN interpretation of the resistance changes in *Laminaria* when bathed in solutions of NaCl, $CaCl_2$, etc., is of importance in the theory of permeability. Several possibilities exist beside alteration of the ionic permeability of the protoplasm.

(1) There may be a change in the specific resistance of the intercellular substance corresponding to its well-known hardening in calcium and the softening in sodium salts. (2) The specific resistance may remain constant while the cross section expands or contracts, as observed by Kotte in the walls of algae. Or (3) a change in the electrical capacitance of the cell surface might alter the effective impedance of the whole system.

None of these interpretations is clearly indicated by measurements taken at one frequency only, so that it seemed desirable to extend the readings made at 1,000 cycles by Osterhout,[1] both to zero frequency and to very high frequencies, in order better to locate the seat of change.

Direct current measurements were made by using magnesium metal ribbons dipping into the sea water of the electrode cups. (The Osterhout apparatus was used for holding the column of *Laminaria* discs. Sea water was kept in the end cups while the discs were bathed in various solutions.) These ribbons acted as reversible electrodes to the magnesium ions, which are present in the sea water in sufficient number to carry small currents without much polarization. They were likewise balanced by another pair of similar electrodes in the adjacent arm of the bridge.

The $CaCl_2$ curves of Osterhout were nicely duplicated with this apparatus and the direct current readings agreed exactly with 1,000 cycle ones taken alternately with the same electrodes. At 40,000 cycles the readings were about 20 per cent. lower, at the highest point, and nearly the same at death.

For very high frequencies a thermocouple ammeter-voltmeter apparatus was employed through the kindness of Dr. Kenneth S. Cole, who made the measurements. Values were obtained at the following frequencies: 6,000, 13,750, 45,500, 115,500, 375,000, 1,090,000, 10,800,000 cycles. Not enough points were obtained to construct good curves, but the essential fact was developed that while the low frequency readings rose and fell during injury, the high frequency readings showed much less change, and at 10^7 cycles the values were nearly constant through the whole run. Whether this constant value is actually that of the dead ohmic resistance must be answered by future research. It is nearly as low, however.

Meanwhile we may conclude from these results that:

(1) There is no change in the specific conductivity of either the inter- or intracellular material during treatment with $CaCl_2$ or NaCl, since the high frequency value remained constant.

(2) The changes in impedance are not due to changes of capacitance since the latter would not affect the direct current readings, which agree entirely with the 1,000 cycle values. What capacitance there is has little effect on the impedance except at much higher frequencies.

(3) Changes in cross section may occur but are not sufficient to explain the results.

We may therefore hold to the interpretation advanced by Osterhout that the observed resistance change is really a change in the permeability of protoplasm to ions. Since the resistance may rise 60 per cent. or more above the normal value in sea-water, it is evident that there must be considerable ionic exchange in the normal state. The reconcilement of this fact to the relatively low permeability of *Valonia* and *Nitella* to ions is a task toward which present experiments are directed.

L. R. BLINKS
THE ROCKEFELLER INSTITUTE
FOR MEDICAL RESEARCH

[1] Osterhout, W. J. V., "Injury, Recovery and Death, in Relation to Conductivity and Permeability," Philadelphia and London, 1922.

THE ABSOLUTE ZERO OF INTERNAL ENERGY AND ENTROPY, AND THE CORRESPONDING INERTNESS OF MATTER

THE controllable internal energy and entropy of a substance or mixture, which varies with the volume v and absolute temperature T, the writer has shown