scribed epithelial proliferation into the submucosa in the bladder in human cases of schistosomiasis hematobia, and considers it a factor in papilloma formation in that viscus.

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139 (2371)

The possible rôle of constant bioelectric currents in growth.

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In a previous note[1] it was stated that the threshold density of an electric current necessary for inhibition of growth in the ends of Obelia internodes turned toward the cathode was very nearly equal to 66 microamperes per square millimeter.

This threshold inhibition is reversible.[2] For orientation of the axis of growth a threshold current density of only 6 to 13 microamperes per square millimeter of cross section is necessary. This is therefore only about one-tenth as great as the current density threshold for inhibition. We may translate this result into its equivalent of threshold of applied difference of electric potential.

The living tissue of the stem and pieces of stem in Obelia have also been shown to be the seat of a relatively constant electric potential.[3] More recently this potential has been measured by the use of a suitable type of electrode.[4] The results show that a difference of potential exists between the inside and outside of

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[1] Lund, E. J., PROC. SOC. EXP. BIOL. AND MED., 1923, xxi, 127.

[2] Lund, E. J., *J. Exp. Zool.*, 1923, xxxvii, 69.

[3] Lund, E. J., *J. Exp. Zool.*, 1922, xxxvi, 477.

[4] Lund, E. J., PROC. SOC. EXP. BIOL. AND MED., 1923, xxi, 128.

the ecto-endoderm layer. The outside surface of the ectoderm being electro-positive to the inside surface of the endoderm. Similar potential differences are well known to occur in the skin of the frog, intestine and some other epithelial structures. The magnitude of the inherent potential in the ecto-endoderm of Obelia is greater in the apical growing point of the main stem of the colony than in the middle, and somewhat lower regions of the same stem. The same statement applies to growing branches of the colony. The result of this difference in the magnitude of the electric potentials across the ecto-endoderm in apical and more basal parts of the stem, is that when the outer surfaces of the apical and basal regions of the stem are connected to a galvanometer, a current flows in the galvanometer circuit from apical to basal parts of the isolated stem.

Now, this inherent current has certain important characteristics. (1) It is relatively constant, and therefore differs from the intermittent bioelectric currents of muscle, nerve, and electric organs of some fish. (2) It is definitely directed, *e. g.,* from inside surface of endoderm to outside surface of ectoderm. (3) Its magnitude across the ecto-endoderm has been found in actual measurements to vary approximately from 0.2 to 10 millevolts in apical pieces of the main stems of different colonies. It can be shown that this range of values is very nearly the same as the calculated range of applied threshold potentials for inhibition of growth toward the cathode. But the direction of the inherent fall of potential at the point of inhibition of growth in an internode is opposite to the direction of the applied potential.

These facts lead to the simple conclusion that inhibition of growth toward the cathode is associated with a diminution or complete neutralization of the inherent difference of potential across the ecto-endoderm by the applied E. M. F. at the point of growth.

Now since the threshold value of the applied potential for orientation of growth is only about one-tenth as great as the threshold of the applied potential for inhibition, and since the latter is nearly the same as the inherent potential across the ecto-endoderm, it follows that the inherent potential difference is approximately ten times greater than would be necessary for a perceptible orientation effect upon the growing tissue, if the inherent potential difference were to be suitably applied to the growing tissue.

It will be observed that the three characteristics named in (1), (2) and (3) above are specifically the same as those of the applied electric current which is necessary for the control of growth in Obelia internodes. In view of the above facts we are forced to a consideration of the possible rôle of such inherent bioelectric currents in the phenomena of inhibition and orientation of growth processes.

In brief the facts suggest a possible new type of mechanism for cell correlation which could conceivably be operative in the early development of animals and plants where neither a visible structural nervous system exists, nor any known specialized mechanism for the transport of chemical substances (hormones).

The detailed experimental facts upon which the statements in this note are based will be and have been in part presented in the Journal of Experimental Zoology.

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Experiments with an active extract of parathyroid.

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(by invitation).

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Recently, H. W. C. Vines has shown that calcium in normal unclotted blood is present in two forms. He found that approximately one-third of the calcium is present in a combined or non-ionized state, while two-thirds are in the ionized form. He also observed that chronic septic infections do not heal rapidly unless the ionic calcium is increased. Vines observed that the administration of dried parathyroid increased the relative ionic calcium and lead to rapid healing of ulcers.

The present authors have also observed similar effects, using an extract of parathyroid made in the following manner: 30 gm. of finely divided ox gland are boiled in 500 cc. of dilute hydrochloric acid (10 parts per thousand), cooled, filtered, and