distance from the cathodal end; the nearer the cathode, the more rapid the progression of the after effect.

3) The magnitude of the supernormal response depends, however, solely on the degree of the polar effect at the end of the previous stimulation, irrespectively of the duration or of the intensity of the first stimulation to induce it. The magnitude of the supernormal response is, in a given region of the cell body, inversely proportional to the degree of the polar effect and it becomes more marked in the region of the body farther from the cathodal tip.

4) As is suggested from the fact given above, it is convenient to distinguish the "rate" factor [(1) and (2)] from the "magnitude" factor [(3)] in the after effect, since conditions to modify these two are quite different from each other, although they are involed in the so-called after-effect of the electric stimulation. From this standpoint it may be stated that the after effect of the electric stimulation in paramecium is slow (the less in the "rate" factor) but marked (the greater in the "magnitude" factor) in the region of the body farther from the cathodal tip.

The fuller description of the present note will appear in the Journal of the Faculty of Science, Tokyo Imperial University.

Effect of Change in Orientation on the Electric Excitation in *Paramecium*

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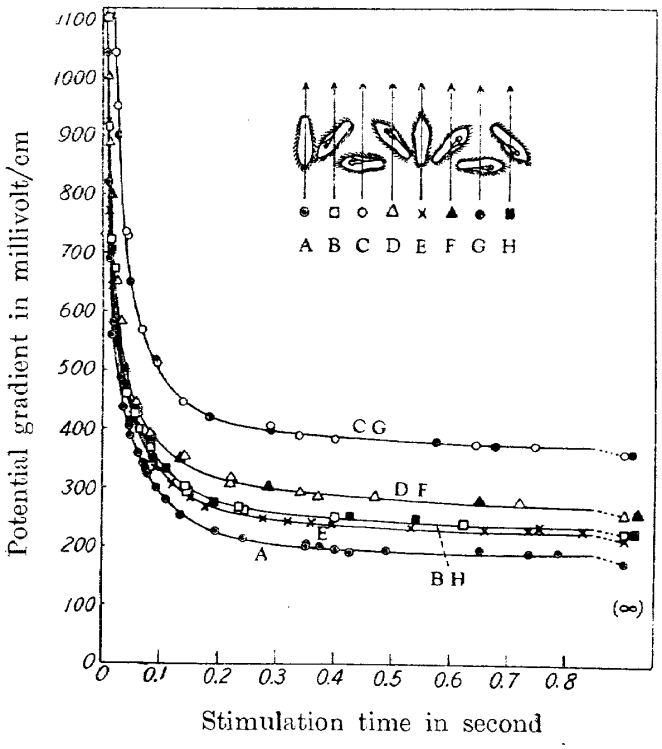
Received April 17, 1936

In nerve and muscle it has been known that the threshold intensity varies with the change in angle they make with the direction of electric current. This relation was studied in paramecium, taking the least (just detectable) make cathodal effect as an electric response. The materials and method were just the same as those employed in my previous experiment on the relation between the stimulation time and the least current intensity to get the least response (KINOSITA: Zool. Mag. (Japan) Vol. 48, p. 155, 1936). The observation was repeated under a modification in orientation angle of the animal from 0° to 360°, and thus the above-mentioned relation was studied in various duration factor of stimulation.



Effect of change in angle between current and the long axis of paramecium on the time-intensity curve for the least response. The values of intensity on the (∞) indicate the minimal threshold corresponding to the 'rheobase.' The arrows in the schema represent the direction of electric current employed. (23.5—27.0°C)

As is known from the accompanying figure, the excitability decreases when the orientation angle approaches 90° (or to 270°). However, it is very remarkable that the ratio of the intensity value at any fixed time factor is fixed in any given two time-intensity curves of different orientation angle. Therefore it may be said that the change in the orientation angle modifies only the intensity factor but not the duration factor of the electrical stimulation in paramecium. This relation was simply explained by the change in the length for the passage of the electric current in the protoplasm of the organism.

Another important fact which seems to contradict the above statement can be pointed out in the figure. In spite of having the common length of protoplasm for the passage of electric current above-mentioned, an unmistakable difference exists between the curve A (Homodrome orientation) and E (Antidrome), or the B-H group (Homodrome) and the D-F group (Antidrome). The higher potential gradient was required in antidrome orientation than in homodrome orientation to induce the same effect. This may probably be due to the fact that the physico-chemical properties underlying the electrical response is different in different region of the cell, contrary to the general belief that the time-intensity relation of stimulation is fixed in a cell (muscle or nerve) as a whole. As is seen from the figure, the above-mentioned polar difference in excitability is only in the longitudinal direction and there was proved no bilateral difference of the response.

The fuller description of this short note will appear in the Journal of the Faculty of Science, Tokyo Imperial University.