THE MECHANISM OF ORIENTATION IN GONIUM

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TWO FIGURES

Recently Mast[1] has published a paper in which he tries to account for the mechanism of orientation in Gonium, using light as a directive stimulus. In 1911 Goodspeed and I[2] published an account of the orientation of the same form under the influence of a galvanic current. Mast does not seem to have been acquainted with our article since he makes no reference to it, although he confirms in the main, our observations.

In neglecting to make a study of the stroke of the individual flagellum, Mast has failed to consider an important factor and perhaps the chief factor in the orientation mechanism of this form. It seems necessary, therefore, to call attention to the analysis of orientation in Gonium which Goodspeed and I published five years ago. Since our paper appeared in a journal not readily accessible, I quote the section dealing directly with the subject in question.

In moving through the water the Gonium colony, in general, keeps its plane perpendicular to the line of direction. This may be modified by a more or less 'wobbly' motion. In addition to the progressive movement the colony rotates in its own plane. The direction of the rotation reverses frequently, seemingly without reference to the amount of linear motion. At times the rotation is suspended for a moment, while the organisms are moving forward.

With reference to the colony, the flagella extend forward and outward. In making a stroke occasionally the entire flagellum takes part, but usually only the peripheral one-half or one-third is used, while the inner part remains practically rigid. The stroke made by the active part of the flagellum describes a cone, the effective component of which is backward. There must be in addition a secondary effective component of the flagellar stroke in order to bring about the rotary motion.

If we observe the movement of an isolated cell it will be seen to describe a circle with the anterior end, in addition to moving forward. These two simultaneous movements cause the cell to follow a spiral path. If the cell reverses the direction of its progress it turns about in a wide half circle always keeping the flagella ahead. The turning may be accomplished by the flagella in one of two ways: 1) One fla-

[1] Mast, S. O., Jour. Exp. Zool. vol. 20, p. 1.

[2] Moore, A. R., and Goodspeed, T. H., Univ. Cali. Publ. Physiol. vol. 4, p. 17.

gellum remains inactive while the other continues the normal beat (fig. 1); 2) both flagella produce the effective component on the same side (fig. 2). Nothing of the nature of a motor reflex was observed.

Now Mast accounts for orientation to a directive stimulus by supposing the zooids farthest from the source of light to increase their activity and thus to bring the plane of the colony perpendicular to the lines of the stimulating force. He assumes equal activity of the two flagella in each cell of the colony, the behavior of the cells varying only in the intensity of their activity. He does not consider the possibility which Goodspeed and I pointed out, viz.: that the turning may be accomplished by an inequality in the beating of the two flagella of each cell. This we showed to take place in the isolated cells of Gonium. In case 1 the flagellum on the kathodal side ceases beating. This type of orientation was observed by Bancroft[3] in Volvox. In case 2 the flagellum on the kathodal side reverses the direction of its effective stroke. This mode of response was observed by Ludloff[4] in Paramecia.

The orientation of Gonium may therefore be accomplished either by increased activity of the cells away from the side stimulated, as Mast assumes, or by cessation of beat or reversal of stroke of the flagellum on the stimulated side of each cell. There remains the possibility that both types of reaction may play a part in orientation.

In view of the facts presented, it is clear that any thorough analysis of the phenomenon of orientation in Gonium must include not only a consideration of the changes in the activity of the cell as a whole but also of the differences in the activity of the individual flagella of each cell.

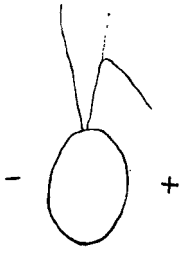

Fig. 1

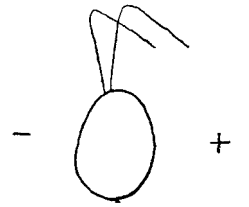

Fig. 2

[3] Bancroft, F. W., Jour. Exp. Zool., vol. 4, p. 157.
[4] Ludloff, Archiv f. Ges. Physiol., vol. 59, p. 525.