VII. ORIENTATION IN ANTS.

Detailed observations were made on ants carrying crumbs of bread and various dead insects. It was found that if the pieces carried are small, the ants pick them up with their jaws and carry them to their nest, taking a fairly direct route; but that if they are large, the ants drag or roll them and proceed backwards or sidewise. The important point is that in going backward or sidewise the ants go practically as directly toward their nest as they do when they go forward. Thus, given individuals were repeatedly observed in transporting pieces of substance to go alternately forward, sidewise and backward, without changing their direction of locomotion. That is, they continually went toward their nest when they traveled backward and sidewise as well as when they traveled forward. The fact that ants can go directly toward a fixed location in space no matter what their axial orientation may be or how this may change shows concluisvely that their direction of locomotion cannot be controlled by anything in the nature of equal or unequal stimulation of organs on opposite sides due to the action of external stimulating agents. It strongly indicates that the direction of locomotion is not directly controlled by the immediate action of anything in the environment and that the processes involved are somewhat similar to those involved in the control in higher organisms of direction of movement toward a given point in space.

THE RELATION BETWEEN RATE OF LOCOMOTION IN AMOEBA PROTEUS AND HYDROGEN-ION CONCENTRATION IN SOLUTIONS CONTAINING SODIUM, POTASSIUM, OR CALCIUM IONS IN DIFFERENT CONCENTRATIONS OR MIXTURES OF THEM

By ROBERT F. PITTS, *Johns Hopkins University*

As test solutions sodium, potassium, and calcium phosphate buffers with hydrogen-ion concentrations ranging from pH 4.2 to 8.0 were used. Constant cation concentration throughout a range of CH was obtained by adding to the primary phosphate of a given normality with respect to the cation (*e.g.*, N/100 NaH_2PO_4) a required amount of the corresponding hydroxide of the same normality (*e.g.*, N/100 NaOH) to give the desired hydrogen-ion concentration. Preliminary tests comparing phosphates and chlorides at the same hydrogen-ion concentrations seemed to indicate little or no effect due to change in the anion. The rate of locomotion was measured by camera lucida drawings of strictly monopodal specimens.

As found in previous investigations the rote of locomotion in a pure solution of a sodium, potassium, or calcium salt at constant hydrogen-ion concentration, decreases with increase in salt concentration from N/1000 to N/100. In sodium or potassium salts the rate of locomotion increases with increasing CH of the solution to an optimum and

then decreases. This optium for sodium or potassium salts in concentrations between N/100 and N/1000 is on the acid side of neutrality, the more concentrated the salt the more acid the optimum.

In calcium salts a somewhat similar effect was noted with the exception that the optima lay on the alkaline side of neutrality, and the rate of locomotion decreased with increased acidity. Much less variation in rate of locomotion with CH of the solution was noted in the work with calcium salts.

In mixtures of sodium and calcium salts and potassium and calcium salts two optima in rate of locomotion were found, one in the neighborhood of pH 6.2, the other close to pH 7.5.

It seems that in sodium or potassium salt solutions either increase in cation concentration or increase in alkalinity produce decrease in rate of locomotion, whereas in calcium salt solutions either increase in cation concentration or increase in acidity produce decrease in rate of locomotion.

THE RELATION BETWEEN LUMINOUS INTENSITY AND RESPONSE IN THE CERCARIAE OF BUCEPHULUS ELEGANS

By GERRIT BEVELANDER, *Union College*

It is well known that in many organisms an increase in luminous intensity evokes a characteristic response. If the change to which these organisms are subjected does not take place rapidly, a response usually does not occur. It is evident therefore that the reaction is dependent upon the rate of change in light intensity. Reactions of this kind are now generally known as "shock-reactions" and are characterized by the fact that the energy necessary to induce a reaction must be delivered at a certain rate.

In many organisms it is not necessary to expose the photic receptors continuously in order to induce a response. The time during which the stimulating agent must act in order to induce a response has been designated as the stimulation-period, the time during which exposure is not necessary, the latent-period. The sum of the two periods is known as the reaction-time. The present investigation deals with the relation between intensity and various phases of response to light in the cercariae of *Bucephulus elegans.*

The Relation Between Reaction-Time and Luminous Intensity.

When the luminous intensity is plotted against the average reaction-time, the resulting curve simulates an hyperbola. This clearly shows that the relation between the two is an inverse one, that is, as the one increases, the other decreases. These results are in agreement with those obtained by other investigators on organisms such as the seedlings of *Avena, Mya, Ciona, Amoeba,* etc.