movement, while those in the oral groove and the gullet continue active. As a consequence locomotion ceases; the animal comes to rest against the solid body, while the cilia of the oral groove continue to drive a stream of water to the mouth. This reaction to a solid body may be called thigmotaxis. If the loose solid body is a mass of bacterial zooglœa, the stream of water carries numbers of bacteria to the mouth, where they pass into the internal protoplasm of the animal and are digested; thus Paramecium gets its food. But the animal conducts itself in exactly the same way toward other loose fibrous bodies, such as bits of cloth, paper, sponge, or the like, the presence or absence of material that will serve as food having nothing to do with the production of the reaction. On the other hand, the substances held in solution in the water have a marked effect on the tendency of the Paramecia to react in the manner above described. If the water is faintly acid in reaction, the Paramecia are much more inclined to come to rest as just described. This is especially noticeable in water containing carbon dioxide. The presence in the water of an alkali in solution has, on the other hand, precisely the opposite effect, tending to inhibit the thigmotactic reaction.

2. Any other change in the conditions, of such a nature as to act as a stimulus, causes a definite change in the movements, which is of a stereotyped character, being of the same nature for almost every stimulus. When stimulated, Paramecium swims backward, turns toward its own aboral side, then swims forward again. The same reaction is produced by stimuli of the most varied kinds—by acids, alkalis, and neutral salts, by heat, by cold, by mechanical shock. The reaction is the same whether the stimulus first affects the anterior end, the posterior end, one side, or the entire surface of the animal at once. The direction in which the animal swims has thus no relation to the localization of the stimulus. If the stimulus comes from the anterior end, swimming backward of course carries the animal away from it; if the same stimulus comes from the posterior end, swimming backward carries the animal toward it. If an injurious chemical substance diffuses in such a way as to first come in contact with the posterior end of a resting Paramecium, the latter therefore swims backward directly into the substance and is killed. The turning is likewise without relation to the position of the stimulus. The animal always turns toward its own aboral side, so that the absolute direction in which it turns depends upon the chance position of the aboral side when the turning begins. As the animal continually revolves, both when swimming forward and when swimming backward, it is impossible to predict in which direction the aboral side will lie after the animal has swum backward a distance from its position when stimulation occurs; and observation shows that when Paramecium strikes on one side against an obstruction, it is fully as likely to turn toward the obstruction, after swimming backward, as to turn away. In the former case it of course strikes the obstruction again; the whole reaction is then repeated. Owing to the continual rotation on the long axis, the aboral side will probably be in a new position next time, so that the animal will turn in a new direction. If this repetition is continued, the Paramecium is certain finally, by the laws of chance, to avoid the obstacle.

The factors determining the direction of motion in Paramecium are thus internal; the direction of its movements has no relation to the position of external objects. This result is of fundamental significance for interpretation of the movements of these creatures, and throws a flood of light on many of the phenomena of their life. Study of some other Infusoria in the light of the result on Paramecium has shown that the