

partly by direct observation of the reaction of the living organism towards various stimuli, and partly by the comparison of the different conditions of existence under which Radiolarians exist, both in the most various depths of the ocean and in all climatic zones (see note A). In general the Radiolaria seem to be sensitive to the following stimuli; (1) pressure (see note B); (2) temperature (see note C); (3) light (see note D); (4) chemical composition of the sea-water (see note E). The reaction towards these stimuli, corresponding to the sensation of pleasure or dislike which they call forth, is shown in various forms of motion of the protoplasm, changes in the currents in it, contraction of the central capsule, changes in the size, position, and form of the pseudopodia, changes in the volume of the calymma (by the evacuation of water), &c. Among the sensory functions of the Radiolaria must be especially mentioned their remarkably developed perception of hydrostatic equilibrium (see note F), as well as their perception of distances, so clearly shown in the production of equal lattice-meshes and other regularly formed skeletal structures (see note G).

A. I can add but little to the communication which I made twenty-four years ago regarding sensation in the Radiolaria (L. N. 16, pp. 128-131). The most important point would be the great difference in irritability which must obtain between the pelagic, zonarial and abyssal Radiolaria, which may be assumed from a consideration of their very different conditions of existence as regards pressure, light, warmth, nutrition, &c. It is natural to suppose that the numerous abyssal Radiolaria, discovered by the Challenger, which live at great depths (2000 to 4500 fathoms) in complete darkness, in icy cold and under an enormous pressure, must have quite different sensations of pleasure from their pelagic relatives which live at the surface of the sea under an equatorial sun. Karl Brandt has recently added much to our knowledge regarding the special action of different vital conditions upon the various Polycyttaria and the degrees of their irritability (L. N. 52, pp. 113-132).

B. Regarding the sensation of pressure or sensation of touch of the Radiolaria and the various degrees of their mechanical irritability, see L. N. 16, p. 129; L. N. 41, p. 464.

C. Regarding the sensation of warmth or temperature-sense and its dependence upon different climatic relations, see L. N. 16, p. 129; L. N. 52, pp. 114-129.

D. Regarding the sensation of light, compare L. N. 16, p. 128; L. N. 42, p. 304; L. N. 52, pp. 102-104, 114.

E. Regarding the sense of taste of the Radiolaria or their peculiar sensitiveness towards the different chemical composition of the water, change in its salinity, presence of organic impurities, &c., see L. N. 16, p. 130; L. N. 52, pp. 103, 113. This chemical irritability seems to be the most highly developed sense in the Radiolaria, even more so than their mechanical irritability.

F. The perception of hydrostatic equilibrium among the Radiolaria is immediately visible from the position which their bodies, floating freely in the water, assume spontaneously, and from the symmetrical development of the skeleton, which by its gravitation necessitates a definite position. It may be assumed that the development of the various geometrical ground forms which correspond to a definite position of equilibrium, is the result of this particular kind of perception (compare §§ 40-45).