

chemotropism if the animal is forced to bring its axis of symmetry into the direction of the lines of diffusion, and to turn its head towards the centre of diffusion. In this orientation again, each pair of symmetrical points of the surface of the animal is cut at the same angle by the lines of diffusion. It can easily be shown that the larvæ of the fly are positively chemotropic towards certain volatile substances, which are formed in putrefying meat and cheese, but which are not contained in fat. The substances in question therefore are volatile nitrogenous compounds. The young larvæ of the fly is guided by these substances to the centre of diffusion in the same way that the moth is guided into the flame. The female fly possesses the same positive chemotropism for these substances as the larvæ, and is therefore led to the meat. On the meat chemical stimuli seem to produce in the form of a reflex the deposition of the eggs. Neither experience nor conscious choice plays any rôle in these processes.

If we raise the question, what must be contained in the egg in order to transmit this instinct, we see that again two things are necessary. First, the presence of a substance, which either is influenced directly by the above-mentioned volatile compounds contained in putrid meat, or from which such changeable substances can originate. Secondly, conditions which lead to a bi-lateral symmetry of the embryo. But neither of these two conditions presupposes any mysterious structure in the egg, such as Nägeli, Weismann and others assume.

3. A third group of instincts is represented by the periodic migrations of animals. I select as an example the periodic depth migrations of sea animals. I should have preferred the more popular instance of bird migrations, if it were not for the fact that we can experimentally analyse the migrations of sea animals, whereas the migrations of birds have not yet been, and cannot very well be, submitted to experimental research. A number of sea animals begin to migrate upwards towards the surface of the ocean in the evening, while in the morning they begin to migrate downwards. But the remarkable circumstance is, that these forms never go deeper than four hundred metres. The latter circumstance points out the light as the moving force in these deep migrations. Water absorbs light and the thicker the layer of water the more light is absorbed. It has been found that at a depth of four hundred metres a photographic plate is no longer affected. The animals which live free at the surface of the ocean, as far as I have been able to examine them, are all positively heliotropic. Those among them which undergo daily the above-mentioned periodic migration into the depth, possess some peculiarities which can only be understood if we go a little deeper into the theory of animal heliotropism.

In addition to animals that are positively heliotropic, there are others that are negatively heliotropic: they bring their median plane also into the direction of the rays of light, but turn their *aboral* poles to the source of light. The difference between negatively and positively heliotropic

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