is apparent that the instinct of the caterpillars to creep upwards after they awake from their winter sleep saves their lives. If they were not guided by such an instinct, those that crept downwards would perish from lack of food. How can such an instinct be transmitted by a single cell?

Experiments which I made eight years ago prove that the young caterpillars of Porthesia, as long as they are starving, are oriented by the light, i.e., the light causes them to bring their plane of symmetry into the direction of the rays of light, and to turn their oral pole toward the source of light. This process is purely mechanical. The light produces in the skin of the animal a change (probably chemical), and this produces, through the central nervous system, changes in the tension of certain muscles. Suppose the light falls upon the right side of the animal. This would lead to an increase in the tension of the muscles which turn the head and body of the animal to the right. As soon as the head of the animal is turned to the source of light and its median plane is in the direction of the rays, the symmetrical points of the surface are cut by the rays of light at the same angle, and the chemical effect of the light is the same in each pair of symmetrical points of the surface of the animal. Correspondingly, the symmetrical muscles of both sides of the body are under equal tension, and there is no reason why the animal should deviate more towards one side than towards the other from the direction of the rays of light. Thus the animal goes towards the source of light. I may mention here, by the way, that this is also the mechanism by which the moth is forced into the flame. There is no such thing as an attraction of the moth by the light, but its fatal flight is only due to an orientation. We call those animals that are forced to turn their heads towards the source of light, and that consequently go towards the source of light, positively heliotropic.

Positive heliotropism of the young caterpillars of Porthesia leads them to the tips of the branches where they find their food. During the cold of winter they are rigid and immovable, the higher temperature of spring produces a chemical change in their bodies which causes them to move. The direction of motion, however, is dictated by the light. In the open air, where the light of the sky falls from all sides upon the animals, we may decompose each ray of light into a horizontal and vertical component. The horizontal components annihilate each other, and only the effect of the vertical component will remain. The animal, therefore, on account of its positive heliotropism, must creep upwards until it reaches the tip of a branch. Here it is held by the light. The chemical stimuli which are given to the animal by the young buds, determine, in a machine-like way, the feeding motions.

From these data we are able to answer the question, how much of a structure must be contained in the egg of Porthesia, in order to render possible the heredity of this curious instinct of the young caterpillars? The answer is, the egg must contain, first, a substance which is sensitive