

Transformation

Many events in the life histories of animals have excited [our] wonder through the centuries—how from an egg a fledgling is hatched out, how birds and fish can migrate so unerringly across the wastes of air and sea, how bees and ants maintain complex societies—but none, perhaps, has so stirred our imagination as has the amazing way in which a humble crawling, earthbound caterpillar, after it chrysalis sleep, becomes transformed into a moth.

The egg of a silkworm hatches into a small grub, and this in turn grows to be a voracious caterpillar, consuming many times its weight in mulberry leaves. When its full size—about three inches long—is reached, the caterpillar ends its feast, and a change comes over its behavior. It raises its head and begins to sway gently back and forth. Soon from a spinneret in its lower lip emerges a tiny silken strand which the caterpillar fastens to a twig or other firm support. Weaving around and around for several days in wide figure eights, it slowly constructs a mantle about itself, a thousand yards or more of precious silk, until it is tightly bound within a white cocoon.

Then all is quiet, and the caterpillar seems to have fallen asleep, wrapped in a silken shroud. Sleep of a sort this might perhaps be called, but within its body the little animal now begins a transformation of the most fantastic sort, for many of its organs and tissues are scrapped and discarded, and from their substance an entirely different set of structures—the organs of the winged moth—is now developed. It is as though this organism were two different animals.

This is no process of decay such as would happen if the body died and decomposed. And yet something not unlike this actually does occur. In the bloodstream of the caterpillar, as in our own bloodstreams, there is a host of phagocytes, a special type of white blood corpuscle whose function it is to act as scavengers by absorbing foreign material and especially by devouring harmful bacteria, thus preventing serious infection. To such efficient police work many organisms owe their relative freedom from bacterial attack. Within the quiescent caterpillar, however, these phagocytes perform a very different task, for they now turn upon the body they have been protecting and devour and disintegrate many of its tissues. The muscles, the intestinal tract, the large salivary glands, and the skin itself are thus destroyed. Other parts break down by enzyme action. In the end, almost all of the original internal structures of the caterpillar, save for a part of the heart and nervous system, have disappeared.

This is no sudden onslaught but a gradual process, and it is accompanied from the start by the growth of new organs. Now appears a strange sort of embryology. Even in the body of the caterpillar there are present here and there tiny disk-like islands of embryonic tissue, the so-called “imaginal disks,” which simply bide their time until the hour arrives for them to take their parts in the drama of regeneration. Some are in the head, others in the tissues under the skin, and still others are in the walls of the intestine. They are immune to phagocyte attack, and as soon as the degeneration of the old structures begins they develop into active centers of growth from which the new structures are gradually formed. The process of transformation is an orderly one; the second set of organs, step by step, replaces the first. A new set of mouth parts, suitable for the very different kind of food the moth will eat, is formed. Two pairs of

wings develop, beautifully folded together and packed into the narrow space inside the cocoon, ready to expand when the moth emerges, and to carry it in its new environment. Sexual organs are developed, for the chief function of this stage in the animal's life is to produce male and female sex cells through the union of which a new generation of grubs and caterpillars will come.

After several weeks the growth of the new structures is complete, and the cocoon is filled with quite a different animal from the one that made it—a white moth. This second edition of the organism is radically different from the first. It is made from the same material, for practically nothing has entered or left the cocoon since it was formed; but the entire bodily architecture has been altered.

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from *The Biology of The Spirit*