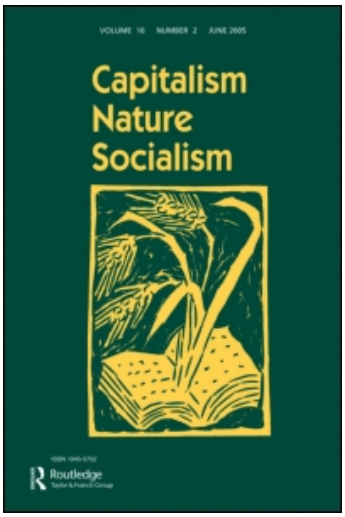


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# Organism and Environment

Nothing is more central to a dialectical understanding of nature than the realization that the conditions necessary for the coming into being of some state of the world may then be destroyed by the very state of nature to which they gave rise. As it is in nature, so it is in the study of nature. The most powerful effect that Darwin had on the development of modern biology was not his creation of a satisfactory theory of evolutionary mechanism. Rather, it was the basic role played in that theory by his rigorous separation of internal and external forces that had, in previous theories, been inseparable. For Lamarck, the organism became permanently and heritably transformed by its willful striving to accommodate itself to nature and so incorporated that outer nature into itself. By totally confounding inner and outer forces in an unanalyzable whole, premodern biology was in fetters that made further progress impossible. Darwin's division of forces into those that were completely internal to organisms and which determined the variation among individuals, and those which were external, the autonomous forces molding the environments in which organisms found themselves accidentally, "burst those fetters asunder." For Darwinian biology the organism is the nexus of the internal and external forces. It is only through natural selection of internally produced variations which happen to match by chance the externally generated environmental demands, that what is outside and what is inside confront each other. Without such a separation of forces the progress made by modern reductionist biology would have been impossible. Yet for the scientific problems of today, that separation is bad biology and presents a barrier to further progress.

The development of an organism is not an unfolding of an internal autonomous program, but the consequence of an interaction between the organism's internal patterns of response and its external milieu. Many experiments have demonstrated, and a great deal has been written about codetermination of the organism by the interplay between gene and

environment in development. Even there, however, the environment is treated as external impingement on an autonomous program or as necessary resources for its realization. But aspects of the environment that are regular occurrences become themselves part of the developmental process. When a seed germinates only after a soaking rain, it is not merely responding to a signal that conditions are suitable. The rain becomes a factor of development as much as the proteins of the seed coat. The development of our ability to see presupposes light, of our muscles presupposes movement.

What has received far less attention, both in concept and in practice is the reciprocal codetermination, the role of the organism in the production of the environment. Darwinism represents the environment as a preexistent element of nature formed by autonomous forces, as a kind of theatrical stage on which the organisms play out their lives. But environments are as much the product of organisms as organisms are of environments. The Darwinian alienation of the environment from its producer, while a necessary condition for the formation of modern biology, stands in the way both of a further development of the sciences of evolution and ecology, and of the elaboration of a rational environmental politics.

There is no organism without an environment, but there is no environment without an organism. There is a physical world outside of organisms and that world undergoes certain transformations that are autonomous. Volcanoes erupt, the earth precesses on its axis of rotation. But the physical world is not an environment, only the circumstances from which environments can be made. The reader might try describing the environment of an organism that he or she has never seen. There is a non- countable infinity of ways in which the bits and pieces of the world might conceivably put together to make environments, but only a small number of those actually have existed, one for each organism. The notion that the environment of an organism preexists the organism is embodied in the concept of the "ecological niche", a kind of hole in ecological space that may be filled by a species, but may be empty, waiting for an occupant. Yet if one asks an ornithologist to describe the "niche" of, say, a phoebe, the description will be something like, "The phoebe flies south in the fall, but returns to the northern mixed forest early in the spring. The male marks out a territory that it patrols and over which it forages for insects, while the female, arriving two weeks later, builds a nest of grass and mud on a horizontal ledge, into which she deposits four eggs. Usually insects are caught in flight but nestlings are fed by regurgitation of insects caught near the ground." The entire niche is described by the sensuous life

activities of the bird, not by some menu of external circumstances. Organisms do not experience or fit into an environment, they construct it.

First, organisms juxtapose bits and pieces of the world and so determine what is relevant to them. The grass growing at the base of a tree is part of the environment of a phoebe that uses it to make a nest, but not of a woodpecker who makes an unlined nest in a hole in the tree. A stone lying in the grass is part of the environment of a snail eating thrush that uses it as an anvil, but is not part of the world of the flycatcher or woodpecker. Temperature would seem like an externally given, fixed condition. But, every terrestrial organism is surrounded by a shell of warm moist air produced by its own metabolism, a shell that constitutes its most immediate "environment". When we ask "what is the temperature tolerance of an ant?" we discover many different meanings. What temperature can an ant tolerate for a few minutes or hours while foraging? What temperature can an ant nest in a tree tolerate for a complete life cycle? What temperatures allow for sufficient vegetation and prey to permit a population of ant colonies to persist in contact with other ant species?

Even the relevance of fundamental physical phenomena is dictated by the nature of the organism itself. Size is critical. While gravitation is an important force in the immediate environment of large objects like trees and human beings, it is not felt by bacteria in a liquid medium. For them, because of their size, Brownian motion is a dominant environmental factor, while we are not buffeted to and fro by bombarding molecules. But that size disparity is a consequence of genetic differences between the life forms, so just as environment is a factor in the development of an organism, so genes are a factor in the construction of the environment.

Second, organisms remake the environment at all times and in all places. Every organism consumes resources necessary for its survival, and produces waste products that are poisonous to itself an others. At the same time organisms create their own resources. Plant roots produce humic acids that facilitate symbiotic relations and they change the physical structure of the soil in ways that promote absorption of nutrients. Ants farm fungi and worms construct their own housing. Many species change the conditions of their surroundings in such a way as to prevent their own offspring from succeeding them. That is what it means to be a weed. Every act of consumption is an act of production and every act of production is an act of consumption. And in the dialectic of production and consumption the conditions of existence of all organisms are changed. At the present no terrestrial species can

evolve unless it can survive an atmosphere of 18 percent oxygen. Yet that oxygen was put into the atmosphere by early forms of life that lived in an atmosphere rich in carbon dioxide which they made unavailable to later forms by depositing it in limestone and in fossil hydrocarbons.

Third, organisms by their life activities modulate the statistical variation of external phenomena as they impinge on the organisms. Plants average their productivity over diurnal and seasonal variation in sunlight and temperature by storing the products of photosynthesis. Potato plants store carbohydrate in tubers. We appropriate that storage in our body fat, in warehouses and in money.

Finally, the very physical natures of the signals from the outer world become transduced by the organism as they are made part of its effective environment. The rarefaction of the air that strike my eardrums and the photons that strike my retina when I hear and see a rattlesnake are transformed by my physiology into elevated levels of a chemical signal, adrenaline, and that transformation is a consequence of my mammalian biology. Were I a rattlesnake a very different transformation would occur.

A consequence of the codetermination of the organism and its environment is that they coevolve. As the species evolves in response to natural selection in its current environment, the world that it constructs around itself is actively changed. At present, because of the narrow problematic of both evolutionary biology and ecology which envision a changing organism in a static or slowly changing autonomous outer world, we know little beyond the anecdotal about the way in which changing organisms lead to changing environments. We know rather more, but still far too little, about how, through their life activities, organisms are the active makers and remakers of their milieu. But a rational political ecology demands that knowledge. One cannot make a sensible environmental politics with the slogan "Save the Environment," first, because "the" environment does not exist and second because every species, not only the human species, is at every moment constructing and destroying the world it inhabits.