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A Blind Spot in Biology

The authors of biology textbooks conspire with nature to keep plant roots and their activities in the dark.

Life requires a supply of energy and of essential nutrient elements. Energy comes from the sun and results in the fixation of carbon from the atmosphere and its incorporation into energy-rich compounds. The role of photosynthesis in the chemical economy of nature is therefore given ample scope in textbooks of biology, and rightly so. Not only that, but there will be some discussion of the biophysics and biochemistry of photosynthesis and of the metabolism of its initial products.

In addition to energy, carbon, and the elements of water, living things require 15 to 20 mineral nutrients, which, for terrestrial life, are derived mainly from the soil and enter food chains via membrane transport mechanisms located in the plasma membranes of the cells of plant roots. Potassium, magnesium, phosphorus, sulfur, iron, and other essential mineral nutrients present in the water of the soil, the "soil solution," in extremely low concentrations are as unavailable to animals and human beings as is carbon in the form of 0.03 percent carbon dioxide in the atmosphere. The processes of active ion transport, whereby the mineral nutrients are initially secured from the nonliving environment and introduced into the biosphere, are therefore as critical for terrestrial life as those that bring about the assimilation of carbon. The leaf is the port of entry for one nutrient; the root is the interface between terrestrial life and the mineral substrate supplying all other essential elements.

Now check the same biology texts that do such an adequate job in their exposition of photosynthesis to see what they say about the entry into the biosphere of the essential inorganic nutrients. There is almost nothing. There may be some vague references to "permselective membranes"; there may even be mention of active transport; but there will be no, or virtually no, presentation of experimental evidence, no discussion of mechanisms—nothing, in fact, that could not have been written at least a generation ago. Nor will there be any exposition of the significance of the process of mineral ion transport in the chemical economy of the biosphere.

There is a growing and justified concern over toxins in the environment and their progression into food chains. The entry of many of these substances into the terrestrial biosphere is via the same route and by the same processes as the entry of the essential mineral nutrients. We need to understand their distribution and fate far better than we do. To this end, knowledge of the transport of solutes across plant root membranes should be extended and diffused among biologists; it is no help to find that the current textbooks of biology all but ignore this subject.

We have witnessed in recent years an amazing recrudescence of a quaint lore about "organic" gardening and food production that reveals an almost total ignorance among many people, including a sizable fraction of our college population, of the most basic facts concerning the nutrient elements of plants and their absorption. The neglect of this subject in the current teaching of biology has no doubt contributed to the ready acceptance among so many students of thoroughly discredited ideas concerning the nutrition of plants.

It is high time that the authors of biology textbooks closed the information gap concerning the processes of active ion transport by which the membranes of the cells of plant roots "mine" that low-grade ore, soil, for essential and other elements—processes that are literally at the root of life on Earth.—EMANUEL EPSTEIN, *Department of Soils and Plant Nutrition, College of Agricultural and Environmental Sciences, University of California, Davis 95616*