

We are all lichens

Scott. F. Gilbert

Swarthmore College and the University of Helsinki

ABSTRACT

Symbiosis is the signature of life. Each organism functions, develops, and evolves as a consortium of several different species. Molecular studies of symbiosis have demolished the notion of genomic individuality in immunology, evolution, development, anatomy, and physiology. Instead, symbiotic interactions of animals and plants with microorganisms are now seen to be the rule, not the exception. Animals cannot be considered individuals by anatomical, or physiological criteria, because a diversity of symbionts are both present and functional in completing metabolic pathways and serving other physiological functions. Similarly, these new studies have shown that animal development is incomplete without symbionts. Symbionts also constitute a second mode of genetic inheritance, providing selectable genetic variation for natural selection, as well as mechanisms for geographic isolation. The immune system also develops, in part, in dialogue with symbionts, and thereby functions as a mechanism for integrating microbes into the animal-cell community. Recognizing the “holobiont”—the eukaryote plus its colonies of persistent symbionts—as a critically important unit of anatomy, development, physiology, immunology, and evolution, opens up new investigative avenues and conceptually challenges the ways in which the biological sub-disciplines have heretofore characterized living entities.