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Book Review

Acquiring Genomes: A Theory of the Origins of Species

By Lynn Margulis and Dorion Sagan
Perseus Publishing (2003, ISBN 0465043925, paperback, 240 pages)

Evolutionary biologists ignore the bacteria and slight the protists

In spite of the title of his most famous book, *The Origin of Species*, Darwin never explained speciation, how species come into being. However, a mechanism for this process was proposed roughly a century later by a group of evolutionary biologists now called neodarwinists. It goes something like this: random mutations (from Mendelian genetics) are sorted out by natural selection (from Darwin) and this eventually leads to the creation of a new species. Further, it is thought that speciation by these means occurs when an existing species is isolated, e.g., on islands, caves or by mating behavior. This explanation for speciation in evolutionary theory is now a fixture in college biology textbooks. It is this orthodox view that is challenged in *Acquiring Genomes*.

The argument of *Acquiring Genomes* centers on a re-definition of the term speciation. The authors point out that most of the evolutionary biologists that support the neodarwinist position on speciation are zoologists who have limited themselves, understandably, to their special areas of interest – animals. Their definition of speciation focuses on reproduction. If two animals can breed and produce fertile offspring, then they are of the same species. The authors of *Acquiring Genomes* argue that this definition is limited because it cannot be extended to other kingdoms of life especially those of microscopic dimensions. The very strange world of protists challenges zoological notions of sex and reproduction as does the nearly boundaryless prokaryote world of bacteria. The constant change and sharing of genomes without the male-female mating game, totally defies the neodarwinist definition. Bacteria, the authors argue, simply cannot be classified into species, and those scientists that do, do so using rather arbitrary boundaries.

Acquiring Genomes argues that the genomes themselves should serve as the basis of a new definition of species and, consequently, speciation. If species are defined in terms of integrated genomes within cells, then whether or not a species reproduces sexually becomes of no importance. In one stroke, this redefinition opens the door to a wide range of organisms, especially protists that may now be classified within a taxonomic scheme applicable to "higher"

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organisms as well. There are radical implications of this redefinition. If organisms are to be classified by integrated genomes, then symbiosis must be a major driving force of evolution. This new evolutionary model reduces the assumed power of random mutations (the keystone of the current evolutionary paradigm) in speciation considerably and replaces it, for the most part, with symbiotic processes leading to symbiogenesis. *Acquiring Genomes*, therefore, makes a most radical proposal, one that subverts the dominant paradigm. But what is the evidence?

On the microscopic level the evidence is abundant. The authors make it clear that eukaryotic cells are simply the results of ancient mergers of prokaryotes. That mitochondria and plastids are the surviving portions of formerly independent organisms that came to live within a host cell is now generally accepted. These organelles retain, in spite of their assimilation, a portion of their original genetic material. Taking the power of symbiotic merger further, the authors focus on the origin of the membrane-bounded nucleus itself. A hypothesis for this crucial evolutionary leap, the basis of the boundary between eukaryotes and prokaryotes, is detailed and makes for fascinating reading. But there is more. "Higher" animals and plants are shown to harbor all kinds of symbionts, some capable of full detachment and others more deeply linked. Squids that glow through the aid of wads of bacteria that it squeezes out of its body on a daily basis, and slugs that ingest organisms with stinging nematocyst cells which, as they resist digestion, become part of their defense system. Photosynthetic green worms sunbathe on the beach. These and much more are evidence that symbiotic processes operate in the present and are presumably advancing evolution, in all of life. The vision of life that emerges is one of unrelated organisms constantly interacting with each other, a vision in which no one species can be separated from its living environment. The authors argue that it is in this close, intimate relating that genomes of different organisms merge and thus provide a great deal of new variation that drives evolution and speciation – and very quickly on the geological time scale.

Acquiring Genomes is a non-specialist book on evolutionary theory, but it is not always an easy read. Some sections require a good grounding in genetics, and it helps to know some microbiology. The argument of the book moves in strange, indirect ways, perhaps like life itself does. The theme is stated at the beginning, but then a few wide detours are made. A discussion on thermodynamics seems a bit incongruous and the chapter on Gaia, which while clearly related to the theme of symbiosis and the interdependence of life, may have been more effective at the end of the book and not in the middle. Still, every topic in the book is related in some way to the argument, it is just not as straight forward as it might have been. Make no mistake, this book puts a revisionist foot in the door of the dominant paradigm and anyone interested in evolutionary theory should know about it.

Bruce Scofield, One Reed Publications
PO Box 561, Amherst, MA 01004, USA