How the Leopard Changed Its Spots:

The Evolution of Complexity

Brian Goodwin, Professor of biology at the Open University (Milton Keynes, UK)

Charles Scribner's Sons, 1994, 252 pp.

There are some authors whose byline never fails to elicit an automatic search for the nearest copier. One marches to the copier, journal in hand. "Copy this no matter what" is the imperative, because that particular author can always be counted on for insights and fresh information. For many non-Darwinians, design theorists, and general biological gadflys, the name "Brian Goodwin" induces such copier-search behavior. Throughout the now nearly twenty-year decline of the neo-Darwinian Synthesis, Goodwin, professor of biology at the Open University (Milton Keynes, UK) and leading developmental biologist, has been one of the most thoughtful critics of the ruling (but weakening) paradigm. Not that Goodwin is opting for design. He shows no signs of breaking with the naturalistic worldview at large. But Goodwin, his colleague Gerry Webster, and other structuralists have consistently shaken the tree of biology, insisting that the conceptual and evidential fruit tumbling down from that tree doesn't belong in any Darwinian bushel basket. More prosaically, they contend that biology must extricate itself from the thought patterns of neo-Darwinism to solve its most pressing puzzles.

In his new book, *How the Leopard Changed Its Spots: The Evolution of Complexity* (Charles Scribner's Sons, 1994, 252 pp.), Goodwin argues that neo-Darwinism fails completely to explain "the large-scale aspects of evolution, including the origin of species" (p. viii). As he puts it:

> *New types of organisms simply appear upon the evolutionary scene, persist for various periods of time, and then become extinct. So Darwin's assumption that the tree of life is a consequence of the*

gradual accumulation of small hereditary differences appears to be without significant support. Some other process is responsible for the emergent properties of life, those distinctive features that separate one group of organisms from another — fishes and amphibians, worms and insects, horsetails and grasses. Clearly something is missing from biology (p. ix).

The science of biology is the "leopard" of Goodwin's title. Biology must shift its focus, Goodwin urges, because the Darwinian perspective, despite the self-assurance of many biologists, is at odds with much of the most important evidence:

There are biologists who take the view that Darwin's theory of evolution is so rock solid, so well formulated and complete in its essentials, that no alternative can be contemplated. ...Such confidence is always interesting, for it reflects the power and persuasiveness of a particular "way of seeing" that has cultural roots as deep as Darwinism.

However, no scientific theory is permanent. ...Some of the basic assumptions that underlie the conceptual structure of the present view of biology [neo-Darwinism] are inconsistent with the evidence. Inconsistency in science is no great sin, as we have seen — it is a spur to clarification. But I see a series of inconsistencies adding up to a need for major revision (pp. 33-34).

Goodwin sees neo-Darwinism as quite incapable of explaining new "types" of organisms. The theory works sufficiently well with what he calls "small-scale aspects of evolution: it can explain the variations and the adaptations within species that produce fine-tuning of varieties" (p. ix). But by paying too much attention to the genetic aspects of organismsm, in its "genocentrism," neo-Darwinism (Goodwin argues) has neglected organisms themselves — leading to what he calls "the disappearance of the organism."

Something very curious and interesting has happened to biology in recent years. Organisms have disappeared as the fundamental units of life. In their place we now have genes, which have taken over all the basic properties that used to characterize living organisms (p. 1).

Goodwin's own solution, like many of those connected with new-wave complexity thinking (e.g., the Santa Fe Institute), is to search for "generic properties" of complex systems, tractable under mathematical and computer analysis, to build organisms. These structures are assumed to exist relatively independently of any necessary genetic basis.

Yet, as Stuart Newman observes in his review of *Leopard* (*Nature* 371 [15 September 1994]: 213-214):

One problem with this view is that real physical and biological systems are made of distinct kinds of materials. If assemblages of electrons, protons and neutrons, or liver cells or ants, have any generic forms in common, they are unlikely to be the most significant properties of these systems... Goodwin concedes that living systems are distinguished from nonliving systems, no matter how complex, by the presence of "powerful particulars that give them the capacity to regenerate and reproduce their own natures under particular conditions." So we are brought *back, despite the author's intentions, to genes and history as distinguishing characteristics of organisms. Whatever the evolutionary origin may have been of particular organismal forms... the present-day developmental realization of these forms must depend greatly on an accumulation of nongeneric molecular circuitry (p. 214).*

For many critics of evolutionary reasoning, however, Goodwin is right about the problems of "genocentrism," wrong about the creating potential of generic properties — as Newman worries — but, *pace* Newman, evolutionary history won't provide the *specificity* needed for the design of living systems. The very phrase "molecular circuitry" is a clue. Living things, as Michael Behe has been compellingly arguing, are irreducibly complex, and are properly *artifactual* in precisely the same sense that any other complex system is, whose components are functionally interdependent. They are designed.