Evolution as a Movement Toward Autonomy

On the Origin of Autonomy by Bernd Rosslenbroich (Springer Verlag, 2014), 297 pages, 61 illustrations

Reviewed by Craig Holdrege

One-celled protozoans, jellyfish, sea urchins, squids, swordfish, and dolphins are all wonderfully adapted to life in water. But that fact tells us little about how each of these creatures lives its life. All these animals are organized differently from each other—they belong to different phyla or classes—and the way they are organized lets them interact with and create environments and relations that are unique to each. They all have "ways of being." According to conventional Darwinian evolutionary theory, the animals have evolved and survived because they are well-adapted to the circumstances in the environment (this is called natural selection). But natural selection does not account for the unique forms and organization of different animals. It can only interact with what is already existent and "weed out" what is not adapted.

So where do all the "endless forms most beautiful and most wonderful" (Darwin) come from? Conventional theory says that through genetic mutations, recombination of genes and, more recently, epigenetic changes arising out of organism-environment interactions, new characteristics arise and are then passed down to subsequent generations. This kind of thinking "explains" characteristics through the supposed mechanisms that brought forth the traits. The characteristics in and of themselves—and therefore also their mutual relations within the organism and their relations to the characteristics of other organisms—are considered to be the fortuitous by-products of the evolutionary mechanisms. On this view, it is enough to propose a plausible mechanism and then describe how any given feature of the organism—the long neck of a giraffe, the color pattern of a grasshopper, the hard shell of a mussel— is a "survival strategy" and as such contributed to the survival of the species.

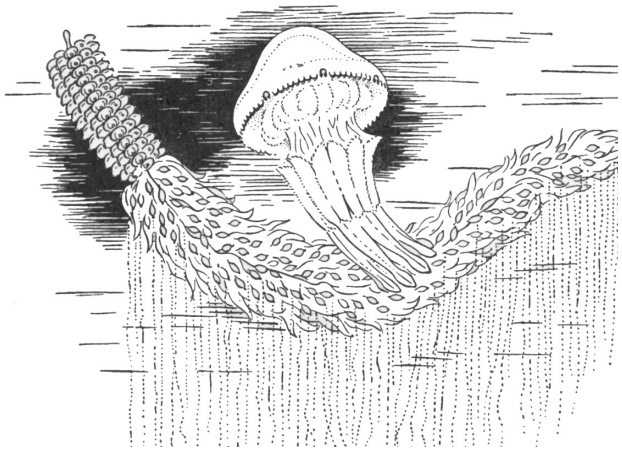
There is, of course, no necessity to "explain" organismic evolution in this way, and it does not provide insight into organic forms as such. New vistas open up when one lets go the idea of mechanism-as-explanation and begins to look at the phenomena in their mutual relations. In *On the Origin of Autonomy,* Bernd Rosslenbroich—who is head of the Institute of Evolutionary Biology at the University of Witten/Herdecke in Germany—takes a step in this direction. He presents a wealth of biological facts that point to a significant, overarching evolutionary pattern: "a recurring central aspect of macroevolutionary innovations is an increase in individual organismal autonomy whereby [the organism] is emancipated from the environment with changes in its capacity for flexibility, self-regulation and self-control of behavior."

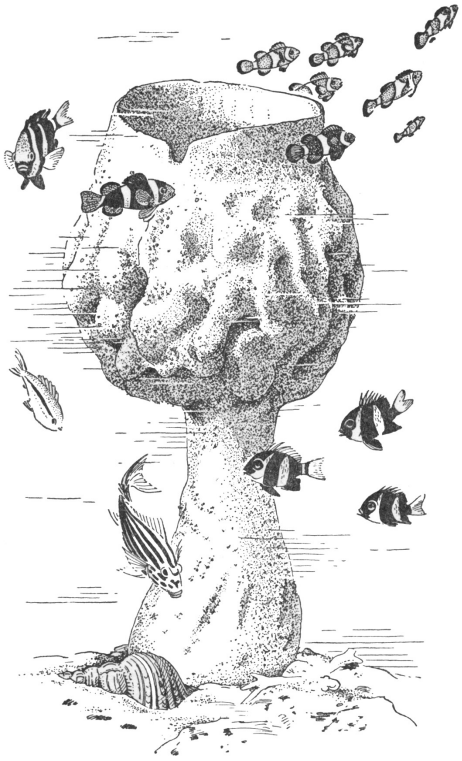
This pattern or trend has been discussed by Goethean biologists Kipp, Schad, Suchantke, Verhulst, and others, and it is a pattern that has been recognized periodically by mainstream biologists. Rosslenbroich's contribution is, first, to show that a certain degree of autonomy can be discovered as a basic characteristic of life, and then to trace in great detail and breadth the countless metamorphoses and intensifications of autonomy in the entire animal kingdom. (He does not deal with plants in this book.)

For example, Rosslenbroich contrasts (Chapter 4.2) the organization of prokaryotes (bacteria and archaea) with the cellular organization of eukaryotes (all other organisms). All biology students learn the difference between these two types of cellular organization: DNA in prokaryotes is not enclosed by a membrane, which is the case in the nucleus of eukaryotic cells; prokaryotic cells are generally much smaller than eukaryotic cells; and so forth. But these facts are generally not viewed within any larger context, which is what Rosslenbroich looks for. He describes how the differing characteristics show an increasing degree of internalization and internal differentiation of organization. Prokaryotes easily exchange genetic material with one another (calling into question the species concept for this group of organisms). In feeding, they are "dependent on the uptake of dissolved substance across their membrane," secrete enzymes into the surrounding medium, and have, therefore, "external digestion." They are (usually) tiny and have a very large surface area in relation to their volume, so that they are essentially surface organisms interfacing with their surroundings.

In contrast, eukaryotic cells have more stable genomes and their nucleus is enclosed within its own nuclear envelope. They have distinct membrane-enclosed organelles such as mitochondria and chloroplasts. There is a cytoskeleton that provides internal mechanical support for the cell. Digestion occurs within the cell. And their larger size means there is a "reduction of relative surface area, thus reducing the direct contact to the environment relatively."

Through Rosslenbroich's detailed and integrative comparison the reader can form a dynamic picture of a process of internalization and compartmentalization of organismic





functions. Since both types of organisms thrive on the planet, the differences do not indicate that eukaryotic cells are in any way better adapted than prokaryotes. The differences are qualitative and point to different ways of being—one showing remarkable embeddedness and responsiveness to the immediate fluid environment and the other moving in the direction of greater self-encapsulation.

In presenting autonomy as an evolutionary trend, Rosslenbroich does not try to make a neat scheme. It is clear that the evolution of the "animal organism" is not linear. He presents, for example, the feature of viviparity—giving birth to live young— which is a telling case of internalization of embryonic development into the maternal organism that is typical in mammals. And yet there are many examples of viviparity in other vertebrate classes (for example, fishes and reptiles). There are even some fish with placenta-like formations in the female body. You begin to get the sense of how the trend toward internalization is in a way spread throughout the animal kingdom and becomes embodied in partial and unique ways in different groups. What may appear almost as an anomaly or exception to the rule in one group becomes a central feature in another.

Released by the academic publisher Springer, the book is written for a mainstream academic audience. The style is dry and the author also adapts, it seems to me, to the expectations of mainstream thinking by framing autonomy sometimes as a "theory" and sometimes as a "hypothesis"—rather than, to use Gregory Bateson's phrase, as "a pattern that connects." He also gives a fair amount of space to the discussion of how biologists try to explain (by proposing mechanisms) the emergence of autonomy traits in evolution. I found these sections of the book least interesting, since they are basically a collection of speculations. *Understanding* evolution—which entails an ever deeper recognition of patterns and relationships—is not the same thing as speculating about mechanisms (Brady 1983), an activity that has unfortunately become all-too dominant in evolutionary biology.

Overall, though, the book is a treasure trove for biologists and biology teachers. It not only offers a wealth of examples that would be hard to find elsewhere, but also provides new contexts of understanding that can help shed light on many biological phenomena that otherwise remain isolated pieces of information.

Notes

Brady, Ronald H. (1983). "Parsimony, Hierarchy, and Biological Implications," in *Advances in Cladistics* vol. 2 (Norman Platnick and V. A. Funk, eds.), pp. 3-60. New York: Columbia University Press. Some of Ronald Brady's insightful writings are available online at: http://natureinstitute.org/txt/rb.

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Drawings from A. Portmann