Darwinian Dynamics

"Darwin changed the way we think about life," psychologist Paul Ekman told a celebratory panel at the New York Academy of Sciences. Honoring the 150th anniversary of the publication of member Charles Darwin's book, *On the Origin of Species*, the panelists spent the evening discussing the changes Darwin brought to biology, with a focus on how much more dynamically we view life today. It is not just species that change but populations, actions, and even the process of evolution itself.

Ekman, who chaired the discussion, is best known for his study of facial expressions and the emotions they signal. Other presenters were Gerald Edelman, winner of the 1972 Nobel Prize for Physiology or Medicine, and Terrence Deacon, biological anthropology and linguistics professor at the University of California, Berkeley. Edelman has shown that evolutionary principles apply to the immune system and possibly to the central nervous system, as well. Deacon has done extensive work on the evolution of brain and language. The panel spoke before a full house in New York and to many participating in online "Webinars" around the world.

Evolution begins with a "generator of diversity," Edelman told the audience, as some tittered at the GOD acronym. He noted that before Darwin, diversity was seen as random noise, a friction breaking with the ideal type. Deacon agreed, and spoke about how naturalists before Darwin had focused on types by studying various body forms or "plans." The great British biologist Richard Owen became one of Darwin's severest critics, precisely because of Darwin's inattention to types. The focus on types, Deacon added, blinded naturalists to the matter of adaptation.

A second requirement of evolution, Edelman said, as he paced in front of the audience, is an environment in which individuals are "embedded," and with which they can interact. Individuals from a diverse population will fit differently into the same environment and will respond differently, as well. Ekman gave the audience an extended example of varying behavioral responses by examining the continuum of "compassionate actions" that individuals show, ranging from the person who devotes years to hiding a hunted refugee to the person who never acts to ease another's troubles. From a humane perspective, one response is more admirable than another, and during the break in the three-hour program, several audience members could be overheard discussing the varieties of compassion. The evolutionary scientists among them stood out because they discussed not just which responses were desirable but also which ones were more adaptive.

In his presentation, Edelman said that an evolutionary process also requires some system for amplifying the best adaptations in future generations. Natural selection is the most famous of the amplification systems, but Deacon pointed out others. In fact, Deacon said, evolution's codiscoverer, Alfred Wallace, eventually came to trouble because he focused only on natural selection, which cannot account for everything observed in biology.

Darwin was more open to the existence of "several powers" of life and also their amplification. As life forms become more complex, the amplification of traits becomes more varied. In addition to natural selection there is sexual selection, or genes might accidentally double and the second version will go off in a new path. In rich ecosystems, organisms can coevolve. Thus, not just the evolution of organisms but the means of amplification also grow more varied.

This focus on evolutionary dynamism produced the evening's second theme—biology's break with the Newtonian logic that defined all science at the time of *The Origin*'s publication. There are now two ways to think about natural processes: An investigator can use either Newtonian (computational) logic or Darwinian (evolutionary) dynamics. Computational logic is predictable and repeatable because it relies on established rules, relationships, and categories. Evolutionary dynamics rely on none of those things, and its results are not as predictable or repeatable.

Edelman entertained the audience with an example of nonrepeatability by showing a video of a robot that had evolved an ability to navigate in a room and stand in one place. The robot had developed a "superstition," as Edelman called it, always bouncing against one point in the room before going to its standing place. A second robot had also evolved the ability to move about the room, but it had not included the superstitious bounce in its repertoire.

The evening's take-home message was the idea that evolutionary processes apply in many domains besides the natural history of life on Earth. As Deacon answered the last question from the audience, he insisted that more and more subjects will be incorporated into evolutionary "space."

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