COMMENTS

Lee Podolsky, Comments on Gerald Schroeder, "Evolution? A Statistical Analysis of the Process", *BDD* 2, Bar-Ilan University Press, 1996, pp. 5-18.

1. In his article, Schroeder devotes Sec. 7 to discussing "The Improbability of Life." An excerpt from his text appears below. Note his emphasis of Prigogine's word: "Zero!"

> We have calculated, statistically, that the evolution of convergent organisms by random mutations is functionally impossible. This is merely an extension of the unlikelihood of life itself. Ilya Prigogine, Nobel laureate in Chemistry, wrote in *Physics Today:* "The statistical probability that organic structures and the most precisely harmonized reactions that typify living organisms would be generated by accident is zero." Zero!

In contrast to Schroeder's quote, the actual text of Prigogine's article in *Physics Today* (November 1972, p. 23) appeared as follows:

> Unfortunately this principle cannot explain the formation of biological structures. The probability that at ordinary temperatures a macroscopic number of molecules is assembled to give rise to the highly ordered structures and to the coordinated functions characterizing living organisms is vanishingly small. The idea of spontaneous genesis of life in its present form is therefore highly improbable, even on the scale of the billions of years during which prebiotic evolution occurred.

Note that the word "zero" appears nowhere in Prigogine's article. Indeed, Schroeder has *paraphrased* Prigogine's sentences and condensed them into a single sentence, rather than *quoted* them. That would be all right were it not for Schroeder's emphasis of the word "zero" which was never written by Prigogine.

2. Much more serious is the fact that Schroeder has attributed to Prigogine an opinion which is the *opposite* of what Prigogine actually wrote. Briefly, Prigogine wrote in *Physics Today* that although living systems cannot arise spontaneously from systems that are *near* thermal equilibrium, living systems *definitely can arise spontaneously* from systems that are *far* from thermal equilibrium. The relevant quote from Prigogine's article (p. 24) follows:

> ... The *destruction* of order always prevails in the neighborhood of thermodynamic equilibrium. In contrast, *creation* of order may occur far from equilibrium and with specific nonlinear kinetic laws, beyond the domain of stability of the states that have the usual thermodynamic behavior.

To summarize, Schroeder presents the view that it is statistically impossible for life to have appeared spontaneously, and he quotes a Nobel laureate — Prigogine — to support his view. In fact, this Nobel laureate has expressed the *opposite* view in the very article that Schroeder references.

3. We next examine Sec. 2 of Schroeder's article, entitled "Convergent Evolution." This term refers to the appearance, in two different species of animals, of organs that are very similar in function or shape — such as the eye of the human and the eye of the squid. If the eye appeared in these two species completely independently, then one speaks of the *convergent evolution of analogous structures*, which is difficult for evolutionists to explain.

So far so good. We will now examine the quotation from the *Science* article cited by Schroeder (p. 8) on this subject, and his discussion of this quote:

> The implications of this genetic similarity led researchers to report in the prestigious journal, *Science*: "The hypothesis that the eye of the cephalopods [squids] has evolved by convergence with the vertebrate [human] eye is challenged by our recent findings of Pax-6 [gene] related sequences in squid *Loligo vulgaris*....The concept that the eyes of invertebrates have evolved completely independently from the vertebrate eye has to be reexamined."
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> An editorial in a highly respected science journal in the United States has asked for a reexamination of the process of evolution! The significance of this statement must not be lost. This genetic similarity is so extensive that it "strongly argues for a common developmental origin." Convergent traits among animals of different phyla have challenged the hypothesis that convergence occurs via independent evolution in each of the phyla. Simply stated, the convergence observed in "convergent evolution" did not happen through random reactions. It could not have happened through random reactions. It *must have been* preprogrammed.

Schroeder dramatically interprets the quotation to give the impression that some sort of revolution has just occurred in evolutionary biology. A new problem has suddenly arisen which calls for "a reexamination of the process of evolution!" The new results are presented as being so surprising that Schroeder emphasizes that "The significance of this statement must not be lost."

If one reads the *Science* article carefully, an *opposite* picture emerges. *Science* is reporting that an old problem has just been *solved.* In the evolution of the eye, convergent evolution *did not happen*, and therefore the difficult problem of explaining the convergent evolution of the eye no longer exists!

Science is telling us of the recent discovery of a certain gene — Pax-6 — which occurs *both* in humans *and* in squids. It is now known that this gene orchestrates the formation of the eye — a precursor gene that does *not* itself produce an eye, but permits eyes to form. Therefore, if *both* humans *and* squids have this gene, there is no need to explain the *independent* evolution of the eye in these two species. Since both species received the necessary genetic machinery from some common ancestor, it follows that the evolution of the Pax-6 "eye gene" did *not* occur *twice* independently, but *once* only. In other words, an old problem in evolutionary biology has now been solved!

This conclusion, reported by *Science*, is the *opposite* of what Schroeder implies to have been reported there. Note Schroeder's final sentence, with its dramatic italics — "It *must have been* preprogrammed." In fact, the presence of a common gene for eye formation in humans and in squids shows that convergent evolution did not occur at all, and therefore need not be explained!

4. My last example refers to Schroeder's discussion of Dollo's Law and Richard Dawkins. Page 9 of Schroeder's article contains the relevant discussion:

> ... Dollo's Law refers to a multitude of mutations first generating a certain organ, and then later mutations gradually eradicating that organ via the same pathway, but now in reverse.
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> Richard Dawkins is a Reader in Zoology at Oxford University. He strongly favors the thesis that random mutations are at the base of all evolution. He is famous for defaming the "cave man" mentality of those who consider the possibility that a Guide may have imposed direction to evolution. Nonetheless, Dawkins acknowledges that "It is vanishingly improbable that exactly the same evolutionary pathway should ever be travelled twice."
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> Yet, convergent evolution comes close to doing just that. It produces two very similar organs (the eye for example) in two unrelated animals (the octopus and the human). How? Dawkins tells us how: "It is all the more striking testimony to the power of natural selection...in which independent lines of evolution appear to have converged from very different starting points."

In line 8 Schroeder uses the words "Dawkins acknowledges" to imply that

Dawkins has somehow been forced to admit something. The following sentence tells us the importance of that admission: "Yet, convergent evolution comes close to doing just that." What is "that"? Why, it is something "vanishingly improbable," as Dawkins himself has just "acknowledged." In this way Schroeder presents the reader with strong evidence that "a Guide may have imposed direction to evolution." After all, implies Schroeder, how else can one explain the "vanishingly improbable" event that "independent lines of evolution appear to have converged from very different starting points"?

What is wrong here is that Dawkins is saying the *opposite*. What Schroeder describes as "Dawkins acknowledges" is merely a statement of Dollo's Law, which, in Dawkins's words, "follows simply from the elementary laws of probability." It is useful to repeat the law here: "It is vanishingly improbable that *exactly the same* evolutionary pathway should ever be travelled twice" (emphasis added). The substance of Dollo's Law lies in the italicized words: *"exactly the same."* And Dawkins states most clearly on pp. 94-95 of his book (referenced by Schroeder as n. 6) that, in convergent evolution, the two species do *not* travel along "exactly the same evolutionary pathway," and, therefore, there exists no puzzle that needs to be explained.

Dawkins emphasizes that although "independent lines of evolution *appear* to have converged" (emphasis added), in reality they have *not* converged. The fact that their evolutionary paths reach significantly different endpoints is "betrayed in the details." Dawkins then goes on to give several examples of strikingly different details between the human eye and the octopus eye.