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# A Poke in the Eye? Lenski and the adaptive acrobatics of *E. coli*

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Jerry Coyne, evolutionary biologist at the University of Chicago, thinks that Richard Lenski's recently published research on citrate utilization by *Escherichia coli*[1] is just that—"another poke in the eye for anti-evolutionists."[2] He goes on to say, "The thing I like most is it says you can get these complex traits evolving by a combination of unlikely events. That's just what creationists say can't happen."[3] I agree that creationists say that cannot happen; however, Lenski's research does not show that it did! Instead Lenski's research is another "feather in the cap" for creationists and further demolishes evolutionary ideas that complex traits can arise by random mutations.

## Lenski's 20-Year Experiment

In 1988 Richard Lenski, an evolutionary biologist at Michigan State University, began culturing 12 identical lines of *E. coli*. Over 44,000 generations and 20 years later, the experiment continues. The bacteria are grown in medium, which has a small amount of glucose (a primary carbon source for *E. coli*) and abundant citrate (a carbon source not utilized by *E. coli*). Every 500 generations, his lab takes samples of the bacteria, which in essence produces a "fossil record" of the different lines. Lenski has observed many changes in the *E. coli* as they adapt to the culture conditions in his lab. While the fitness of the bacteria has increased (as compared to the starting bacteria), it has come at a cost. For example, all the lines have lost the ability to catabolize ribose (a sugar).[4] Some lines have lost the ability to repair DNA.[5] These bacteria may indeed be more fit in a lab setting, but if put in competition with their wild-type (normal) counterparts in a natural setting, they would not stand a chance. [A detailed analysis of Lenski's work from a creationist perspective will be presented at the International Conference on Creationism (ICC) 2008 and in a paper published in the *Proceedings of the Sixth International Conference on Creationism*[6]].

Many evolutionists state that the bacteria are experiencing "adaptive evolution." However, this is not evolution but rather adaptation. Molecules-to-man evolution requires an increase in information and functional systems. Instead, these bacteria are likely experiencing a loss of information and functional systems as has been observed in other mutant bacteria in Lenski's lab. While these changes are beneficial in the lab environment, they do not lead to a net gain that moves bacteria in an upward evolutionary direction.

## The Magic Generation: 31,500

Lenski's lab discovered that at generation 31,500, one line of *E. coli* could utilize citrate (Cit+). As mentioned previously, *E. coli* are not usually able to utilize citrate (Cit-), and this fact is typically used as diagnostic identification of *E. coli*. A *New Scientist* writer proclaims, "A major innovation has unfurled right in front of researchers' eyes. It's the first time evolution has been caught in the act of making such a rare and complex new trait."[7] However, as we will see, this is a gross overstatement in regards to what actually occurred.

Previous research has shown that wild-type *E. coli* can utilize citrate when oxygen levels are low.[8] Under these conditions, citrate is taken into the cell and used in a fermentation pathway. The gene (citT) in E. coli is believed to encode a citrate transporter (a protein which transports citrate into the cell).[9] When oxygen levels are high, it is thought that the citrate transporter does not function or is not produced (even though they still possess the enzymes necessary to utilize citrate). Thus, wild-type *E. coli* already have the ability to transport citrate into the cell and utilize it—so much for the idea of a "major innovation" and "evolution … making a rare and complex new trait"! Other labs have also produced Cit+ *E. coli* and speculated that mutation(s) in citT (or its regulators) allow the citrate transporter to function or be produced under high oxygen levels.[10,11] These types of changes are very consistent with the creation model (see below), but cannot serve as a means for evolution.

Lenski's lab has not yet identified the genetic alterations of the Cit+ *E. coli* line, but he believes that there are multiple mutations involved. Studies of the "fossil record" of this line indicate that one or more mutations occurred around generation 20,000 which he terms "potentiating" mutations that were necessary before

additional mutations around generation 31,500 led to Cit+ cells. Lenski thinks that the mutations may have activated a "cryptic" transporter (a once functional transporter that has been damaged due to the accumulation of mutations) that can now transport citrate. However, he states, "A more likely possibility, in our view, is that an existing transporter has been coopted [*sic*] for citrate transport under oxic [high oxygen levels] conditions."[12] He believes this could be the same citrate transporter (citT) used in low oxygen conditions (inferring a loss of regulation) or a transporter for another substrate that has been modified to transport citrate (inferring a loss of specificity).

Lenski states (based on calculated mutation rates in *E. coli*), "It is clearly very difficult for *E. coli* to evolve this function. In fact, the mutation rate of the ancestral strain from Cit- to Cit+ is immeasurably low… ."[13] If developing the ability to utilize citrate under certain conditions using random mutations of a pre-existing citrate utilization system is so rare, then how even more improbable is it to believe that these same random mutations can lead to completely new information and functional systems that allow dinosaurs to turn into birds! Lenski's work shows a clear case of adaptation and not evolution.

## A Creationist Perspective

Mutations which lead to adaptation, termed adaptive mutations, can readily fit within a creation model where adaptive mechanisms are a designed feature of bacteria allowing them to survive in a fallen world.[14] Since *E. coli* already possess the ability to transport and utilize citrate under certain conditions, it is conceivable that they could adapt and gain the ability to utilize citrate under broader conditions. This does not require the addition of new genetic information or functional systems (there are no known "additive" mechanisms). Instead degenerative events are likely to have occurred resulting in the loss of regulation and/or specificity. It is possible that the first mutations or potentiating mutations (at generation 20,000) were either slightly beneficial or neutral in their effect.

Given the selective pressure exerted by the media of a limited carbon source (glucose) but abundant alternative carbon source (citrate), the cells with slightly beneficial mutations would be selected for and increase in the population. Alternatively, if the mutational effects were neutral the cells with these mutations might remain in the population just by chance, since they would not be selected for or against. Around generation 31,500 additional mutations enabled the cells to utilize citrate and grow more rapidly than cells without the adaptive mutations. Adaptive mechanisms in bacteria work by altering currently existing genetic information or functional systems to make the bacteria more suitable for a particular environment. Further understanding of Lenski's research is valuable for development of a creation model for adaptation of bacterial populations in response to the adverse environmental conditions in a post-Fall, post-Flood world.

## Conclusion

It is interesting that in spite of the clear evidence for the adaptation of *E. coli*, Lenski refers to his findings as evidence for bacteria developing a "key innovation" and a "new function" and a "fascinating case of evolution in action."[15] Obviously, presuppositions (human reason versus God's Word) play a major role in interpreting the evidence. Richard Lenski and I are looking at the same evidence but drawing different conclusions based on our source of truth—man's ideas or God's ideas. It is only possible to obtain truth about the past if we start with the only source of absolute truth in the present—the inerrant Word of God.

## Footnotes

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