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Evolutionary innovation caught in the act

By Hristio Boytchev,

Scientists following the evolution of a single strain of bacteria reported that it underwent several steps of mutation, surprising in its complexity, to acquire the ability to use a new food source.

The findings, reported Wednesday in the science magazine Nature, are the result of an experiment started 25 years ago by Richard Lenski of Michigan State University.

“When I started that project, I thought I would find one or two mutations and be done with it,” said Zachary Blount, a member of Lenski’s lab. “But instead, there may be dozens of mutations working together.”

“Creationists sometimes argue that even two mutations for one trait is too much complexity, yet here we see that evolution manages that with ease,” he said.

To study evolution in real time, Lenski followed the descendents of a single E. coli bacterium, a bug that normally populates our intestines. Bacteria have short life spans and in this experiment went through more than six generations a day.

Every day for 25 years — over 50,000 bacterial lifetimes — members of Lenski’s lab transferred the E. coli into a new flask with sugar solution. Every 500 generations, a part of the population was stowed in a freezer, creating a fossil record that can be brought back to life.

One day in 2003, the scientists observed something peculiar: A flask was much more densely populated than usual. At first the scientists suspected contamination. But then they found that after 30,000 generations, the bacteria had discovered how

to use a different chemical as a food source. Citrate, the chemical in question, is given to the bacteria to help them absorb minerals and cannot normally be digested in the presence of oxygen.

What the researchers found was that a gene, normally responsible for letting citrate into the cell only in the absence of oxygen, had moved to a new location in the bacterium's DNA. There it was controlled by a different switch, enabling citrate to enter even when oxygen was present. But this was only the second of three steps, the scientists found. An additional set of mutations were necessary in the beginning; the final step was multiplying the gene inside the DNA to make the bacteria much more efficient in their absorption of citrate.

The scientists conclude that these three stages may be universal evolutionary principles. "Even evolutionary changes that seem to be very sudden and dramatic may typically require a series of multiple steps drawn out over much longer periods of time than meets the eye," Lenski said.

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