SCIENCE & TECHNOLOGY

Why Sex?

THE SOURCE: "On the Origin of Sexual Reproduction" by Carl Zimmer, in ***Science***, June 5, 2009.

There are so many simpler ways to reproduce than sex. Consider bacteria. They just divide. Or aspen trees. They just send out runners. So how did such an inefficient system—requiring cell division, finding a mate, hooking up, and producing a new, unique combination—triumph over other reproductive methods? Carl Zimmer, a science writer whose most recent book is *Microcosm: E. coli and the New Science of Life* (2008), says new evidence from a colony of New Zealand snails explains how sex simply improves the fitness of a population more reliably than asexual reproduction.

Some species, he notes, can multiply either way, sexually or asexually. Yeast and many plants have this ability. During good times—for example, when the yeast equivalent of the stock market looks solid at 14,000—yeast reproduces asexually. But when times are tough in the yeast world, it reproduces sexually. Over millions of years, the sexual activities of plants with either/or capabilities increased. "By triggering organisms to reproduce sexually, [the sexually produced] genes could become combined with new sets of genes that were better able to withstand the crisis, leading to the greater proliferation of the 'sexual' individuals," according to Zimmer.

As evolution proceeded, sexual reproduction moved from optional to mandatory in many species. Mathematical researcher Lilach Hadany of Tel Aviv University thinks the triumph has to do with sexiness. Sexy individuals, such as male guppies with bright spots or male frogs with loud croaks, can attract large numbers of mates, and they produce many more offspring than would be possible through asexual reproduction.

Theories fall into "good," "bad" and "ugly" categories, Zimmer says. Sexually produced genes can adapt faster than asexual ones. If an individual in an asexual species develops a beneficial mutation, it can pass it on only to its immediate offspring. Sexual reproduction, by contrast, splits up genes that can then recombine with other "good" mutations present in the mate to produce even better progeny. Asexual reproduction can easily pass on marginally bad mutations for generation after generation until the accumulation of "bad" genes leaves the organism completely outclassed in the evolutionary rat race.

"Ugly" mutations—such as parasites—grow in a boom-and-bust cycle on a host organism. They can multiply until they destroy the most common strain of host and move on to the next victim. This "Red Queen" effect—named after the *Alice in Wonderland* character who takes Alice on a run without ever getting anywhere—is, like other theories about reproduction, hard to test in nature. But researchers studying a species of New Zealand snail that sometimes reproduces sexually and sometimes asexually have recently found evidence that the Red Queen effect exists. As asexual snails became increasingly affected by a parasite that made them unable to reproduce, the most common asexual strain of *Potamopyrgus antipodarum* almost disappeared. Eventually a rare asexual strain resistant to the parasite began to take over, illustrating the boom-and-bust cycle in a mere 15 years. The "Red Queen" problem so affected the asexual snails that it gave the sexy variant of *Potamopyrgus antipodarum* an edge: The asexuals increased and then almost died out, but the sexual snails reproduced reliably, multiplying at a steady pace.

SCIENCE & TECHNOLOGY

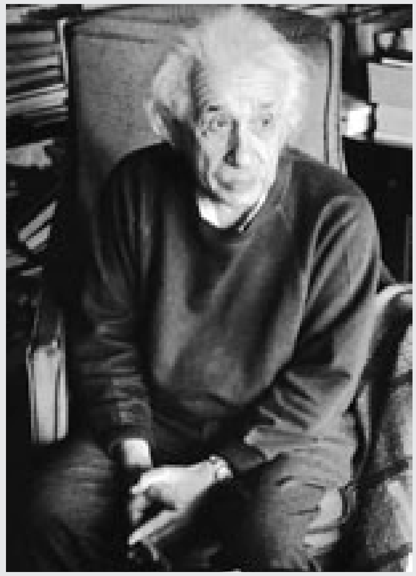
From Foraging to Farming

THE SOURCE: "Evidence for Food Storage and Predomestication Granaries 11,000 Years Ago in the Jordan Valley" by Ian Kuijt and Bill Finlayson, in ***Proceedings of the National Academy of Sciences***, July 7, 2009.

It took thousands of years for humans to transition from on-the-go foraging bands to settled

EXCERPT

Time to Go



[Albert Einstein] discovered general relativity by trusting an underlying principle, and that made him a "fanatic believer" that comparable methods would eventually lead to a unified field theory. . . . One day in April 1955, when he was working at his office . . . Einstein began to feel a great pain in his stomach. He had long been plagued by an aneurism in his abdominal aorta, and it had started to rupture. A group of doctors . . . recommended a surgeon who might be able, though it was thought unlikely, to repair the aorta. Einstein refused. "It is tasteless to prolong life artificially. . . . I have done my share, it is time to go. I will do it elegantly."

He was taken to the Princeton hospital, where one of his final requests was for some notepaper and pencils so he could continue to work on his elusive unified field theory. . . . The final thing he wrote, before he went to sleep for the last time, was one more line of symbols and numbers that he hoped might get him, and the rest of us, just a little step closer to the spirit manifest in the laws of the universe.

—**WALTER ISAACSON**, president and CEO of the Aspen Institute and author of *Einstein: His Life and Universe* (2007), in ***In Character*** (Spring 2009)

farming villages. How did this change come about? Recent excavations at an archaeological site near the Dead Sea in Jordan have provided a clue: Humans living about 11,000 years ago grew and stored wild grains for more than a millennium before they began growing domesticated plants. The surpluses they salted away enabled humans to settle and to develop farming techniques and new crops.

Humans who lived even earlier had built and lived in semipermanent settlements in the region, but none of the ruins from that period 15,000 to 12,800 years ago show direct evidence of food storage. Presumably, the inhabitants had multiple food sources that provided enough yield regardless of the season, without the need to build up stores for leaner times. A period of climate change nearly 13,000 years ago forced the villagers to abandon their settlements and return to a nomadic lifestyle.

When the climate stabilized about 11,500 years ago, people in the region began to invest more energy and resources in building more permanent dwellings. Two archaeologists, Ian Kuijt at the University of Notre Dame, and Bill Finlayson at the Council for British Research in the Levant, have found microscopic silica from the husks of wild barley stored inside sophisticated granaries from this period. They write that the granaries are from "the first time . . . people started to live in larger communities that were based, at least in part, upon systematic large-scale food storage of cultivated plants."

Kuijt and Finlayson's dig has so far revealed at least four granaries, all of which were circular and made of mud. Wood floors rested on stones, elevating the grain off the ground and thereby providing protection from rodents and moisture. The granaries are located outside of the residential structures on the site, indicating that the food stores were used and owned communally. Over the next 1,500 years, food storage moved inside people's homes, indicating a shift to a system of property ownership by individuals or families—one more step on the path to the world we know today.