UCSD Chemistry professor, Stanley Miller, speaks at 207th American Chemical Society national meeting about "Life on Earth May Have Formed in Less than 10 Million Years"

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LIFE ON EARTH MAY HAVE FORMED IN LESS THAN 10 MILLION YEARS

Contrary to traditional beliefs that life is so complex that it took many hundreds of millions of years to begin on earth, a new theory suggests the whole process could have taken less than 10 million years.

As outlined at the 207th American Chemical Society national meeting in San Diego, the theory is based roughly on what is known about the geological record of blue-green algae (cyanobacteria), and calculations on how fast life formed and early enzymes evolved.

"We see no compelling reason to assume that this process, from beginning of the primitive soup to cyanobacteria, took more than 10 million years," said Stanley Miller, a professor of chemistry at the University of California, San Diego.

Miller, who gained fame as a graduate student in 1953 for demonstrating in a laboratory how elements on Earth could by themselves combine to spontaneously create life, presented his new theory along with Antonio Lazcano, a professor of biochemistry at the National University of Mexico.

Briefly, the genesis of the new theory begins with the discovery of microfossils for blue-green algae dating back 3.5 billion years. Since scientists believe the earth was bombarded with large asteroids as late as 3.8 billion years ago--likely destroying all life that might have been formed up to that time-- that leaves about 300 million years for the 7,000 enzymes that make up blue-green algae to evolve from a prebiotic mix of chemicals.

"People were bothered because they couldn't understand how such a complex process could take only 300 million years," said Miller. "However, 300 million years is much more than sufficient."

In fact, the process is likely to have taken place in less than 10 million years. Two pieces of evidence point to this conclusion, Miller said.

First, the chemical structure of most of the 7,000 enzymes in blue-green algae appear to be closely related, suggesting they could have rapidly evolved. According to Miller's calculations, it could have taken 7 million years or less to create all the enzymes in blue-green algae.

Second, he argues, the intermediate organic compounds needed for life--generally unstable--would have been destroyed when they passed through the hellish environment of the ocean's hydrothermal vents. Over a

10 million-year period, the entire ocean passes through these deep-sea fissures, whose temperatures measure upwards of 350 degrees Centigrade. All organic material is destroyed at these temperatures.

"Therefore, it is likely that self-replicating systems capable of undergoing Darwinian evolution emerged in a period shorter than the destruction rates of the component compounds, or less than 5 million years," Miller said.

In related talks at the ACS meeting, Miller and his collaborators discuss potential chemical precursors to RNA in the prebiotic world. "To me the central problem of the origin of life studies is what was the precursor to RNA," said Miller. "We don't know the answer to that, but we are attacking the problem in various ways."

His studies include the search for alternative RNA bases that might have survived the harsh environment of the early earth. In particular, Miller's group--which includes Vera Kolb of the University of Wisconsin Parkside and graduate student Jason Dworkin--is homing in on one chemical called urazole that they argue is an "attractive candidate" to replace uracil in prebiotic RNA. Uracil is one of the four bases the make up the chemical backbone of present-day RNA.

"Urazole is a leading candidate because it reacts nicely with ribose, whereas other bases don't," Miller said. "And it doesn't absorb UV (ultraviolet rays). So in the absence of an ozone layer blocking the UV, they will survive nicely, while present RNA bases will not."

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