BBC NEWS

New spark in classic experiments

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There's a new spark of life in iconic experiments first done in the 1950s, on the kind of primordial "soup" that may have predated life itself on Earth.

Ageing vials of chemicals have been discovered in a Californian lab, surviving samples from the legendary experiments performed by chemist Stanley Miller.

They hold evidence that life may have born violently, in erupting volcanoes in the midst of a thunderstorm.

Miller was just 22 years old and studying for his PhD when he carried out his original, groundbreaking experiments (under his University of Chicago mentor, Harold Urey).

He wanted to test the current ideas for the origin of life, by striking electric sparks in a mixture of gases thought to resemble the atmosphere of the young Earth.

When his analysis of the products in the experiments revealed traces of the building blocks of life, amino acids (which combine to make proteins), Stanley Miller became an instant celebrity - though the 1950s newspapers were overstating the case when they claimed he had actually recreated life in the lab.

> **Each one of those volcanoes could have been a little, local prebiotic factory**
> Jeffrey Bada, University of California, San Diego

When Stanley Miller died in May last year, his former student, Jeffrey Bada, inherited his materials; including, it turns out, several boxes containing vials of dried samples from those 1950s experiments, and the accompanying notebooks.

"We started going through some of the stuff that was piled up in the corner, and here were several little cardboard boxes, taped shut and all dusty, carefully labelled with all of these little vials with dried material from his experiments," Professor Bada, of the University of California, San Diego, told the BBC.

Miller's well-known experiments first done in 1952 used water along with methane, ammonia and hydrogen, the kinds of gases then thought to have dominated the Earth's oxygen-free atmosphere more than two billion years ago.

His sparks turned the mixture red, then yellow-brown, and made a number of amino acids, including glycine and alanine, commonly found in proteins.

But soon after, Miller had revised those experiments by injecting hot steam into the gas mixture, so that conditions resembled those you might find in an erupting volcano.

These experiments were the ones that intrigued Jeffrey Bada. Because not long after Miller's original experiments, it became clear the Earth's early atmosphere was nothing like the "reducing" mixture simulated in his apparatus.

The first experiments remained iconic in their attempt at simulating pre-biotic chemistry, but became irrelevant in detail.

But conditions locally in volcanoes, says Professor Bada, might not have been so different. The trouble was, Miller published only the sketchiest of details of those tests, and the apparatus was lost. It had looked like a dead end, until those dusty boxes turned up with their 200 vials.

"We started sorting through these, and lo and behold, we found a whole collection, almost a complete

collection, of the extract samples from the volcanic experiments. And so we just went at it, using the state-of-the-art techniques we have today and analysed these samples.

"We found not only did these make more of certain amino acids than in the classic experiment, but they made a greater diversity of amino acids."

Miller, using the old methods, had found five amino acids; Jeffrey Bada and his teams tracked down 22. What is more, the overall chemical yields were often higher than in the first set of experiments - the mixture appeared to be more fertile.

Professor Bada points out that today, almost all volcanic eruptions are accompanied by violent electric storms. The same could have been true on the young Earth.

"What we suggest is that volcanoes belched out gases just like the ones Stanley had used, and were immediately subjected to intense volcanic lightning.

"And so each one of those volcanoes could have been a little, local prebiotic factory. And so all of that went into making the material that we refer to as the prebiotic soup."

That material could then have been washed down the flanks of volcanoes into pools or coastal bays, where the building blocks of life might have kick-started evolution.

Jeffrey Bada and colleagues report their latest work in the journal Science.

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