The history of lifeA warm little pond?

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On Mars, that is

IN 1871, in a letter to his friend Joseph Hooker, Charles Darwin speculated about how life might have got started.

> But if (and Oh! What a big if!) we could conceive in some warm little pond, with all sorts of ammonia and phosphoric salts, light, heat, electricity etc, present, that a protein compound was chemically formed ready to undergo still more complex changes...

Although no one is sure, that “warm little pond” is just how many modern biologists imagine life on Earth really did get going. And perhaps the same is true of life in other places, too. On December 9th, writing in *Science*, a team led by John Grotzinger of the California Institute of Technology announced that they had found evidence such a lake existed, billions of years ago, on the surface of Mars.

Dr Grotzinger is the chief scientist for NASA’s Mars Science Laboratory mission, whose rover, *Curiosity*, landed on the planet last year. Thanks to the work of previous rovers and orbiting probes, researchers already know that ancient Mars had many of the ingredients thought necessary for life.

Soon after it formed about 4.5 billion years ago, liquid water seems to have flowed over the surface of the planet. Its climate may also have been warmer than it is today, courtesy of an atmosphere much thicker than its wispy modern counterpart. But what *Curiosity* has done is to suggest that all the ingredients were present in one specific place, and for a reasonably long stretch of time.

That place is what appears to be part of a dried-up lake bed (pictured) just south of the Martian equator. The researchers call it "Yellowknife Bay", in honour of a Canadian town from which many geological expeditions have been launched over the years. Analysis by *Curiosity* revealed the presence of mudstone, a type of rock formed by fine grains of sediment settling out of a column of calm, still water. The surrounding geology supports that hypothesis, with evidence of ancient river channels that lead into a lake which would have been about 50km (30 miles) long and 5km wide.

Chemical analysis of Yellowknife Bay's rocks bolsters the researchers' case. The six elements held by biologists to be fundamental to Earthlike life—carbon, hydrogen, oxygen, sulphur, nitrogen and phosphorous—are all present. Better still, the rocks suggest the ancient lake was neither too acidic, nor too alkaline, nor too salty.

And it may have persisted for quite some time. By measuring the thickness of the strata, and making some educated estimates about how quickly they might have formed, Dr Grotzinger and his colleagues reckon the lake could have endured for anything from centuries to millennia. Add in a little plausible speculation—specifically, that there may be more sedimentary rocks buried beyond *Curiosity*'s reach, or that other rocks may have eroded over the course of time—and the lake's possible lifespan rises to tens of millions of years. The surface may not have been wet for all of that period, notes Dr Grotzinger, but groundwater could have persisted even when the surface was temporarily dry.

The sort of environment described in the paper is the kind that plenty of Earthly organisms would thrive in. If any Martians did live there, they probably bore a passing resemblance to Earth-bound critters called chemolithoautotrophs: hardy, single-celled organisms that make use of chemical energy rather than sunlight and which are able to create complicated biological molecules from elemental ingredients.

Evidence of habitability is not, of course, the same as evidence of habitation. Short of stumbling across the Martian equivalent of stromatolites—distinctive bacteria-built mounds that provide the earliest evidence for life on Earth—*Curiosity* is almost certainly incapable of telling whether life ever did actually arise on Mars. But it seems more and more likely that it could have.