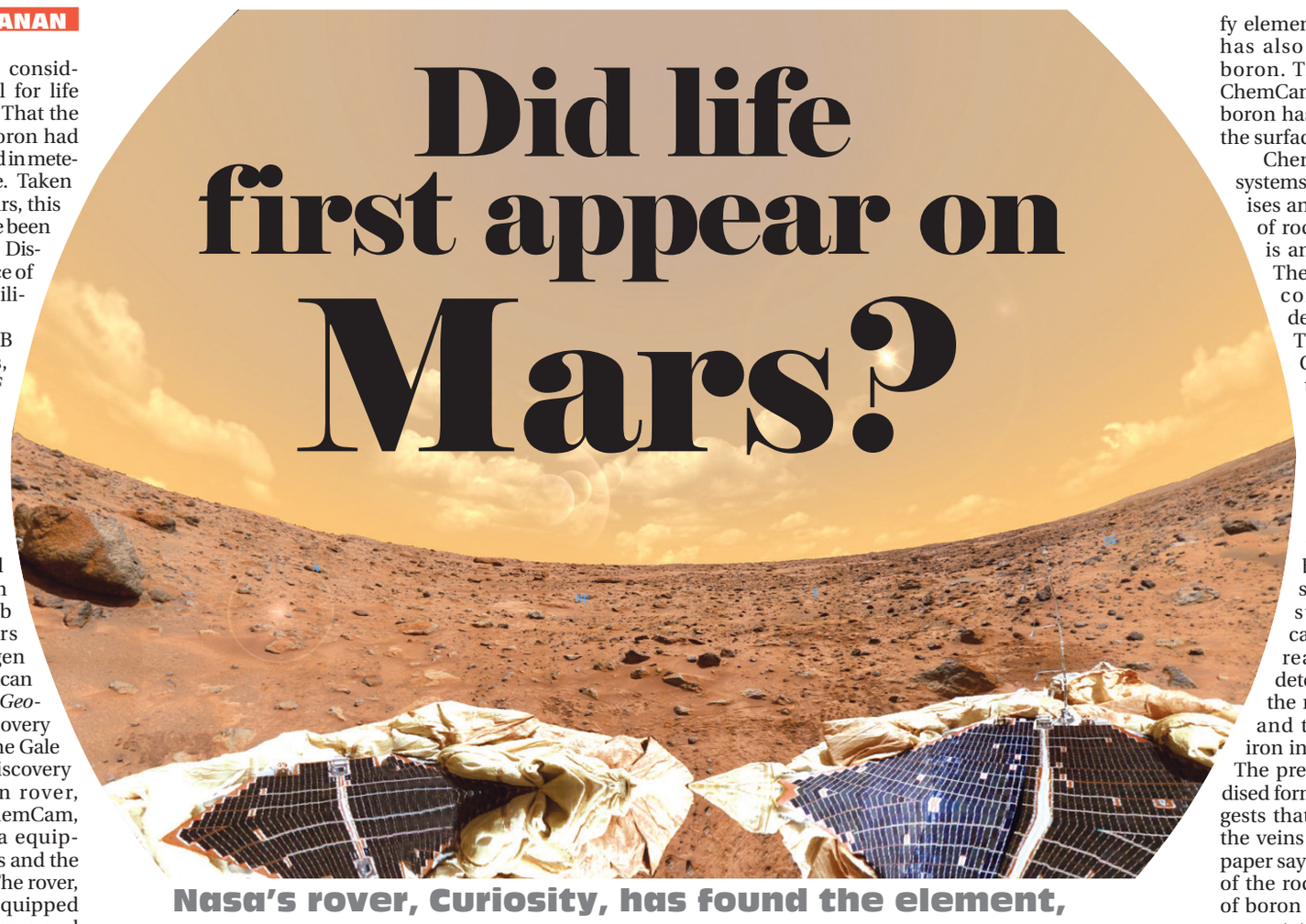
Did life first appear on Mars?



Nasa's rover, Curiosity, has found the element, boron, on the surface of the red planet

S ANANTHANARAYANAN

Boron is an element considered to be essential for life forms to proliferate. That the planet, Mars, had boron had been inferred from traces found in meteorites that originated there. Taken with other conditions on Mars, this suggested that Mars may have been the source of life on Earth itself. Discovery of boron on the surface of Mars strengthens the possibility.

Patrick J Gasda, Ethan B Haldeman, Roger C Wiens, William Rapin, Thomas F Bristow, John C Bridges, Susanne P Schwenzer, Benton Clark, Kenneth Herkenhoff, Jens Frydenvang, Nina L Lanza, Sylvestre Maurice, Samuel Clegg, Dorothea M Delapp, Veronica L Sanford, Madeleine R Bodine, and Rhonda McInroy, a team largely at the Los Alamos Lab in New Mexico, with others labs in the USA, Copenhagen and Paris report in the American Geophysical Union journal, *Geophysical Letters*, the first discovery of boron in rock fissures in the Gale crater region of Mars. The discovery was made by the Martian rover, Curiosity, which deploys ChemCam, the Chemistry and Camera equipment, built at the Los Alamos and the French CESR Laboratories. The rover, a motor car-sized vehicle equipped with locomotion, drills, lasers and laboratory capability, has been active on the surface of Mars since August 2012.

A major objective of Curiosity was to see if conditions that support life could have existed on Mars. Initial discoveries by Curiosity included a number of chemical constituents — carbon, hydrogen, nitrogen, oxygen, phosphorus, and sulphur, the raw materials of amino acids and proteins. This, with the evidence that Mars had abundant water, strongly suggested the possibility of the planet having supported life.

A difficulty in coming finally to this conclusion, however, is that it takes just a little more than the basic building blocks for life forms to arise. This little more is in the form of trace elements, particularly molybdenum and boron, which have to be there for life supporting molecules to be stable. Protein synthesis depends on transcription of pieces of genetic code, which is carried out by DNA-like structures called RNA. Simply putting the correct raw materials is not good enough to form RNA and DNA. Exposing just the raw materials to heat and light would form not RNA but something like tar, Stephen Benner of the Westheimer Institute for Science and Technology had written in 2013.

Benner noted that just before Curiosity landed on Mars, a large meteorite that originated from a meteor strike on Mars had crashed into the Earth in the Moroccan desert. Analysis of the meteorite showed traces of boron, which suggested there was boron on Mars. Benner observed that although Earth had all the necessary ingredients for life to arise, the early Earth was covered with water, while boron only occurs in the driest of places. The early Earth was also oxygen deficient and molybdenum would not have been in the highly-oxidised form that was required.

For these and other reasons, Benner argued that it was not really possible for life to have originated on Earth. On Mars, on the other hand, water did not cover the whole planet and there was evidence that the planet contained the oxidised form of molybdenum. Now with the discovery of boron, Benner suggested that life really originated on Mars and was carried to the Earth perhaps on a piece of rock. While life could not continue on Mars when conditions changed, the changes were for the better on the Earth and here, life has thrived.

This is an attractive theory of the dynamics of the origins of life, early interplanetary travel and reviving the image of the little green men on Mars. The trouble is that the theory is pinned on the presence of boron on Mars and the only evidence we have of this are the traces found on the meteorite of 2011.

The picture changes with the discovery that the Los Alamos group has announced. The authors of the paper in *Geophysical Letters* note that the spectral signature of boron has not appeared in remote sensing observations of Mars. CheMin, the Chemistry and Minerology instrument on the Curiosity rover, which uses X Ray scattering and fluorescence to identify elements or minerals in samples, has also not found any traces of boron. The discovery of boron by ChemCam is hence the first time that boron has directly been detected on the surface of Mars.

ChemCam consists of a pair of systems. One has a laser that vaporises and induces the components of rock to emit radiation, which is analysed by a spectrometer. The presence of elements and compounds can then be detected with great sensitivity. The other system on ChemCam is the high-resolution telescope that provides scientists with images of the sampling areas of rock and soil before and after the laser and spectrometer system zaps them for analysis.

The result of the prospecting has been that boron was detected in a sizeable number of calcium sulphate filled fractures, called "veins" in the rock. The reason for boron not being detected in the rock itself is that the rock has high iron content, and the emission spectrum of iron interferes with that of boron. The presence of boron, in the oxidised form of borate, in the veins suggests that that the boron came into the veins by the action of water, the paper says. Although the iron content of the rock precludes measurement of boron in the rock, it may well be present, the authors say.

"The presence of boron on Mars opens up new possibilities for habitability because of the important role borate may have played in prebiotic chemistry on early Earth. Thus, the discovery of boron in Gale crater opens up intriguing questions about whether life could have arisen on Mars," the paper says. Analysis of the age of borate bearing media would place the earliest and latest time limits on when life could have formed on Mars, the paper says. While some deposits on Mars are of greater antiquity than those on Earth, study of the Martian geology and the hydrology and the search for borates have become a high priority for Curiosity and future missions to Mars, the paper says.

The writer can be contacted at *response@simplescience.in*

How animals vote

Democracy is not just for humans, according to new research

JAN HOOLE

Today we opt for ballot boxes but humans have used numerous ways of voting to have their say throughout history.

However, we're not the only ones living (or seeking to live) in a democratic society — a new study has suggested that African wild dogs vote to make group decisions. It has found that these dogs sneeze to decide when to stop resting and start hunting.

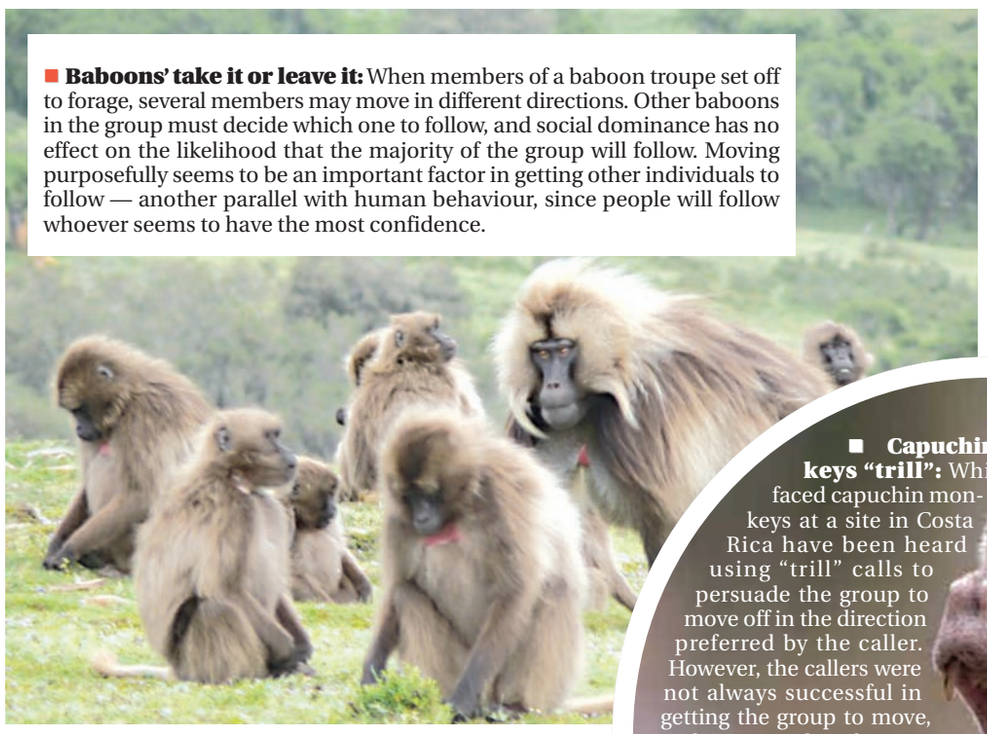
Researchers found that the rates of sneezing during greeting rallies — which happen after, or sometimes during, a rest period — affect the likelihood of the pack departing to hunt, rather than going back to sleep. If dominant individuals start the rally it is much more likely to result in a hunt, and only two or three sneezes are required to get the pack started.

But if a subordinate individual wishes to start a hunt, they have to sneeze a lot more — around ten times — to get the pack to move off. The researchers think that this sneezing is the pack members voting on when to start a hunt, since it is often the lower ranking (and therefore the hungriest) dogs who start the rallies.

Communal decisions are essential for social living, and in animals it is rare to find a social system where one individual coerces the rest of the group into performing a particular action. But since animals cannot produce the kind of pre-election propaganda so beloved of human politicians, social groups must have different ways of suggesting and gaining consensus for activities.

Voting by animals is not a subject that has been studied to any great extent, although political systems are common among social animals and are quite well documented, but if wild dog, meerkats and ants are doing it, you can bet your bottom dollar that other species are doing it too.

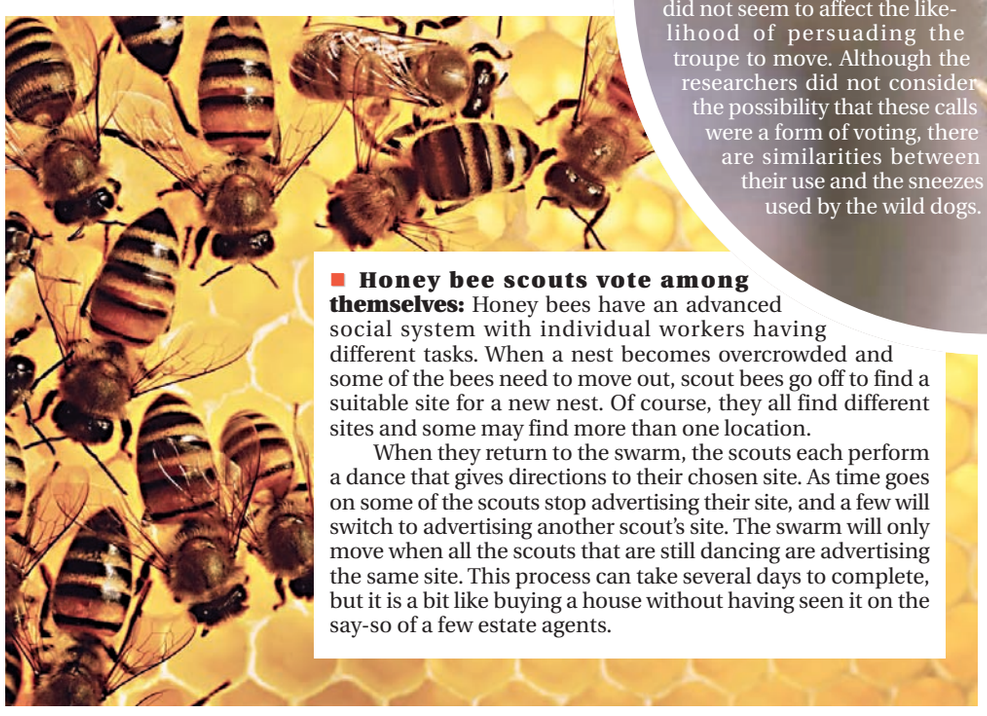
The writer is a lecturer in biology, Keele University
The independent



■ **Baboons' take it or leave it:** When members of a baboon troupe set off to forage, several members may move in different directions. Other baboons in the group must decide which one to follow, and social dominance has no effect on the likelihood that the majority of the group will follow. Moving purposefully seems to be an important factor in getting other individuals to follow — another parallel with human behaviour, since people will follow whoever seems to have the most confidence.

■ **Meerkat voice voting:** In meerkat mobs, social cohesion is vital for survival, and moving from one patch to another must be done together. A meerkat going it alone will very soon be an ex-meerkat. In order to get the group to head quickly to a new patch, an individual will emit a "moving call". If three or more meerkats make moving calls within a short period of time, the group will speed up its movement, but two or fewer individuals calling does not affect the speed. In meerkat mobs three is evidently considered a quorum.

■ **Capuchin monkeys "trill":** White-faced capuchin monkeys at a site in Costa Rica have been heard using "trill" calls to persuade the group to move off in the direction preferred by the caller. However, the callers were not always successful in getting the group to move, and status within the group did not seem to affect the likelihood of persuading the troupe to move. Although the researchers did not consider the possibility that these calls were a form of voting, there are similarities between their use and the sneezes used by the wild dogs.



■ **Honey bee scouts vote among themselves:** Honey bees have an advanced social system with individual workers having different tasks. When a nest becomes overcrowded and some of the bees need to move out, scout bees go off to find a suitable site for a new nest. Of course, they all find different sites and some may find more than one location.

When they return to the swarm, the scouts each perform a dance that gives directions to their chosen site. As time goes on some of the scouts stop advertising their site, and a few will switch to advertising another scout's site. The swarm will only move when all the scouts that are still dancing are advertising the same site. This process can take several days to complete, but it is a bit like buying a house without having seen it on the say-so of a few estate agents.

■ **Ants vote with their feet:** Rock ants, found in the south of England, choose a new nest site based on the quality of the site, with entrance size and darkness among assessed criteria. They appear to use a simple voting system consisting of leaving the nest site if an individual does not perceive the quality to be high enough. When enough ants have accumulated at a site, it is deemed to be of a suitable quality (or perhaps the best that can be found in the area), and the ants move in. If the quality subsequently deteriorates, individuals drift away to another site until enough of the colony have left the original nest and joined the new site. A simple but apparently effective system.

PLUS POINTS

Not getting enough

A "catastrophic sleep-loss epidemic" is causing a host of potentially fatal diseases, a leading expert has said.

In an interview with the *Guardian*, Professor Matthew Walker, director of the Centre for Human Sleep Science at the University of California, Berkeley, said that sleep deprivation affected "every aspect of our biology" and was widespread in modern society. And yet the problem was not being taken seriously by politicians and employers, with a desire to get a decent night's sleep often stigmatised as a sign of laziness, he said.

Electric lights, television and computer screens, longer commutes, the blurring of the line between work and personal time, and a host of other aspects of modern life have contributed to sleep deprivation, which is defined as less than seven hours a night. But this has been linked to cancer, diabetes, heart disease, stroke, Alzheimer's disease, obesity and poor mental health among other health problems. In short, a lack of sleep is killing us.

"No aspect of our biology is left unscathed by sleep deprivation. It sinks down into every possible nook and cranny. And yet no one is doing anything about it.

"I take my sleep incredibly seriously because I have seen the evidence," said Walker, whose book *Why We Sleep: The New Science of Sleep and Dreams* is due out next month.

"Once you know that after just one night of only four or five hours' sleep, your natural killer cells — the ones that attack the cancer cells that appear in your body every day — drop by 70 per cent, or that a lack of sleep is linked to cancer of the bowel, prostate and breast, or even just that the World Health Organisation has classed any form of night-time shift work as a probable carcinogen, how could you do anything else?"

The independent

Learning from nature

New insights into how animals spin silk could lead to new, greener ways of producing synthetic fibres, according to academics at the University of Sheffield.

Researchers from the university's department of material science and engineering have shown that animals spin silk by pulling rather than pushing it out of their bodies. They suggest that if this process can be copied in an industrial setting, it could improve how synthetic materials are processed and offer more environmentally-friendly alternatives.

Conventional synthetic textiles are made by extrusion — pushing a liquid feedstock through a dye and then using high changes in temperature and exposure to harsh chemicals to solidify. However, silk can solidify into a fibre at room temperature and leave only water, therefore causing less environmental damage.

The new study, by academics at the University of Sheffield, has been published in the journal *Nature Communications*. Lead author Jamie Sparkes, a PhD student in the University of Sheffield's natural materials group, said, "Traditional production process for silk is both arduous and time-consuming, but if we can bypass that by mimicking nature in an industrial setting, we could improve not only silk, but also how we process our synthetic materials."

Researchers examined how animals, including silkworms and spiders, push materials like silk out of their bodies. Chris Holland, head of the natural materials group, said, "While it is easy to assume that silk is propelled out of the body like we see in comic books, we wanted to put that to the test.

"By combining computer models with experimental data and practical measurements, we determined the forces needed to squeeze unspun silk down the animals' silk gland and spin a fibre."

However, by measuring the forces required to pull silk from the animal's body, the researchers found that it was well within the capability of the silkworm to pull a fibre, a process they refer to as pultrusion.