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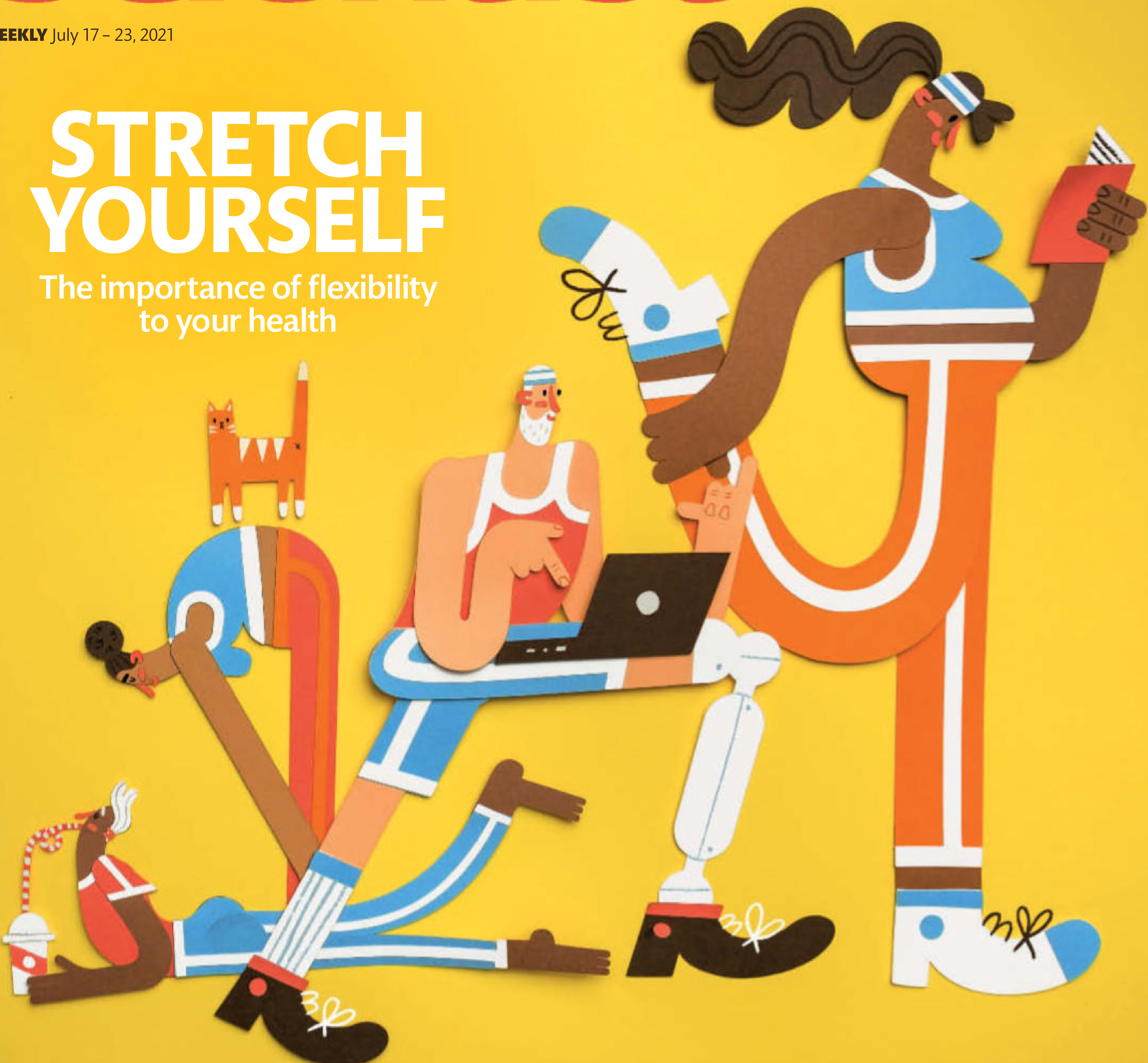

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Astronomy

Mystery Venus gas may be volcanic

Phosphine in planet's clouds was a potential sign of life, but it may come from eruptions

Leah Crane

THE unexpected discovery of a gas called phosphine on Venus led to speculation that there may be life floating in the planet's clouds – but it may have come from huge volcanic eruptions instead.

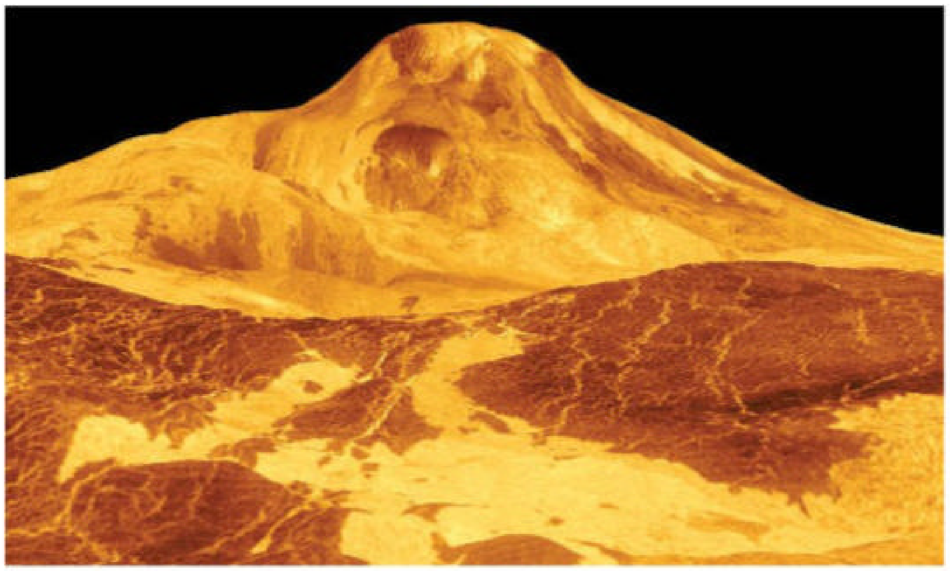
In 2020, a team led by Jane Greaves at Cardiff University in the UK saw evidence of phosphine in Venus's clouds, which are mainly made of concentrated sulphuric acid. When the researchers analysed ways to make phosphine on Venus, they didn't find any that could produce enough of it to explain the signal. They suggested that it may have come from living organisms, which is the main way the gas is made on Earth.

Now, Ngoc Truong and Jonathan Lunine at Cornell University in New York have calculated that if Venus is as volcanically active as some of the most volcanic areas on Earth, that could produce enough phosphine to explain the signal without invoking the possibility of life on Venus.

The thick atmosphere on Venus has made it difficult to study its surface, so we don't know for certain whether it is volcanically active. "Many of the volcanic eruptions on Earth are things that would escape our attention if they happened on Venus because of this blanket of sulphuric acid clouds," says Lunine.

However, there are hints that volcanoes may be erupting on Venus. Radar images from orbiting spacecraft have shown features that could be relatively fresh lava, but it isn't clear that is what they are. And changing amounts of sulphur dioxide in the air could be explained by eruptions tossing particles aloft. Truong and Lunine suggest that phosphorus in the planet's mantle could erupt from volcanoes in huge plumes and then interact with sulphuric acid to form phosphine (*PNAS*, doi.org/gnf7).

Maat Mons, a volcano on Venus, in a radar image from the Magellan mission



NASA/JPL

Not everyone agrees that this is a viable explanation. "We do not think that deep mantle plume volcanism can produce sufficient amounts of phosphine to explain the observations," says Janusz Petkowski at the Massachusetts Institute of Technology, a member of Greaves's team. He says that it isn't clear whether there is as much phosphorus in the Venusian mantle as Truong and Lunine assumed based on comparisons with Earth.

Additionally, we don't know enough about the chemistry of Venus's atmosphere to say for sure what would happen if that phosphorus was erupted into the sky. "I'd expect chemical spikes of other gases if a huge plume had happened," says Greaves. We haven't seen such unexplained spikes in the abundances of other chemicals in the atmosphere.

Lunine agrees that we don't have enough data to say for sure what might be producing the phosphine, but he says volcanism is a less outlandish potential explanation than life in Venus's toxic clouds. "Unfortunately, we're sitting here with these little hints of volcanism from all these pieces of circumstantial evidence, phosphine included," he says. "We don't know what Venus is capable of." ■

Biology

Fish brains grow or shrink depending on how much they think

FISH literally get brainier when they have to think harder, and less brainy when they don't. At least, that is the implication of two studies by Frederic Laberge at the University of Guelph in Canada and his colleagues that show fish brains grow larger relative to their body size in more challenging environments and shrink in less challenging ones.

Changing relative brain size as needed could help fish save vital resources. "The brain is known to be one of the most energetically expensive tissues to maintain," says Laberge.

In one study, Laberge and his team studied lake trout (*Salvelinus namaycush*) across six consecutive seasons in two lakes in Ontario, Canada. They found that brain size relative to body size increased in autumn and winter and decreased in spring and summer.

Lake trout avoid warm water, so they are limited to deeper water in the summer, Laberge says. But during the winter they forage in shallower waters near the shore, which is a more complex environment. This higher cognitive demand appears to boost brain growth (*Authorea*, doi.org/gnb9).

In a second study, the team compared the brain sizes of rainbow trout that had escaped from a fish farm in Canada and begun living wild in a lake with those that remained captive. After seven months, the brains of the escaped trout were 15 per cent heavier relative to body size than those of the captive fish (bioRxiv, doi.org/gnb8).

"The brain is known to be one of the most energetically expensive tissues to maintain"

This increase was specific to the brain, says Laberge. There was no change in the relative size of the heart, for instance.

Previous lab studies by other groups have suggested that fish brains change size as needed, says Laberge. Fish in labs have smaller brains compared with the same fish in the wild, and enriching their environment increases brain size. His team is the first to show this happening in the wild. ■

Michael Le Page