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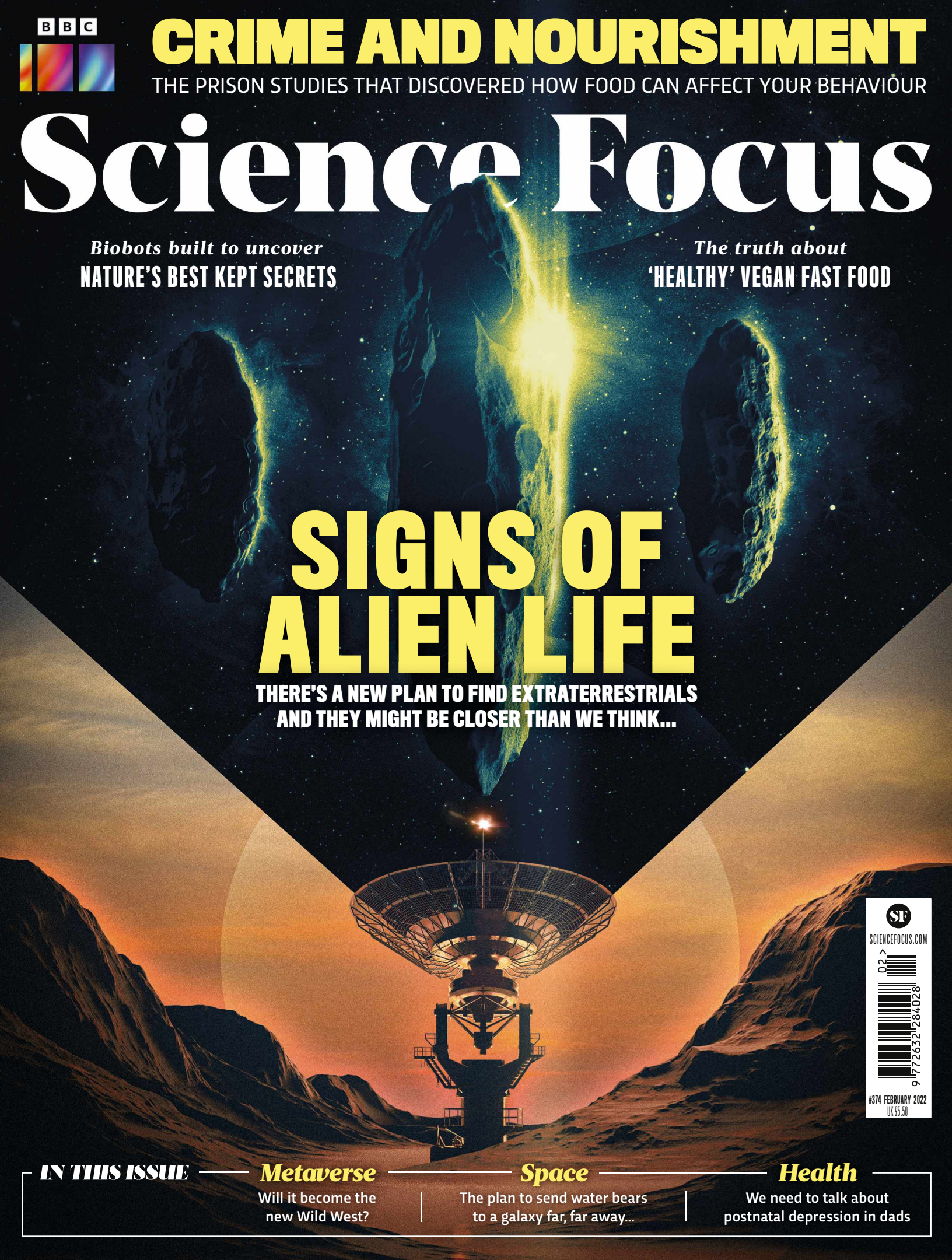

SIGNS OF ALIEN LIFE

THERE'S A NEW PLAN TO FIND EXTRATERRESTRIALS AND THEY MIGHT BE CLOSER THAN WE THINK...

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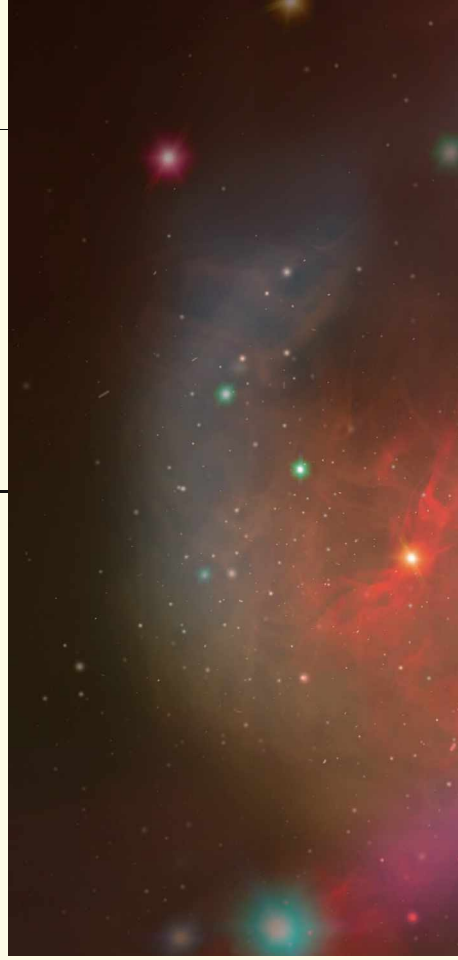


Horizons

Microscopic water bears could be the first interstellar space travellers

A group of NASA-funded physicists, philosophers and biologists have come up with a list of organisms that could withstand interstellar space. Team member Stephen Lantin tells us more...

In 2019, a spacecraft containing strange, microscopic organisms crash-landed on the Moon. Israel's Beresheet Lunar Lander was the first non-governmental craft to attempt a landing on the lunar surface. It carried a collection of items, including a digital copy of Wikipedia, human DNA samples, an Israeli flag, and thousands of tiny animals called tardigrades. We can't say for sure if any of the so-called 'water bears' survived the crash, but if they did, they are the only Earthlings to have spent years away from their home planet.

ISRAEL SENT TARDIGRADES TO THE MOON, AND NOW YOUR RESEARCH TEAM HAS DRAWN UP PLANS TO SEND MORE ORGANISMS INTO SPACE. HOW DID YOU CHOOSE WHAT TO SEND?

First, we decided the organisms needed to be small. The smaller they are, the more we can pack in. And if a couple of them die, at least we might have some that survive. That narrowed it down to things like tardigrades, certain forms of bacteria, single cells and also a worm called *Caenorhabditis elegans.* This worm is the model organism chosen for a lot of studies in science.

Then we asked, can they survive the space environment? Experiments on the International Space Station (ISS) have explored this idea, and there are quite a few organisms that can survive the radiation environment in space without a lot of shielding. In space, there is radiation from the Sun, which we refer to as solar cosmic radiation. And the farther you get out, there's also galactic cosmic radiation that comes from elsewhere.

The organisms we picked have mechanisms that can repair their DNA if it's damaged by radiation. There's also this really interesting thing called cryptobiosis, where these organisms can undergo a sort of hibernation, but on a more intense scale. Their metabolic activity just completely drops. It's almost like they're dead, but they're not, because once conditions are right they can revive themselves.

SO CONCENTRATING ON TARDIGRADES, CAN YOU TELL ME WHAT THEY ACTUALLY ARE?

They're pretty simple organisms. They're also known as water bears, because if you look at them microscopically they look like eight-legged bears. But what's really cool about them is their radiation tolerance. They have the ability to withstand very extreme environments. People tend to throw around the word 'extremophiles', but tardigrades are more 'extremo-tolerant' organisms.

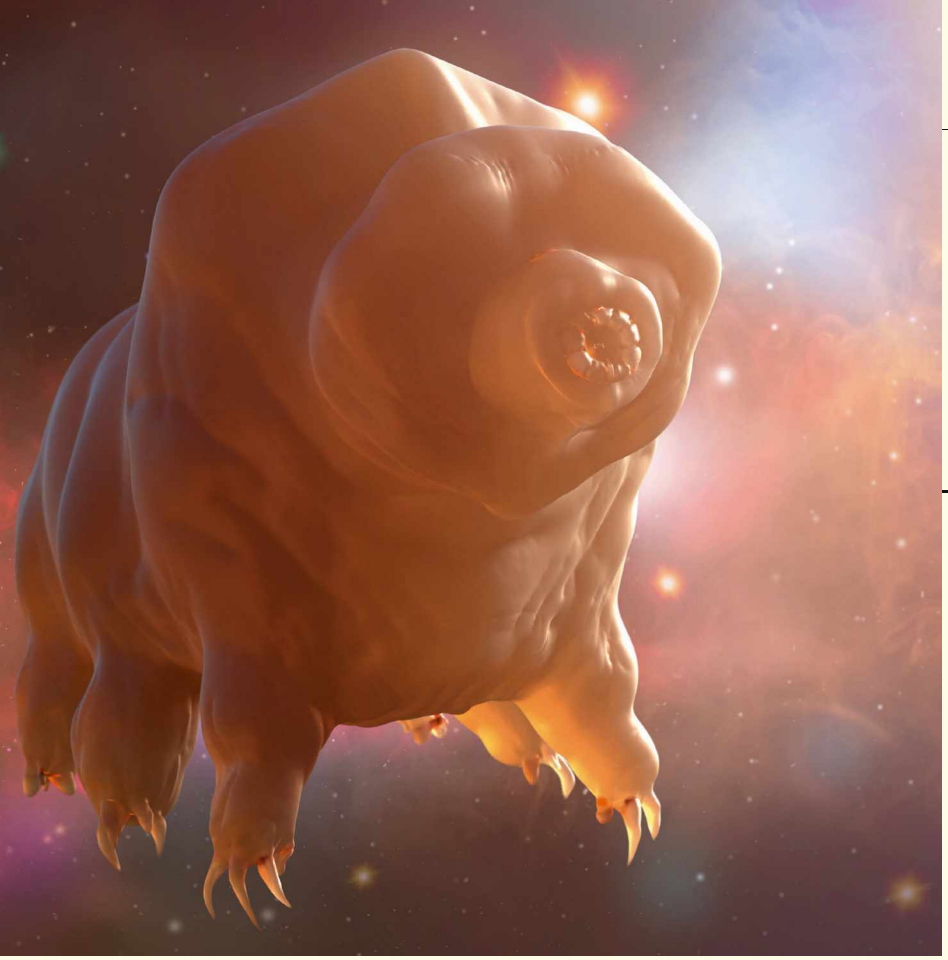
You know, if you go outside and find some mossy rocks, take a sample and put it under a microscope, you'll probably find tardigrades.

HOW WOULD YOU HAVE CONTACT WITH THEM WHILE THEY'RE IN SPACE?

We'd have different sensors on board along with these organisms, so we can study their behaviour over time. Ideally, we would send them out in their dehydrated, cryptobiotic form, and then we would remotely wake them up, with some water or something. We would monitor them, to see how many of them actually revive in space. Then we'd look at how their cells change to see if there is a genetic response. By looking at the different cells, we can almost understand what's going on, even if we're really, really far away.

CAN THIS HELP INFORM US ABOUT WHAT WOULD HAPPEN TO HUMANS IN THE SAME SITUATION?

Yeah, absolutely. This, more than anything, would be testing how life responds to radiation environments that we ourselves haven't experienced. Testing these sorts of things will mean we can better characterise the response not just for small organisms, but for bigger ones as well.



Tardigrades, also known as water bears, can withstand extreme conditions, making them ideal candidates to visit outer space

GETTY IMAGES

"The organisms we picked can repair their DNA if it's damaged by radiation"

WOULD THEY RETURN TO EARTH?

Right now, we definitely don't envision them returning. They get accelerated to very high speeds [on take off], and in order to get them back, we would need to somehow accelerate them in the other direction.

DOESN'T THAT RISK THEM CONTAMINATING OTHER ECOSYSTEMS?

That is definitely where we get the most flack from people outside of that research. What about all the potential ecosystems that might have life on them? Are we ruining them by shooting out life into them?

The short answer is if the spacecraft are being launched at very high speeds, there's virtually no chance of them [the tardigrades] surviving an actual impact onto a planet. Anything that is launched that fast and hits any sort of target gets vaporised instantly. There's not really a way at this point to get them to colonise other planets.

We also consider how and what targets we choose when we're shooting these off into space. There's an ethical component to this research, which is why we brought on board our philosopher Michael Walthemathe. He is familiar with the ethics of doing these sorts of things. We had some very interesting conversations.

WHY CAN'T WE JUST SEND ROBOTS? WHAT'S THE BENEFIT TO SENDING ORGANISMS?

Robots are good to use – we can use robotics to study exoplanets and learn lots of really good information. But it's not really an either/or situation. You can probably do both.

In terms of sending biology, this is something that we really have no experience with. We've never really done this before, in terms of sending organisms that far into space. The only stuff we've tested is in low-Earth orbit and the Moon. There are some plans to do research outside of low-Earth orbit, there's a biosensing programme at NASA's Ames Air Base in California. But largely, this space is untapped.

We thought it would be a good opportunity to push this out into the world, and see what people thought.

WHEN COULD TARDIGRADES BE SENT INTO SPACE?

We worked with a NASA-funded programme called Project Starlight, and its method for sending spacecraft into interstellar space could be ready in, as a rough estimate, 20 years, but that doesn't mean they'll be onboard a 2040 flight.

Project Starlight's whole big thing is laser sail propulsion: shooting lasers, either from the ground or from a separate spacecraft, and directing them onto a sail.

YOU MEAN, LIKE THE WIND SAIL ON A BOAT?

Exactly. Doing that imparts the momentum from the photons [particles of light] in the laser into the sail, which launches something at high speeds.

The propulsion physics have been tested. So we know that something like this would work. The only problem is scaling it up. We would need very large laser arrays – on the scale of kilometres – to accelerate things to significant fractions of the speed of light and send a craft like this into space.

That's not to say that large scientific projects like this haven't been done before. Look at CERN: they built a 17-kilometre ring to study particle acceleration. If there's the imperative to do something like this, we could. We have the energy to do it, there's a lot of good nuclear fusion research coming online. This is something that could be reasonably done.

However, no one's really working on the biological payloads for interstellar space quite yet. We hope with our paper that we can convince people to start thinking about these things.

STEPHEN LANTIN
Stephen is a PhD student and NASA space technology graduate researcher.