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Space missions set out to uncover the secrets of the solar system

Alex Wilkins

THE mysteries of two neighbouring planets may soon start to be unravelled, with the launch of a spacecraft that will eventually bring a chunk of a Martian moon to Earth and the descent of another craft into Mercury's orbit.

Understanding the origins of Mars's moons Phobos and Deimos, and how they came to be orbiting the planet, can hopefully tell us a bit about the evolution of Mars in general and its history, says Emelia Branagan-Harris at the Natural History Museum in London.

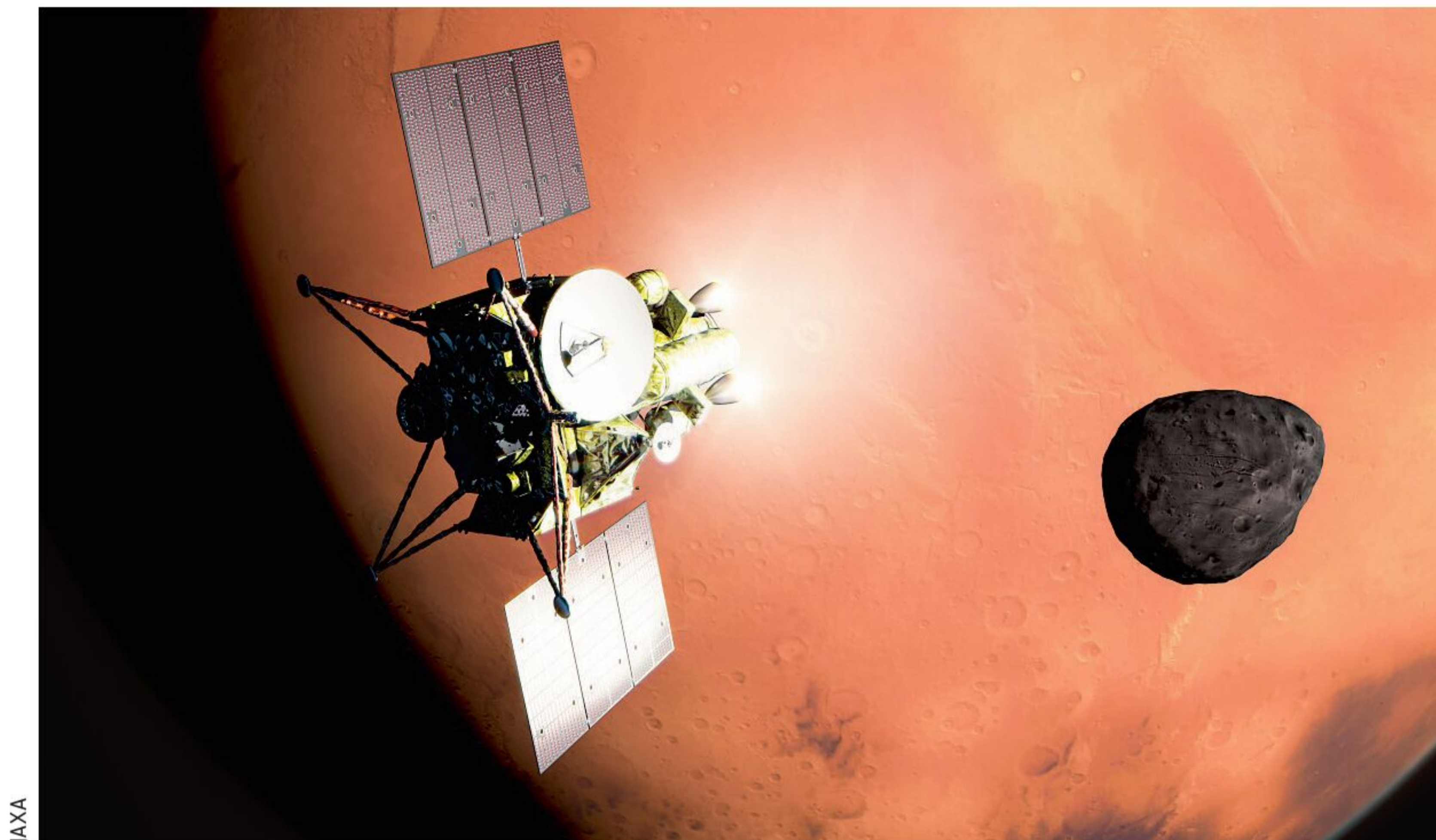
There are two competing hypotheses for how these moons came to orbit Mars: the Red Planet could have captured them as a pair of asteroids, which were either conjoined and later separated or closely orbited each other, or they could have been produced from an asteroid smashing into Mars itself, like how Earth's moon formed.

So far, we have limited evidence for either scenario, but the Japan Aerospace Exploration Agency (JAXA)'s Martian Moons eXploration spacecraft, which will launch sometime after April, should be able to definitively rule out one scenario or the other, says Branagan-Harris. The spacecraft is equipped with a raft of cameras and spectrometers it can use while orbiting the moons, which it is scheduled to reach in 2027, as well as a rover that it will deploy to the surface of Phobos to collect samples.

If the observations find abundant carbon-rich molecules and water, this could suggest that the asteroid capture theory is correct. But if they are absent, then we might need to wait for the samples to return to Earth for analysis, which is currently scheduled for 2031.

These samples will consist of rock both from Phobos's surface and from several centimetres into the ground. Once we can test the material itself, we can see whether it shows signs of melting in the past and infer whether it came from a collision with the Martian surface.

Regardless of Phobos's origin, it orbits close enough to Mars that it might



A spacecraft scheduled to launch this year will orbit the moons of Mars

contain well-preserved samples from the planet at an earlier time in its history. "There's a potential there that Phobos could have pieces of ancient Mars from back when it had liquid water, so we'd be learning a lot about the history of Mars as well," says Branagan-Harris.

From Mars to Mercury

We may also begin to learn Mercury's secrets this year, as the BepiColombo mission descends into orbit around the solar system's innermost planet.

BepiColombo consists of a pair of spacecraft from both the European Space Agency (ESA) and JAXA. The Mercury Planetary Orbiter (MPO) and the Mercury Magnetospheric Orbiter (Mio) are attached to a parent spacecraft, the Mercury Transfer Module (MTM).

Since launching in 2018, the MTM has flown by Mercury six times, using the planet's gravity to slow its descent until it can easily slot into orbit, a technique invented by the mission's namesake, physicist Giuseppe "Bepi" Colombo.

The mission has collected important scientific data, such as clues about the solar wind and high-resolution images of Mercury's surface. But its most powerful instruments, such as a pair of X-ray spectrometers on ESA's MPO, haven't yet been used because their view has been obscured by the MTM.

"If you can understand how the planets came to be, you can understand the whole solar system"

In September, MPO and Mio will detach from the MTM and begin their descent into orbit, which is expected to be complete by November, letting them finally set their eyes on the planet.

Charly Feldman at the University of Leicester, UK, worked on one of the MPO's instruments. "It's been building for a very long time, so whilst it is incredibly exciting, it's also a little bit nerve-wracking."

As well as imaging Mercury's magnetic environment in far more detail than any previous mission, Mercury's surface will be extensively mapped and analysed, using tools like the MPO's spectrometers. "It will be taking the first X-ray images of a surface of another planetary body," says Feldman.

This could help us solve mysteries such as the unexpectedly high amount of X-rays coming from the planet's night side, facing away from the sun, which previous missions measured. It can also measure X-rays coming from the planet's sun-facing side, which will allow scientists to work out what Mercury's surface is made of, which can then tell us about how the planet evolved. "If you can understand how the different planets have come to be as they are, you can understand the dynamics of the whole solar system," says Feldman. ■