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STARGAZING WITH BINOCULARS: HOW TO DO IT RIGHT

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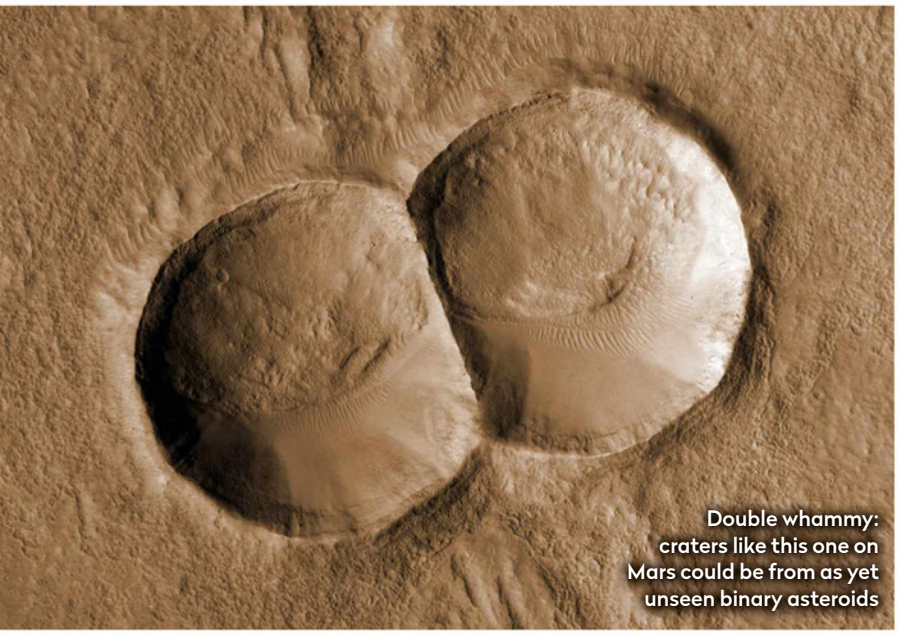

Double whammy: craters like this one on Mars could be from as yet unseen binary asteroids

NASA/JPL-CALTECH/UARIZONA, CHIME/FRB COLLABORATION WITH ARTISTIC ADDITIONS BY LUKA VLAJIĆ

Double craters are clue to vanished double asteroids

Impact craters tell us a lot about asteroids that are otherwise impossible to observe

Binary craters are something of a curiosity. They're much more than two craters that happen to have formed side by side. Instead, they're believed to have been created simultaneously by the impact of a binary asteroid – a larger body being orbited by a natural satellite. About 15 per cent of all small asteroids are believed to be orbited by their own little moon, so dual craters, formed by the impact of both an asteroid and its moon at the same time, are actually relatively common.

As such, double craters can also tell us something very useful about the population of binary asteroids. Binary asteroids in space are currently detected directly using radar, but this is only possible for the closest, near-Earth asteroids. They can also be inferred from a periodic change in their brightness, measured by telescope observations. But this only works well for binary asteroids with a small separation from each other, and the moon needs to be orbiting edge-on to Earth. So these observational techniques suffer from significant biases in the sorts of binary asteroids they're able to find.

Looking at binary craters formed when these twinned asteroids impact on planetary surfaces, however, reveals more information on the population of binary asteroids in the Solar System. A recent study of Mars, for example, found 150 examples of binary craters.

Tracking down twins

This month's paper focuses on the surfaces of the two largest asteroids, Ceres and Vesta, which have been photographed and mapped at high resolution by NASA's Dawn probe. The team – led by Carianna Herrera, at the time a Masters student at Université Côte d'Azur, France – began with databases of almost 45,000 craters on Ceres and almost 12,000 on Vesta. They looked for close-by craters that appeared to have formed at the same time, based upon the presence of a straight wall where the neighbouring craters contact each other, and upon the absence of signs that ejecta from one crater has partially filled the other. Pairs of craters where one is visibly less well preserved, and therefore significantly older than the other, were also ruled out.

The team identified a set of 39 binary craters on Ceres and 18 on Vesta. Then they studied the parameters of these binary craters, such as the separation between the two and the inferred sizes of the original impactor and its satellite. They found these parameters to be similar to those found for binary craters on Mars. But importantly, these binary-crater-forming objects are very different from the binary asteroid population known from observations. The craters on Ceres and Vesta (and also Mars) indicate binary asteroids where the partners are roughly equal in size and relatively separated.

"The craters indicate binary asteroids where the partners are roughly equal in size and relatively separated"

As we saw above, due to observational biases, the binary asteroids detected in the Solar System are often pairs significantly different in size and in a close orbit around each other. And so the binary craters studied by Herrera are the footprints left behind by objects that have long since vaporised. They reveal a population of asteroids that has not yet been observed in space.

Prof Lewis Dartnell is an astrobiologist at the University of Westminster

Lewis Dartnell was reading... *Binary Craters on Ceres and Vesta and Implications for Binary Asteroids* by Carianna Herrera et al.
Read it online at: arxiv.org/abs/2405.18460