

# OUR MOON IS NOT THE ORIGINAL MOON?

By Henry Holden

**A**CCORDING TO some scientists, the Moon, as we see it today, may not be the original Moon, but instead the last in a series of moons that orbited our planet.

There is a new study which challenges the ubiquitous theory that our natural satellite resulted from a massive impact with the ancient Earth.

The newly proposed theory by Assistant Prof. Hagai Perets, of the Technion, and Weizmann Institute Raluca Rufu (lead author) and Prof. Oded Aharonson, runs counter to the commonly held "giant impact" paradigm that the Moon is a single object that was formed following a single giant collision between a small Mars-like planet called Theia and the ancient Earth.

According to Perets, "Our model suggests that the ancient Earth once hosted a series of moons, each one formed from a different collision with the proto-Earth.

"It is likely that such "moonlets" were later ejected, or collided with Earth or with each other to form bigger moons," said Perets.

In the single impact setup, a Mars-sized body collided with the Earth, sending trillions of tons of debris of the embryonic Earth into space. Gravity bound the ejected particles together, creating the moon.

However, the single impact setup does not explain why the physical makeup of the moon is nearly identical to the Earth's, rather than a mix of Earth and another planet.

To create the conditions for the formation of these mini-moons or moonlets the researchers ran 800 simulations of large, moon-to-Mars size, but not giant, bodies hitting Earth. They found the impacts produced small discs, which formed small moons. Those moonlets migrated outward and formed together to create what we know as the Moon. The researchers said it took "about 20" collisions to form the Moon.

"It is likely that small moons formed through the process and

with science's current understanding of the formation of Earth. Each of these impacts contributed more material to the proto-Earth, until it reached its current size.

## FORMED OVER MILLIONS OF YEARS

That means the moon was formed over millions of years, not in an instant, said the scientific journal Nature

journal said, "but unlikely."

The scientists speculate that the tidal forces from Earth may have caused moons to slowly migrate outwards - the current Moon is slowly doing that at a pace of about one centimetre a year. A pre-existing moon would slowly move out by the time another moon forms. However, their mutual gravitational attraction would eventually cause the moons to affect each other and change their orbits.

"The multiple impact scenario is a more "natural" way of



An artistic depiction of a collision between two planetary bodies that will form a new moon, while a pre-existing moon already orbits the proto-Earth. (Credit: Hagai Perets. Real images of Mars and Ganymede and artist image of a planet courtesy of NASA were used in the picture construction.)

crossed orbits, collided and merged," said Rufu. "After each impact, the debris formed disks around the Earth like Saturn's rings. Over centuries, debris in several disks accumulated to form moonlets that eventually migrated outwards and merged to form one big moon.

"A long series of such moon-moon collisions could gradually build-up a bigger moon - the Moon we see today," said Rufu.

The new model is consistent

Geoscience, which published the trio's study in January. The prevailing belief has been that the moon was a piece of material that broke off from Earth.

But the research trio thought they would follow-up on the big impact theory. They said the fact the moon's makeup is similar to Earth's meant if a big clash did happen, the moon would have been formed either mostly from Earth or whatever collided with it. "Both are possible," the

explaining the formation of the Moon," said Rufu. "In the early stages of the solar system, impacts were very abundant, therefore it is more natural that several common impactors formed the moon rather than one special one," said Rufu.

The Earth and moon's interiors may be less well mixed than in a giant-impact scenario, potentially preserving a record of this period of bombardment, he added. →