# New moon

Earth may have many more moons than you think. Perhaps we should pay one a visit, says **Stuart Clark**

DETLEV VAN RAVENSWAAY/SCIENCE PHOTO LIBRARY

ALMOST a century ago, something strange split the sky across North America. On 9 February 1913, eyewitnesses reported dozens of burning fireballs cutting a swathe across the night sky. It was a display unlike any other meteor shower. Instead of shooting stars raining down in all directions, a train of bright fireballs moved slowly and deliberately over much of the continent.

The first sighting was in Saskatchewan, Canada. Burning red-hot from its passage through the atmosphere and trailing streaks of vapour, the meteor train moved south-east, passing just a few kilometres north of New York and then out over the Atlantic Ocean. Final sightings of the spectacle came from Bermuda and a steamer ship near the equator.

The distance between the first and last observing points was 9200 kilometres. To be seen over such an expanse, the meteors must have been in orbit around our planet. The conclusion was compelling: what people had seen that night was probably the break up of a small, previously undiscovered moon of Earth.

We are now realising that the events of 1913 may not be unique. Computer models of asteroid orbits are showing that small space rocks a few metres across can lodge in Earth's gravitational field if they stray too close. Only a tiny fraction of them break up and hit our planet. Most orbit unseen for months or years, somewhere beyond the moon, before slipping safely and silently back into deep space. But while they remain close, they are mini-moons of Earth. Not only are they turning out to be more common than anyone thought, they could play a vital role in unravelling our solar system's secrets.

It is not unheard of for a planet to capture a small celestial object. Jupiter is a master of the art: it is 320 times more massive than Earth, and also orbits five times farther away from the sun. At that distance, the sun's gravity is much weaker, so Jupiter can wrestle objects away from it and clutch its prey more tightly. Jupiter's most notable recent catch was comet Shoemaker-Levy 9. The giant planet's gravity subsequently pulled the comet to pieces and swallowed it in a series of spectacular explosions in July 1994.

Thankfully for us, Earth's gravity is much weaker, meaning such violent acts are extremely rare. Most of the objects that do make it to Earth originate in the asteroid belt between the orbits of Mars and Jupiter. However, telescopes designed to identify asteroids that may one day smack into Earth have found growing numbers of objects in orbits across the solar system. Most are small, fragments of once larger objects that have broken up in collisions over the aeons. Any such small body that finds itself passing by on an orbit similar to Earth's is likely to be snagged and yanked onto a course that takes it around our planet instead – if only for a short while.

## Moon trackers

Mikael Granvik at the University of Helsinki in Finland and his colleagues are among those dedicated to tracking down these celestial fly-by-nights. Calculations by Granvik's group show that mini-moons are likely to be a few metres across and orbit slowly at up to 12 times the distance of the moon. The course they chart around Earth is a delicate one because of perturbations in the gravitational field from the sun and other planets (see "Mini-moon or quasi-moon?", page 50). As a result, Granvik's model predicts that most captured objects drift off again, spending on average just 9 months in orbit. Perhaps the biggest surprise, however, is that such temporary mini-moons are common. "There is probably one up there right now," says Granvik.

Finding a mini-moon is no easy matter because their small size means they reflect little light. Present surveys, such as the one conducted with the Pan-STARRS telescope in Haleakalā, Hawaii, are looking for potentially hazardous near-Earth asteroids. But they are not really powerful enough to search for metre-sized mini-moons.

What Granvik and others do see often turns out to be space junk masquerading as small asteroids. "Out of six objects we have investigated, five have turned out to be upper stages of rockets," says Paul Chodas at NASA's Jet Propulsion Laboratory in Pasadena, California (see "Space junkie", page 50).

That leaves one. On 14 September ›