ASTEROID WHAT?

John Valley

Asteroids have a PR problem. The name, ending in -oid, connotes being sort of like something else, but not quite. *Aster* means "star" in Latin; so what is an asteroid? There are no constellations of heroic warriors immortalizing asteroids because the Greeks couldn't see them. Most were only found in the last decade. Today, the popular dream of space travel might mean going to the planets or beyond, but probably not to YP139. Most people, if they think about asteroids at all, consider them either far away and obscure or nearby and menacing, perhaps coming to end civilization.

This view has been fueled by the motion picture industry. In the summer of 1998, two disaster movies captivated millions with images of asteroids (or comets), death, and destruction. The plot lines were identical: heroic attempts with variable effect to save the Earth from NEAs (near-Earth asteroids) using manned spacecraft, rock drills, and nuclear devices. In *Deep Impact*, Robert Duvall lands on an 11 km diameter body and blows it into two pieces, one of which lands in the Atlantic causing a dramatic mega-tsunami. In *Armageddon*, Bruce Willis lands on an asteroid and blows it up, this time showering Earth with exploding rocks. Lamentably, *Armageddon* is overblown and portrays science and scientists poorly, yet it did better at the box office. I confess: I saw both films. I saw *Armageddon* in Mammoth Lakes, California, inside the Long Valley caldera. In an amazing coincidence, a magnitude-5 earthquake rattled the theatre just as a meteorite (in the movie) was vaporizing Paris. There were no injuries (in the theater), but what great special effects!

More seriously, disastrous meteorite impacts are a continuing part of Earth history. The frequency is low and poorly understood, but the results can exceed even Hollywood's lively imagination. Chelyabinsk (2013) and Tunguska (1908) were dramatic, but they were relatively small events. Some impacts recorded in the rock record were far larger, but are only known from geophysical evidence, thin spherule layers, or detrital shocked minerals. Others caused large craters or mass extinctions. Clearly, the study of past impacts

Fictional meteorite striking Paris from the 1998 movie *Armageddon*

and the prediction of those in the future are of more than academic interest, as is the study of asteroids themselves.

Many organizations are searching for NEAs from Earth-based observatories and more recently from space. There are 1450 potentially hazardous near-Earth objects known. The NASA spacecraft NEOWISE (Near-Earth-Object Wide-Field Infrared Survey Explorer) reported discovery of the newest potentially hazardous NEA on December 29, 2013. Using its 20 cm telescope and infrared cameras, it determined the size (650 m), albedo, thermal properties, and trajectory of YP139, which is currently 43 million kilometers from Earth but is predicted to eventually pass within 490,000 km, about the distance from Earth to the Moon. In 2010–2011, the spacecraft discovered 34,000 new asteroids, bringing the total identified by all researchers to about 600,000.

If you are curious about asteroids, read on in this issue of *Elements*. Six articles review the discovery and different types of asteroids, as well as current and future space missions to study or recover them. Asteroids are highly organized, but they do not occur in one homogeneous "belt." How do they form? What causes a well-behaved body to become a rogue NEA? Three special asteroids are singled out. The former asteroid 2008 TC_3 became the Almahata Sitta meteorite after fragmenting above the Sudanese desert on October 7, 2008. The asteroid Itokawa was sampled by the JAXA mission Hayabusa, providing the only non-meteoritic samples of an asteroid. Vesta is the most-studied asteroid and the second most massive; it was visited by NASA's Dawn mission and is interpreted to be the source of 100 known meteorites. Whether or not asteroids ever had a PR problem for you, I think you will find this a fascinating issue.

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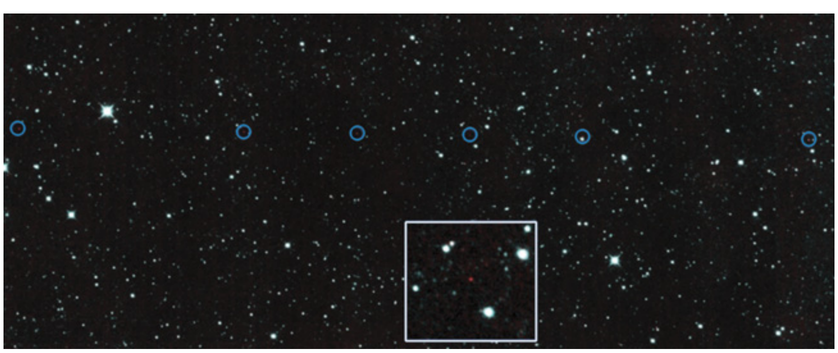

The 650 m diameter, potentially hazardous near-Earth asteroid YP139 (red dot in box) was discovered by NEOWISE on December 29, 2013. Image from JPL