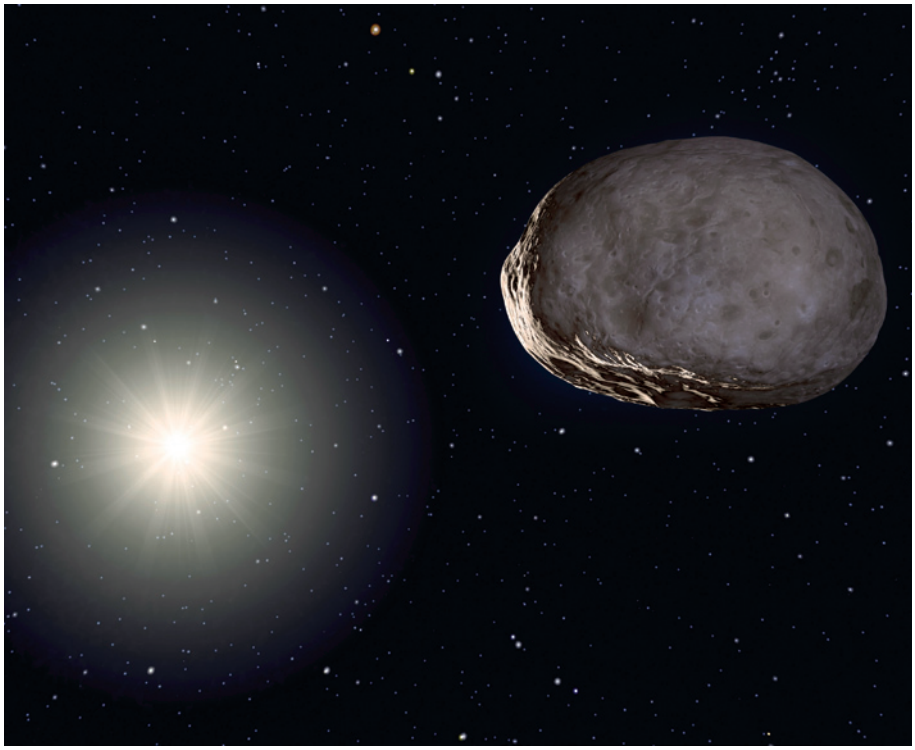
NEWS IN FOCUS

C. BUTLER/SPL



The asteroid Vesta, seen here in an artist's model with the Sun in the background, has complex geology.

PLANETARY SCIENCE

Dawn nears Vesta

Mission poised to explore the Solar System's largest asteroids in detail.

BY RON COWEN

The Dawn spacecraft had a difficult birth: it was threatened by cost overruns and technical concerns, cancelled, reinstated and scaled down. Now, after a four-year journey spiralling out from Earth's orbit, the probe is set to explore the beginnings of the Solar System.

On 16 July, Dawn will enter orbit around Vesta (see 'Dawn patrol'), an asteroid that, at 500 kilometres wide, is the second largest in the Solar System. It will spend a year there before flying on to Ceres, the Solar System's largest asteroid at nearly 1,000 kilometres wide. There are hundreds of thousands of bodies in the main asteroid belt, which sprawls between the orbits of Mars and Jupiter and is a storehouse of material that formed early in the Solar System's history. But because Vesta and Ceres have apparently survived in one piece since then, "they are like time capsules telling us about the earliest stages of planet formation", says Carol Raymond, deputy principal investigator of the mission and a planetary scientist at NASA's Jet Propulsion Laboratory in Pasadena, California.

Dawn's comparative study of the two bodies should also help to show how similarly sized objects can evolve very differently. Glimpses of Vesta suggest that its structure is like that of a miniature Earth, with a metallic core and a rocky mantle and crust, but that its growth was halted when Jupiter's far-reaching gravitational influence prevented asteroids in the belt from coalescing any further. Vesta's composition, deduced from afar through its spectral properties, suggests that after its formation, the asteroid was initially hot enough for lava to ooze out onto its surface. By contrast, Ceres contains many water-bearing minerals, and with an average density lower than that of Earth's rocky crust, it may be one-quarter ice beneath its dust-coated surface. The asteroid could even hold a subsurface ocean, long frozen or perhaps still liquid.

Dawn will use three instruments to probe those differences. A camera will image surface features as small as 10 metres across; a spectrometer will map crustal minerals at various electromagnetic wavelengths; and a γ-ray and neutron detector will reveal the quantities of elements by detecting radiation and particles produced when cosmic rays hit atomic nucleii on the surface of the asteroids.

This information, together with models of where in the early Solar System Ceres and Vesta originated, might confirm one theory as to why the asteroids are so different: that Vesta formed a few million years before Ceres. That would have given Vesta enough time to incorporate the radioactive isotope aluminium-26, which was abundant in the earliest years of the Solar System but decayed before most of the asteroids in the belt formed. The radioactivity could have provided enough heat to drive volcanic eruptions, changing the character of Vesta's surface.

Tectonic upheavals erased evidence of early heating on Earth and the other rocky planets — but not on Vesta. "Vesta is telling us what the planet-formation process looked like after the first 10 minutes in the oven," says Richard Binzel, a planetary scientist at the Massachusetts Institute of Technology in Cambridge and a long-time observer of Vesta, who first tracked the asteroid as part of a school project in 1973.

Dawn will also take advantage of a window into Vesta's interior, notes Christopher Russell, lead scientist of the mission and a geophysicist at the University of California, Los Angeles. Pictures taken by the Hubble Space Telescope in 1996 revealed an impact crater 13 kilometres deep, gouged into the asteroid at its south pole. Dawn will peer into that hole to discern any geological ▶

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diversity exposed by the impact. Three types of meteorite found on Earth — eucrites, howardites and diogenites — are thought to be chips of Vesta, blasted away by the collision. Linking these convenient specimens to particular internal layers of Vesta is a key driver of the Dawn mission, notes Binzel.

"It's a little bit like the Humpty Dumpty problem — we've got a lot of pieces of Vesta and we'd like to see how they all fit together," he says.

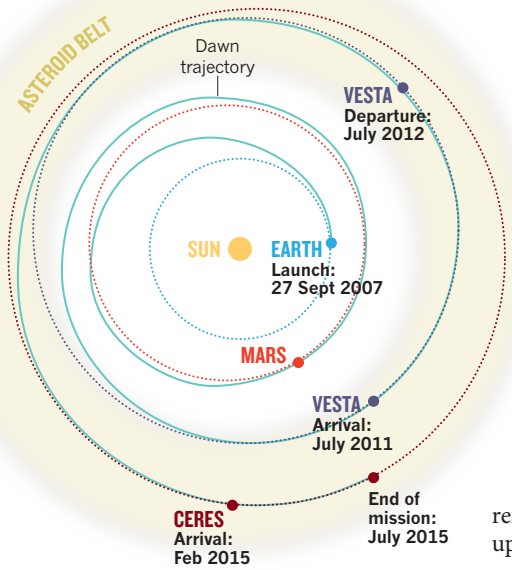
After its tour of Vesta, Dawn will fire up its ion thrusters — solar-powered jets that supply a weak but long-lasting push — and set a course for Ceres, which it will inspect over five months in 2015.

Before launch, budget issues caused the mission team to drop two instruments originally meant to fly aboard Dawn; one of them, a magnetometer, will be especially mourned once the craft reaches Ceres. The magnetometer could have looked for fluctuations in the strength of the asteroid's magnetic field that might have provided clues as to whether the body harbours a briny ocean. Losing the instrument "was a big blow", says Raymond.

Although Dawn has so far survived the ravages of budget changes, politics and four years in interplanetary space, Russell says that he won't relax until the craft enters orbit around Ceres. Casey Lisse, a planetary scientist at Johns Hopkins University's Applied Physics Laboratory in Laurel, Maryland, agrees. "We've learned most of what we can from remote observations of Ceres, and we need an up-close and personal look," he says. ■

DAWN PATROL

A seven-year flight plan includes encounters with two major asteroids.



EPIDEMIOLOGY

African outbreak stumps experts

With few leads to go on, researchers pursue the childhood malady nodding syndrome.

BY MEREDITH WADMAN

The boy was perhaps seven or eight, although he could have been older: among other things, the disease that afflicts him stunts growth. When a seizure began, his mother summoned Sudhir Bunga, who found the boy sitting under a tree in a school playground. "The child was staring blankly and his head was intermittently nodding every five to eight seconds," Bunga says. "This lasted about three minutes."

Bunga was not surprised by what he saw. A physician and epidemiologist with the US Centers for Disease Control and Prevention (CDC) in Atlanta, Georgia, he was in rural southern Sudan in May as part of an emergency-response team trying to assess a mysterious illness seen in children in the region. But despite his preparation, Bunga was deeply affected by his first encounter with 'nodding syndrome'. "Actually seeing it out in the community was overwhelming and distressing," he says. "The burden of the disease looked really high."

Nodding syndrome is a poorly understood and seemingly growing problem in eastern Africa, where it is devastating communities in South Sudan and northern Uganda. It has existed separately for decades in a secluded mountainous area of southern Tanzania[1]. In South Sudan, "it's affecting thousands of children," says Abdinasir Abubakar, a physician for the World Health Organization (WHO) based in South Sudan who coordinated the recent CDC trip. "Of course, the question is whether this syndrome is spreading to new communities."

For South Sudan, which achieved political independence only on 9 July, the syndrome raises the additional fear that the new nation's limited capacity to deal with an emerging medical threat will be quickly overwhelmed without outside resources and expertise.

"Nodding syndrome cannot be left with the nascent government in South Sudan," says Martin Opoka, an epidemiologist with the WHO's eastern Mediterranean regional office in Cairo. "They will certainly need assistance from the international community."

Opoka helped to investigate the occurrence of nodding syndrome in southern Sudan as part of a WHO team in 2002, and returned to the region this year to assist the CDC investigators. The CDC team — consisting of four physician-epidemiologists with specialities in paediatrics, neurology and nutrition — was dispatched by the US agency's Division

S. BUNGA/CDC

In some villages in South Sudan, almost every family has a child affected by nodding syndrome.