ECOLOGY

Mangrove maintenance

The stilt-rooted trees of mangrove forests host rich biological diversity, as well as supporting fisheries and protecting shores from storm damage and erosion. These tidal-zone trees can maintain an appropriate soil elevation for local sea levels and inundation rates by accreting sediment or organic material around their roots (pictured, mangroves in Indonesia). But on page 559 of this issue, Lovelock *et al.* (C. E. Lovelock *et al. Nature* **526,** 559–563; 2015) show that for many forests, current rates of sea-level rise outpace this adaptive capacity.

Assessing 27 sites across the Indo-Pacific, the authors find that sediment availability is a key survival factor for mangroves in the region. But river damming and land-use change are reducing sediment supply. The researchers' modelling predicts that, at current rates of sea-level rise, many mangrove forests could be submerged by 2070. **Marian Turner**

JANE GOULD/ALAMY

EXOPLANETS

A glimpse of Earth's fate

Analysis of data from the Kepler space observatory and ground-based telescopes has led to the detection of one, and possibly several, minor planets that are in a state of disintegration in orbit around a white dwarf star. SEE LETTER P.546

FRANCESCA FAEDI

What will Earth's fate be when the Sun dies? Writing on page 546 of this issue, Vanderburg *et al.*[1] offer a dramatic answer in their discovery of one, or possibly several, dying minor planets, which have a rocky bulk and chemical composition similar to Earth's. These small bodies are in a tight orbit around a white dwarf, the remnant of a Sun-like star that has reached the end of its life, and they are being shredded to pieces by the star's strong gravity and radiation field. The authors' observations of the system reveal multiple transit signals — the periodic dimming of the stellar light caused by passing foreground objects — induced by one or several disintegrating bodies that have orbital periods of 4.5 to 4.9 hours.

The vast majority of exoplanets discovered up to now orbit main-sequence stars, which, like our Sun, are in the prime of their lives. By contrast, the minor planets discovered by Vanderburg *et al.* are orbiting a member of the stellar graveyard, but not for much longer. A star like the Sun reaches the end of its life when the nuclear fuel in the stellar core is exhausted. During this process the Sun will expand and become a red-giant star that will engulf the inner planets Mercury and Venus. Whether the Earth will be swallowed up by the bloated Sun is still a matter of debate; however, even if the Earth survives, its surface will be roasted. Following the red-giant phase, and before becoming a white dwarf, the Sun will lose a large fraction of its original mass.

This overall process will destabilize the planetary orbits[2] and might cause collisions between the planets, similar to those that occurred during the infancy of the Solar System. Some planets might in this way be shattered to pieces resembling asteroids. If such an asteroid wanders too close to the white dwarf it will be ripped apart by strong tidal (gravitational) forces, and a circumstellar dust disk will form[3,4] of similar chemical composition to that of the original planetary core. Such a disk can be then accreted onto the atmosphere of the white dwarf[5].

White dwarfs are small but extremely dense, and so they have strong gravitational fields. Consequently, elements heavier than helium (called metals by astronomers) that fall into a white dwarf's pure hydrogen or helium atmosphere are expected to sink towards the star's core within a matter of days. But astronomers have discovered metals such as carbon, silicon, oxygen and iron in the atmospheres of one-third of all known white dwarfs[6], and observations at infrared wavelengths have revealed that some of these stars have circumstellar dust disks[7,8]. Thus the atmospheric pollution of white dwarfs by metals such as these, which plausibly originated in circumstellar disks, provides strong evidence that a substantial fraction of white dwarfs have devoured broken-up planets or asteroids of chemical compositions similar to those of terrestrial bodies. After all, carbon, silicon, oxygen and iron make up roughly 93% of Earth's mass[9].

The NASA Kepler space observatory was launched in 2009 and since then it has been obtaining high-precision photometric measurements of the brightness of stars in the constellations Cygnus and Lyra[10]. By monitoring planetary transits, these observations