to play it safe and keep the spacecraft about 100 diameters away, a theoretical limit for temporarily bound satellites and debris. From such a distance, a direct mass determination is impossible.

The discovery of an object 1.4 km in diameter close to Ida showed how wise the flight engineers were to be cautious and served as a testimonial to the contributions made by amateur astronomers. Belton *et al.* point out that the likelihood of the object's being a random passing asteroid is astronomically small. The real asteroid belt does not resemble the crashing boulder fields depicted in popular science fiction films; on average, kilometre-sized asteroids are separated by millions of kilometres. From its slow relative motion with respect to Ida, the Galileo scientists further argued, and the International Astronomical Union agreed, that the object must be a satellite in orbit around Ida. The name Dactyl is derived from beings in Greek mythology who resided on Mount Ida.

Whereas the discovery of Dactyl might have been a gift from the Fates, determining its orbit was a task for the Titans. Although the satellite was identified in 47 separate images, Galileo, Ida and Dactyl represented three moving targets experiencing a constantly changing geometry. In addition, the duration of the encounter covered only a fraction of any likely orbital period. The task accomplished by Belton *et al.* was to constrain the orbit as well as possible, and, with the help of Kepler's Third Law, to derive a mass for Ida. Combining this mass with a volume derived from imaging, they find a bulk density for Ida of 2.6 ± 0.5 g cm^{-3}, lower than expected for either pure stony-iron or ordinary chondrite material. To account for this density, Belton *et al.* argue that Ida has some internal porosity, assuming its interior is fractured. A porosity between 23 and 48 per cent is most consistent with values inferred for other small Solar System bodies. Porosities in this range yield Ida's observed bulk density if the predominant solid material is chondritic.

If Ida is indeed composed of ordinary chondrite material, why don't its spectral characteristics (or those of S-asteroids in general) more closely match laboratory spectra of chondrite meteorites? Central to the long debate[6] on whether the S-asteroids have an ordinary chondrite or stony-iron connection has been whether some surface alteration, termed 'space weathering', might be operating on asteroids as it does on the Moon[7]. Demonstrating that such a process occurs on asteroids is tantamount to closing the link between S-asteroids and ordinary chondrites.

In comparing Ida's spectrum with its satellite's, Chapman *et al.* argue that the less red colour of Dactyl and its deeper absorption bands are evidence of space weathering. Specifically, they assume that Ida and Dactyl originated as identical twins in the break-up of a single parent body that formed a large cluster of asteroids, known as the Koronis family, in which they reside. Dactyl being smaller, they suggest that its surface is more frequently refreshed and younger than Ida's. Ida's older and redder surface, they argue, demonstrates the occurrence of a space weathering process that could forge the sought-after link between S-asteroids and ordinary chondrites.

Although Ida's density measurement and Dactyl's colour difference tip the scales towards an ordinary chondrite link for Ida and similar S-asteroids, a final decision would be premature. The unknown porosity of Ida, which could be substantially higher than assumed if it is composed of multiple pieces reassembled from the Koronis parent body, still leaves room for argument for a stony-iron composition. Similarly, no space weathering process need be invoked if Ida and Dactyl are fraternal siblings. Dactyl's spectral signature does fall within the range seen for other Koronis family members. Even Dactyl's 'fresh' surface does not display a spectrum fully matching that of an ordinary chondrite meteorite.

Where do we go from here? The new era of asteroid science ushered in by Galileo's flybys was made possible though NASA's farsighted policy of allowing outer planet missions to investigate asteroids encountered *en route*. This policy has now been abandoned, and sadly, the Cassini mission to Saturn will turn a blind eye when it passes through the asteroid belt.

The missing ingredient in Galileo's opportunistic asteroid missions has been an elemental abundance analysis which can only be obtained by a rendezvous. Fortunately, such measurements are a goal for the Near-Earth Asteroid Rendezvous (NEAR) mission scheduled for launch next year. As part of NASA's new Discovery programme, NEAR will rendezvous with the S-type asteroid 433 Eros in 1999. From this first dedicated asteroid mission, we can hope that a knock-out punch will be delivered in resolving a meteorite analogue for the S-asteroids. □

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DAEDALUS

Money teaches

THE recent British 'Science Week' aimed to persuade children to take up science, on the absurd pretence that Science is Fun. In fact there is no demand for scientists, as shown by their low salaries and dismal career prospects. Daedalus is seeking a sounder way to influence the educational choices of the young. He notes how the stockmarket enables a technical project to be judged at every stage, not by its starry-eyed proponents, but by those shrewd outsiders, the shareholders. He therefore wants to take student loan schemes to their logical conclusion, and set up a formal stockmarket in students.

A potential student will simply float himself on the educational stockmarket, and issue share capital in the project of his own education. At once the benevolent disciplines of the market will come into play. Suppose he wants to study physics. If the market feels him to be a rotten physicist, or reckons there are too many physicists already, he will find it hard to raise capital. His shareholders will steer him towards classics, advertising studies, or wherever they see the best future returns. They may even judge that he already has as much education as he can hold, and should get a job instead.

This elegant system does away with rigid formal entrance requirements. Dedicated but unqualified mature students, outsiders with unusual qualifications, eccentric geniuses who terrify the examiners, all will have a fair chance at last. They need only convince the market of their worth, and the portals of education will open to them. Once inside, they will have a powerful incentive to do well. If they seem out of their depth, or neglectful of their studies, further investment may not be forthcoming.

Colleges and universities will benefit too. At last they will have clear market signals about the worth of their activities. If the share price of the students plummets when Professor X is appointed, or the new ecosociology course is unveiled, a wise vice-chancellor will reconsider his plans. Yet many tricky decisions will be avoided. Projects to encourage minorities or women to go in for this or that subject, for example, will become irrelevant. If it's worth doing, the market will do it anyway.

Once a student has graduated, the shareholders will look for their return. He will pay them a steady dividend on his earnings, deductable against tax (after all, the State has not paid for his education). If he does particularly well, he may even be able to buy back his own shares, and enjoy the pleasure of full self-made independence. David Jones