The Economist

Dealing with asteroid strikes

A close shave

After a hit and a near miss minds are focusing on the risks from space rocks

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It came from outer space

ONE close shave with an asteroid is cause for excitement. Two on the same day is scary. On February 15th planet Earth experienced exactly that, as a hunk of itinerant space rock passed by extremely close, while another exploded spectacularly in the skies above Russia.

The first asteroid, called 2012 DA14, had been known to astronomers for around a year. They had calculated that there was no risk of collision. But the 30-metre, 190,000-tonne rock came close: 27,700km (17,200 miles) above the surface, inside the orbit of some satellites. It was the nearest ever recorded for an asteroid that size.

The second came quite literally out of a clear blue sky, appearing without warning and then disintegrating about 30 seconds later over Chelyabinsk. According to NASA, the 10,000-tonne meteor released about 500 kilotonnes of energy when it broke apart, equivalent to the yield of a largish nuclear bomb. Only the height of the detonation—dozens of kilometres up—kept the fatality count at zero, although more than 1,000 people were injured as windows were blown out of buildings.

This double whammy has focused minds on the threat from asteroids, something that astronomers have long known is real but which tends to be treated with giggles whenever it is brought up outside the lab. Some politicians have nevertheless taken action. In 1998 America's Congress ordered NASA to begin cataloguing the very largest, "planet-killer" asteroids—defined as those more than a kilometre across. The agency reckons it has accounted for more than 90% of them. But as the impact from such a beast would be catastrophic, the few undiscovered rocks still represent a threat.

Deep impact

These days, a mix of national organisations and universities run an alphabet soup of detectors. But the field is still a bit of a backwater, and budgets are tight. John Tonry, an astronomer at the University of Hawaii, is building an asteroid-hunting telescope called ATLAS with $5m from NASA. Dr Tonry cannot afford to hire a proper telescope engineer, and is having to design the device himself.

ATLAS is intended to spot mid-sized "city killers" like 2012 DA14. Astronomers reckon the risk from these is at least as great as that from the biggest ones because there are many more of them. Exactly how many more, though, is hard to say because, being small, they are hard to see. ATLAS should be able to spot a rock on a collision course a few days before it hits, giving time to organise a hasty evacuation.

Of course, rather than evacuating the impact zone, it would be better if there were some way to deal with a threatening asteroid more directly, by nudging it into a different orbit. Asteroid deflection suffers from an even greater giggle factor than asteroid detection, but several ideas have been proposed. One popular method is to use nuclear weapons. Detonating a nuke (or several) near an asteroid's surface could boil away some of the rock and—by Newton's third law of motion—impart a shove in the other direction. Done early enough, this would shift the object's orbit sufficiently to stop it hitting Earth. (It is worth noting, for pedantry's sake, that the 1996 Comprehensive Test Ban Treaty bans nuclear explosions in space.) Alternatively, simply ramming the offending rock might provide enough force to provoke a suitable reaction and change in orbit. The European Space Agency plans to launch, in 2015, a spacecraft called *Don Quijote* that will test the feasibility of doing this.

Other ideas are more elegant: painting the rock white, for instance, will alter the way it interacts with sunlight, nudging it into a new orbit. Or rocket motors might be strapped to it, to propel it in a desirable direction. Or a large spacecraft could orbit around it, where its gravity would alter the asteroid's orbit around the sun.

The trouble is that many of these ideas rely on having plenty of warning. Even small asteroids are big, as 2012 DA14 shows. That means shifting them at short notice is going to be difficult. When America's National Research Council studied the problem in 2010, it came to the conclusion that even nuclear weapons would require warning times measured in years or decades. Evacuation, it said, was the only feasible option for dealing with hard-to-spot asteroids arriving with little warning. Others are more optimistic. The day before the explosion over Russia (but, no doubt, with an eye on the close passage of 2012 DA14) researchers at the University of California, Santa Barbara, proposed putting into orbit a solar-powered laser that could use its beam to vaporise the surface of an incoming asteroid and thus knock it off course, even at a few days' notice.

Bet your life?

Hard-nosed economists might wonder whether spending money on asteroid research—either for detection or deflection—is really worth it. After all, for all their drama asteroid strikes are rare, and there are plenty of other threats to worry about. But the relative lack of information makes the true risk difficult to calculate. An asteroid strike is an event with a low probability, but a high death toll when it does happen. That, as Dr Tonry points out, does funny things to the risk calculations. "Our best guess is that you can expect maybe 100 people a year to die from asteroid strikes," he says. "Of course, what that really means is that you might see 100,000 deaths every thousand years, or 100m every million." After dodging two potential catastrophes in one day, the world may decide it is better to be safe than sorry.

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