# Defending Planet Earth

By Dr Michael McEllin

The fireball that exploded over Chelyabinsk in February 2013 with the force of 500,000 tonnes of TNT is the first well-verified extra-terrestrial impact that has produced a significant number of human casualties. This has more effect on public perception of risk that the most authoritative statistics studies. However, even the experts' risk perceptions are relatively recent.

Until 1980, when evidence emerged of the giant asteroid strike that produced a mass extinction at the end of the Cretaceous period, few geologists believed that the Earth was subject to regular extra-terrestrial impacts. Once our eyes were opened it because easy to recognise other impact craters in relatively plane view, and we now know of about 190, mostly no more than 200 million years old. In fact, we come across them wherever geologists happen to be working, and there are almost certainly many, many more in parts of the World (the greater part) where there has been no systematic examinations.

Are we likely to see further, perhaps larger impacts threatening our existence? Since the turn of the century systematic searches, mainly undertaken in the USA at the behest of Congress, have been slowly cataloguing the "Near Earth Objects", or NEOs, that might conceivably prove to be a hazard, and by 2030 we will probably be able to track perhaps 95% of asteroids that might at some point find themselves on a collision course with Earth.

Why bother? What could we do about an incoming strike with our name on it? Quite a lot, it turns out. In this respect asteroid impacts are unique amongst natural hazards: they are the only one that we can potentially completely counteract. If nothing else, having a good prediction of the strike location well in advance allows a controlled evacuation to save lives. That might be a last resource, but we already have space technology that could deflect smaller asteroids away from a collision and entirely plausible designs that would cope with larger bodies. Politicians to some extend fear doing nothing to prevent major consequences when it is quite clear that something could have been done.

There are also other political issues: a deflection mission might work only partially, and suppose that, for example, we managed to prevent an impact in, say, the USA, by deflecting the strike just enough to land in, perhaps, Russia. Who decides whether the risk is worth taking? The time to sort out the protocols for handling this type of mission is before we see an incoming strike in our telescopes, and indeed the United Nations Committee on the Peaceful Exploitation of Outer Space now has a sub-committee considering how such missions would be conceived, planned, authorised and controlled.

It is reassuring to find that much of the work has been quietly going on for some years. Do not, however, get too complacent. It is somewhat underfunded when one considers the level of risk compared, say to

actions that would be required against a similar scale of industrial hazard, and sometimes depends on equipment that is, frankly, almost clapped out. Politicians like to hand out responsibilities, but do not relish finding the money to support the required actions. Nevertheless, we are better off than we might be, and scientific missions conceived for other purposes are, as a by-product, now helping to meet some of the asteroid tracking goals. Expect to see more reports of rather near misses in the next few years as instruments already under construction come on stream.

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Dr McEllin, who is a physicist and expert in nuclear safety, gave a fascinating and well-illustrated lecture on the impact dangers to the Earth and humankind from asteroid and meteorite impacts. He started his talk with a review of the fireball that exploded above Chelyabinsk in Russia in 2013 with the force of 500,000 tonnes of TNT as this is the first well-verified extra-terrestrial impact that has produced a significant number of human casualties and thus has a greater effect on the public perception of risk that the most authoritative studies.

Until 1980, when evidence emerged of the giant asteroid strike that produced a mass extinction at the end of the Cretaceous period, few geologists believed that the Earth was subject to regular extra-terrestrial impacts. However, we now know of about 190 such impacts that are mostly no more than 200 million years old.

The lecturer then discussed the work being done in the USA on cataloguing Near Earth Objects (NEOs) that might prove to be a hazard to life on Earth stating that, by 2030, we will probably be able to track some 95% of asteroids that might be on a collision course with Earth. There then followed a brief resume of possible defensive actions including asteroid deflection or destruction in space and pre-emptive human evacuation of danger zones.

Defensive actions require decisions of a political nature that could themselves be highly charged, particularly if, for example, a US-made decision to deflect an asteroid resulted it an impact in Russia. Reassuringly, the United Nations Committee on the Peaceful Exploitation of Outer Space now has a sub-committee considering how such missions would be conceived, planned, authorised and controlled.

As asteroid tracking capabilities improve we may expect to see more reports of near misses in the next few years but, as always with public funded projects, more money to fund defence of our planet may be difficult to achieve politically.