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Watching for the big one

Space sentinels patrol the skies, looking for asteroids or comets that could smash into Earth with devastating results. But it's hard to get money to to plan for something that may not happen for hundreds, maybe millions, of years. ANNE McILROY reports

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By ANNE McILROY
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Shortly before dawn on Dec. 6, 1997, Jim Scotti was at his post atop a mountain in Arizona, scanning the heavens for a killer.

Mr. Scotti, an astronomer at the University of Arizona, is part of a small community of space sentinels, researchers who use land-based telescopes to patrol a large volume of space around Earth for giant asteroids and comets heading our way.

They are trying to protect mankind from going the way of the dinosaurs, which, if they weren't instantly blown up or burned to a crisp, probably starved to death after a heavenly body 10 to 15 kilometres in diameter smashed into the Yucatan Peninsula in Mexico 65 million years ago.

Every night, two telescopes on Kitt Peak are pointed at the sky, right about where the sun would be at high noon. As the astronomer on duty, Mr. Scotti sat in a small office by himself, sipping Tang and watching hundreds of asteroids drift by on three computer screens. Most were moving quite slowly, travelling a distance equal to half the diameter of the moon every 24 hours.

Then his asteroid-spotting software picked out a blurry circle on the screen that was moving

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more quickly, a candidate for what astronomers call Near Earth Objects, asteroids that might one day hit the planet and wipe out the human race.

His discovery was named 1997 XF11, and over the next 90 days, other astronomers did some quick calculations and figured that the asteroid was almost two kilometres in diameter and travelling at more than 27,000 kilometres an hour.

They concluded that 1997 XF11 was the most dangerous asteroid yet observed and would pass within 57,000 kilometres of Earth -- a hair width in astronomical terms. It was coming in our direction, and if it hit, it would explode with the energy of two million Hiroshima-sized atomic bombs.

"My first thought was, 'This is our ticket,' " Mr. Scotti remembers.

This is not the line of dramatic dialogue a Hollywood screenwriter would write at this point in an asteroid impact disaster flick. But Mr. Scotti saw the possibilities rather than the danger of an asteroid that might kill billions of people.

Fear over an impact might galvanize governments into spending more money spotting asteroids, a pursuit that began in earnest only 10 years ago and is still only meagrely funded compared with other elements of the U.S. space program.

Researchers meeting this week at the annual conference of the American Association for the Advancement of Science lamented the lack of funding, especially for studies on how to best prepare for when the big one hits, which if the initial calculations had been right, would have been Oct. 26, 2028. Fortunately, they were wrong.

A few months later, astronomers found earlier images of 1997 XF11 that nobody had noticed, and calculated that it would miss Earth by a far more comfortable margin. It was no longer a threat.

The story of 1997 XF11 demonstrates two truths -- one of them comforting, the other disturbing -- about the men and women who guard our planet from cosmic catastrophe.

They don't lose sleep fretting over the doomsday scenarios they have helped to piece together on what would happen if an asteroid or comet hits. They don't worry about their hometown being turned into a crater or about being baked to death when the surface of the Earth turns into a convection oven after a major impact.

Those who work near the ocean aren't moving away for fear of tidal waves as high as the sea is deep. They aren't survivalists, stockpiling food for the three-year winter that would be caused by all the dust blocking out the rays of the sun. Many of them have children, are saving for retirement. They don't have bunkers in the basement.

"True, we live in a shooting gallery, but it is a big shooting gallery and we are a small target," says Jay Melosh, another astronomer at the University of Arizona. "The risk of dying when an asteroid hits is about the same as dying in a plane crash or winning the lottery."

Someone always wins the lottery, but if the apocalypse experts aren't neurotic about death by fireball, then why should we be?

That's where the disturbing truth about asteroid researchers comes in. They make mistakes. Sometimes, they don't see asteroids or comets heading in our general direction until after they have whizzed by. Sometimes, they underestimate the destructive power of giant hunks of rock and metal travelling 50 to 100 times faster than a speeding bullet.

Take the case of Comet Shoemaker-Levy, which was heading toward an impact with Jupiter in 1994. In an article for the journal Nature, comet expert Paul Weissman predicted that the impact would be a "cosmic fizzle."

Instead, the giant fireballs that ignited in Jupiter's atmosphere were visible through telescopes on Earth. One of the chunks, fragment G, left a dark brown scar as big as our

entire planet.

The surface of the Earth is pockmarked with its own cosmic scars, 171 impact craters around the world, 31 in Canada. From the air, they look like ring-shaped stains left by the bottom of giant coffee cups. Most impact sites are likely under the oceans that cover three-quarters of the Earth's surface. There is plenty of proof we have been hit before, and will be hit again.

The last time the Earth was struck by something as destructive as the Shoemaker-Levy comet was 65 million years ago, when a heavenly body careened into Mexico, leaving a crater that was the first, and so far the only one on Earth, to be linked to one of the mass extinctions of plant and animal life that the fossil record shows happen every 26 million to 30 million years. In this case, it was the dinosaurs and 99 per cent of the plants and animals that lived with them during the age of the reptiles that disappeared forever.

It was a distinguished Canadian geologist, Digby McLaren, who in 1970 first proposed that asteroids or comets might be linked to mass extinctions. The theory was controversial, but gained momentum when Luis Alvarez and his team found a high incidence of iridium, an element far more common in extraterrestrial objects than on Earth, in the fossil record just as the dinosaurs disappeared.

The search for the crater began, and in 1990 Canadian Alan Hildebrand, now at the University of Calgary, helped to prove that the crater in the Yucatan landed just before the dinosaurs disappeared.

"What would be the impact of an asteroid the same size in today's world? I honestly don't know what fraction of the human population would survive. It would certainly be less than a 10th, maybe much less, and we would lose many of the existing species on land, sea and air," Dr. Hildebrand says.

Something that size hits only every 100 million years or so, he adds.

Scientists generally accept the theory that an asteroid or a comet killed the dinosaurs, although they aren't sure which it was.

Big asteroids are rubble piles of dense, pitted rock and metal, described by scientists as being more like popcorn balls than giant boulders. Comets are "dirty snowballs," a combination of rock and ice that travel far faster than asteroids and in orbits that can make them difficult to detect until they are heading right for us.

Because they are so fast, comets have the potential to do much more damage. But they are also less dense, which may make them less deadly. They are seen as wildcards, and account for about 10 per cent of the risk of a deadly impact.

Risk assessment is a large part of this branch of astronomy. How do you deal with a threat that is low probability, but high risk? Is it worth spending billions of dollars detecting small asteroids that might kill only a few million people? What about a few billion people? The analysis changes with new scientific developments.

For example, Dr. Melosh recently unearthed a U.S. Defence Department study of underwater nuclear explosions that found the waves created by an asteroid impact certainly wouldn't be as high as the sea is deep, as many scientists predicted. In fact, the waves created after an impact would be smaller, and probably break offshore.

This is comforting news, since the odds are that asteroids will land in the sea. But for astronomers, it may mean fewer resources in the future for asteroid surveillance.

The U.S. National Aeronautics and Space Administration first crunched the numbers in the early 1990s, and came to the conclusion that Near Earth Objects larger than one kilometre in diameter are the biggest threat.

Known as "civilization enders," they would explode with energy many times greater than all

the nuclear weapons stockpiled on Earth. Half of the world's population could be wiped out.

In 1998, NASA started the Spaceguard survey to track these asteroids, and by 2008, it expects to have identified 90 per cent of the big ones coming within eight million kilometres of Earth.

But that doesn't mean we can relax, says Canadian Robert Jedicke, who is starting up the next phase of asteroid surveillance this year at an observatory in Hawaii.

Mid-size asteroids would still be catastrophic enough to turn countries the size of England into smoking craters, and kill a billion or half a billion people.

The aim of Dr. Jedicke's project, called PanSTARRS, is to track and catalogue 90 per cent of all asteroids bigger than 300 metres in diameter. This work, funded by the U.S. Defence Department, will probably take 15 or 20 years.

When the mid-size asteroids have all been discovered, the next step will be to locate all asteroids greater than 100 metres in diameter, Dr. Jedicke says.

Asteroids around 50 metres in diameter will probably explode in the atmosphere before they hit the Earth. But even these "small" ones can be extremely dangerous. On June 30, 1908, a meteor probably 60 metres in diameter exploded seven kilometres over Siberia, incinerating 12,000 square kilometres of forest in seconds.

The idea, Dr. Jedicke says, is to set up some kind of early-warning system. The best-case scenario would be to give people a decade or so notice of an asteroid impact. In the case of big asteroids, this would give scientists time to come up with a deflection plan and launch a mission to intercept. Even a warning of a month or a few weeks would save lives.

"We want an early-warning system that will say there is an asteroid heading for Central Canada, and then people can start thinking about it. Then we can say, 'It is actually going to hit Saskatoon,' " Dr. Jedicke says.

Then what? That's the question that was posed this week at the annual meeting of the American Association for the Advancement of Science, the world's largest scientific society. The AAAS devoted one of its high-profile sessions to risks of asteroid impacts.

There is no international procedure for an asteroid impact, no discussion of how to handle a crisis that could dwarf any the world has faced.

"This is a new kind of problem," says Lee Clarke, a professor of sociology at Rutgers University in New Jersey. Like global warming or other environmental problems, it requires action and money now to protect future generations. A large asteroid or comet will eventually hit Earth, but it may not be for hundreds, or even millions, of years.

The worst-case scenario is that an asteroid or comet suddenly appears and there is no time to deflect it. Should humanity be warned anyway?

Geoffrey Sommer of the Rand Corporation in California says there is no point. Global panic won't help the situation. "If an extinction-type impact is inevitable, then ignorance for the populous is bliss."

Dr. Clarke, an expert in disaster response, disagrees. He says studies have shown that Americans don't panic in the face of natural disasters, such as hurricanes or earthquakes, if they get information from their leaders that they can trust.

He has spent some time thinking about what the final days would be like before an asteroid hits. "I think it would be a lot like the plague in the Middle Ages. Some people would turn to hedonism. Most people would continue doing what they did yesterday. Some people would quit work, but others would try to continue their networks of social affiliation, which in many cases is work," he says.

An even better scenario, and one that would be more in line with a Hollywood movie, would give the human race enough time to dispatch a team of astronauts to the asteroid. They would gently nudge it into a slightly different orbit. Civilization would be saved.

But the conclusion of this particular real-life drama may not be known for generations. The handful of scientists now watching the skies for asteroids can only hope the work they are doing now leads to a happy ending.

Anne McIlroy is The Globe and Mail's Science Reporter.

Asteroids are hunks of rock and metal. Like the Earth, they orbit the sun, but they are too small to be considered planets. Asteroids are believed to be material left over from the formaton of the solar system, and most are found in an asteroid belt between Mars and Jupiter. The Earth passes through the orbits of an estimated 20 million asteroids in its journey around the sun. Earth-asteroid collisions have happened many times in the past. Scientists say another one is certain. The queston is when, and how big the asteroid will be.

Civilization enders are a kilometre in diameter or more. NASA estimates there are a thousand of them with orbits that bring them close enough to require monitoring. If one of these struck land, it would release the same amount of energy as more than a million Hiroshima-sized nuclear bombs. Upon impact, millions of asteroid chunks would fly back into space and rain down on Earth, turning the surface of the planet into a convection oven. Enough dust would swirl into the sky to block out the rays of the sun for at least one growing season, maybe more. Billions of people would die. It is estimated one will hit every 800,000 years.

Country killers are smaller, 200 metres to just under a kilometre in diameter, but still deadly enough to do serious damage to a country the size of England. It is estimated one will hit once every 100,000 years.

City flatteners, asteroids less than 50 metres in diameter, explode when they enter the Earth's atmosphere, but that doesn't mean they aren't a danger. In 1908, a small one exploded above Siberia with the force of a conventional hydrogen bomb, and flattened 12,000 square kilometres of forest. One of these above New York City, Toronto or any other heavily populated area could result in serious casualties. It is estimated one will hit every 1,000 years.