Graphic by Margaret Bessai

CHICKEN LITTLE WAS RIGHT

The sky is falling! And a Regina scientist and his partner know just what to do about it.

By Carmen Pauls

Call it Chicken Little with a twist. When Martin Beech and Peter G. Brown, a pair of Canadian astronomy graduate students, were first struck with the idea that the Earth's billion-dollar ring of artificial satellites was in danger from falling space pebbles, they expected to be laughed at.

But unlike Chicken Little, whose hasty conclusions about falling acorns landed her in serious hot water, Beech and Brown weren't roasted by their peers. Instead, soon after their findings appeared in June 1993's Monthly Notices of the Royal Astronomical Society, the pair began getting calls from some of the biggest cocks in the astronomical henhouse: NASA, the Canadian Space Agency and the Hubble Space Telescope Science Institute, all wanting to know how their scientists had failed to realize that their precious satellites were sitting ducks for the last of this century's major meteor storms.

Peter Brown is cocooned in a soft, vibrating hum - the gentle throbbing of more than half a dozen computers busy crunching data about dust. This isn't your everyday, Hoover-it-off-the-floor-type dust. This is space dust. To be more precise, it's the Leonid meteor stream, which every 33 1/4 years unleashes a shower of thousands of glittering bits of residue from Comet Tempel-Tuttle. It's the biggest celestial fireworks show in town, big enough to send any meteor specialist into academic ecstasy.

Brown's University of Western Ontario office is a labyrinth of boxes and dusty computers, with an intricate path leading from desk to door. Directly behind his desk, thumbtacked to the wall, is a movie poster - a birthday gift from Brown's research colleague, Martin Beech, with whom Brown shared this office until Beech moved to Regina last January to teach astronomy at the University of Regina's Campion College. Black cape aflutter, the dark-suited man on the poster glows with a radioactive green light, while behind him a handful of meteors chase each other across the night sky. Below the figure, in eye-popping green and yellow letters, is the film's title, The Meteor Man.

Five years after the initial paper on satellites appeared, Peter Brown is comfortably settled into the UWO as director of the Leonid Meteor Storm Hazard Risk Assessment Program. Back in 1993, his calculations - and Beech's written analysis - of the potential hazards of meteor storms were based on amateur observations and an innovative theory. Now the program has money (with backers such as NASA, the U.S. Air Force and the Canadian Department of Defence, to name a few), a staff and a mission: to save Earth's artificial satellites from this November's Leonid storm.

It's been quite a trip for the star-gazing kid from Fort McMurray, Alta. But it wouldn't have happened without a few detours along the way including a seemingly innocuous drive to Pittsburgh in the fall of 1992.

That October, a meteorite slammed into a parked car in Peekskill, N.Y., and its glowing descent was recorded on video by amateur meteor watchers. Intrigued by the research opportunity the tapes offered, Beech and Brown set out to collect them. While they were on the road, Brown happened to mention an idea that had been germinating in his mind over the last several years.

While reading Carl Sagan's novel Contact, Brown had been caught by a comment made by one of the characters about the dangers of space travel during the Leonid meteor storm of 1999 (predicted as one of the peak years for Leonid activity). Noting that, he wondered: what could happen to other objects floating outside Earth's orbit during such a storm? What could happen to a man-made satellite?

The two students were soon mulling over the possible implications, and upon returning to the

UWO campus in London, Ont., they pulled their theory into a short paper based on their assumptions about the upcoming Perseids meteor storm scheduled for August 1993.

Although the pair were intrigued by their idea, they decided it wasn't worth talking over with any of their professional colleagues.

"We weren't sure (at that point) that it would be anything other than a pure academic paper," Brown says.

"Both of us had a feeling we would be rejected, that we'd be laughed at," admits Martin Beech, his rapid-fire Oxford accent picking up the thread of the story. "But to our great surprise, the paper was accepted."

Indeed it was - and any lingering doubts about the validity of their theory were soon erased by a telephone call from Larry Petro, a scientist working with the Hubble Space Telescope Science Institute. After listening to the pair's recommendations, Hubble scientists decided to reorient their craft's position to prevent any chance of being hit by a celestial dust bunny.

Learning that the space telescope was at risk from meteors came as quite a shock to the Hubble scientists, Petro says. Even though the institute had a massive volume of procedures on prevention of damage by meteors, meteor storms had never entered into the equation.

"No one had drawn the connections (between space equipment and meteor storms)," Petro explains. "Beech and Brown were ideally placed (to make this discovery) - they do know a lot about meteors. Those of us who operate the telescope don't know a whole lot about them."

Ideally placed or not, Beech and Brown were certainly giving the issue more thought than their fellow astronomers were. Back in the 1960s, NASA had been worried that meteors might pose a risk to manned space flight, and thus devoted a lot of time and money to meteor research. But once humans had successfully reached the moon, the research stopped.

So with nothing to go on in the official NASA literature, most satellite operators were as skeptical as Chicken Little's friends about the doomsday warnings from a pair of unknowns.

That attitude soon began to change, especially after a decision made by NASA less than two months after Beech and Brown's first paper appeared. NASA had scheduled a shuttle launch for Aug. 10, 1993, the peak of the Perseids meteor storm. However, a few weeks before the launch, NASA's head of orbital space debris research, Don Kessler, received word of what Hubble had done and why. He decided to call Beech and Brown. The launch was eventually delayed by two weeks, and the two grad students were suddenly catapulted into the public eye.

"What had caught people by surprise was that nobody had anticipated it," Beech explains. "All the various groups at NASA and the European Space Agency that dealt with space debris had assumed they knew all about these meteoroid streams, and it didn't enter anyone's conscience that maybe there were times you had to worry."

And why should they have? Meteors - commonly known as "shooting stars" - are as common as feathers in a henhouse. Estimates are that on an average night, 50,000 visible meteors pass through Earth's atmosphere, and there has only been one documented case of a person being hit by a meteorite chunk. And although there had been rumors of satellites being hit by meteoroids (as the chunks are known if they haven't yet passed through Earth's atmosphere), there was no documented proof of such a collision.

But any skeptics ready to dismiss Beech and Brown's theory found themselves with egg on their faces on the night of Aug. 10, 1993, when Olympus, a European telecommunications satellite, was hit by a Perseid meteoroid. Traveling 40 times faster than a supersonic jet, the meteoroid ripped like a bullet into the satellite's south solar panel. The satellite immediately began to spin out of control. While its operators managed to restore Olympus' stability, it took all the remaining fuel to do so - rendering the $800 million satellite essentially useless. Within two months of being hit, Olympus was put into a "graveyard" orbit - permanently crippled by a rock the size of a grain of table salt.

"It was the first case of a meteoroid hitting a satellite and causing it to no longer be usable, and (the collision) was within an hour of what we had predicted as the most probable time of a satellite being lost. So people got very interested after that," Brown says.

By December 1995, that interest had grown to the point that Beech and Brown were commissioned to do a one-year study called the Meteor Storm Hazard Risk Assessment Program. Funded by Canada's Department of National Defence, the Canadian Space Agency, TMI Communications and the Institute for Space and Terrestrial Science, the $100,000 study confirmed much of what the two astronomers had suspected - the satellites were sitting ducks in the case of a major meteor storm, with the biggest storm of all less than three years away.

The Leonids are named for the place the storm appears to "radiate" from, the constellation Leo. In fact, the Leonid meteoroids are bits of debris from Comet Tempel-Tuttle. The comet's orbit brings it closer and closer to the sun, so that three times each century Earth is likely to see an astonishing meteor storm.

The last time that happened was in 1966, when estimates of visible meteors per second ranged from 10 to 200. But in 1966, the space age had just begun. Satellites were few and far between, and the common perception of meteors among scientists was that they were, as Carl Sagan put it in his 1980 book Cosmos, "less shooting stars than falling fluff."

But that was before satellites started springing up like dandelions on a planet-sized lawn. Welcome to the modern space age.

After their one-year study was complete, Beech, Brown and their research colleagues published their report in the summer 1996 edition of the Quarterly Journal of the Royal Astronomical Society. As media attention grew, so did public interest. And the satellite operators who had scoffed at Beech a year earlier were now calling him with eager inquiries.

And with what Brown estimates to be $200 billion worth of hardware and services hanging in the balance, it's no wonder they

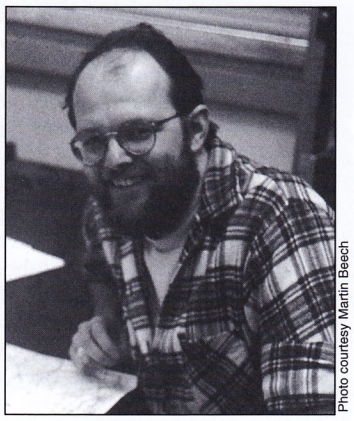

Photo courtesy Martin Beech

Martin Beech

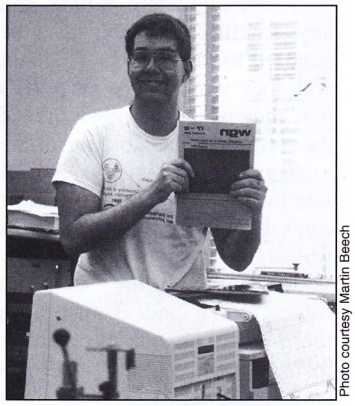

Photo courtesy Martin Beech

Peter G. Brown

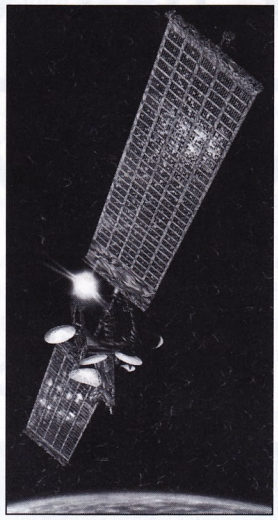

Photo courtesy of European Space Agency

Any Satellite

were worried. Artificial satellites are now used for both military and civilian communications (everything from sending secret service reports to broadcasting Seinfeld reruns), as well as navigating aircraft, tracking and predicting weather, and sending instant banking and stock market updates across the globe. Satellites were used in the Gulf War to locate targets and fire missiles, and farmers use them to locate where chemicals should be sprayed on their fields.

Unfortunately, however, space dust doesn't discriminate - it lands where it lands.

"There's nowhere to hide, and any satellite in orbit can be exposed to meteoroids. The only way they wouldn't be (exposed) is if they're on the other side of the earth from the direction of the meteoroids," Brown says. Not all satellites will be so lucky: most can't be moved out of harm's way.

However, unlike Chicken Little, Beech and Brown have more than just warnings to offer their listeners. Brown has developed a numerical model which the UWO's computers are using to crunch data about the Leonids. This, combined with Beech's ongoing theoretical research, should help satellite operators get properly prepared for the storm.

The main thing is to know when - and for how long - the satellites must be reoriented to avoid major damage from the storm, Brown says.

"If they [satellite operators] have a six or seven hour window... that's six or seven hours they're not making money or doing business, and on a satellite that's a lot of money," he explains. "So we'll tell them when, and we'll also give them some indication of how strong the storm will be."

In addition to physically adjusting their satellites - or in the case of low-earth orbit satellites, taking them down - the operators will likely also have extra precautions in place: well-trained ground crews, adjustments to the power flow as required, and minute-by-minute reports, courtesy of Beech and Brown, as the meteor storm unfolds.

Fast-forward to Nov. 17, 1998. Dusk is falling, and around the world, satellite operators are making last-minute adjustments. Somewhere in southeast Asia, where the Leonid storm is expected to be most visible, two Canadians are watching the heavens, waiting for the sky to fall. It's been quite a trip for Martin Beech and Peter Brown.

Six years ago, they were just another pair of grad students working in a little-explored field of theoretical research, hoping to someday make a name for themselves. Now they're on a first-name basis with some of the top scientists, and their work has the potential to save satellite operators millions of dollars.

Satellite design has been permanently altered - it's now standard practice to add an extra 10 per cent of bulk to the sides of satellites to allow for meteoroid damage. Before Beech and Brown came along, it was just another good idea. Miniature satellites and satellites with key components tucked inside are now on the drawing boards. The pair's professional credibility - and the direction of their research work - is now secure.

"Science is one of the most illogical processes I've ever come across," Beech says. "There's no way to predict which way the ideas will go.... Literally a chance conversation on the way to Pittsburgh can dictate what you end up doing for the next seven years."

When NASA's Don Kessler first called in 1993, he was expecting to be talking with experts like himself. Beech laughs, remembering the long silence from the telephone receiver that followed Kessler's discovery that he was, in fact, talking to a pair of students.

"If you're going to delay a launch of a major mission on the basis of what two graduate students say, that makes you very uncomfortable," Beech explains.

"They suddenly realized that they had no one in their vast organization who knew anything about meteor storms," he says, a smile on his face. NASA, it seemed, was going to have to listen to the little guys for a change.

Not bad Chicken Little. Not bad at all. J