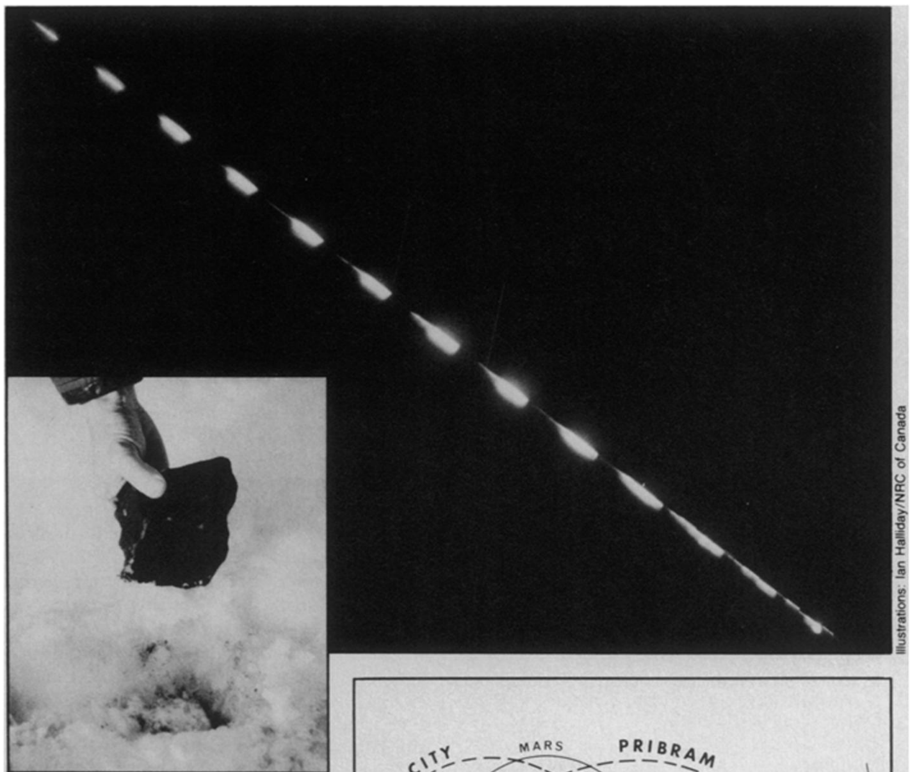
Innisfree Meteorite: After—and Before—the Fall

"It took about half a second to recognize it," says Ian Halliday, who found it. Slightly larger than a fist, the irregular, blackish rock lay atop about a foot of snow on William Fedechko's farm near the town of Innisfree, Alberta, Canada, about 150 kilometers east of Edmonton. An untrained searcher might or might not have spotted it. Fortunately, Halliday, from the planetary sciences section of the Canadian National Research Council's Hertzberg Institute of Astrophysics, knew exactly what he was looking for: only the third meteorite ever recovered that had been photographed accurately enough during its descent for its prior orbit to be determined.

It was the photographs, in fact, that also led to its recovery. But the search didn't begin with film. The first reports came from airline pilots, who had seen the object's fiery descent through the atmosphere on Feb. 5. Thus alerted, Halliday and others checked the films from the cameras in Canada's 12-station Meteorite Observation and Recovery Project. The network's cameras, triggered automatically by photometers in response to the incoming fireball, had been at work for seven years without ever enabling a recovery. Until now.



Illustrations: Ian Halliday/NRC of Canada

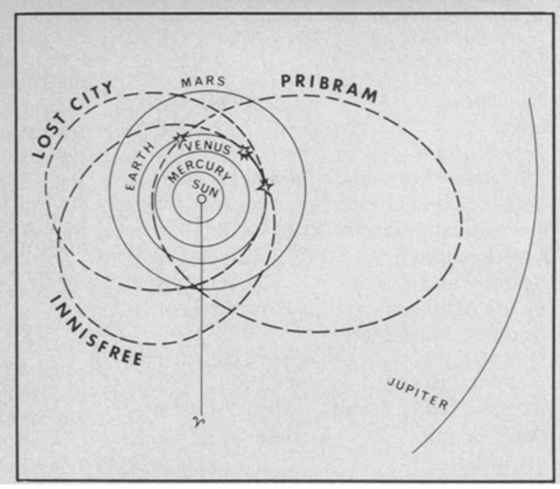


Photo of a fiery descent through the atmosphere, taken by an automatic camera, led to the recovery in Canada of only the third meteorite for which an orbit has also been calculated. Diagram shows calculated orbits for all three objects, together with the points at which they intersected the orbit of earth.

In order to pinpoint the impact area, as well as the orbit that led to it, at least two of the cameras had to record the bright streak of the descent. One camera, located at Vegreville, Alberta, caught it perfectly. A second just got it on the edge of a frame. In the better picture, the trail can be seen down to about 21 kilometers above the ground, with another kilometer or so visible by peering closely at the negative. The camera's focal-plane shutter blocked off the track four times per second throughout the time exposure, producing breaks in the image that enabled Halliday's team to calculate the meteorite's velocity of 14.2 kilometers per second through the upper atmosphere. (If the earth's gravity were not pulling on the object, Halliday says, the velocity would have been 8.9 km/sec.)

By Feb. 11, measurements from the plates were in an NRC computer in Ottawa, and by the 16th, following a flight and a drive, the searchers were at the computer's predicted impact area, arranging with four local youths for the use of their snowmobiles and chauffering skills. The quest began the following day, and at about 4 p.m., Halliday found the prize.

It is a hypersthene chondrite, a stony (low-iron) meteorite weighing in at 2.07 kilograms "as recovered," making it the smallest of the three that have been both tracked by photography and brought back from the field. The first one, in fragments totaling nearly 10 kilograms, was a bronzite chondrite found near Pribram, Czechoslovakia, on April 7, 1959. The second, whose four major chunks added up to more than 17 kilograms, was another bronzite found on a back road near Lost City, Okla., on Jan. 3, 1970, with the aid of the Prairie Network, a now-defunct U.S. chain of camera stations set up about five years before the Canadian system.

A meteorite, to the researchers who study it, is a free spacecraft, providing a natural record of cosmic rays, solar activity and other conditions of the environment from which it came. Being able to backtrack its orbit simply pins down where, in fact, it did come from. The Pribram, Lost City and Innisfree objects all struck the earth while following orbits whose aphelions were inside the orbit of Jupiter, suggesting the not unreasonable possibility that they came from the asteroid belt, perhaps perturbed into earth-crossing paths by close encounters with Jupiter itself. Typical of the data gathered from such knowledge, says Edward Fireman of the Harvard-Smithsonian Center for Astrophysics, was the finding from the Lost City fragments that the cosmic ray flux rises by about 20 percent over a distance of 2 astronomical units (about 300 million kilometers) out from the earth, with the more rapid growth shown in the higher-energy part of the cosmic-ray spectrum. The solar wind is, in effect, "holding off" the cosmic rays.

Prompt recovery of the meteorite is also a major plus, since it allows study of such short-half-lived isotopes as argon 37 (35 days). Ratios between shorter- and longer-lived isotopes can yield chronologies of changing conditions that now include the important new possibility of the inconstant sun. □