Science News

- Science@NASA Headline News
  - 2010
  - 2009
  - 2008
  - 2007
  - 2006
  - 2005
  - 2004
  - 2003
  - 2002
  - 2001
  - 2000
  - 1999
  - 1998
  - 1997
  - 1996
- Ciencia@NASA
- News & Features
- Press Releases
- RSS Feeds

Meteorites Don't Pop Corn

Meteorites Don't Pop Corn

A fireball that dazzled Americans on July 23rd was a piece of a comet or an asteroid, scientists say. Contrary to reports, however, it probably didn't scorch any cornfields.

Listen to this story via streaming audio, a downloadable file, or get help.

July 27, 2001: Every few weeks, somewhere on Earth, a fiery light streaks across the sky casting strange shadows and unleashing sonic booms. Astronomers call them fireballs or "bolides." They're unusually bright meteors caused by small asteroids that disintegrate in our planet's atmosphere. Often they explode high in the air like kilotons of TNT -- blasting tiny meteorites far and wide.

It happens all the time, say experts, but usually no one notices. We live on a big planet, after all, and very little of Earth's surface is inhabited by people. Most debris from space falls unseen over oceans or sparsely-populated land areas -- or during times when sky watchers simply aren't paying attention.

Above: Artist Duane Hilton → created this rendition of the July 23rd fireball streaking over a Pennsylvania farmhouse.

Last Monday was different, however. On July 23rd hundreds of thousands of people were looking when, unexpected, a fireball appeared over the US east coast. It was 6:15 p.m. local time. The Sun hadn't set, but onlookers had no trouble seeing the fireball in broad daylight. Witnesses from Canada to Virginia agreed that the colorful fireball was brighter than a Full Moon, and some saw a smoky trail lingering long after it had passed.

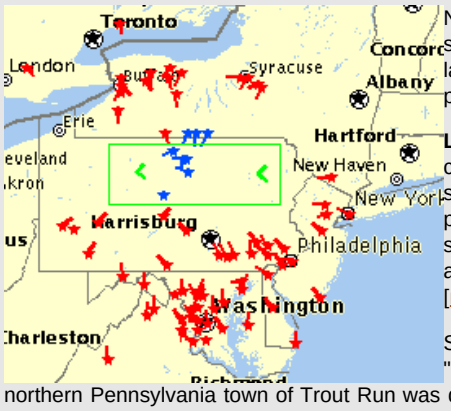
"Contrary to some reports this was not a meteor shower," says Donald Yeomans, manager of NASA's Near Earth Object program at the Jet Propulsion Laboratory. Meteor showers happen when Earth passes through the debris trails of comets and countless thousands of cosmic dust specks burn up in Earth's atmosphere. At the heart of Monday's fireball, however, was a solitary object -- perhaps a small asteroid or a piece of a comet.

Hundreds of eyewitness reports collected by the American Meteor Society establish that the fireball was moving on an east-west trajectory that carried it directly over the state of Pennsylvania. "It was traveling perhaps 15 km/s (34,000 mph) or faster when it exploded in the atmosphere with the force of about 3 kilotons of TNT," says Bill Cooke, a member of the Space Environments team at

the Marshall Space Flight Center. If this was a rocky asteroid, then it probably measured between 1 and 2 meters across and weighed 30 or so metric tons.

"Asteroids that size enter Earth's atmosphere every month or so," says Yeomans.

"The pressure wave from the airburst shattered some windows in towns west of Williamsport," Cooke continued. "Breaking glass requires an overpressure of about 5 millibars (0.5 kPa), which means that those homes were within 100 km of the explosion."



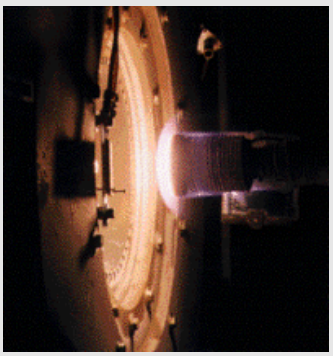
No one knows if any sizable fragments of the object survived the blast. But if they did, the meteorites probably landed in the wooded, hilly terrain west of Williamsport -- perhaps in one of the many state parks of that area.

Left: Jim Richardson of the American Meteor Society created this July 23, 2001, fireball sighting map. Red stars denote witness locations; the tail on each star points in the direction that the fireball was spotted. Blue stars denote sonic booms. The green rectangle and arrows indicate the approximate trajectory of the fireball. [more →]

Says Bob Young of the State Museum of Pennsylvania: "One of our planetarium staff was told that the little northern Pennsylvania town of Trout Run was destroyed by the meteor! The witness was about 100 miles away when she heard the tale from her hairdresser." Other reports credit the fireball for scorching a cornfield → in Lycoming County, PA, and littering the countryside with burnt rocks.

In fact, says Yeomans, it's unlikely that any substantial meteorites reached the ground. Atmospheric friction would have reduced most of the fragments to dust. Even if fragments did survive, he added, they wouldn't burn cornfields because --despite their fiery appearance in the sky-- freshly-fallen meteorites are not hot.

Objects from space that enter Earth's atmosphere are -- like space itself -- very cold and they remain so even as they blaze a hot-looking trail toward the ground. "The outer layers are warmed by atmospheric friction, and little bits flake away as they descend," explains Yeomans. This is called ablation → and it's a wonderful way to remove heat. (Some commercial heat shields use ablation to keep spacecraft cool when they re-enter Earth's atmosphere.) "Rocky asteroids are poor conductors of heat," Yeomans continued. "Their central regions remain cool even as the hot outer layers are ablated away."



Right: This ablative heat shield → protected a space probe in 1986 as it made a high-speed plunge from NASA's Galileo spacecraft into the atmosphere of Jupiter. Meteorites racing through Earth's atmosphere likewise shed heat via ablation. [more information →]

Asteroids move faster than the speed of sound in Earth's atmosphere. As a result, the air pressure ahead of a fireball can substantially exceed the air pressure behind it. "The difference can be so great that it actually crushes the object," says Cooke. "This is probably what triggered the airburst over Pennsylvania."

Small fragments from such explosions lose much of their kinetic energy as they heat the atmosphere via friction. They quickly decelerate and become sub-sonic. Dusty debris from airbursts (and ablation) can linger in the atmosphere for weeks or months, carried around the globe by winds. Walnut- to baseball-sized fragments might hit the ground right away at a few hundred kilometers per hour.

"Small rocky meteorites found immediately after landing will not be hot to the touch," says Yeomans. They will not scorch the ground or start fires. On the other hand, notes Cooke, "if we got hit by something large enough to leave a crater, the fragments might be very hot indeed." A stony meteorite larger than 50 meters might be able to punch through the atmosphere and do such damage -- but that's far larger than the object that flew over Pennsylvania.

No one knows what kind of space debris caused the July 23rd fireball. It might have been a small piece of an icy comet, in which case it's unlikely that anything larger than dust grains survived. It might also have been a rocky asteroid -- the most likely candidate -- or perhaps a nickel-iron meteorite. "Iron objects are more likely to survive a descent to Earth," says Yeomans, "but they are rare."

It's possible that fragments will never be found, notes Cooke. "We still don't have a precise trajectory for this object," he explains. "And so much of the targeted area (in central Pennsylvania) is heavily forested -- searching for debris will be like looking for a needle in a haystack."

Or should that be a needle in a cornfield?

"I suppose it's possible that some ablative fragments fell into that field," says Cooke, "but it is strange that only a small area was affected. I doubt it's a

good candidate impact site."

"I wouldn't start looking there either," agrees Yeomans. "That scorched cornfield story sounds a little too corny for me...."

Editor's note: Did you see the July 23rd fireball? If so, please submit a report → to the American Meteor Society. They can use your information to refine the trajectory of the meteor and possibly pinpoint the location of meteoritic debris. Also, the terms fireball and bolide are often confused -- even by professional astronomers. A fireball is a meteor at least as bright as the planet Venus (visual magnitude -3 or -4). A bolide is a fireball that explodes, often with sound effects.

Meteorites Don't Pop Corn
July 27, 2001
presented by ThursdaysClassroom.com →

Â Thursday's Classroom Corner

These lessons and activities are based on the Science@NASA story "Meteorites Don't Pop Corn →."

- **Discussion Questions** → : Ignite a fiery discussion in your classroom about hot meteors and cold meteorites. [lesson plan →] [activity sheet →]
- **Speeding in Space** → : Scientists say the Pennsylvania fireball ripped through the atmosphere at 15 km/s. In this math activity, students will compare the fireball's speed to the speed of Earth's orbital motion around the Sun -- and practice their English to metric conversions! [lesson plan →] [activity sheet →] [key →]
- **Dino-Colors** → : It's a good idea to keep an eye on near-Earth asteroids -- just ask any dinosaur! Younger kids will enjoy coloring these pictures by Duane Hilton. [You call *that* an asteroid? →] [Dinosaur Sky Watcher →]

Use this button to download the story with lessons and activities in printer-friendly Adobe PDF format → :

One-Click Download
Adobe PDF Format

Web Links

Frequently Asked Questions about Fireballs → - from the American Meteor Society

Meteorite leaves trail of fire, confusion → -- (CNN) A streaking fireball or fireballs witnessed over much of the eastern United States seems to have disappeared without a trace, save perhaps for strange markings in a Pennsylvania cornfield.

Arctic Asteroid! → -- ***Science@NASA*** A 200 metric ton rock from space streaked across the skies of western Canada on January 18, 2000 and scattered intriguing meteorites across a frozen lake.

: In 1992 a fireball raced over the eastern US and dumped a 12-kg rocky meteorite in the trunk of a parked car in Peekskill, NY. At least 14 people captured videos of the meteor -- one of which is reproduced here as a 0.9 MB mpeg movie. [more →]

NASA's Near-Earth Object Program → -- one-stop shopping for information about Earth approaching asteroids and comets.

Meteors, Meteorites and Impacts → -- from "The Nine Planets." (external site)

Solar System Bodies: Meteoroids, Meteors and Meteorites → -- from JPL.

Join our growing list of subscribers - **sign up for our express news delivery** and you will receive a mail message every time we post a new story!!!

More Headlines

THE END

Topics: Small bodies of Solar System Technology