

Asteroids and Earth Impacts

Movies like Deep Impact and Space Cowboys presented stories about major meteorite impacts on Earth. These movies discussed what might happen if a meteor or asteroid was discovered on a collision course with Earth. Both movies involved space ships going to the asteroid and trying to blow it up or deflect it with nuclear weapons. In the end, mankind was saved just in time.

Is an asteroid or meteorite impact possible? Could this really happen, or is it just “Hollywood” fantasy? If so, when will it happen?

We know in the geologic past that meteorites have impacted the earth. One good example is the meteorite crater left in the Arizona desert (Meteorite Crater). I took several photos of Meteor Crater in Arizona on a visit in the mid 1990s. Several of these photos are located on my website.

Roy A. Gallant, in his book Meteorite Hunter, ISBN 007137224-5, writes;

“According to NASA, a 10-meter-diameter cosmic missile passes closer to us than the moon’s distance each day. An object 100 meters in diameter crosses earth’s orbit at about the moon’s distance on average of once a month. In January 1991 a 10-meter-diameter object missed earth by only half the moon’s distance just 12 hours after astronomers spotted it. On December 9, 1994, Asteroid 1994XM missed us by 100 kilometers. It was 13 meters in diameter. The size of a house, the small asteroid would have completely wiped out the greater New York area had it made a direct hit on Manhattan. We can expect to get hit by such house-size objects about once every 100 years. Every 1000 to 3000 years we can expect to be hit by Near Earth Objects (NEOs) ranging in size from 100 to several hundred meters. Fortunately we don’t have to worry about those stoney objects smaller than about 50 meters in diameter because most burn up in the atmosphere. But if an object is made of iron, then some worry is justified. For instance, a metal asteroid about 30 meters in diameter carved out a crater 1.2 kilometers across in the Arizona desert 50,000 years ago.

Asteroids about 100 meters and larger deserve our greatest respect, and we know of some 100,000 of them that inhabit the Solar System this side of Mars. A direct hit by one of these would wipe out a continent. They visit earth once every 50,000 to 500,000 years. More troublesome are the 1,000 to 2,000 NEOs roughly 1 kilometer and larger in diameter that collide with Earth once every 300,000 years or so. There are real Earth crunchers that cause mass extinctions. Chicxulub was one, but that was 65 million years ago. If our numbers game is a reliable one, then where are all the more recent impact sites? In any case, as one writer put it, “we live in a cosmic shooting gallery.”

One thing that alerted astronomers to just how often Earth is targeted by bombs from space was a U.S. military report made public early in 1994. According the report, from 1975 to 1992 military satellites detected 136 high-altitude explosions with a force of 500 to 15,000 tons of high explosives –in effect, small atomic bombs. This report went on to reveal, to the astonishment of the scientific community, that the objects entered the atmosphere at 16 to 48 kilometers per second, that they exploded 27 to 32 kilometers above the ground, and that there probably were

10 times more events than were detected. If that were so, then there are about eighty such explosive events a year.

Currently, the University of Arizona's Spacewatch program detects about twenty new NEOs a month. According to Spacewatch director Robert S. McMillan as many as nine hundred 1-kilometer-diameter asteroids capable of wreaking global havoc may pose a collision threat to Earth.

Just how much energy does a moderately sized asteroid – say, a 1-kilometer-wide object pack? Tom Gehrels says we can use the mathematical expression $1/2mv^2$ to calculate the kinetic energy. Let m represent the object's mass and v its velocity of entry into the atmosphere. If the object has a density of 3grams per cubic centimeter, which we get from meteorites, and the entry velocity is 20 kilometers per second, then an asteroid 1 kilometer in diameter packs a striking force of millions of times the explosive forces of the atomic bomb dropped on Hiroshima. Gehrels is reassuring when he tells us that the Spacewatch team knows of only about ten Chicxulub-size objects with Earth-crossing orbits."

A list of Potentially Hazardous Asteroids (PHAs) is updated by the Spacewatch project. This list is located on the following educational website:

<http://cfa-www.harvard.edu/iau/lists/PHACloseApp.html>

According to the PHA website:

"... the mean distance of the moon is 0.0026 AU = 384400 km = 238900 miles. (1 AU is approximately the mean distance of the earth from the sun = 149597870 km = 92955810 miles."

AU stand for Astronomical distance Unit: One AU is about 1.5×10^8 km, (roughly the average distance between the Earth and the Sun).

NASA and JPL have put together a Future Close Approach table. This table predicts close approaches between 2001 and May 2040, for projected approaches within 0.2 au. A link to this table is at http://ssd.jpl.nasa.gov/cgi-bin/ca_future?date.

From the studies that have been done, and the research that is ongoing, it is impossible to think that a major meteorite impact will not happen. Like earthquakes on major fault zones, meteorite impacts are part of our physical world. The only real variable is time.

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