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Physics in the news

Largest in a century: the February 2013 Russian meteor

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When meteorites are found, they are usually named after the nearest geographical locality, for example, a village or a lake. Fragments of the Russian meteorite that fell on 15 February 2013 have been found in Lake Chebarkul, so this is the name that will be suggested to the Meteoritical Society when scientists publish the results of their analysis in the *Meteoritical Bulletin* in 2 or 3 months time. (See below for a note on definitions — meteorite, meteor, etc.)

From information recorded as the meteor entered the atmosphere and disintegrated over Chelyabinsk, scientists estimate that its diameter was about 17 metres and its mass about 10 000 tonnes. The period of time from it entering the atmosphere until it disintegrated was just 32.5 seconds. The size of the blast is estimated at slightly under 500 kilotonnes. For comparison, the atomic bombs dropped on Japan were about 12.5 kilotonnes.

The meteoroid broke into a number of pieces, one of which made a hole in the ice covering Lake Chebarkul, and small pieces found around the hole are said to show that it is a stony meteorite (called a **chondrite**) that contains about 10% iron. At the time of writing, scientists have collected 53 fragments and the largest is only 7 mm. No large pieces have been found, probably because the meteoroid exploded and is scattered in pieces or on the bottom of the lake. There are a lot of people who have found small stones by spotting a hole in the snow and then digging. At first, some people suggested that it might be a comet, not a meteoroid, because comets are made largely of ice, which could explain why no large debris was found.

There is a similar mystery about the Tunguska event, an explosion in Siberia in 1908. This is thought to have been caused by the explosion of a meteoroid or comet about 5 to 10 km above the Earth's surface. The **shockwave** knocked down about 800 million trees covering an area of about 830 square miles, but there is no impact crater. Estimates of the blast range from 3 to 30 megatonnes. The Russian meteor is the largest reported since the Tunguska event and will help scientists to understand more about these impacts.

Was it linked to Asteroid DA14?

The obvious question is whether the meteorite was in some way connected to the flyby of Asteroid 2912 DA14 later on 15 February. Scientists have said there is no connection — it was a coincidence.

This leads to another question: 'How do they know?' The answer comes from looking at the trajectory of each object. In videos of the meteor you can see that it passes from left to right in front of the rising Sun, which means it was travelling from north to south. The trajectory of Asteroid DA14 is from south to north, so it approached Earth from the opposite direction.

The energy of the blast

The unit for measuring the energy of a blast is a tonne of TNT. When a tonne of TNT explodes it releases 4.2×10^9 J of energy. So the blast from the Russian meteor was of the order of 2×10^{15} J. This caused a shockwave that travelled at high speed and broke glass windows. Most of the injuries caused were from flying glass.

A shockwave occurs when the speed of waves in a medium is as fast as the speed of sound or faster. The wavefronts pile up and form a large-amplitude shockwave. When you watch some videos of the meteorite with sound you will notice that you can't hear it until the sound of the explosion arrives and the glass breaks suddenly in a noise called a **sonic boom**.

Meteors, meteoroids and meteorites

Finally, a note on names:

- **Meteoroids** are solid bodies in interplanetary space.
- **Meteors** are shooting stars or other bright trajectories seen when a meteoroid burns up on its journey through the Earth's atmosphere.
- When a meteoroid does not completely burn up and a piece, or pieces, of rock are found, these are called **meteorites**.
- **Asteroids** are minor planets — they orbit the Sun. Most are in the Asteroid Belt between Mars and Venus. Some have orbits that bring them close to the Earth and are called Near Earth Asteroids (NEAs).

Find out more

PHYSICS REVIEW articles

'An asteroid called Apophis' Vol. 20, No. 4, pp. 2–6.

'Physics in the news: Apophis update' Vol. 22, No. 3, online resource.

News from NASA

http://www.nasa.gov/mission_pages/asteroids/news/asteroid20130215.html

Compilation of meteor clips

<http://www.youtube.com/watch?v=rsOKcjc0zgM>

The explosion

<http://www.youtube.com/watch?v=eXcaog9J6u8>

The Tunguska event

http://science.nasa.gov/science-news/science-at-nasa/2008/30jun_tunguska/