Tunguska, 1908
What caused the explosion, meteor or comet?

Artist's rendering of the Tunguska event in 1908

On June 30th, 1908, a powerful explosion rocked the Tunguska River region of Russia. Around 5-10 kilometers above the Earth's surface a large meteoroid or comet fragment broke apart, and the resulting air burst created a devastating blast. Despite the fact that this fragment splintered in the air and never touched down, it is still considered a significant impact event.

Many scientists have studied the facts of the event, and estimate the object's size to have been between 40-70 meters across. Researchers estimate the energy of the blast to be similar to the explosion of 10 to 15 megatons of TNT. To put it into perspective, that's almost 1,000 times as powerful as the atomic bomb dropped on Hiroshima, Japan during World War II.

The Tunguska explosion knocked over around 80 million trees covering 2,150 square kilometers (830 square miles). Such an explosion would have been capable of destroying a large metropolitan area. As a result, Tunguska has been used as an example to motivate development of asteroid deflecting technology.

While Tunguska was the largest impact event ever recorded over land, countless other similar explosions have probably happened over the oceans and gone unnoticed by humans. It wasn't until global satellite technology was developed in the late 1960's that scientists were able to observe these watery impact events.

A view of the Tungusk area today. *Photo credit: RGO, Tunguska Page of Bologna University*

Photo taken 19 years afterward shows trees flattened by the Tunguska event. *Photo credit: European Space Agency, Flickr*

Tunguska Wood (1908)
Obtained: 2017
Partial slice, 232 x 210 mm
Provenance: G. Tomelleri, R. Wesel, C. Whitford

The Tunguska Event As Recorded In A Tree Trunk

Of the over 80 million trees that were affected by the Tunguska event, nearly all of them remain there burnt, bent over, or completely uprooted. The sheer force of the explosion caused these flattened trees to be laid out in a radial pattern with their roots pointing toward the epicenter.

As there are no witnesses to the actual explosion, many theories about what could cause this destruction without leaving a crater or evidence on the Earth's surface have arisen. Theories vary from the more plausible natural gas explosion to the more far-fetched conspiracies of it being caused by an exploding flying saucer, antimatter, or black holes! But very few scientists have thought to ask the trees what happened. Of course, they can't really ask them, but they can study how the explosion affected the ecology of the blast site to try and piece together what happened.

Non-tropical trees go through annual periods of growth due to photosynthesis that cause rings to form in their trunks. These growth patterns are annual, which means you can count the rings on a tree stump to figure out how old the tree was when it was cut down. By looking at the carbon isotopes present in each ring, scientists can use these rings to get a larger picture of what the environment was like all the way back to the beginning of the tree's life. Given that trees can live hundreds of years, tree rings can be invaluable wells of knowledge!

In the case of the Tunguska trees, scientists were able to figure out that there were no major changes in the 14C (a type of carbon isotope) within the tree rings. In fact, beyond some traumatic resin ducts, which are common in trees after they suffer some kind of injury and an extremely low growth rate in the years just after the Tunguska event, they were unable to find many definitive abnormalities.

The meteorite fall of February 15, 2013

Chelyabinsk Meteor
An exceptionally bright meteor about 100 times brighter than the full moon called a superbolide, the Chelyabinsk meteor entered Earth's atmosphere over Russia on February 15, 2013.

Chelyabinsk Meteor Trail *Photo credit: NASA, Copyright M. Ahmetvaleev*

Chelyabinsk Object
50 ft wide

Tunguska Object
130 ft wide

Football Field, 360 ft wide

The meteor was caused by a 20 meter (66 feet) near-Earth asteroid that lit up brighter than the Sun so that it was able to be seen 100 km (that's 62 miles) away. Along with the light, some eyewitnesses claimed to feel an intense heat emanating from the superbolide. The object was moving between 64,000 to 69,000 kph (about 40,000 to 42,900 mph) and hit the Earth's atmosphere at a shallow angle, causing the meteor to explode in an airburst over Chelyabinsk Oblast. This explosion created a hot cloud of dust and gas, many small meteorite fragments, and a large shock wave. While most of the energy of the explosion was absorbed by the Earth's atmosphere, the meteor's shockwave let off 26 to 33 times as much energy as that released by the atomic bomb detonated at Hiroshima.

Due to the meteor's location in relation to the sun, the source direction of the object was masked from view which caused the meteoroid to be undetected at first. The meteoroid itself didn't cause any damage, but its shockwave blew in windows and caused damage to some 7,200 buildings across the 6 cities affected in the region. This event also caused 1,500 local citizens to seek medical attention.

Chelyabinsk Meteorite
Unlike the Tunguska Event, the Chelyabinsk Meteor left behind some fragments after the explosion. The largest of these meteorites was found at the bottom of Lake Cherbarkul on October 16th, 2013 and weighed a whopping 1,190 pounds. This behemoth created a 6 meter wide hole in the frozen surface of the lake. Scientists estimate that prior to entering the Earth's atmosphere the original meteoroid weighed around 7,000 tons.

Lake Cherbarkul.
Photo credit: Sergey Kolisnichenko, Russia

Chelyabinsk
Fell: February 15, 2013
Mass: 1 t
Classification: LL5, chondrite
Specimen Wt: 37.04 g
Provenance: C. Whitford

Chelyabinsk "Berries"
Fell: February 15, 2013
Mass: 1 t
Classification: LL5, chondrite
Specimen Wt: 7.12 g (13 pcs)
Provenance: C. Whitford

Glass fragments from a shattered window caused by the meteor shockwave.
Provenance: Zauralsky village, 9. Raduzhnaya St., Russia, Chelyabinsk Region.