

When the Sky Explodes

A violent explosion high above a stretch of the Podkamennaya Tunguska river in Siberia over 100 years ago is still today the subject of research and debate as the scientific community attempts to answer the question; “Why did the sky explode with an apparently spontaneous spectacular blast equivalent to the power of a 10 Megaton nuclear bomb, enough energy to vaporise everything directly below it and equivalent to 500 bombs of the type that was dropped on Nagasaki in 1945?”

At approximately 7am (local time) on the morning of 30th June 1908 a huge explosion releasing about one billion mega joules of energy and occurring at an altitude of about 8 to 10 kilometres above the ground¹ flattened everything below within a radius of about fifty kilometres². The explosion could be heard over 1000 Kilometres away and physically knocked over people living more than 60 kilometres away. The resulting fallout caused darkened skies some 9000 kilometres east on the Pacific coast of the United States of America³. The fact that there were few, if any visible signs of a physical impact coupled with the fact that the event occurred in a lightly populated remote part of Siberia, and the subsequent delay (of many decades) before proper investigation meant that there was very little evidence to indicate the cause of this event.



Location of the Tunguska Event (Image courtesy of wikipedia.com)

Although there is a consensus of scientific opinion that a celestial body collided with the earth causing a massive explosion in the lower atmosphere, the precise cause of the mysterious explosion remains the subject of scientific debate, a debate that centres on what type of celestial body hit the earth.

Asteroid or Comet

The 41st Lunar and Planetary Science Conference (2010) concluded that the Tunguska blast was consistent with a large 50 – 100 meter body colliding with the earth⁴. Whilst the precise nature of the body remains unknown it is generally accepted that it was

¹Dept. of Physics, University of Bologna, <http://www-th.bo.infn.it/tunguska/index.html>

² Universe 9th Edition, Freedman & Kaufmann, p386

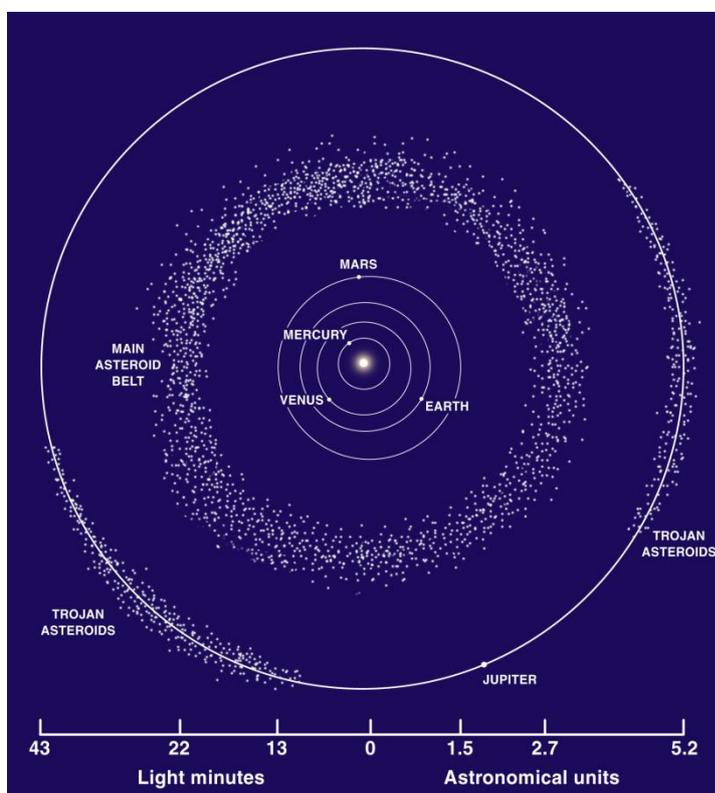
³ Universe 9th Edition, Freedman & Kaufmann, p386

⁴ <http://www.lpi.usra.edu/meetings/lpsc2010/pdf/1268.pdf>

either a comet or an asteroid, although the real difference is perhaps unimportant because as with many areas of astronomy the precise definition of each is not well established or universally accepted⁵.

It is known that asteroids, sometimes known as planetoids or small solar system bodies are remnants of solar nebulae (giant clouds of gases, dust etc. that formed during the creation of the solar system) and subsequently formed bodies known as planetesimals⁶. Whilst planetesimals are generally considered to be large objects they are not quite large enough to become planets. As a result of collisions with other celestial objects planetesimals fragment, creating asteroids.

Most asteroids (and comets) are believed to originate either in the Oort cloud which is found on the edge of the solar system or in the asteroid belt that lies between the orbits of Mars and Jupiter, although there are still a large number that originate either outside of, or lie within other parts of the solar system, and many that could potentially collide (either in whole or as fragments) with our planet.



The Asteroid Belt (Image courtesy of scienceclass.ning.com)

Whereas asteroids are generally considered to be inactive structures of either rocks or a compound mass of ice, methane, other gases and dust; a comet is more "active" because its orbit brings it near to the sun, melting ice and releasing gasses and dust⁷. Illuminated by the sun the vapour trail is what is known as it's "tail" and the bright ball shaped component its "coma". As ice melts, fragments break away from the main body or nucleus of the comet and have been known to collide with (or fall to) earth.

Comets or asteroids crossing a fictitious line delimited by Mars's orbit around the sun are known as "near earth objects" or "potentially hazardous asteroids". In 1994 a "near earth object"

known as "XM1" measuring approximately 10 meters in diameter was observed as it came within 100,000 kilometres of earth⁸, a rather small distance in astronomical terms

⁵ <http://en.wikipedia.org/wiki/Asteroid>

⁶ <http://en.wikipedia.org/wiki/Planetesimal>

⁷ <http://neo.jpl.nasa.gov/faq/>

⁸ Universe 9th Edition, Freedman & Kaufmann, p383

(by comparison the moon is about 385,000 kilometres away from the earth⁹) and further proof, if needed that such objects could indeed collide with our planet.

It is only since the 1960's that near earth objects have been actively tracked. Although even today only the largest meteoroids entering the earth's atmosphere are likely to be detected by radar or large telescopes¹⁰. Recent history shows us that meteoroid tracking has not yet been mastered as evidenced by a surprise 50 Kiloton blast (about three times the size of the Hiroshima bomb) over Indonesia in October 2009 caused by an asteroid¹¹ and further proof that Tunguska could well have been caused by a similar meteoroid.

Through the analyses of data captured by sensors around the world it appears certain that the Tunguska blast was caused by a massive meteoroid (the whole or part of an asteroid or a comet) of between 50 - 100 meters wide¹² entering the earth's atmosphere at a speed of approximately 22km/s (79,200Km/h)¹³. At this speed the friction caused by the earth's atmosphere would have generated temperatures and pressures that caused the meteoroid to explode (although some studies suggest that it was superheated gasses surrounding the meteoroid that exploded¹⁴) sending massive supersonic shockwaves in all directions.

It is suggested that these shockwaves (as opposed to the explosion or impact itself) that hit the ground directly below, felling

trees and flattening ground. The explosion would have been visible from a great distance and the resulting fallout caused by ground based debris being pulled high into the atmosphere and pushed around by high altitude winds stopped some sunlight from reaching the ground, hence the reason why darkened skies may have been observed on the Western seaboard of the United States.

A number of subtle variations on the asteroid or comet theory have also been put forward, notably a study of the nearby Lake Checko by researchers from the University of Bologna who concluded that the lake was likely formed by the Tunguska event¹⁵, and suggested that a large (probably approx. one metre) fragment of meteoroid hit the ground following the low atmosphere explosion. Other research claims that that samples



Artist's Impression of the Tunguska Blast
(Image courtesy of universetoday.com)

⁹ <http://www.universetoday.com/19426/distance-to-the-moon/>

¹⁰ <http://neo.jpl.nasa.gov/stats/>

¹¹ <http://www.newscientist.com/article/dn18046-asteroid-blast-reveals-holes-in-earth-s-defences.html?DCMP=OTC-rss&nsref=online-news#>

¹² <http://www.lpi.usra.edu/meetings/lpsc2010/pdf/1268.pdf>

¹³ Universe 9th Edition, Freedman & Kaufmann, p386

¹⁴ http://impact.arc.nasa.gov/news_detail.cfm?ID=179

¹⁵ <http://onlinelibrary.wiley.com/doi/10.1111/j.1365-3121.2009.00906.x/pdf>

taken from trees many years later contain elements found only in asteroids¹⁶, a claim similar to others including Vladimir Alexeev from the Troitsk Innovation and Nuclear Research Institute who used ground penetrating radar to find what is believed to be a fragment of a piece of ice that broke away from the nucleus of a comet¹⁷ in the Suslov crater that lies in the vicinity of the Tunguska event.

Other Theories

The resulting lack of evidence to support direct contact with the ground led to a host of other generally less accepted theories including work by astrophysicist Wolfgang Kundt who theorised that the blast was due to methane gas escaping from the large natural reserves just under the surface of the Tunguska region¹⁸. Ryan & Jackson of the University of Texas implied that a small black hole collided with the earth¹⁹. This theory has been discounted because there is no identified exit point. If a black hole did in fact collide with the earth around Tunguska then it's trajectory, density and mass should have caused it to "burrow" right through the earth and exit somewhere in the North Atlantic Ocean. There is no evidence to suggest that an entry point, let alone an exit point exists on earth. Indeed there are some who still question the mere existence of black holes. The Russian media even suggested that the explosion was caused by an unidentified flying object or extra-terrestrial life²⁰ although no evidence has been provided to support such a claim.

Conclusive Cause

Whilst all of the evidence points firmly towards a meteoroid colliding with the earth, until it is possible to prove the precise nature of the meteoroid, its composition and exact trajectory then even after more than 100 years the Tunguska event will still be justifiably called, a mystery!

¹⁶ <http://www-th.bo.infn.it/tunguska/papers/planetspace.html>

¹⁷ http://english.pravda.ru/science/mysteries/25-10-2010/115495-tunguska_meteorite-0/

¹⁸ <http://www.chjaa.org/2003/Italy/55.pdf>

¹⁹ <http://www.nature.com/nature/journal/v245/n5420/abs/245088a0.html>

²⁰ <http://english.pravda.ru/science/mysteries/22-09-2006/84587-tunguska-0/>