LIGHTNING & BALL LIGHTING

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Lightning is a massive natural electrostatic discharge produced during a thunderstorm. Lightning's abrupt electric discharge is accompanied by the emission of light. The electricity passing through the atmosphere rapidly heats and expands the air, producing lightning's characteristic thunder sound.

How Lightning is Formed

The first process in the generation of lightning generation is the separation of positive and negative charges within a cloud. Ice crystals inside cumulonimbus clouds rub against one another due to the strong updrafts in these clouds, thus building up a strong static charge.

Positively charged crystals tend to rise to the top causing the cloud top to build up a positive static charge and negatively charged crystals and hailstones drop to the middle and bottom layers of the cloud building up a negative static charge. Cumulonimbus clouds that do not produce enough ice crystals usually fail to produce enough static electricity to cause lightning.

Lightning can also occur as a result of volcanic eruptions or violent forest fires which generate sufficient dust to create a static charge.

The second process is the build up of positive charges on the ground beneath the clouds. The Earth is normally negatively charged with respect to the atmosphere. But as the thunderstorm passes over the ground, the negative charges at the bottom of the cumulonimbus cloud cause the positive charges on the ground to gather along the surface for several miles around the storm and becomes concentrated in vertical objects including trees and tall buildings. If you feel your hair stand up on end in a lightning storm beware. The negative charges from the cloud are pulling the positive charges inside your body to the top of your head and you could be in danger of being struck.

The third process is the generation of the lightning. When sufficient negatives and positives gather in this way, an electrical discharge occurs within the clouds or between the clouds and the ground, producing the bolt.

Negative Lightning

A bolt of lightning usually begins when an invisible negatively charged stepped leader stroke is sent out from the cloud. As it does so, a positively charged streamer is sent out from the positively charged ground or cloud. When the leader and streamer meet, the electrical discharge takes place up the streamer into the cloud. This return stroke is the most luminous part of the strike, and the part that is really visible.

Most lightning strikes usually last about a quarter of a second. Sometimes several strokes will travel up and down the same leader strike, causing a flickering effect. Thunder is caused when the discharge rapidly super heats the air around the strike, causing a shock wave to be sent out.

Research published in 2002 indicates that every lighting bolt also causes a similar but weaker electrodynamic pulse in the mesosphere, located 50 to 80 km (31 to 53 miles) above the earth, and above into the thermosphere.

This type of lightning is known as negative lightning due to the discharge of negative charge from the cloud, and accounts for over 95% of all lightning.

Statistics: an average bolt of negative lightning carries a current of 30 kiloamperes, transfers a charge of 5 coulombs, has a potential difference of about 100 megavolts, and lasts a few milliseconds.

Positive Lightning

Positive lightning makes up less than 5% of all lightning. It occurs when the stepped leader forms at the positively charged cloud tops, with the consequence that a positively charged streamer issues from the ground. The overall effect is a discharge of positive charges to the ground.

Research carried out after the discovery of positive lightning in the 1970s showed that positive lightning bolts are typically six to ten times more powerful than negative bolts, last around ten times longer, and can strike several miles distant from the clouds. During a positive lighting strike, huge quantities of ELF and VLF radio waves are generated.

As a result of their power, positive lightning strikes are considerably more dangerous. At the present time aircraft are not designed to withstand such strikes, since their existence was unknown at the time standards were set, and the dangers unappreciated until the destruction of a glider in 1999. It has since been suggested that it may have been positive lightning that caused the crash of Pan Am flight 214 in 1963. Positive lighting is now also thought to be responsible for many forest fires.

Positive lightning has also been shown to trigger the occurrence of upper atmospheric lightning. It tends to occur more frequently in winter storms and at the end of a thunderstorm.

Statistics (based on a small number of measurements): an average bolt of positive lightning carries a current of 300,000 amperes, transfers a charge of up to 300 coulombs, has a potential difference up to 1 gigavolt (a thousand million volts), and lasts for tens or hundreds of milliseconds.

Bipolar Lightning

Bipolar lightning occurs when bolts of negative and positive lightning alternately use the same channel through the air.

Various Types of Lightning

Some lightning strikes take on particular characteristics, and scientists and the public have given names to these various types of lightning.

Intracloud Lightning, Sheet Lightning, Anvil Crawlers

Intracloud lightning is the most common type of lightning which occurs completely inside one cumulonimbus cloud, jumping between different charged regions within the cloud. Intracloud lightning is commonly known as sheet lightning because it lights up the cloud and the surrounding sky with an apparent sheet of light. One special type of intracloud lightning is commonly called an anvil crawler. Discharges of electricity in anvil crawlers travel up the sides of the cumulonimbus cloud branching out at the anvil top.

Cloud-to-Ground Lightning, Anvil Lightning, Bead Lightning, Ribbon Lightning, Staccato Lightning

Cloud-to-ground lightning is a great lightning discharge between a cumulonimbus cloud and the ground initiated by the downward-moving leader stroke. This is the second most common type of lightning. One special type of cloud-to-ground lightning is anvil lightning, a form of positive lightning, since it emanates from the anvil top of a cumulonimbus cloud where the ice crystals are positively charged, and is a form of positive lightning. In anvil lightning, the leader stroke issues forth in a nearly horizontal direction till it veers toward the

ground. These usually occur miles ahead of the main storm and will strike without warning on a sunny day. They are signs of an approaching storm.

Another special type of cloud-to-ground lightning is bead lightning. This is a regular cloud-to-ground stroke that contains a higher intensity of luminosity. When the discharge fades it leaves behind a string of beads effect for a brief moment in the leader channel. A third special type of cloud-to-ground lightning is ribbon lightning. These occur in thunderstorms where there are high cross winds and multiple return strokes. The winds will blow each successive return stroke slightly to one side of the previous return stoke, causing a ribbon effect. The last special type of cloud-to-ground lightning is staccato lightning which is nothing more than a leader stroke with only one return stroke.

Cloud-to-Cloud Lightning

Cloud-to-cloud lightning is a somewhat rare type of discharge lightning between two or more completely separate cumulonimbus clouds.

Ground-to-Cloud Lightning

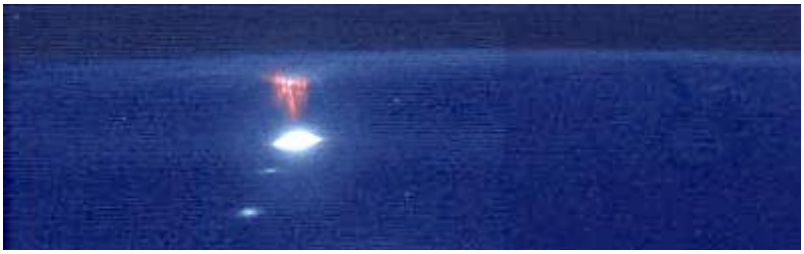
Ground-to-cloud lightning is a lightning discharge between the ground and a cumulonimbus cloud from an upward-moving leader stroke. Most ground-to-cloud lightning occurs off of tall buildings, mountains and towers.

Heat lightning

Heat lightning is nothing more than the faint flashes of lightning on the horizon from distant thunderstorms. Heat lightning was named because it often occurs on hot summer nights. Heat lightning can be an early warning sign that thunderstorms are approaching. In Florida, heat lightning is often seen out over the water at night, the remnants of storms that formed during the day along a seabreeze front coming in from the opposite coast.

Sprites, Elves, Jets and other Upper Atmospheric Lightning

Reports by scientists of strange lightning phenomena above storms date back to at least 1886, however it is only in recent years that fuller investigations have been made.



Sprites are now well documented electrical discharges that occur high above the cumulonimbus cloud of an active thunderstorm. They appear as luminous reddish-orange neon-like flashes, last longer than normal lower stratospheric discharges (typically around 17 milliseconds), and are usually spawned by discharges of positive lightning between the cloud and the ground.

Sprites usually occur in clusters of two or more simultaneous vertical discharges, typically extending from 65 to 75 km (40 to 47 miles) above the earth, with or without less intense filaments reaching above and below. Sprites are preceded by a sprite halo that forms due to heating and ionization less than 1 milisecond before the sprite.

Sprites were first photographed on July 6, 1989, by scientists from the University of Minnesota and named after the mischievous sprites in the plays of Shakespeare. They are caused by the electric field of a lighting stroke - as opposed to the electromagnetic pulse that causes a sprite.

Recent research carried out at the University of Houston in 2002 indicates that some normal (negative) lighting discharges produce a sprite halo, the precursor of a sprite, and that every lightning bolt between cloud and ground attempts to produce a sprite or a sprite halo.

Mysterious "Sprites" Light Shows Captured on Film National Geographic - June 19, 2007

Ice Lightning - Clouds with more ice produced more lightning Live Science - August 13, 2005

High-altitude light show in focus BBC - July 2004
Photos of red sprites, blue jets, elves and sprite halos are now flowing into the University of California, Berkeley's Space Sciences Laboratory from the first satellite instrument devoted to the study of these puzzling high-altitude lightning flashes. Blue jets differ from sprites in that they project from the top of the cumulonimbus above a thunderstorm, typically in a narrow cone, to the lowest levels of the ionosphere 40 to 50 km (25 to 30 miles) above the earth. They are also brighter than sprites and, as implied by their name, are blue in colour. They were first recorded on October 21, 1989 on a video taken from the space shuttle as it passed over Australia.

Elves

Elves appear as a dim, flattened expanding glow around 400 km (250 miles) in diameter that lasts for, typically, just one millisecond. They occur in the ionosphere 100 km (60 miles) above the ground over thunderstorms. Their color was a puzzle for some time, but is now believed to be a red hue.

Elves were first recorded on another shuttle mission, this time recorded off French Guiana on October 7, 1990. Elves is a frivolous acronym for Emissions of Light and Very Low Frequency Perturbations From Electromagnetic Pulse Sources. This refers to the process by which the light is generated; the excitation of nitrogen molecules due to electron collisions (the electrons having been energised by the electromagnetic pulse caused by a positive lightning bolt.

On September 14, 2001, scientists at the Arecibo Observatory photographed a huge jet double the height of those previously observed, reaching around 80 km (50 miles) into the atmosphere. The jet was located above a thunderstorm over the ocean, and lasted under a second. Lightning was initially observed traveling up at around 50,000 m per second in a similar way to a typical blue jet, but then divided in two and speeded to 250,000 m / second to the ionosphere, where they spread out in a bright burst of light.

On July 22, 2002 five gigantic jets between 60 and 70 km (35 to 45 miles) in length were observed over the South China Sea from Taiwan, reported in Nature. The jets lasted under a second, with shapes likened by the researchers to giant trees and carrots.

Researchers have speculated that such forms of upper atmospheric lightning may play a role in the formation of the ozone layer.

Streak Lightning

All lightning is streak lighting. This is nothing more than the return stroke, the visible part of the lightning stroke. Because most of these strokes occur inside a cloud, we do not see many of the individual return strokes in a thunderstorm.

Triggered Lightning

Lightning has been triggered in several instances. Lightning struck the Apollo 12 soon after takeoff, and has struck soon after thermonuclear explosions. For more information, see triggered lightning.

Lightning throughout the Solar System

Lightning has been observed on other planets, such as Venus and Jupiter, and electrical discharges between Jupiter and Io often occur.

Lightning on Jupiter is estimated to be 100 times as powerful, but fifteen times rarer, than that which occurs on Earth.

Lightning on Venus occurs so often that it is speculated that, were colonization to ever occur on Venus, lightning would be a primary power source.

Cassini sees lightning in Saturn's atmosphere BBC - July 2004

Lightning Facts

A bolt of lightning can reach temperatures approaching 28,000 kelvin (or about 50,000 degrees Fahrenheit) in a split second. This is many times hotter than the surface of the sun. A result of this is that lightning strikes that hit a loose soil or sandy region of the ground may fuse the soil or sand into channels called fulgurites.

These fulgurites are sometimes found under the sandy surfaces of beaches and golf courses or in desert regions. It is one evidence that lightning spreads out into branching channels when it strikes the ground.

Lightning Safety

Lightning is responsible for approximately 100 deaths a year in the United States alone. Lightning ranks second only to floods for storm related casualties in the U.S. every year. Many of these deaths could be prevented if basic precautions were taken when thunderstorms are expected in an area. Listening to a radio to keep up to date on storms in the area is the best way to prepare for safety.

One way to prepare for lightning safety is to install a device known as lightning conductor (commonly known as a lightning rod) for preventing damage by lightning to a building. A lightning conductor is a metal spike that is connected to earth by a low-resistance path. Should lightning strike a building, the current will travel through the conductor rather than through the fabric of the building, causing less damage.

Electrical equipment can be protected from lightning by a lightning arrester. This is a device that contains one or more gas-filled spark gaps between the equipment's cables and earth. Should lightning strike one of the cables, the high voltage will cause the gas in the spark gap to break down and become a conductor, providing a path for the lightning to reach the ground without passing through the equipment.

Safer Locations

No place is truly 100% safe in a thunderstorm, but some places are more safe than others. Larger, better constructed structures are better than smaller or more open structures. Fully enclosed metal vehicles with the windows rolled up are good shelters, providing that no contact is made with any exposed metal inside or outside the vehicle.

When outside, avoid the following:

High places and open fields
isolated trees
unprotected gazebos
rain or picnic shelters
baseball dugouts
communications towers
flagpoles
light poles
bleachers (stadium seating) (metal or wood) metal fences convertibles golf carts
water - ocean, lakes, swimming pools, rivers, etc.
metal-shafted umbrellas

If you find yourself trapped in an open area during a storm, position yourself close to the ground by squatting with your feet close together and on the balls of your feet. Crouch in a ditch if possible. Avoid proximity to other people (minimum 5 meters or 15 feet). Since lightning spreads when it hits the ground, you want to minimize as much surface area between you and the ground. Remember, humans are good conductors of electricity, lightning tends to strike at the highest thing in an area, because electricity will always take the path of least resistance.

What's It Feel Like to Be Struck by Lightning, and How Can You Avoid It?ABC - July 2004

When inside avoid the following:

- phones - use of the land lines
- anything to do with the use of water
- being near windows and doors
- using electrical appliances that plug into the wall
- avoid contact with conductive surfaces with exposure to the outside such as metal door or window frames, electrical wiring, cable TV wiring, etc.

Lightning in Cultures and Media

Lightning is often considered a divine or supernatural phenomenon. In many mythologies, it plays a role, and often have an affiliation with a certain god.

In Greek mythology lightning and thunder are weapons of Zeus, given from Cyclopes.

In Mayan mythology Huracan is sometimes represented as three lightning bolts.

In Norse mythology Odin's spear Gungnir is an embodiment of lightning. In addition, his son, Thor is specifically the God of Thunder and Lightning

In Native American mythology, the Ani Hyuntikwalaski ("Thunder Beings") are beings that cause lightning fire in a hollow sycamore tree.

In movies and comics of the contemporary U.S. and many other countries, the lightning is often employed as an omnious, dramatic sign. It may herald a waking of a great evil or emergence of a crisis. Various novels and role playing games with fantasy tint involves wizardry of lightning bolt, weapon embodying the power of lightning, etc. The comic book character Billy Batson changed into the superhero Captain Marvel by saying the word, "Shazam!" which called down a bolt of magic lightning to strike to change.

- Wikipedia

Sicily: Space Aliens Blamed For Electric Universe Thunderbolts - August 1, 2008

Misunderstood history has a way of repeating itself, or so the clich&#65533; goes.

In the News ...

Lightning Remains Huge Mystery Live Science - July 18, 2008

Lightning Strikes Deadliest In Summer Science Daily - June 29, 2007

Video Reveals 'Sprite' Lightning Secrets Live Science - June 12, 2007

Noxious Lightning NASA - April 27, 2007
Lightning is more than light and noise: It's an intense chemical factory that affects both local air quality and global climate.

Electrical Storm Over Sydney Harbour, March 4, 2007

Arkansas Daily Mail - July 2006

When a rainbow formed in the sky people stopped and stared at the natural wonder. But then lightning sparked across the evening panorama as two of nature's most spectacular phenomenon created an unusual alliance.

The clash of weather was seen above the affluent city of Fort Smith, in the Southern state Arkansas.O ne onlooker said, "It was awe inspiring. The lightning made a huge rumbling sound and when you looked up there was also this incredible rainbow forming on the horizon."

The intracloud lightning, known as an anvil crawler, is the most common form of lightning, with the electrical charge contained within a single cumulonimbus cloud.

Lightning often occurs during heavy storms while rainbows are generally formed after the rain has stopped, making an appearance of both simultaneously relatively rare. The actual electric charge in a flash of lightning comes from particles from the sun sent out in the solar wind which gather in the outer atmospheric layers before creating a strike.

Scientists are still divided by what actually causes lightning, with one theory suggesting falling droplets of ice and rain become electrically polarised as they fall through the natural electric field in the Earth's atmosphere. This would explain why lightning often accompanies storms and heavy rain. The same droplets also cause the rainbow, when light from the sun is refracted by the water to cause a spectrum.

Ball Lightning

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