

Aurora Borealis and Magnetism

Jacob Campbell & Reannen Brewer

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Salt Lake Community College

Abstract:

The Aurora Borealis has been an integral part in human folklore and development of many well known cultures for example the Norse, Icelanders and the Danish. Many different cultures saw the Aurora as a higher power, created by the Gods causing fear and enlightenment for many centuries. The Aurora happens when the sun's particles interact with the earth's magnetic field creating the ghostly lights. Magnetism not only plays an enormous role in the creation of the Aurora, but has played an integral part in the evolution of human existence. It has protected the earth from interplanetary objects, solar rays and is a definitive part in medical advancement using MRI's and X-Ray, both of which technologies were discovered using magnetism.

History:

Near the poles of the earth there is a strange occurrence of night lights. These “night lights” are usually a pale green hue but can range from yellow to purple. These night lights are referred to as the Aurora Borealis if seen near the North Pole, or the Aurora Australis if seen near the South Pole. Even though the French astronomer Pierre Gassendi (1592-1655) is credited to naming the Aurora Borealis or the Northern lights it was not the first time that they were observed. (Odenwald) As far back as 700 A.D. there have been oral traditions referring to the Northern Lights. This was mainly by Eskimos and Scandinavian people but has also included ancient Chinese and Greek.

The oldest detailed description belongs to Norse Literature dating back to 1200 A.D, four hundred years before Galileo. This thirteenth century Norwegian Chronicle entitled the Kings Mirror has a very detailed, technically and emotionally account of the Aurora Borealis. It was also the first to propose the name of the Aurora Borealis referring to the lights as the Northern Dawn. (Egeland) The term Aurora Borealis has been scientific term for the Northern

Dawn since 1620.



(Figure 1; Location: Yellowknife, Canada)

There is much folklore associated with the Northern Lights, the Norse believed the aurora was the Bifrost,

which is a heavenly bridge between

earth and Asgard. It was also believed that the Aurora Borealis would collapse at the end of the

world or Ragnarock. In the Nordic countries it was considered to be an active volcano of the north that was to bring warmth and happiness to the people of the earth.

Finland's interpretation of the lights resulted in the Archangel Michael who lit up the skies in lights to battle the devil by the name of Beelzebub. The Lapps people conceived that the lights were caused by the battle between Thor and the Mountain King. A more romantic interpretation by the Danish, was that swans had flown to far north and had their wings frozen and every time they flapped the Northern Lights would reflect off their wings and dance.



But not every nation considered the Northern lights a grand gesture, most feared it,

(Figure 2; Location: Churchill, Canada)

the Eskimos when the lights would appear they would take their children inside believing that the lights would take their heads and use them to play games. In Rinnmarks-Vidda it was taught to the children that if they mocked the lights would oscillate rapidly and take their life. Icelanders believed that if a pregnant woman gazed at the lights then here child would be born cross eyed.

In early twentieth century America, a common story was that the Aurora was caused by the sun reflecting off of the icebergs in the North Pole. Though the Aurora is created in part by the sun, it is not a reflection. The suns powerful solar storms disturb the Earth's magnetic field. This field then rearranges itself then converts a part of its stored energy into fast moving

particles. These particles, partly from earth and partly from the sun flow towards earth, they encounter the ionosphere where their energy is increased. The particles collide with Nitrogen and Oxygen atoms, which absorb the energy, putting their electrons in an excited state, as the electrons come back to their ground state they release a photon of light, producing the auroral light. (Odenwald) There is no direct contact of the solar particles in the Polar Regions to create the aurora, Solar flares have no effect on the Aurora Borealis.

There are many different colors associated with the Northern Lights, greens, reds, yellows and blues. The explanation for this does not involve the wrath of the Gods or any of the common folklore, it simply deals with which atoms the sun particles are interacting with. Oxygen is the most common in the Earth's atmosphere so, that is where most of the particles are going to collide and when the collision occurs the photon which oxygen releases is a green and yellow color. This is why the most common colors in the Aurora are green or yellow.

Blue lights in the aurora are caused by ionized nitrogen colliding with the particles, whereas red light is caused by excited nitrogen. The colors are all shown in:

3. Magnetism is the main cause of the Aurora and has been discovered for just as long. Magnetism was discovered earliest by either the Greeks or the Chinese, it is unsure who discovered it first. The commonly



(Figure 3; Located: Maine)

believed legend is that an elderly Sheppard named Magnes was herding his sheep and the nails in his shoes and the metal tip of his staff became stuck in a large black rock on which he was standing. This rock was subsequently called Magnetite. No one knows for sure the exact moment of discovery. (Geno Jezek, 2011) In the first century B.C. the writings of Lucretius and Pliny the Elder (23-79 A.D.), Pliny had many writings that involved a hill that attracted iron.

The most historic use of Magnets is that of a compass, a compass is a tool that used a magnetized needle that always points true north. Chinese sailors were the first to create and use compasses. Since then they have only improved becoming smaller and more accurate.

Current:

Magnets are used everyday in life, the first ideas of magnets that come to mind are simple things such as, pinning a child's picture to the fridge or an extension magnet to pick up



small metal items in tight spaces. Magnets are even used to entertain children, developers have come up with toys that are a combination of little magnetic balls, which can keep a child entertained for hours. A simple way to keep doors closed

(Figure 4: Everyday magnets on a fridge) on cabinets or refrigerators (see figure 4).

Every speaker, from a little iDock to the PA systems at a Jazz game, have magnets, the stronger the magnet, the better the sound quality. Motors have a set of permanent magnets that are connected to a battery, when connected the electromagnets repel permanent magnets and

force the motor to spin. Of course, the longest known use of magnets is on a compass, that is a compass always points north or where there is the most magnetic force pulling towards it, although this is a natural magnet it is still used today, although not as frequently. These examples of how magnets are used in our world, although more prevalent, are just a very small portion of how they are used.

For many years after the discovery of magnets they were perceived of items of magic, this of course, is not true. A magnet is any object that has a magnetic field. These magnets attract ferrous objects (objects that contain iron, steel, nickel or cobalt, metals), so every object, such as a fridge, that magnets are attracted to are ferrous objects. Since, a magnet has to have a magnetic field to be labeled a “magnet”, how is this magnetic field created? In the example of a bar magnet the magnetic field results from the motion of negatively charged electrons in the magnet. Every time the refrigerator door is closed the metals from the fridge come into contact with the magnet’s magnetic force and is attracted to it, thus the reason why your fridge remains closed. A strong magnet occurs when the magnetic domains are all aligned with each other. Magnetic domains can be described as mini magnets within an object, when the domains are all facing different way there is not magnetic charge but, when the object becomes magnetized all the domains face the same way.

While these are all relatively simple advances in the study of magnetism, although much more prevalent than say, just a compass (see figure 5), there are in fact many larger and much more complicated advances that deal with magnetism and magnets. We (humans in general) have now sent out many satellites that can monitor the magnetic field surrounding the Earth.

Year after year satellites have been developed so they can come even closer and thus develop better resolution.



(Figure 5: Compass)

Magnets have now become, in a way, security guard or trackers. They are used in metal detectors in airports and some schools, searching for metal devices which can include guns or knives, the metal passes through the magnetic field and that element sends an electrical current through the magnet which triggers an alarm. The same concept is used, although in a different way, when we look at hand held metal detectors, more used for “treasure hunting” than as a protective device.

It is safe to agree that money runs the world, without it you cannot buy food, you could grow it but the average, lets use American, no longer farms. Most people do not like carrying around big old wads of cash so, we have credit and debit cards that hold information in a little



(Figure 6: Money cards that use a magnetic strip)

magnetized strip on the back of the card (See figure 6). We have come so far as to hold information on a tiny strip. As well as credit cards there are ID cards that have the same magnetic strip but, instead of money information this strip contains personal information that identifies who we are. Not only are magnets making it more convenient (maybe too convenient) to carry money but they are also identifying who we are.

Everywhere you look there is a plethora of magnets being used, as has been shown, in science, personal life, money and now the idea that magnets can be beneficial to health, not a believer?

Magnetic Resonance Imaging (MRI) machines are a powerful diagnostic tool that the medical community sees a way to see soft tissue in the body. The first use of superconducting magnets was in the 1960's with the discovery of NbTi alloy but, it was not until MRI's came around that superconducting magnets were commonly used more often. MRI's use intense magnetic fields to make images of the inside of the body without the need to actually be inside the body, their main objective is to detect problems within the body or brain (such as cancer) without needing surgery. The fact that there was now a pain-free way to get a picture of the inside of the body was outstanding and was (still is) becoming a necessity in most big hospitals.

All the previous examples of the advances of magnets deal with magnetism, when you approach the subject of electromagnetic waves or radiation, a whole new door of advances opens up.



(Figure 7: Microwave)

to you by electromagnetic radiation.

I do not know about you but, being a college student, the microwave has become my best friend, a quick meal in the morning can go a long way. That would not be possible without electromagnetic radiation and at the same time I am enjoying this delicious microwaved meal, it is likely I am also listening to the radio, all brought

As already expressed the effects on human of advances of magnetism vary from being able to be healthier because of inventions such as MRI machines and x-rays, which make it easier to spot something wrong with a certain person's body. They are also making it easier to be identified and carry money conveniently. Plus, if it were not for magnetism we would not

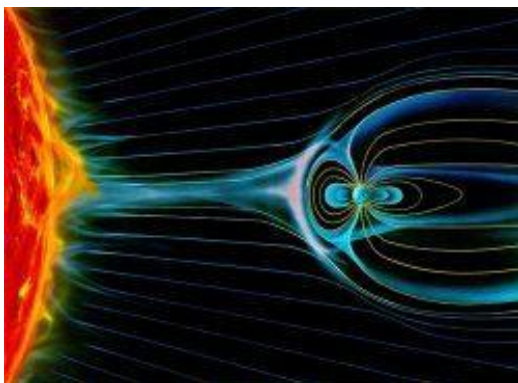
have any electrical equipment, or games, or this laptop I am currently working on.



(Figure 8: An MRI machine)

The magnetic field of the Earth also protects us more than most people know. The Sun is 93 million miles away and yet we still feel the heat from it and if it were not for the magnetic field

around the Earth we would all burn up. At different time the Sun will send gusts of charged solar particles hurtling across space and if Earth should so happen to be that path then our magnetic field act like a barrier or shield. When the charged particles from the sun strike these atoms and molecules that are in the Earth's atmosphere, they create a lot more movement from the atoms, causing them to light up. This is most



(Figure 9: Magnetic Field surrounding earth)

commonly seen close to the north and south poles hence the Aurora Borealis. So, while the "Northern Light" or Aurora Borealis may be pretty to look at, it is actually a sign that the o-zone is getting burned away by the sun, slowly yes, but all

the same it is happening. Why is it easier to see the lights at the poles of the Earth? Well, the thinnest spot of the layer protecting the Earth from the Sun's vicious rays is, you guessed it, in the northern and southern points of the Earth so the electrons are hitting the air molecules of the atmosphere lower than normal making it visible in the atmosphere.

There are other less scientific effects that the Aurora creates. Economics, for instance, people travel from all over the globe to see this natural phenomenon. In a way the Aurora provides a push for economic stability by causing people to travel and in that way spending money.

Currently the lights have no physical effect on the living nor will they ever, they are more of a sign that the magnetic field protecting the Earth is getting weaker.



(Figure 10: Satellite Photo of the Aurora Borealis)

When the lights start to become visible in all parts of the world that is the point within which we should start to worry because, this means the rest of our protective layer is getting weaker.

Conclusion:

Who knows what would have become of current civilization if not for the discovery of magnets. One thing's for sure, life on earth would not exist if not for the protective shield of the earth's magnetic field. Magnetism is a part of our growth of our society without it we would not have had the many advances that we have today.

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