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About Atmospheric Electricity

L. Begeman
Iowa State Teachers College

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ABOUT ATMOSPHERIC ELECTRICITY

Our atmosphere is electrified at all times. During the summer the average increase of potential from the earth's surface up is about 100 volts for one meter of ascent. This potential gradient, however, diminishes with increasing altitude until at the height of one mile it is only 25 volts per meter. During the winter the atmosphere is much more intensely electrified. The average increase of electrical potential near the earth's surface during this season is as much as 250 volts per meter of ascent.

One might think that when the potential gradient is as much as 250 volts per meter, which would mean 2500 volts between the earth and a point ten meters above, that it would be possible to draw an inexhaustible supply of current electricity from the atmosphere. It is well to note, however, that mere potential difference, however great, is not sufficient to produce a large current of electricity. In winter one may oftentimes produce a charge whose potential is 30,000 volts or more, merely by stroking a hard rubber rod with fur, or a glass flask with silk, but no large current can be derived from such a charge. It takes a large quantity of electrification as well as a high potential difference to make such a current. Now the quantity of electrification in the atmosphere per cubic meter is quite small. This circumstance makes its practical utilization at any future time quite improbable.

How does the atmosphere get its electrification? This question has been the subject of much investigation. The earth's surface itself is practically always negatively charged. No one has yet been able to find out why this is so, although there have been many guesses. It is quite certain, however, that the atmosphere receives its electrification from several sources. In the first place, the lower strata of air always contain small quantities of radium and thorium emanation. The radiations from these emanations are powerful enough to knock out electrons from the molecules of the atmosphere, causing them to be ionized or electrified. Furthermore, there are continual radiations from the radio-active elements of the soil which act in the same manner as those from the ever present emanations.

It was discovered by Rutherford and others during the first years of this century that there is a very penetrating radiation always present in the lower atmosphere which has its source from somewhere outside of the earth. This powerful radiation is continually adding to the ionization or electrification of the atmosphere. Some have even ventured the guess that this radiation from the outside knocks out electrons from the gas molecules of air with such force that they are driven to the earth's surface where they continually maintain a negative charge. Finally, violent motions of the air, as in high winds, doubtless also contribute to the electrification of the atmosphere.

Does the atmosphere possess electric currents? We quite generally call the

electrification of the atmosphere static electricity. When harsh grinding noises are heard in our radios, which we feel sure are not due to any artificial interference, we immediately lay it to "static" in the atmosphere. It is very likely, however, that these noises are due to disruptive currents or discharges of electricity in the atmosphere. It is a case of non-static rather than of "static".

Research has disclosed the existence of four different kinds of electric currents in the atmosphere. The first are the violent disruptive discharges called lightning, familiar to everyone living in climates where thunderstorms occur. The second are harmless convection currents due to the mechanical motion of ionized molecules or groups of molecules which are always present in the air. The third are precipitation currents due to electrified rain drops falling from thunderclouds. Raindrops are always electrified, most generally carrying positive charges. They are negatively charged at an average of about once in every four times that it rains during the season or year. The fourth kind of current is always present in the atmosphere and is called a conduction current. This is due to a stream of ascending negative ions as well as a stream of descending positive ions. It is estimated that the total current of this nature over the entire earth's surface amounts to about 1500 amperes.

There are two experimental proofs to show that the atmosphere at any locality is always electrified. These can be easily carried out by anyone. In the first place an electrified conductor, no matter how carefully it is insulated, will gradually lose its charge when exposed to the atmosphere, whatever the state of humidity. This shows that the atmosphere is at all times conducting and hence ionized or electrified. In the second place an insulated conductor always becomes gradually electrified when exposed to the atmosphere even under a clear sky.

Why do thunderstorms occur only in the summer season in the temperate zones? One would naturally think that since the atmospheric electrification is most intense during the winter season that there would be more thunderstorms in winter than in summer.

Dr. C. S. Simpson of the meteorological department of India carried on a series of observations covering a period of two years, 1908, 1909, at Simla, India, at an altitude of 7000 feet. He concluded from these observations that the electricity of thunderstorms is generated in the cumulus clouds. According to him the generation is caused by a violent updraft of humid air in the cloud itself. This updraft causes an electric separation which leaves a positive charge at the bottom of the cloud and an equally large negative charge at the top. He discovered also that most lightning strokes take place in the clouds themselves between these two separated charges. He also found that the relatively rare strokes between the lower part of the cloud and the earth occur only when the upper charge is separated from the lower by strong lateral winds. When thus isolated the lower positive charge of a cumulus cloud is free by means of its field to induce charges upon objects below it. This may cause a lightning stroke between the cloud and the earth, depending, of course, upon the intensity of the electrification induced. In the tropics where there are numerous storms during the wet seasons with rare lateral winds, lightning strokes are confined almost wholly to the clouds. In the temperate zones where lateral winds nearly always accompany thunderstorms lightning strokes to the earth are much more common.

Another interesting manifestation of atmospheric electricity is the aurora polaris or aurora borealis. Auroras show themselves in the northern skies in the form of bands, rays, draperies, curtains, coronas, or patches of light.

Some of these are quiescent and others are very active, frequently appearing like tongues of flame. Auroras are most numerous during sun spot maxima and occur most frequently before midnight at heights of 50 to 200 miles. Most auroras are white, but some show red, green or yellow. Often they appear as an ensemble of all these colors.

The fact that auroras are always accompanied by magnetic storms over the earth's surface makes it certain that they are silent electric discharges. These discharges of currents of electricity are probably induced by the sun, since they occur most frequently during sun spot maxima. The theory is that they are due to streams of alpha particles shot off from the radio-active substances in the sun. L. Begeman.

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THE PLANETESIMAL HYPOTHESIS

In a former article the writer called attention to the fact that the La Placian hypothesis has been abandoned by scientists because of the serious astronomical, biological, dynamical, and geological difficulties encountered. The Planetesimal or Accretion hypothesis, which has superseded it, is the gift of Doctor T. C. Chamberlin, formerly head of the Department of Geology at the University of Chicago and Director of the United States Geological Survey. After long detailed study of glaciation in America, Doctor Chamberlin became convinced that the La Placian hypothesis could not account satisfactorily for the appearance of glaciation so early in the earth's history, nor explain the nature of the Primary, or Archeozoic rocks.

In order to interpret the past history of the earth in terms of present day processes, both the solar system and star systems were carefully examined for any evidence that might lead to a more scientific explanation of the origin of the earth.

Doctor Chamberlin spent several years trying to reorganize the La Placian hypothesis in such a way as to overcome the many fatal weaknesses which recent scientific study had revealed, but with little success. He then discarded, for the time, the La Placian conception and worked on the Meteoritic hypothesis of Lockyer and Darwin, with the result that this hypothesis, like the La Placian, was found to involve several destructive fallacies. Doctor Chamberlin then attempted a combination of the La Placian and Meteoritic hypotheses, but to no avail. The scientist was fair to these old conceptions, having abandoned them only when it was found that neither could stand the rigid test of modern dynamics.

After discarding the old hypotheses, Doctor Chamberlin began an entirely new attack on the problem of the origin of the earth and in 1905 gave to the world a new conception called the Planetesimal or Accretion hypothesis. In working out its contacts with the closely allied sciences of physics, chemistry, geology, mathematics, and astronomy, he was ably assisted by Doctors Millikan, Stieglitz, Moulton, and a host of others.

In stating his hypothesis, Doctor Chamberlin lays down two fundamental premises. He postulates first an ancestral sun, and secondly, an episode in the history of this sun in which the matter necessary to build our planets, satellites and asteroids was lost from it through tidal action.

It is now known that large masses of hot gases are often shot from the sun's surface with velocities that carry them to heights of thousands of miles. If in some extreme cases matter were to leave the sun's surface with the critical velocity, which is 385 miles per second, it would be lost to the sun entirely. It is fair to assume, however, that the matter in the sun is in a state of equilibrium; that is, the sun's gravi-

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