

THE AURORA BOREALIS.

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Experiments were conducted in the past four years to determine the reasons for disturbances in the atmosphere and to electrical transmission systems during the aurora borealis. The claims of Prof. R. A. Millikan and Prof. W. Kohlhorster with reference to the alleged discovery made in 1925 that cosmic rays of outer planetary origin penetrate the earth were also investigated.

In order to ascertain these reasons and claims, evidence gathered since 1923 has produced some very interesting data. These data show that the aurora borealis is a direct cause of disturbance to high power transmission systems. High frequency rays and electromagnetic waves emanating or discharged from the aurora are the chief causes for these disturbances.

In order to disclose the results obtained during the experiments, a concise discussion will not be given until a later date. The entire details will then be presented for publication setting forth some very interesting facts.

When these electromagnetic waves penetrate the lower atmosphere, they impinge upon the high voltage transmission lines causing local disturbances in various locations. Very peculiar cases have been observed where such disturbances have either been electromagnetic or of the order of high frequency rays. These rays penetrate many substances. The remarkable values of these rays have been of a wide range of frequencies. In some cases the supposed high frequency radiation was attributed to terrestrial sources, while in others its origin was sought in the atmosphere itself. The plan was to observe the rate at which the instruments would show a deflection and measure the charges according to their intensities.

Location of Experiments. The experiments were conducted in the day and during the aurora borealis and in the evenings, since January, 1923. The most extreme aurora displays occurred on April 14, June 2, September 8, October 15, 1926, and October 11, 1927. The aurora on these dates appeared of a very brilliant and powerful nature. Experiments were conducted in a concrete pipe shaft with lead lining, installed in the river channel, of the Hackensack River, Secaucus, N. J. The pipe shaft was used for the purpose of descending to the river bed with a pair of electroscopes and other sensitive instruments. A wooden float was used for conveying the instruments to the pipe shaft for the purpose of detecting any delicate or feeble charges therein.

Determination of Penetrating Charges. Two electroscopes were carefully lowered into the pipe shaft each time to determine the nature and quantity of the charges. It was discovered that these charges con-

sist of extraordinary rays of a very short wave length, of a very penetrating nature, and electromagnetic waves. These hard rays and electromagnetic waves emanate, or are thrown off from the brilliant aurora streamers and scattered into space.

The electroscopes showed that current charges were circulating in the entire length of the enclosed pipe shaft and in the surrounding salt sea water. The concrete pipe shaft $3\frac{1}{2}$ feet in diameter contained a heavy lead-lined concrete cover at the entrance above the water. The river bed was a distance of 103 feet below the water surface at this location in the river channel.

With the observed readings and numerical coefficients a sum of figures is being prepared. This sum will consist of recorded and calculated values. The readings increase gradually with the depths showing the higher values of penetrating rays and current charges are distributed or scattered about the river bed. This also reveals that ordinary sea water is of a higher density than sweet water. The sea water is more susceptible to electrical charges due to the salt contained therein.

It has recently been observed that the values of these aurora charges are not of any limited quantity, but vary more or less according to the surrounding atmospheric conditions and amount of solar changes. The higher radiation values appear during the spring and autumn seasons.

Penetrating Power of the Aurora Rays. According to recent investigations the highest readings or maximum values of these charges are within the area of water explored. The absorption coefficients are very high in the atmosphere and are equivalent in absorbing power to about 28 feet of water. These high frequency aurora rays coming into the earth possess a penetrating power capable of piercing 103 feet plus 28 which would equal 131 feet of salt water before being completely absorbed. These rays therefore are much harder than any known rays and are capable of penetrating the hardest material substance.

The most penetrating X-rays in commercial use today cannot pass through a half inch of lead whereas these rays can penetrate nearly 13 feet of pure lead. From these experiments it can be well assumed that there is a region of frequencies, as far up above the X-ray frequencies, as are the discovered rays above the frequencies of light waves. However, according to our present day knowledge of physics, these aurora rays are of a high frequency range.

These aurora rays and electromagnetic waves originate from solar radiation. The hardest rays that we are fairly well acquainted with at the present time are the gamma rays of radium and thorium. These hard rays are produced by nuclear transformation within atoms, that is, they are produced by the change of one atom over into another atom or by the birth of a new type of atom.

Since the energy of the nuclear change corresponds to the formation of ordinary helium out of hydrogen the corresponding frequencies were prepared and found to correspond to the known highest frequency rays which were obtained during these experiments from 1923 to 1927 inclusive. In order to compute these frequencies it was necessary to formulate their ranges and calculate them by standard methods used in the

X-ray and gamma ray field. These newly discovered rays have been found to fit on at the top of the well known spectrum and now extend it into the regions unexplored.

Since the atmosphere contains a certain percentage of moisture some of the penetrating charges are absorbed before reaching the river. The rest of the charges are scattered about the earth extending to the river bed which happens to carry them more uniformly in all directions.

It is now definitely known that the aurora is the real cause for creating disturbances in the atmosphere. Since these very delicate charges have been carefully measured interesting data and other information will soon be available.

From experiments carefully conducted in and under the Hackensack River, it was observed that high frequency rays emitted from the aurora borealis impinge upon the earth according to the Compton effect. These high frequency rays are transformed partially into soft scattered rays and into electromagnetic waves. These latter electromagnetic waves travel in all directions. These transformations are enormously more energetic than are those taking place in any radioactive changes which we know anything about.

Conclusions. The surprising results of these investigations are of considerable interest to scientists. They will learn of some of the most interesting facts in conjunction with an important discovery which offers proof that these rays are extremely energetic. It is hardly believable to human intelligence, that such energetic rays and powerful electromagnetic waves are in force during the aurora. It is a discovery of considerable importance and offers possibilities of brighter views into the principles pertaining to astrophysics. It also offers a clear conception of terrestrial disturbances to high voltage transmission, telegraph and radio systems. Emphasis is strongly based upon the knowledge gathered from evidence through experiments.

What the future has in store no living individual knows. At the present moment there appear to be many possibilities ahead for very interesting applications. This very recent discovery has led to a conception of radiant energy traveling through space, at intervals in all directions. This energy appears to our senses in the order of high frequency rays. It emphasizes the apparent impossibility of scientists unraveling the present stage of development of any single consistent and universally applicable scheme of interpretation. An important point of considerable interest is that these rays can penetrate any solid material substance for a considerable depth.

