

emanates from the sun in the manner here assumed." It is not improbable that the great mass of radiant matter into which we suppose we look when observing the zodiacal light, is capable of diffusing enough sunlight to produce the luminosity of that phenomenon.—[c. A., jr.]

550.77.4

#### A POSSIBLE CONNECTION BETWEEN MAGNETIC AND METEOROLOGIC PHENOMENA.

By KRISTIAN BIRKELAND.

[Reprinted from Miss Jessie Muir's English text of "The Norwegian Aurora Polar expedition, 1902-1903." v. 1, 2d section. Christiania. 1913. p. 449-450.]

93. If the view we have maintained is correct, namely, that the magnetic storms are due to corpuscular rays that are drawn in in zones round the magnetic poles, where they pass directly down into the atmosphere of the earth, it is clear that these rays, especially in the upper strata of the atmosphere, must be assumed to produce a strong ionisation in the air. In our expedition of 1902-03, atmospheric-electrical measurements were made, which will be gone into later on; but it may be remarked here, that the result of these measurements showed that the "Zerstreuung" of the air at those stations averaged about twice as much as in Christiania, indicating that the air up there is considerably more ionised than in lower latitudes. In an expedition which I made in company with my assistant, Mr. Krogness, to Kaafiord at the time when Halley's comet crossed the sun's disc in May, 1910, I had an opportunity of studying this matter more closely.

Instead of, as before, making the measurements at places that are at no great height above sea-level, I on this occasion investigated it at my old aurora observatory on the top of Halde Mountain, about 910 meters above the sea. Here there proved to be sometimes tremendous variations. On the 20th May, for instance, values were found that went up to about 500 times the normal. Unfortunately the attempt was interrupted in the middle of these measurements; but I had an opportunity of making insulation-tests twice at that time, which proved there was no perceptible leakage. If we can demonstrate this circumstance with certainty, we presumably have before us a phenomenon that is closely connected with the peculiar light-phenomena that Lemström discovered in 1882-3 on a mountain-top at Sodankylä.

There is no doubt that such strong ionisations will have a very great influence upon atmospheric conditions, especially upon the formation of clouds, and must thus be assumed to be a meteorological factor of no small importance, especially for the districts in the vicinity of the auroral zone. I am of the opinion that this is a very important connecting link between terrestrial-magnetic and meteorological phenomena. I have therefore recently submitted to the Norwegian State authorities, a suggestion that a permanent up-to-date magnetic-meteorological observatory be established upon the top of Halde, for the purpose, if possible, of throwing light upon these interesting and meteorologically important matters.

There was another phenomenon, striking examples of which we had the opportunity of seeing on this expedition in May, 1910, namely, the formation of what may be called auroral clouds. In addition to the usual polar bands, which in a clear sky, could very often be observed

in the form of several evenly luminous arcs, of which, however, one was especially conspicuous, exactly similar to parallel auroral arcs, we very frequently found formations of cirrus clouds, which exhibited the most perfect agreement with various auroral formations. Several times we had capital examples of the manner in which such clouds are formed, how drapery-formations appeared in a short time, exactly in the same manner as an auroral drapery. The first observer, who has called attention to this very interesting fact seems to be Adam Poulsen [Paulsen].<sup>1</sup> As far as I know, no one has, however, studied this phenomenon in connection with simultaneous magnetic registrations at the same place. This we had the opportunity of doing, and the very interesting fact came out, that the formation of these clouds was always accompanied by simultaneous magnetic storms and earth-currents; and there thus appears to be no doubt that these are direct cloud-forming effects of the same rays that occur in the auroral phenomena. From this it seems, that these cirrus-clouds are directly formed by the corpuscular rays which we suppose to be the cause of magnetic storms and aurora. The first hypothesis that one naturally might form as to this phenomenon is, that the clouds are due to water-vapor brought to condensation by the ions formed by the impact of negative rays. It is, however, also a probability that some of the observed "auroral clouds" are not real clouds, but merely a very strong concentration of corpuscular rays, which in the case of darkness might appear luminous; in the daytime the concentration of corpuscles should have the effect of making the places where they occur less transparent, and able to diffuse light, and thus become visible. In such a way also possibly certain faint polar bands observed in the polar regions might be explained. According to circumstances these concentrations may disappear, or perhaps give rise to real clouds.

#### RADIOTRANSMISSION AND WEATHER.

By A. H. TAYLOR.

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In a previous paper on this subject<sup>1</sup> the writer submitted evidence which seemed to show that unusually good radiotransmission across long overland distances at night is preceded the day before by generally cloudy conditions prevailing in the region across which the nocturnal good transmission takes place.

The evidence presented in that paper has been greatly strengthened by subsequent observations. In particular it may be mentioned, that out of some 60 cases of good transmission studied since September 24, 1913, 44 have followed a generally cloudy condition over the area in case, while of the other 16, a majority have occurred during the shortest days of the year, when the hours of sunlight in the latitude of Grand Forks, N. Dak., are relatively few.

Before discussing the bearing of this evidence on the idea of the reflection and refraction<sup>2</sup> of electric waves by ionized layers of the earth's atmosphere, it will perhaps be well to examine some of the data collected at this station since September 24, 1913, for evidence of a somewhat different character.

In commenting upon the previous paper, the editor of the Electrical World suggested that the effects noted

<sup>1</sup> Paulsen, Adam. Wolkenbildung durch das Nordlicht. (Aus einer Mittheilung an die k. dänische Akad. d. Wiss., 1895.) Meteor. Ztschr., Wien, 1895, 19. Jhrg. p. 161-169.

<sup>2</sup> Electrical World, Aug. 30, 1913.

<sup>3</sup> Dr. Eccles, in The Electrician, Sept. 27, 1912, and Sept. 19, 1913.