sure. Nordmann[5] in 1903 advanced the theory that they were produced by electric waves from the sun ionizing the upper atmosphere. Paulsen[6] later put forth a theory similar to the second of Birkeland's, but providing for an accumulation of "auroral material," a mixture of ionized air and cathode rays, produced by cathode rays and ultra violet light from the sun.

Finally Störmer, in the paper here under review, taking up Birkeland's first theory, worked out mathematically the trajectories of cathode rays projected into such a magnetic field as that of the earth. He showed that so great is the variation in path produced by slight differences in the velocity and original direction of such particles that Birkeland's simple first theory is ample to account for observed phenomena.

A negative electron projected into a magnetic field in an equatorial plane, moves in a curved path the form of that described by a point on a circle rolling on the inside of a larger circle. The stronger the magnetic field the smaller is the generating circle. Shot obliquely into a field, such a particle moves in a spiral path and if the field be convergent the spiral path is conical. The particle moves along the cone to where the field reaches a certain intensity and back again on another cone with its axis slightly displaced from the first. Störmer shows that in the earth's field the trajectory has the form of a wire wound on a cow's horn with its apex toward a magnetic pole.

Cathode rays would not be emitted freely at all times from all parts of the surface of the sun on account of the residual positive field. We should expect them to break forth in limited clouds during severe electrical storms in connection with sun spots. A small group just reaching the earth after sunset in winter would strike the earth's field tangentially in an oblique direction, move on a curved spiral path toward the North Pole, reverse and move toward the South Pole, again reverse and so on until absorbed by the atmosphere. On each trip north or south they would move in a different group of paths, hence the serrated structure of the simple aurora. Linear velocity and hence luminescence produced would be greatest at the north and south ends of the paths. The trip from north to south would occupy from about half a second to five seconds, according to the inclination and original velocity of the rays. This would be a plausible origin of the magnetic fluctuations observed during the smaller but more active displays.

More extended clouds of electrons from the sun would produce draped and diffused auroras. More intense displays might even be accompanied by ordinary electrical conduction and hence the reddish tints sometimes observed.

All things considered, the Birkeland-Störmer theory is by far the most satisfactory thus far advanced, both in its simplicity and in its explanation of widely varied phenomena. It is indeed the only theory thus far advanced that is free from radical objections.

RECENT ADDITIONS TO THE WEATHER BUREAU LIBRARY.

H. H. KIMBALL, Librarian.

The following titles have been selected from among the books recently received, as representing those most likely to be useful to Weather Bureau officials in their meteorological work and studies. Most of them can be loaned for a limited time to officials and employees who make application for them. Anonymous publications are indicated by a ——.

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[6] Adam Paulsen, Bull. Acad. Sci. Danemark, 2, 109, 1906. Cf. Vol. XII, T. M., p. 94.

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H. H. KIMBALL, Librarian.

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