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# On the polar auroras

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that of *xy*, since the pitch of the reciprocal screw in this case is infinite, and therefore  $P$  is zero.

We hope that the account we have now given of the author's Theory of Screws, so far as it goes, will be intelligible to readers unacquainted with the subject, and that it may induce some of them to peruse the work itself. Our limits will only allow us to add that in an Appendix of sixteen pages Mr. Ball gives an account of the memoirs bearing on the subject of his treatise.

### LVIII. *Intelligence and Miscellaneous Articles.*

ON THE POLAR AURORAS. BY G. PLANTÉ.

“NOTHING should be neglected that can induce complete conviction, in the theory of the forces of nature, and enable us to pass from the disquiet of investigation to the security of known truth. Should we be quite sure, for example, of the theory of the rainbow, if we had not, by spiriting drops of water in the sunshine, reproduced in all its details that brilliant phenomenon? The experiments of the cabinet are modest, but useful, and therefore valuable.” These words of an illustrious Member of the Academy encourage me to pursue the analogies between the effects of electric currents of high tension and the grand electrical manifestations of nature. De la Rive's experiment has already brought out the connexion of the polar auroras with terrestrial magnetism, but does not suffice to explain all the circumstances accompanying them. In the experiments which are the subject of the present memoir the electric flow takes place in the presence of aqueous masses, as in the atmosphere; and hence result a series of phenomena altogether similar to the various phases of the polar auroras.

1. If the positive electrode of the powerful secondary battery which I employ is put in contact with the moist sides of a vessel containing salt water in which the negative electrode is previously immersed, there is seen, according to the greater or less distance of the liquid, either a wreath round the electrode (fig. 1), or an arc bordered with a fringe of bright rays (fig. 2), or a sinuous line

Fig. 1.

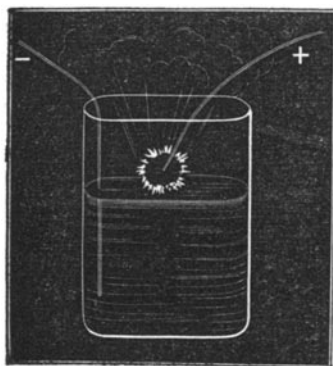
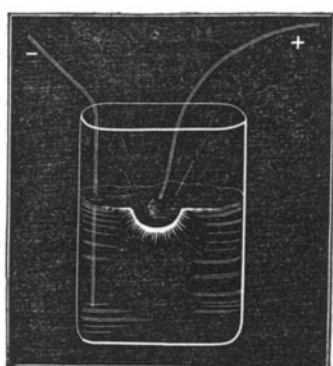
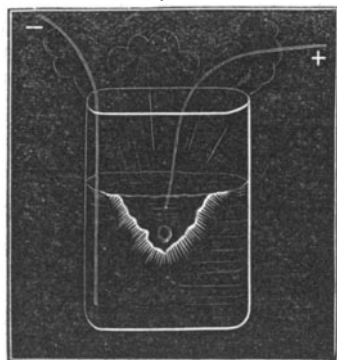


Fig. 2.



rapidly folding and refolding upon itself (fig. 3). This undulatory motion perfectly resembles that which, in the aurora, has been com-

Fig. 3.



pared to the bending and wriggling of a serpent or the undulations of drapery agitated by the wind.

2. Although, in consequence of the employment of salt water, yellow light predominates in these experiments, purple and violet tints similar to those of the aurora are also observed at the parts where the water from the condensed vapour is less charged with salt.

3. The rays of the luminous arc arise from the penetration of the electric flow into the liquid; and as the resulting vacuum is filled up, new rays are formed: thus we explain how it is that the jets of light of the aurora *dart*, or appear to be momentarily shot forth and renewed.

4. The dark circle or segment formed in the aurora by the mist or nebulous veil encountered by the electric flow corresponds to the humid circle or segment which, in the experiment, surrounds the electrode, and around which the voltaic current spreads.

5. The form of an arc in the voltameter results from the liquid not entirely surrounding the electrode; but if more of the wire be immersed, luminous waves or entire circles are produced, the same as in the auroras—of which the arc is often considered to be the portion visible to the observer, of a complete luminous circle.

6. The liquid is violently agitated by the electric blast; luminous vortices and rings are produced by the shock of the electrified waves against one another; and, finally, if the operation is conducted with only a small quantity of liquid, a luminous ebullition is produced corresponding to that fluctuation of light which also characterizes the polar auroras.

7. The deeper the electrode penetrates into the liquid, the more briskly and abundantly is aqueous vapour liberated. This phenomenon, of which the most powerful batteries of static electricity hardly afford a suspicion, is important for consideration; because

it explains naturally the abundant falls of rain or snow which have always been noticed during the polar auroras.

8. The sound that accompanies these experiments corresponds to that which has often been heard during the aurora when the distance was relatively small; it is due to the vaporization produced by the electric trails of fire penetrating a liquid mass.

9. The magnetic perturbations caused by the auroras are reproduced in these experiments, on placing a magnetized needle near the circuit. The deviation increases or diminishes as the luminous arc becomes more or less developed in the liquid.

10. It follows, further, from these facts that the aurora must be produced by a flow of *positive* electricity; for the luminous phenomena are the same as those at the positive electrode in the voltmeter, and the negative electrode exhibits nothing similar.

11. But are the polar auroras a discharge between the positive electricity of the atmosphere and that of the earth supposed negative? If they were so, we ought to observe very frequent falls of lightning at the poles, or gleams or luminous tufts on the projecting parts of the ground, forming the counterpart of the phenomenon that takes place in the air. Now observation shows that such is not the case. I am therefore inclined to think that it is the imperfect vacuum of the upper regions that, acting as an immense conductive envelope, plays the part of the negative electrode in the above experiments, and that the positive electricity flows off towards the planetary spaces, and not to the earth, through the icy mists or clouds which float above the poles.

12. As to the origin of this polar electricity, it has been assumed that it comes from the equator and the tropical regions. But it may be objected that the electrified clouds must discharge themselves during so long a journey; and, in fact, we know that tempests are rarer and rarer in proportion as we get nearer the poles. My previous experiments, and others not yet published, having led me to consider the heavenly bodies charged with positive electricity (perhaps the only sort that exists), I should be inclined to regard the earth itself as charged with positive electricity, which is liberated from the land and sea by simple emission, radiated from the whole surface, at the poles as at the equator, producing very different effects in the atmosphere in consequence of the diametrically opposite meteorological conditions of these regions.

Admitting this last hypothesis, one might conclude that the aurora results from the diffusion in the upper strata of the atmosphere, around the magnetic poles, of the positive electricity emanating from the polar regions themselves, either in obscure radiations when no obstacle is interposed, or converted into heat and light by meeting with aqueous masses in the solid or liquid state, which it vaporizes with a noise, and reprecipitates in the form of rain or snow at the surface of the globe.—*Comptes Rendus de l'Académie des Sciences*, vol. lxxxii. pp. 626-629.