

trial magnetism, which must not be confounded with the purely mathematical branch of the study, those persons only will obtain perfect satisfaction who, as in the science of the meteorological processes of the atmosphere, conveniently turn aside the practical bearing of all phenomena that can not be explained according to their own views.

Terrestrial magnetism, and the electro-dynamic forces computed by the intellectual Ampère,* stand in simultaneous and intimate connection with the terrestrial or polar light, as well as with the internal and external heat of our planet, whose magnetic poles may be considered as the poles of cold.† The old conjecture hazarded one hundred and twenty-eight years since by Halley,‡ that the Aurora Borealis was a magnetic phenomenon, has acquired empirical certainty from Faraday's brilliant discovery of the evolution of light by magnetic forces. The northern light is preceded by premonitory signs. Thus, in the morning before the occurrence of the phenomenon, the irregular horary course of the magnetic needle generally indicates a disturbance of the equilibrium in the distribution of

* Instead of ascribing the internal heat of the Earth to the transition of matter from a vapor-like fluid to a solid condition, which accompanies the formation of the planets, Ampère has propounded the idea, which I regard as highly improbable, that the Earth's temperature may be the consequence of the continuous chemical action of a nucleus of the metals of the earths and alkalies on the oxydizing external crust. "It can not be doubted," he observes in his masterly *Théorie des Phénomènes Electro-dynamiques*, 1826, p. 199, "that electro-magnetic currents exist in the interior of the globe, and that these currents are the cause of its temperature. They arise from the action of a central metallic nucleus, composed of the metals discovered by Sir Humphrey Davy, acting on the surrounding oxydized layer."

† The remarkable connection between the curvature of the magnetic lines and that of my isothermal lines was first detected by Sir David Brewster. See the *Transactions of the Royal Society of Edinburgh*, vol. ix., 1821, p. 318, and *Treatise on Magnetism*, 1837, p. 42, 44, 47, and 268. This distinguished physicist admits two cold poles (poles of maximum cold) in the northern hemisphere, an American one near Cape Walker (73° lat., 100° W. long.), and an Asiatic one (73° lat., 80° E. long.); whence arise, according to him, two hot and two cold meridians, *i. e.*, meridians of greatest heat and cold. Even in the sixteenth century, Acosta (*Historia Natural de las Indias*, 1589, lib. i., cap. 17), grounding his opinion on the observations of a very experienced Portuguese pilot, taught that there were four lines without declination. It would seem from the controversy of Henry Bond (the author of *The Longitude Found*, 1676) with Beckborrow, that this view in some measure influenced Halley in his theory of four magnetic poles. See my *Examen Critique de l'Hist. de la Géographie*, t. iii., p. 60.

‡ Halley, in the *Philosophical Transactions*, vol. xxix. (for 1714-1716), No. 341.