

When the needle, by its sudden disturbance in its horary course, indicates the presence of a magnetic storm, we are still unfortunately ignorant whether the seat of the disturbing cause is to be sought in the Earth itself or in the upper regions of the atmosphere. If we regard the Earth as a true magnet, we are obliged, according to the views entertained by Friedrich Gauss (the acute propounder of a general theory of terrestrial magnetism), to ascribe to every portion of the globe measuring one eighth of a cubic meter (or  $3\frac{7}{8}$ ths of a French cubic foot) in volume, an average amount of magnetism equal to that contained in a magnetic rod of 1 lb. weight.\* If iron and nickel; and probably, also, cobalt (but not chrome, as has long been believed),† are the only substances which become permanently magnetic, and retain polarity from a certain coercive force, the phenomena of Arago's magnetism of rotation and of Faraday's induced currents show, on the other hand, that all telluric substances may possibly be made transitorily magnetic. According to the experiments of the

I have observed a variation of the magnetic inclination amounting to  $9^{\circ}$  (centesimal division); and from Callao to Guayaquil, which differ in latitude by  $9^{\circ} 50'$ , a variation of  $23^{\circ} \cdot 5$ . (See my *Relat. Hist.*, t. iii., p. 622.) At Guarmey ( $10^{\circ} 4'$  south lat.), Huaura ( $11^{\circ} 3'$  south lat.), and Chancay ( $11^{\circ} 32'$  south lat.), the inclinations are  $6^{\circ} \cdot 80$ ,  $9^{\circ}$ , and  $10^{\circ} \cdot 35$  of the centesimal division. The determination of position by means of the magnetic inclination has this remarkable feature connected with it, that where the ship's course cuts the isoclinal line almost perpendicularly, it is the only one that is independent of all determination of time, and, consequently, of observations of the sun or stars. It is only lately that I discovered, for the first time, that as early as at the close of the sixteenth century, and consequently hardly twenty years after Robert Norman had invented the inclinorium, William Gilbert, in his great work *De Magnete*, proposed to determine the latitude by the inclination of the magnetic needle. Gilbert (*Physiologia Nova de Magnete*, lib. v., cap. 8, p. 200) commends the method as applicable "aëre caliginoso." Edward Wright, in the introduction which he added to his master's great work, describes this proposal as "worth much gold." As he fell into the same error with Gilbert, of presuming that the isoclinal lines coincided with the geographical parallel circles, and that the magnetic and geographical equators were identical, he did not perceive that the proposed method had only a local and very limited application.

\* Gauss and Weber, *Resultate des Magnet. Vereins*, 1838, § 31, s. 146.

† According to Faraday (*London and Edinburgh Philosophical Magazine*, 1836, vol. viii., p. 178), pure cobalt is totally devoid of magnetic power. I know, however, that other celebrated chemists (Heinrich Rose and Wöhler) do not admit this as absolutely certain. If out of two carefully-purified masses of cobalt totally free from nickel, one appears altogether non-magnetic (in a state of equilibrium), I think it probable that the other owes its magnetic property to a want of purity; and this opinion coincides with Faraday's view.