from the surface to the center, and is of opinion that all heat has penetrated from without inward, and that the temperature of the globe depends upon the very high or very low temperature of the regions of space through which the solar system has moved. This hypothesis, imagined by one of the most acute mathematicians of our time, has not satisfied physicists or geologists, or scarcely, indeed, any one besides its author. But, whatever may be the cause of the internal heat of our planet, and of its limited or unlimited increase in deep strata, it leads us, in this general sketch of nature, through the intimate connection of all primitive phenomena of matter, and through the common bond by which molecular forces are united, into the mysterious domain of magnetism. Changes of temperature call forth magnetic and electric currents. Terrestrial magnetism, whose main character, expressed in the three-fold manifestation of its forces, is incessant periodic variability, is ascribed either to the heated mass of the Earth itself,* or to those galvanic currents which we consider as electricity in motion, that is, electricity moving in a closed circuit.†

The mysterious course of the magnetic needle is equally affected by time and space, by the sun's course, and by changes of place on the Earth's surface. Between the tropics, the hour of the day may be known by the direction of the needle as well as by the oscillations of the barometer. It is affected instantly, but only transiently, by the distant northern light as it shoots from the pole, flashing in beams of colored light across the heavens. When the uniform horary motion of the needle is disturbed by a magnetic storm, the perturbation manifests itself *simultaneously*, in the strictest sense of the word, over hundreds and thousands of miles of sea and land, or propagates itself by degrees, in short intervals of time, in

* William Gilbert, of Colchester, whom Galileo pronounced "great to a degree that might be envied," said "magnus magnes ipse est globus terrestris." He ridicules the magnetic mountains of Frascatori, the great cotemporary of Columbus, as being magnetic poles: "rejicienda est vulgaris opinio de montibus magneticis, aut rupe aliqua magnetica, aut polo phantastico a polo mundi distante." He assumes the declination of the magnetic needle at any given point on the surface of the Earth to be invariable (variatio uniuscujusque loci constans est), and refers the curvatures of the isogonic lines to the configuration of continents and the relative positions of sea basins, which possess a weaker magnetic force than the solid masses rising above the ocean. (Gilbert, *de Magnete*, ed. 1633, p. 42, 98, 152, and 155.)

† Gauss, *Allgemeine Theorie des Erdmagnetismus*, in the *Resultate aus den Beob. des Magnet. Vereins*, 1838, s. 41, p. 56.