One presumes that the supersonic solar wind has been blowing since the formation of the Solar System, providing the dynamical plasma and magnetic field throughout interplanetary space. It appears that the early massive solar wind and simultaneous strong solar magnetic fields carried away the initial angular momentum of the young Sun during the first $3 \times 10^8$ years or so, leaving the leisurely 25-day equatorial rotation period that we see today (Schatzman 1959, 1973; Biermann 1973). Nowadays the tenuous wind carries no significant angular momentum or mass from the Sun, but it continues to be the dominating condition in interplanetary space, providing the outward sweeping spiral magnetic field, impacting the terrestrial magnetosphere, drastically reducing the intensity of the galactic cosmic rays, and pushing the interstellar gas and galactic magnetic field out beyond the farthest planets. The consequences for the terrestrial environment are profound, but not immediately obvious to us who dwell at the surface of Earth. So the history of the thoughts leading to the recognition of the solar wind extends back more than two millennia. Progress has been paced largely by the development of physics from the days of Gilbert (1544–1603) and Galileo (1562–1642). That is to say, with the exception of the aurora, the effects of the solar wind are not available to our biological senses, but require observations and measurements that can be made only with specially devised scientific instruments. And then it requires an advanced state of physics to infer the implications of the observations. So the history of the solar wind follows both the advances in fundamental classical physics and the studies of the natural phenomena pertinent to the solar wind.

The presence of the solar wind is directly indicated by the continuing fluctuations of the geomagnetic field at the surface of Earth, particularly at high latitudes, the continuing aurora at high latitudes, the varying intensity of the galactic cosmic rays, and the antisolar orientation of the gaseous tails of comets. However, these effects, known individually for decades and centuries, are evidence only of some form of external disturbance, and the scientific challenge over the last century has been to work out precisely what that disturbance really is.

Historically there has been no end of ambiguities and distractions. For instance, starting from the classical point of view that space is completely empty, Kelvin proved that the Sun is not capable of such large magnetic variations as would extrapolate to the observed geomagnetic fluctuations at a distance of 1 AU. From this he asserted that there can be no connection between the activity of the Sun and the magnetic fluctuations at Earth. With the same hypothesis that space is completely empty it was thought possible that the observed variations in the cosmic ray intensity are a consequence of large electrostatic potential differences across interplanetary space. The antisolar orientation of gaseous comet tails was attributed to the radiation pressure of sunlight. The implications of the continuing aurora and high-latitude geomagnetic fluctuations were largely ignored, their origin perhaps meteorological.

To go back to the beginning of the concepts on which the solar wind is based, it must be recalled that the concept of space itself is essential and is only a relatively recent development in human thought. In primitive times the sky was not viewed as the window looking out into space. Rather the sky was the abode of gods and spirits, who looked after, or
were represented by, the Sun and the Moon and the various planets and stars, which in turn had a powerful influence on our personal destinies. The sky was “that inverted bowl they call the sky whereunder crawling coop’d we live and die” (Omar Khayyam). Knowledge of geography was as limited as the concept of the sky. Some mythologies would have humans descending to Earth from a beginning in the sky, and not so very long ago at that. The concept of the span of time was as stunted as the localized concept of the sky and space. The idea that the whole world was created around us primarily to accommodate us humans is still alive and well today, demonstrating the reluctance of the human mind to relinquish the egocentric world of fantasy.

So it is not surprising that the realization of the vast space in which the tiny Earth resides developed only slowly and sporadically. We owe great respect and admiration to Aristarchus of Samos (circa 275 BC), as the first ancient philosopher-scientist of record to recognize the central position of the Sun in our local system and the vastness of the surrounding space. Armed with a clear understanding of geometry he realized from the converging umbral shadow of Earth during an eclipse of the Moon that the Sun is larger than Earth. From this he recognized that it is more likely that little Earth orbits the large Sun, rather than vice versa. He viewed the Solar System much as Copernicus did 1800 years later, recognizing the great distance to the stars. Needless to say, the contemporary experts found his ideas disturbing, undermining their infallibility, so he was officially rejected. Fortunately he was not entirely ignored, and his penetrating insights, although lost in the original, have come down to us through the writings of others.

Copernicus (1473–1543), beginning in 1530 and finally published in his De revolutionibus orbium coelestium in 1543, swept away the Earth-centered crystal spheres of the Ptolemaic geocentric system (first developed by Hipparchus c. 150 BC), thereby clearing space of its classical intellectual rubbish and making way for the concept of local terrestrial effects from distant astronomical sources. Equally important, of course, Copernicus, followed by Kepler (1571–1630) and by Galileo with the application of the telescope, began to make sense out of celestial mechanics. This prepared the way for Newton (1642–1727) to develop the Newtonian theory of gravitation and mechanics published in his Principia in 1686.

The gradual recognition of the magnetic field of Earth, with the invention of the magnetic compass in China during the Han dynasty about two millennia ago, was another important step on the long road leading to an understanding of the solar wind. The scientific credit here goes particularly to Gilbert (1600) whose ingenious, careful, and quantitative laboratory experiments first established the precise form of the dipole magnetic field around a more or less uniformly magnetized sphere (composed of magnetic iron oxide, magnetite). He recognized that the magnetic field is a special stress system in the space surrounding the magnetized sphere – in other words, that the phenomenon of forces between magnetic objects involves a force-field extending through the space between them. He was the first, then, to recognize the magnetic field as a physical entity throughout the space around a magnet.

The accumulating records of magnetic declination and inclination from extensive ocean voyages were enough for Gilbert to show that Earth itself is a magnetized sphere, and he pointed out that the surrounding space is a special region as a consequence of the magnetic field extending out from Earth. In short, Gilbert recognized the terrestrial magnetosphere, as seen from its lower boundary at the surface of Earth.

**GEOMAGNETIC ACTIVITY AND CLASSICAL PHYSICS**

It was more than a hundred years after Gilbert’s work that Graham (1724) observed a delicately suspended magnetic needle with a microscope and discovered the slight agitation of the needle, implying fluctuations in the magnetic field of Earth. One can appreciate the care that must have been taken to avoid vibrations and air currents to be sure that the agitation was of geomagnetic origin. Celsius (1741) became engaged in similar observations and noticed that the appearance of the aurora was accompanied by enhanced magnetic fluctuations. Celsius and Graham corresponded and soon established that the observed periods of enhanced fluctuation were often simultaneous, thereby showing their large geographic scale.

Wilcke (1777) recognized that the auroral rays are oriented along Gilbert’s dipole geomagnetic field. Canton (1759) introduced the first observational connection to the Sun, pointing out that the quiet-time geomagnetic fluctuations are stronger in the summer when the hemisphere is tilted toward the Sun.

It is interesting to note that de Mairan (1754) proposed that the aurora arises from the entry of particles from the Sun into the terrestrial magnetosphere. His idea was based on the contemporary interpretation of the zodiacal light as an extension of the solar corona. Thus Earth orbits through this extended corona, and he proposed that the aurora and the associated geomagnetic fluctuations are the result. It was an inspired conjecture, but he could not do more because the physics of charged particles and magnetic fields was unknown at the time.

Cardan in 1551 had clearly distinguished magnetic and electric effects, and Gilbert emphasized the fundamental difference. In 1733 Du Fay distinguished between positive and negative charge, and a decade later Franklin carried out