

Historical Milestones in Solar-Terrestrial Physics

Pre-19th century... Linking the aurora with terrestrial magnetism...

1200 - compasses already in widespread use

1500s - observations of magnetic declination and dip angles

1600 - William Gilbert, in "de Magnete", postulates that Earth itself is a giant magnet

1610 - Johannes and David Fabricius first make telescopic observations of sunspots

1619 - Galileo Galilei first uses the term "aurora borealis" or "dawn of the north"

[1645-1700 - Maunder minimum; anomalously few sunspots or auroras seen]

1716 - Edmond Halley—who had spent years sailing the North and South Atlantic Ocean to map out Earth's magnetic field—points out that the aurora is aligned with the terrestrial magnetic field. (But earlier, in an attempt to explain his magnetic observations, he had speculated that the Earth is composed of several concentric, spherical shells filled with glowing gas, and that auroras are composed of escaping subsurface gas.)

1722 - George Graham is the first to point out continual compass variations

1741 - Olof Hiorter makes systematic observations of the geomagnetic field in fixed locations over time; discovers diurnal variation of field, notes change in Earth's magnetic field as the aurora passes overhead

1770 - aurora australis sighted by Capt. James Cook

1790 - Henry Cavendish estimates auroral height at 52-71 miles by triangulation

19th century... Linking the Sun with auroras and terrestrial magnetism...

1850 - Heinrich Schwabe discovers sunspot cycle

1851 - Edward Sabine connects intensity in geomagnetic disturbances with sunspot cycle

1859 - solar pioneer Richard Carrington observes great white-light flare; large geomagnetic disturbances and auroras follow over next day and a half

1878 - Henri Becquerel suggests Sun is the source of particles that cause aurora

1882 - Balfour Stewart concludes that the upper atmosphere must carry currents that cause magnetic variations, proposes atmospheric-dynamo mechanism (conducting gas flowing across magnetic field lines drives a current)

1903 - Kristian Birkeland discovers field-aligned currents during aurora, posits solar origin of electrons; later constructs laboratory terrella as a simulation device

20th century... Discovery and identification of regions in near-Earth space...

1902 - **Arthur Kennelly** and **Oliver Heaviside** postulate an electrically conducting ionosphere to explain **Guglielmo Marconi's** transatlantic radio transmissions

1924 - existence of the Kennelly-Heaviside layer is confirmed by **Edward Appleton**, who names it the E (electrically reflecting) layer or region. (He also gives the names D and F to the lower and higher regions .)

1930 - **Sydney Chapman** and co-workers begin to work out how a plasma stream from the Sun would reshape the Earth's dipole field [sketch]

1951 - **Ludwig Biermann** attributes the shape of comet tails to a solar wind

1957 (IGY) - **Hannes Alfvén** predicts that the solar wind carries magnetic fields, leading to “draped” magnetic fields in comet tails (later, it turns out that this also explains why unmagnetized planets have magnetospheres) [sketch]

1958 (IGY, cont.) - **Eugene Parker** lays out theory of solar wind formation; **James Van Allen** discovers the belts of trapped radiation that bear his name

1961 - **James Dungey** postulates "reconnection" (on the dayside, and again on the nightside) as the mechanism by which the north-south orientation of the solar wind magnetic field exerts control over geomagnetic activity; the Explorer 10 satellite crosses the magnetopause [sketch]

1964 - the OGO satellite observes the bow shock (a collisionless shock)

1975 to present - interplanetary probes explore the magnetospheres of other planets and even the Sun (heliosphere)