SMALL DICTIONARY OF ECLIPSES

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A

@**absolute magnitude** (symbol M) - **1**. The brightness a star would have if it were at a distance of 10 parsecs in a void space, without interstellar absorption. The absolute magnitude is usually deduced from the visual magnitude, measured through a V filter, when it is written as M_v. If it is defined for another wavelength, it gets another index (U, B, etc.). If the radiation on all wavelengths is included, it becomes absolute bolometric magnitude, M_{bol}. The Sun has absolute magnitude +4.8. Most of the stars have absolute magnitudes ranging between -9 (supergiants) and +19 (red dwarfs).
2. The brightness a comet or asteroid would have if it were at a distance of 1 AU both from the Sun and the Earth and were completely illuminated by the Sun.

@**accretion** - a process by which the mass of a body grows through matter accumulation under the form of either gas or small solid bodies, which collide with or adhere to the body. The bodies in the solar system formed through accretion; there are stars surrounded by accretion disks.

@**albedo** - the fraction of the total light or other radiation which falls on a non-luminous body, such as a planet or a planetary formation, and which is reflected by it. Generally, the albedo is equal to the ratio between the light quantity reflected and the light quantity received. The albedo values range between 0.0 (0%), for a perfectly black area, which absorbs all incident light and 1.0 (100%) for a perfect reflector. The planets or planetary satellites with dense atmospheres have greater albedos than those of transparent atmospheres or of no atmospheres. The albedo can vary from one surface point to another, so that a mean albedo is given for practical purposes. The natural surfaces reflect different light quantities in different directions and the albedo can be expressed in several ways, depending on the way in which the measurement was made: in one direction or on the average in all directions.

@**annular eclipse** - an eclipse which takes place when the Moon is close to the apogee and its apparent diameter is smaller than that of the Sun, so that, at the middle of the eclipse, a ring or an "annulus" from the Sun's disk remains visible throughout a narrow band on Earth. An annular eclipse can last for 12m 30 s at the most.

@**aphelion** - the farthest point from the Sun's centre, on the elliptical orbit around it.

@**apogee** - the farthest point from the Earth's centre on the elliptic orbit around it.

@**apogee eclipse** - an eclipse (of the Sun or Moon) which takes place when the Moon is at the apogee of its orbit. The solar apogee eclipses, when they are not only partial, are always annular. The maximum duration of an apogee solar eclipse is of 6h 15m (between the first and the fourth contact). The maximum duration of a lunar apogee eclipse, between the two exterior contacts of the Moon with the penumbra, is of 6h 18m (the maximum totality being of 1h 44 m).

@**apparent diameter** - the linear dimension of a celestial body, such as it is seen by an observer, expressed in angle units; it is equivalent to the angular diameter.

@**apparent magnitude** (symbol *m*) - the luminosity of a celestial body as it is measured by an observer. Sirius, the brightest star, has an apparent magnitude of -1.46, while the weakest stars visible with the naked eye, in the most favourable observation conditions, have magnitudes of about +6.5. The stars of magnitude less than +23 are measured by professional observatories and those of magnitude less than +30 by HST (Hubble Space Telescope). If *m* has no index it means that there is a *visual magnitude*, if it has the *bol* index, there is a *bolometric magnitude*.

@**apparent position** - a position given by the coordinates calculated for a star, if it were seen from the Earth's centre, relative to the real equator and the real equinox, at a certain date. It includes the displacements from one heliocentric direction, given in a stellar catalogue, due to precession, nutation, aberration, proper motions, annual parallax and light gravitational deviation.

@**Aristarchus of Samos** (320 - 250 BC) - Greek mathematician and astronomer. He tried to calculate the dimensions of the Sun and Moon and the distances to them, coming to the conclusion that the Sun is much larger than the Earth and much farther away than the Moon. He also formulated the first heliocentric theory. He placed the Sun at the centre of the terrestrial orbit and fixed the stars on a sphere at a great distance from the Sun. His theory won but few adherents, on account of the competition of Aristotle's geocentric theory, but mainly because at that time it was inconceivable that the Earth is moving. Archimedes said, "*Aristarchus discovered that the apparent dimension of the Sun was approximately the 720th part of the zodiacal circle*", namely 30'.

@**Aristotle** (384 - 322 BC) - Greek philosopher. He based his geometric model on the system of concentric spheres proposed by Eudoxos and increased the number of spheres to 49 in order to calculate the motions of all celestial bodies. The farthest sphere, on which the fixed stars were situated, controlled the motions of the others and a supernatural force itself controlled it. Aristotle's point of view, modified by Ptolemy, who replaced the spheres with the epicycles, was not changed essentially for almost two thousand years. Aristotle demonstrated that the Earth is spherical, according to the shadow it produces during a lunar eclipse, and calculated its dimension, obtaining a result 50% higher than the real value.

@**ascending node** - a point on the orbit in which a celestial body crosses the reference plane from south to north, such as the ecliptic's plane or the celestial equator. The ascending node longitude is one of the elements of the Keplerian orbit of any celestial body.

@**astrolabe** - an old instrument which measures the stars' altitude (a simple sextant, for example). The basic astrolabe is made up of a disk hanging vertically with a rule, which is rotated so that it can be directed to the star chosen. The local time can be thus read from the face (table) of the astrolabe. Different tables, at various latitudes, can be used; the modern, sophisticated versions are used for high precision measurements of the star positions.

@**astronomical unit** (AU) - a length unit, defined until recently as being equal to the average distance between the Earth and the Sun (or the large semiaxis of the terrestrial orbit). In the original definition, it was given by the third law of Kepler (the squares of the sideral periods of any two planets are proportional to the cubes of their mean distances from the Sun). The astronomical unit is defined at present as the distance from the Sun of the particles without mass, which move on a circular orbit around the Sun, with the orbital period of one *Gauss year*, of $2\pi/k$ days of the ephemerides. The average distance between the Earth and the Sun is of 1,000000031 AU, where 1 AU = 149, 597, 870 km.

@**atmosphere** - gaseous coat surrounding a celestial body. Several planets (the Earth included) retain considerable atmospheres, due to their strong gravitational force. The motions of the gas in the planetary atmosphere, as a response to the heating, coupled with the rotation forces, generate the meteorological systems. The planetary satellites Titan and Triton also have atmospheres. Pluto has a seasonal atmosphere, which forms when the planet is closer to perihelion.

@**azimuth** - the direction to a celestial body, measured in grades, counter - clockwise, from the north, around the observer's horizon

B

@**Bacon, Roger** (1124 -1194) - English scholar. He invented the *camera obscura*, which he used to observe a solar eclipse.

@**Baily's Bead**s - a phenomenon which is seen, during a solar eclipse, immediately before and after the totality, when the Sun's light crosses the valleys at the edge of the lunar limb. They appear as a curved row of pearls. It bears the name of F. Baily, who described the effect he observed at a solar eclipse in 1836.

@**Baily, Francis** (1774 -1844) - English stockbroker and astronomer. In 1826 he drew up a catalogue consisting of very precise positions for 2,881 stars. Describing a solar annular eclipse, which he observed in Scotland in 1836, he discovered a row of points, like beads in a rosary, which seemed to be running across the lunar disk and mentioned those who had also seen it before. Ever since this phenomenon has been known under the name of "*Baily's Beads*". He is also mentioned as the author of important editions of some historical stellar catalogues, such as those of Ptolemy, Tycho Brahe, Hevelius and Flamsteed.

@**butterfly diagram** - a graph on which the latitudes of the sunspots are presented depending on time. It shows how the spots migrate from high latitudes (30^0 - 40^0 north or south) to the equator (latitude of about 5^0) during each solar cycle, according to Spörer's law. The form of these distributions, when it is represented for both hemispheres, resembles the wings of a butterfly.

C

@**Canon der Finsternisse** - The most famous catalogue of solar and lunar eclipses. Published in 1887 by Theodor von Oppolzer, the catalogue contains the elements of all solar and lunar eclipses between 1208 BC and 2161 AD. It has been superseded by the catalogue of Meeus and Mucke.

@**Carrington,** Richard Christopher (1826 - 1875) - English astronomer. In 1853 he founded a private observatory, where, in parallel with his night observations for " *The Catalogue of 3,735 circumpolar stars*" (published in 1875), he began a day program to measure the heliographic positions of the sunspots, which he continued until 1861. The results, published in 1863, included the estimate of the Sun's rotation axis position with an unpreceeded precision and measurements of the sunspots distribution and the rotation period depending on the heliographic latitude at the Carrington rotations system.

@**Carrington rotation** - a system used to identify the individual rotations of the Sun. The Sun has an average sideral rotation period of 25.38 days. The zero longitude of number one rotation is defined as crossing the central meridian of the Sun at 12.00 UT starting with January 1, 1854. The system was initiated by R.C. Carrington.

@**CCD** (Charge-Coupled Device) - i.e. a device operating with coupling by charge; a silicon piece which contains a surface of many light sensitive diodes used to capture images. The photodiodes, arranged in a surface of lines and columns, charge when light falls on them. The charge quantity depends on the light quantity, which can be reported in time. These charges are displayed column by column, offering a signal analogous to the image on the surface, which is then converted under a digital form and stocked in the computer. Both professional and amateur astronomers use CCDs today on a large scale, because they are much more sensitive to light than a photographic emulsion. The image can be displayed almost immediately at the end of the exposure, being ready for analysis.

@**celestial equator** - the big circle on the celestial sphere, situated in the terrestrial equator plane. Any point on the celestial equator is equally distanced from the north and south celestial poles. On the celestial equator the declination is zero.

@**celestial pole** - any one of the two points relative to which the celestial sphere rotates every day. The celestial poles are, on the celestial sphere, right above the terrestrial geographical poles, and at 90^0 relative to the celestial equator. Because of precession, the celestial poles describe a circle around the ecliptic's poles every 25,800 years.

@**celestial sphere** - an imaginary sphere, of a large but indefinite dimension, used as a basis to define the position coordinates of the celestial bodies. The sphere can have as centre the Earth, the observer or any other point which plays the role of origin of a given system of coordinates. Seen from the Earth, the celestial sphere rotates against the axis that unites the celestial poles every 23h 56m 04s (the sidereal day), as a result of the Earth's rotation. Two important circles on the celestial sphere are the *celestial equator* and the *ecliptic*. The angle between them is of about 23.4^0 and is known as the *ecliptic obliquity*. The celestial equator and the ecliptic intersect in the points of the *spring and autumn equinoxes*. The positions of the celestial poles and therefore of the celestial equator move gradually on the celestial sphere, due to a slow oscillation of the Earth in space, known as *precession.*

@**central eclipse** - an eclipse during which the axis of the lunar shadow cone intersects the Earth's surface (in the case of solar eclipses) or the axis of the terrestrial shadow cone intersects the lunar surface (in the case of lunar eclipses). The total and annular solar eclipses are usually central. They can also be not central; then, they are visible only from places situated at high latitudes.

@**chromosphere** - a region of the stellar atmosphere situated above its photosphere. The Sun's chromosphere extends from the temperature minimum, of approx. 500 km above the photosphere basis, up to 9,000 km, where it meets the corona. For a plane parallel model, throughout the first 1,500 km the chromosphere is more or less continuous, but beyond that it breaks into indented spicules. The chromosphere temperature grows from 4,400 K at 500 km to almost 6,000 K at 1,000 - 2,000 km. A rapid growth of the coronal temperatures is registered at heights of about 2,500 km (the transition region), the exact height depending on the local magnetic field intensity. Actually, the chromosphere is made of rising and, often, falling jets called spicules, which go up to 15,000 km. In the uppermost part of the chromosphere the density is the millionth part of its density at the base. Immediately before or after a total solar eclipse, the chromosphere becomes visible either as a crescent or as a red diamond ring - due to $H\alpha$ emission- from which it also gets its name (meaning "colored sphere"). Besides at eclipses, it can be seen in $H\alpha$ and in K lines of calcium and, from space, in ultraviolet emission lines. The presence of the chromosphere around the cold dwarfs is deduced from similar emissions.

@**Codex of Dresden** - a manuscript consisting of numerous calendar and astronomical data, probably dating from the 12th century. It seems that it is, nevertheless, an updated copy of a document from the period of the old Maya Empire (4th - 9th centuries). It contains a data table which covers over 32 years, grouping 45 successive lunations, divided into 69 groups of 5 or 6 lunations. The data are calculated in days and correspond remarkably to the intervals in an eclipse table: each group ends at the probable date of a solar eclipse.

@**coelostat** - instrument using two plane mirrors, mounted and driven to compensate the apparent motion of the stars; it reflects a particular area of sky into a fixed instrument. It is used for fixed solar spectrographs, when a long focal distance is necessary and for horizontal or vertical solar telescopes.

@**conjunction** - a position of two bodies in the solar system when they have the same celestial longitude, seen from the Earth. The bodies can be a planet and the Sun, two planets or the Moon and a planet. The exterior planets (namely those which orbit around the Sun beyond the Earth) are in conjunction with the Sun, when, seen from the Earth, they are right behind the Sun. Mercury and Venus (interior planets), which are closer to the Sun, have two conjunctions with the Sun: *inferior conjunction*, when they are between the Earth and the Sun, and *superior conjunction*, when they are on the other side of the Sun.

@**coronal condensation** - a part of the corona where the gas density and the temperature are higher than in its vicinity. The coronal condensations are visible on the solar limb, above the spots groups. The images in X radiation and those supplied by coronagraphs in white light bring forth such condensations consisting of structures under the form of nodes, which underline the corona magnetic field.

@**coronal hole** - a region of the solar corona of very small density, almost 100 times smaller than the active coronal regions. The coronal holes appear as voids (blanks) apparent on the X radiation images or at the limb, as an absence of the white light emission in coronagraph images. A large coronal hole is always present at each one of the Sun's poles. The low latitude coronal holes appear a little before the solar minimum, growing in dimension for several months, merging even with one of the coronal holes at the poles. Other holes can contract or disappear. The magnetic field in the coronal holes has open magnetic field lines, which extend in space, along which plasma flows to produce high-speed streams in the solar wind.

@**coronal line** - an emission line in the solar corona spectrum, coming by the strongly ionised atoms. Ions like FeX (Fe^{+9}, that is iron minus 9 electrons) and Fe XIV (Fe^{+13}, that is Fe minus 13 electrons) give birth to the so called red or green coronal lines, at wavelengths of 637.5 and 530.3 nm, respectively. It was believed, from their discovery in 1870 through 1939 that these forbidden lines would be due to an unknown element, namely "coronium". Ultraviolet and X-ray coronal lines are detectable in the stars also.

@**coronal loop** - a structure in the Sun's corona, seen in images taken in X-ray or ultraviolet radiation, or in white light; it is shaped as an arch, sometimes with a height of up to 10,000 km, whose ends are over the photosphere. The big, thin coronal loops are associated with the calm corona (i.e. beyond the active regions), while the short, bright coronal loops appear in the active regions, making up coronal condensations or luminous points in the X radiation. The two ends of the loop are situated in photosphere regions of opposite magnetic polarity. This implies that the coronal loops are tubes of magnetic flux filled with hot plasma.

@**coronal mass ejection** - a massive mass ejection from the solar corona at a speed of 10 – 1,000 km/s. The mass involved in such an event is of almost 10^{13} kg. The space coronagraphs show that a typical coronal mass ejection consists of a part of the gas that forms a loop or, rather, from a bulb in the corona, placed above a dark cavity. In Hα- light, an erupting prominence moves to the exterior in a dark cavity. An ejection produces a perturbation in the solar wind, preceded by a shock wave. The interplanetary probes that have met such perturbations have registered an increase of the solar wind speed and densities, as well as a rapid variation of the magnetic field. When these interplanetary perturbations meet the Earth, they create geomagnetic storms

@**coronal (polar) wedge -** a thin, radial formation in the white light solar corona, in the coronal holes from the Sun's poles. Coronal wedges are best seen at the solar minimum. They can be also seen in the spectrograms of some ultraviolet lines, such as the line of strongly ionised magnesium at 36.8 nm.

@**coronagraph** - an instrument which permits the observation of the solar corona outside the solar eclipses. B. Lyot invented it in 1930. It is a kind of refractor telescope with the objective lens protected against the dust and the static charge, sometimes by means of a thin oil stratum. An occulting disk, placed in the first focus, makes an artificial eclipse. A lens situated right behind this disk makes an image of the objective on a diaphragm, through which passes the greatest part of the direct light coming from the objective. A third lens, situated behind the diaphragm, actually makes the image of the corona on the film or the detector. Only observatories situated at high altitudes and with exceptional atmospheric conditions can use the coronographs with success. Even then, only the interior part of the E corona can be observed, although the K corona can be detected using polarization analysers. Space coronagraphs of the Lyot type, such as the inactive C1 coronagraph of LASCO, can observe the corona up to a distance of several solar radii, using electronic images instead of photography. LASCO (Large Angle Spectroscopic Coronograph) on the SOHO space probe. The C2 and C3 externally occulted coronagraphs on LASCO together observe the corona from about 3 solar radii to over 30 solar radii.

D

@**D** lines - two close, strong lines, in the yellow region of the spectrum, at wavelengths of 589.0 and 586.6 nm, produced by neutral sodium atoms. They were determined to be specific to the solar spectrum by J. von Fraunhofer. They are strong in relatively cold stars, the Sun included, and are also present in the spectrum of very far off stars due to the absorption by the sodium atoms in the interstellar space.

@D3 – the yellow spectral line sat 587.6 nm which helium was discovered at the eclipse of 1868, decades before it was isolated on Earth. It was at first confused with the sodium D pair of lines, which is why it was soon given the distinctive name of D3.

@**Danjon**, André (1890 - 1967) - French astronomer. Beginning with 1921 he built various types of special photometers for the study of the lunar eclipses (for which he set up the "Danjon scale") and variable stars and calculated for the first time the exact albedos of the Moon and of the planets Venus and Mercury. He improved the scheme of the prism astrolabe to measure the star positions (the Danjon astrolabe).

@**Danjon astrolabe -** a prismatic astrolabe with a micrometer, invented in 1938 by the French astronomer A. Danjon. It does away with the personal equation of the observer for the measurement of the moment when the direct and reflected images of a star coincide; that is why it is also known as the *impersonal astrolabe*. The main prism is equilateral, so that the observations are made at a constant zenith distance of 30^0. Danjon astrolabes have been used beginning in the 1950s to measure time and latitude, as well as for observations to compile stellar catalogues. One was used in

Bucharest during the total solar eclipse of August 11, 1999 to observe a solar prominence.

@**Danjon scale** - a scale to evaluate as exactly as possible the darkening degree of a total lunar eclipse, set up by A. Danjon. The 5 steps of the scale run from 0 (extremely dark, invisible Moon) to 4 (extremely bright, the eclipse having a very weak effect on the Moon's visibility). The darkening at a lunar eclipse is determined to a great extent by the transparency of the terrestrial atmosphere, which is affected by clouds and the dust from the volcanic eruptions.

@**declination** (symbol δ) - a coordinate on the celestial sphere, equivalent to the latitude on Earth. It is measured in grades north or south of the celestial equator, from 0^0 at the celestial equator up to $+ 90^0$ at the north celestial pole, $– 90^0$ at the southern one, respectively. It is an equatorial coordinate.

@**diamond ring** - an effect seen at a solar eclipse immediately before or after the totality. It is produced by photosphere light, which passes through a valley of the lunar limb, causing the appearance of a bright point of a rare beauty.

@**Donici**, Nicolae (1874 - 1956?) - Romanian astronomer, a founding member of the International Astronomical Union, an honorary member of the Romanian Academy. In 1908 he built a private astronomical observatory at Dubasarii Vechi, on the right bank of the river Nistru. He observed many total solar eclipses in Europe, Asia and America.

E

@**E** corona - a part of the solar corona defined by the emission lines of the hot gases. These emission lines include the so-called forbidden lines of the strongly ionised atoms of iron, calcium and other elements. The E corona is thinner than the K and F coronas.

@**Earth** - the third planet from the Sun. At perihelion (at every beginning of January), it is 147,099,590 km from the Sun, at aphelion (at the beginning of July) it is 152,096,150 km from the Sun. Seen from space it has a predominantly blue colour, due to its atmosphere. It has a slightly ellipsoidal shape (equatorial diameter 12,756 km, polar diameter 12,714 km). Physical data: flattening = 0.0034; equator inclination against the orbit = 23.44^0; rotation period around the axis (sidereal) = 23.934 hours; average density = 5.52 g/cm^3; mass = 5,974 10^{24} kg; escape velocity = 11.18 km/s; average (geometrical) albedo = 0.37.

Orbital data: average distance from the Sun = 149,598x10^6 km (= 1 AU = an astronomical unit); orbital eccentricity = 0.017; orbital period (sidereal) = 365.256 days. The Earth's atmosphere consists of (relative to its volume) 78% nitrogen, 21% oxygen and 0.9% argon, plus carbon dioxide, hydrogen and other gases in much smaller quantities. Water vapour is also present in a variable quantity. White clouds of condensed water vapours can sometimes cover a quarter of the Earth's surface, cloud belts usually surrounding the equator and the temperate or polar latitudes. The atmospheric pressure at sea level varies around 1,000 mbar. The surface average temperature is of 15^0 C, but it varies between -50^0 C on the average in winter, in Siberia, and up to + 40^0 C in summer, in Sahara.

Liquid water covers 71% of the terrestrial surface. There are volcanoes and almost 100 meteoritic impact craters; over 5,000 active volcanoes were registered throughout man's known history. The impact craters formed especially at the beginning of the Earth's history. The atmosphere protects us today from the impact with the great meteorites. The erosion and the ice or water deposits give the dominant geological process at the Earth surface. Liquid water is also responsible for the existence of life, which, in its turn, played an important part in the modification of the planet's appearance.

The exterior layer of the planet is the lithosphere, covered with crust; together they have between 70 km under the oceans and 150 km in the thickest parts of the continents. Under the lithosphere there is the aestenosphere, which descends down to 2,900 km inside the Earth, where the nucleus of iron - nickel begins. This nucleus permitted the development of the magnetic field, which reaches about $3x10^{-5}$ tesla near the equator. The convection in the aestenosphere, coupled with the thick crust gave birth to the displacement of the tectonic plates and to the continental displacements, creating the mountain chains and the deep oceans. The Earth has only one natural satellite, the Moon.

@**earthshine** - the visibility of that part of the Moon not illuminated by the Sun. The solar light reflected by the Earth produces the phenomenon. It was explained correctly for the first time by Leonardo da Vinci.

@**eccentricity** (symbol e) - a measure of a conical orbit shape; it shows how much this deviates from a circle. If $e = 0$, the orbit is a circle. If $e < 1$, the orbit is an ellipse, if $e > 1$ it is a hyperbola, and if $e = 1$ it is a parabola. The orbits of the major planets and satellites are ellipses of small eccentricity. The eccentricity is one of the six elements that define a Keplerian orbit.

@**eclipse** - the passage of the shadow of a celestial body over the surface of another. Every year, the maximum number of solar and lunar visible eclipses is seven. The minimum number is two, both being solar. The eclipses appear generally in pairs, a lunar eclipse being preceded or followed, in about two weeks, by a solar eclipse at the opposite node of the lunar orbit.

Solar eclipses take place when the new Moon is close to a node of its orbit and on the same longitude with the Sun. At that moment either the shadow cone, or its extension, or only the penumbra surrounding them touches the surface of the Earth. For an observer situated in the shadow cone the eclipse is total, while for one placed in the cone extension it is annular. Annular eclipses occur around lunar apogee. An observer situated in the penumbra sees only a partial eclipse. A total or annular eclipse can be seen from a band with a width of 270 km at the most, around which, to the north and south, the much larger, partiality zone extends. The Moon's shadow crosses the Earth from west to east with a speed of about 3,200 km/h. At a total eclipse the Sun's disk is completely covered and the solar corona can be seen. The total solar eclipses are rare in the same place on Earth, so that the astronomers usually travel great distances to see them. A solar eclipse can last up to 3 hours (between the first and the fourth

contact). Totality has a theoretical maximum duration of 7m 31s, but it is usually shorter.
A lunar eclipse can be seen from the Earth from any place where the Moon is above the horizon of that place; it takes place when the full Moon passes through the central, dark shadow of the Earth. The Earth's shadow is much wider than the Moon that is why the lunar eclipses can last even four hours (between the first and the fourth contact). Totality can be of 1h 47m at most.
Planetary satellites can be also eclipsed by the landlord planets shadows; the easiest to observe are the eclipses of Jupiter's Galilean satellites.

@**eclipse coverage** - the area of the Sun's surface covered by the Moon.

@**eclipse magnitude** - the measure of eclipse coverage. At a solar eclipse it is the fraction from the solar disk diameter covered by the Moon. If the eclipse is total, the magnitude is replaced by the ratio between the apparent diameters of the Moon and Sun, which is of 1.00 or even more during the totality. The magnitude of a lunar eclipse is the fraction of the Moon's diameter covered by the Earth's shadow; at a total eclipse it can be greater than 1.00 (or 100%) because the Earth's shadow is greater than the Moon. An eclipse magnitude is expressed either in decimal fractions or in percents; thus, at a partial eclipse it can be of 0.59 or 59%. It should not be mistaken for the *eclipse coverage.*

@**eclipse season** - the period when the Sun is close enough to one of the lunar orbit nodes so that an eclipse can take place. It lasts for 37 days for solar eclipses and for almost 24 days for lunar eclipses. These intervals repeat every 173.31 days. Two eclipse seasons make up an eclipse year.

@**ecliptic** - the apparent trajectory of the Sun on the celestial sphere throughout one year. The Sun's motion along the ecliptic is actually the equivalent to the Earth's motion on its orbit around the Sun. Thus, the ecliptic is actually the projection of the Earth's orbit plane on the celestial sphere. Because of the inclination of the Earth's rotation axis, the ecliptic is inclined with approx. 23.4^0 against the celestial equator, an angle known as the *obliquity of the ecliptic*. The ecliptic crosses the celestial equator at the equinoxes. Its name is due to the fact that the eclipses take place when the Moon is close to the ecliptic plane, meaning "disappearance" in Greek.

@**ecliptic limit** - the maximum angular distance at which the Sun can be situated against the lunar orbit nodes, when an eclipse may take place. At a partial solar eclipse the solar ecliptic limit (namely the maximum possible distance between the Sun and the lunar orbit node at the new Moon phase) is of 18.5°; at a total solar eclipse it is of 11.8°. At a partial lunar eclipse, the lunar ecliptic limit (namely the maximum possible distance between the Sun and the lunar orbit node at the full Moon phase) is of 12.3°; at a total lunar eclipse it is of 4.6°.

@**effective temperature** - the temperature of a black body which radiates the same total energy per area unit as a given body, for instance a star. It is the most useful measure of a star's surface temperature. For instance, the effective temperature of the Sun is of 5,800 K. In other circumstances it can mislead us, such as with a planetary nebula, whose kinetic temperature (obtained from the average energy of the particles) can be of 10,000 K, but whose effective temperature is of only 50 K, because of the law density.

@**emission line** - a luminous part of the spectrum, marking a certain wavelength given by hot or excited atoms. The emission lines can appear superimposed on a normal absorption spectrum, being produced by the hot gas around a star, or can appear by themselves in the spectrum of a nebula excited by the radiation from a hot star situated nearby. They permit the determination of the emittent gas composition.

@**ephemeris time** (ET) - a time scales which was used to calculate the orbits in the solar system, from 1960 until 1984. Its fundamental unit was the ephemeris second, which was defined so that the tropical year at the epoch 1900.0 should be of exactly 31,556,925.9747 seconds of ephemerides. The ephemeris time was inconvenient in many ways and in 1984 was replaced with the terrestrial dynamic time (TDT), whose fundamental unit is the SI second.

@**epoch** - the moment when an observation was made or for which the celestial bodies' positions and the orbital elements are calculated. Due to precession and nutation the celestial coordinates change in time, so that the celestial bodies' positions must be referred to a certain date. The standard epoch used in ephemerides and stellar catalogues at present is January 1, 2000, 12h (written also as 2000.0).

@**equator** - the intersection between the surface of a body and the perpendicular plane to the body's rotation axis. The equator plane passes through the body's centre, dividing the body into the northern and the southern hemispheres. All the points on the equator are equally distanced from the body's rotation poles.

@**equinox** - one of the two points in which the annual apparent trajectory of the Sun (the ecliptic) intersects the celestial equator; or the date at which these things take place, namely around March 21 (the spring equinox) and September 23 (the autumn equinox). When the equinox type is not specified, then one assumes the spring equinox (vernal). Around the equinoxes, the day and the night are equal all over the globe. The equinox is not a fixed point; it moves due to precession and nutation. If only precession is taken into account, the point that results is known as the *average equinox* of the date. If nutation is also taken into account, then it is the *real equinox.*

@**eruptive prominence** - a solar prominence which was initially calm, but began to grow suddenly by several hundred kilometres per second and could not longer be seen. Such prominences are often observed on the solar limb, in association with the coronal mass ejections. The equivalent phenomenon on the solar disk is also called *eruptive filament* or *sudden disappearance*.

@**Eudoxos of Cnidos** (408 - 355 BC) - the author of a world system based on concentric spheres, which stood at the bases of classical astronomy. According to Eudoxos's theory, three spheres that rotated with periods of 24 hours, 223 lunations and 27 days represented the Moon's revolution. The combination of these three motions permitted eclipses to be predicted.

F

@**F** band - the Fraunhofer line in the solar spectrum situated at 486.1 nm and due to the absorption by hydrogen. It is also known under the name of H_β line in the Balmer series.

@**F** corona - the exterior part of the solar corona, illuminated by solar light scattered or reflected by solid dust particles. The same phenomenon also produces zodiacal light, much farther away from the Sun. The dust particles have several micrometers at the most and make up a disk stretched over almost 1 solar radius (700, 000 km) from the Sun's surface. Unlike the electrons, which are responsible for the K corona, the dust particles move relatively slowly. Thus, the light scattered by them has the same spectrum as the photosphere, its Fraunhofer lines (hence the name "F corona") included. The F corona is the most luminous part of the corona at 1.5 solar radii from the Sun's surface.

@**facula** - a brighter and hotter spot on the solar photosphere, visible in white light and best seen near the solar limb, in contrast with its dark background. The faculae appear often immediately before the formation of a sunspot group and remain visible for several days or weeks after the disappearance of the spots. High latitude faculae (polar) also appear quite far away from sunspots, unlike the faculae of the sunspots, which are much more numerous at the beginning of a solar cycle. The faculae are somewhat hotter (by almost 300 K) than the surrounding photosphere. They are the premises of strong magnetic fields (0.01-0.05 tesla) and coincide with the luminous spots on the chromosphere and chromosphere network. Normally they can be resorbed in small luminous facular points, approx. 1000 km wide and which last for about 20 minutes. There is often a connection between the faculae and the structure of the great sunspots, particularly the light bridges that are bridges of luminous matter, crossing a sunspot.

@**filament** - a long tongue of a relatively cold matter (10,000 K), suspended in the solar corona (2 million K). The filaments seem dark in $H\alpha$ light when they are seen projected on the solar disk; at the limb they look as what they actually are: prominences. *Quiet filaments* (the equivalent of the quiet prominences on the limb) can undergo gradual changes, but filament portions can move much faster, with speeds of several kilometres per second. *Filament loops* (equivalent to the prominence loops) can sometimes be seen around the greatest flares. The equivalent of an eruptive prominence is a filament that disappears, sometimes called also a *disappearing filament.*

@**filter** - 1. Optical component through which only certain wavelengths can pass, others being blocked. There are two types generally used: glass filters and interference filters. The first type is made from disks of coloured glass. The interference filters are made from multiple glass layers, which create the interference between the wavelengths, allowing only some of them to pass. Glass filters are used especially in wide band photometry, while the other ones are used in the intermediary or narrow interferometry. The bandwidth of the filters (namely the range of wavelengths crossed) is between 30 and 100 nm for the wide band, 10 - 30 nm for the intermediary and 3 - 10 nm for the narrow one.

2. Electronic equipment indicating the transmission of certain frequencies and the elimination of others. They can be made from active crystals with passband < 0.1 mm.

@**finder** - a small refractor, set up on a larger one to help it identify a celestial body. It offers a larger view field; sometimes, it is endowed with a thread reticule, to mark the centre.

@**first contact** - with a solar eclipse it is the moment when the eastern part of the lunar limb touches the western limb of the Sun, marking the beginning of an eclipse; or, at a lunar eclipse, the moment when the eastern limb of the Moon is the first to enter the Earth's shadow.

@**first quarter** - a lunar phase which takes place at the middle of the interval between the new Moon and the full Moon, when half of the Moon's disk is illuminated. At the first quarter, the Moon is situated at 90^0 east of the Sun.

@**flash spectrum** - the chromosphere spectrum, which becomes manifest by replacing the absorption lines with the bright emission lines in the extremely short interval when only the photosphere is eclipsed by the Moon, but not the chromosphere. C. A. Young observed it for the first time in Spain, at the solar eclipse in 1870.

@**focal distance** (symbol F or, sometimes, f) - the distance between a lens or a mirror and its focus. It is one of the main characteristics of a lens or concave mirror. The greater the focal distance, the higher the image scale is.

@**focal plane** - a plane perpendicular to the optical axis of a lens or mirror, which contains the focus or focal point and where the image of an object forms at infinite.

@**focus** or **focal point** or **optical focus** - a point where the parallel light rays which come from a far off body are gathered together by a lens or a concave mirror (convergent); it is the place where the clearest image of a distant body forms. The distance between the focus and the lens or mirror is *the focal distance.*

@**focal ratio** - a ratio between the focal distance of a lens or mirror and its diameter, usually expressed by a number. The smaller the focal ratio, the smaller the image scale and the more luminous the image for a given opening. The small focal ratios, under f/6, are called *rapid focal ratios*, those greater than f/8, *slow focal ratio* (where f is the focal distance), terms adopted from photography.

@**Fraunhofer**, Joseph (1787 - 1826) - German physicist and optician. In 1814 he made the first spectroscope to measure lens dispersion power, using a yellow flame as a light source. He compared the flame spectrum with the Sun's spectrum produced by a prism, noting and registering the Fraunhofer lines of the Sun. Later he observed similar lines in the spectra of other stars; he also made achromatic lenses and the first diffraction network. He improved the equatorial mountings of the astronomical instruments and built a 16 cm heliometer, which F. W. Bessel used to measure the parallax of the star 61 Cygni.

@**Fraunhofer** lines - absorption lines and bands in the solar spectrum, observed for the first time in 1814 by J. von Fraunhofer. In descending order from red they are A, a, B, C, D, E, b, F, G, H and K. The A and B bands are due to the absorption by the oxygen molecules in the terrestrial atmosphere and band a is due to the absorption by the terrestrial water vapours, but what remains results from the absorption in the Sun's photosphere. The most important ones are lines D of sodium, lines H and K of the ionised calcium, the lines H_α, H_β, H_γ of the hydrogen and band G, produced by neutral iron and the CH molecules, all of them being characteristic of the stars of type F, G and K.

@**full Moon** - a lunar phase when the moon's hemisphere facing the Earth is completely illuminated. At this phase the geometrical longitudes of the Moon and Sun differ with 180^0. Anybody who sees the Moon above the horizon sees at the same moment the same phase of the Moon.

G

@**general eclipse** - a solar or lunar eclipse, considered between the two exterior contacts. The term of general eclipse is used especially in connection with the duration of an eclipse.

@**general relativity theory** - a theory advanced by A. Einstein, in 1916, which describes the way in which space and time are affected by the gravitational fields of matter. According to this theory, gravitational fields change the geometry of the space - time continuum by curving it. The curve can be emphasized in several ways. Firstly, the photons' trajectory is curved in a gravitational field, a prediction confirmed by the photographic measurements of the star positions near the solar limb during the total eclipse of 1919. The same effect becomes manifest through a delay of radio signals, that come from the distant space probes, when the signals pass by the solar limb. The space curvature resorting from the Sun also makes the perihelion of Mercury's orbit advance by 43" per century more than Newton's theory foresees. With pulsar orbits in binary systems, the perihelion's advance can reach several degrees per year. Another effect predicted by general relativity is the redshift. This fact was demonstrated by the displacement to the red of the lines in the Sun's spectrum and, even more obviously, with white dwarfs. Other predictions of the same theory include the effect of gravitational lens, gravitational waves, singularities and the invariance of the universal gravitational constant G. General relativity developed from the principle of the equivalence between the gravitational and inertial forces matter.

@**geometric albedo -** a measure of the reflectivity of one surface, especially of the bodies in the solar system (planet, satellite or asteroid); it is also called *physical albedo*. The geometric albedo is the ratio between the light (or other radiation) reflected by a body, such as it is seen from the direction of the Sun (namely at a zero phase angle) and that which would be reflected by a hypothetical white sphere, which reflects perfectly (namely an albedo of 1.0); it is assumed that this hypothetical sphere would have the same apparent dimension and would be placed at the same distance as the real body. The wavelength or the series of wavelengths to which the geometric albedo is applied must be defined. The bolometric geometric albedo refers to reflectivity on all wavelengths.

@**granulation** - on the Sun's photosphere, the numerous small luminous zones, called granules. The individual granules have dimensions of the order of 1,000 km and may have polygonal shapes. They are separated by intergranular spaces, of almost 400 K colder than the granules. The life duration of the granules is about 20 minutes; granules are born from the fragments of the preceding granules. They die by fragmentation or even by exploding into small fragments. Granules are oblong in the vicinity of sunspots; they appear even in the sunspots' shadow. Spectroscopic observations suggest that granules could be convection cells or ascending hot gas, the intergranular spaces marking the regions of descending, colder gas.

@**G star** - a star of the spectral type G, which also includes the Sun. The stars of type G, on the main sequence, have temperatures of 5,300 - 6,000 K, and therefore appear of yellow colour. Giants of type G are with almost 100 - 500 K colder than the stars in the main sequence. Supergiants of type G have temperatures of 4,500 - 5,500 K. The solar spectrum (the Sun is of type G2) is dominated by the lines of ionized calcium (the lines H and K, mainly) and neutral metals. In colder G stars the molecular bands of CH and CN become visible. The G stars in the main sequence and giants (such as Capella) have masses of 0.8 -1.1 solar masses, while the supergiants are of 10 - 12 solar masses. The luminosities of the type G giants are of almost 30 - 60 times greater than those of the Sun, while the supergiants are 10,000 - 30,000 times greater

H

@**H** and **K** lines - two Fraunhofer lines in the ultraviolet part of the spectrum, at 396.8 and 393.4 nm, respectively, due to the ionized calcium (Ca II). They are important for the spectra of the solar type and colder stars. The emission in the H and K lines is often found in the stars with pronounced magnetic activity.

@**Hale**, George Ellery (1868 - 1938) - American solar astronomer. In 1889 he invented the spectroheliograph, which he used to study the chromosphere. In 1905 he discovered that the sunspots could be colder than the surrounding photosphere and, using the Zeeman effect in their spectra, he showed in 1908 that they have strong magnetic fields. In 1925, he discovered a reversal of the solar magnetic field polarity at each successive cycle. He was responsible for the setting up of three telescopes, each one being the greatest one in the world in its own way. The 1 m refractor of Yerkes Observatory was set up in 1897 and is still the greatest refractor in the world. The Hooker telescope of 2.5 m was set up at the Observatory on Mount Wilson in 1917 and the refractor of 5 m (later called the Hale telescope) at the Palomar Observatory on Palomar Mountain, in 1948.

@**Hα** - The most important line of hydrogen in the Balmer series. It has a wavelength of 656.3 nm, in the red part of the spectrum.

@**Halley**, Edmond (1656 -1742) - English scholar. From 1676 he stayed for two years in St. Helena Island to observe the southern sky, and in 1678 he published a catalogue for 341 stars, the first catalogue of southern stars, complied from telescopic observations. He was the first to suggest that the observations of Venus's passages could be used to measure the distance to the Sun, which was made long after his death. In 1683 he began a long series of lunar studies and discovered, in 1693, the Moon's secular acceleration. In 1684 he visited Newton and convinced him to publish his "*Principia*". In 1705 he published "*Synopsis of Cometary Astronomy*", in which he drew the conclusion that, in 1682, he observed a comet which had already passed in 1531 and 1607. (Since this publication it has been called Halley's comet.) In 1718, he concluded that the brightest stars changed their position relative to that, which they had in Ptolemy's time, discovering thus proper motions. As the second royal astronomer (beginning with 1720) he initiated a series of lunar and solar observations over a period of 18 years - a complete Saros. In 1721 he formulated the problem that was to be called later "*Olbers' paradox*".

@**Hanle effect** - a rotation of the plane of polarization of spectral lines due to the magnetic field. It is used to measure the weak magnetic field of the solar prominences, which is 10^{-3} tesla and over 10^{-2} tesla for the active prominences. The effect bears the name of the German physicist Wilhelm Hanle (1901 - 1993).

@**heliopause** - a border of the heliosphere, where the solar wind pressure is in equilibrium with that of the interstellar gas. It is believed that it is situated at approx. 100 AU from the Sun.

@**HELIOS** - a series of German space probes, launched by NASA, to study the Sun and the interplanetary space. Helios 1, launched in December 1974, was placed in an orbit which took it to 45 million km from the Sun at the perihelion, closer than any other preceding probe. Helios 2, launched in January 1976, approached the Sun up to 43 million km.

@**helioseismology** - the study of the solar interior through the observation of oscillations at its surface. The solar oscillations take place both at a global and a local scale. The local oscillations become manifest through a small Doppler displacement in the Fraunhofer lines, in various zones of the solar disk. The wave period is on the average of 5 min, with maximum speeds of about 0.5 km/s. An oscillation model appears over several thousands kilometers and persists for 30 min. The oscillations are due to the superposition of several sound waves or *p modes*, which travel around the Sun between the surface and the lower strata of its interior. The global oscillations are observed through the Doppler effect in the Fraunhofer lines from the Sun's integrated light. Such large scale oscillations are due to the *p modulations*, which travel from the Sun's surface to the deepest parts of its interior; the oscillation period is of approx. 5 min, varying from 4 to 8 min.

@**heliosphere** - a region around the Sun, where the solar wind blows. It is considered that its outer limit is about 100 AU; it is bordered by the heliopause, outside which the interstellar gas exerts an equal pressure from the exterior. The shape of the heliosphere is unknown, but if there is a leakage of interstellar matter around it from a certain direction (an interstellar wind) the heliosphere should be like the terrestrial magnetosphere: spherical on one side, but with the shape of a long tail on the other side.

@**heliostat** - a plane mirror on an equatorial mounting, driven at a 24-hour rate to follow the Sun and reflect its light into a stable telescope. If the telescope is oriented parallel to the Earth axis, only the mirror is necessary. Nevertheless, the Sun's orientation seen through the telescope will change throughout the day.

@**Hertzsprung - Russell diagram** (HR diagram) - a graph in which the luminosity of the stars (usually their absolute magnitude) is presented, depending on their temperature at the surface (either the spectral type or the colour index). From the star positions in the diagram, the astronomers can deduce their mass and evolution stage. Most of the stars are in the main sequence. Such a star consumes its hydrogen from the nucleus and, during this stage, will remain in a diagram point determined by its mass. Other zones of the HR diagram are populated by stars which do not consume their nucleus hydrogen, but only that from a small stratum. Here is also the giants branch, populated by stars which have finished their nucleus fuel. Another zone is occupied by the supergiants, which are from 300 to 100,000 times brighter than the Sun, and by white dwarfs, dying stars, 10,000 times less bright than the Sun.

@**Hevelius** (Hewelke), Jan (1611 - 1687) - Polish astronomer, the author of a stellar catalogue and of the first synthesis work on comets. Discoverer of the solar faculae

@**"horizontal" eclipse** - a lunar eclipse during which the Sun sets and the eclipsed Moon, which rises, are above the observer's horizon for a short time. The phenomenon is due to the atmospheric refraction, which makes the observed height of the bodies situated close to the horizon greater than the real one. At the horizon this motion reaches 36', which allows the "horizontal" eclipse to take place. Cleomede described the phenomenon at the beginning of our era.

I

@**IGY** (International Geophysical Year) – In 1952, the International Council of Scientific Unions decided to establish July 1, 1957, to December 31, 1958, as the IGY, because the scientists knew that the cycles of solar activity would be at a high point then. IGY was modeled on the International Polar Years of 1882-1883 and 1932-1933 to allow scientists from around the world to take part in a series of coordinated observations of various geophysical phenomena. On October 4, 1957, the Soviet Union successfully launched Sputnik I, the world's first artificial satellite.

@**IQSY** (International Quiet Sun Years) - a period between January 1, 1964 and December, 31, 1965, around the solar minimum, when the observatories all over the globe and the space missions studied the Sun and the geophysical phenomena to understand better the solar - terrestrial relations.

@**ISEE** (International Sun-Earth Explorer) - a series of joint NASA - ESA projects to study the terrestrial magnetosphere and the solar effects on it. The ISEE - 1 and ISEE - 2 probes were launched in October 1977 on orbits which carried them into the magnetosphere. The instruments aboard included magnetometers and particles detectors. ISEE - 3 was launched in August 1978 on an orbit outside the magnetosphere, to measure the flow of the solar wind independently of any terrestrial influence. It was later sent to intercept the Giacobini - Zinner comet and was thus renamed International Cometary Explorer (ICE).

@**IUE** (International Ultraviolet Explorer) - a satellite for ultraviolet astronomy, launched by NASA - ESA -UK, in January 1978. It was equipped with a telescope of 0.45 m, and two spectrometers for wavelengths ranging between 115 - 200 and 190 - 320 nm. The satellite observed, from a geosynchronus orbit, objects in the solar system including bright stars and extragalactic bodies with magnitudes of up to 21. IUE ended its activity in September 1996, after 18 years, becoming the most lasting astronomical satellite.

J

@**Janssen** (Pierre) Jules César (1824 - 1907) - French spectroscopist. In 1862 he discovered and named the terrestrial lines in the solar spectrum, which originated in the terrestrial atmosphere, and realised that similar lines in planetary spectra would set forth the composition of their atmospheres. In 1868 he observed, independently of J.N. Lockyer, the spectrum of solar prominences at a total eclipse and created the *spectrohelioscope*. He discovered a new line in the solar spectrum, which Lockyer attributed to a new element, named *helium*. In 1870, during the French - Prussian war, Janssen escaped in a balloon from besieged Paris and flew to the Atlantic coast to observe an eclipse. He was the founder of the Meudon Observatory, devoting it to astrophysical research. He obtained photos of sunspots and solar granules, the best until 1950.

K

@**K corona -** an interior luminous part of the solar corona, produced by light diffused by the electrons. It is the real corona, unlike the F corona, which is due to the light diffused by dust particles. Due to the extremely high speed of free electrons (on the average 10,000 km/s for a coronal temperature of 2 million K), the Fraunhofer lines of the photospheric spectrum are destroyed, so that the spectrum of the K corona is almost continuous (K actually comes from the German word Kontinuum). The K corona is more luminous than the F corona up to 1.5 solar radii from the Sun's surface.

@**Kirchhoff**, Gustav Robert (1824 - 1887) - German physicist. He established the principles of the spectral analysis together with the chemist Robert Wilhelm Bunsen (1811 - 1899). In 1859 he stated that the Fraunhofer lines in the solar spectrum showed that light from the photosphere was absorbed, at those wavelengths, by the Sun's atmosphere. Moreover, he realised that the D Fraunhofer lines are produced by sodium in the solar atmosphere and that other Fraunhofer lines should prove what other elements could be present in the Sun. Since then spectroscopic astronomy developed rapidly thanks to P.A. Secchi in Italy and W. Huggins in England, among others.

L

@**last contact** - another name used for the fourth contact at an eclipse.

@**last quarter** - a Moon phase which takes place at the middle of the interval between the full Moon and the new Moon, when half the Moon is illuminated. At this phase, the Moon is at 90° west from the Sun.

@**light deflection** - the light deviation by the Sun's gravitational field. Near the Sun's limb it is 1.75", radial from the Sun. This effect is taken into consideration at the reduction of the star positions from the middle position to the apparent one.

@**limb** - the border of a celestial body's visible disk, as it is seen from Earth. The borders of the Moon's visible face are also called the limb regions.

@**line of nodes** - the straight line which unites the ascending and descending nodes of an orbit.

@**lunar eclipse** - the passage of the Moon through the Earth's shadow cone, having as a result a darkening, which can be from a hardly detectable shadow during an eclipse through the penumbra up to a very dark phase, when the Moon enters the Earth's shadow entirely. Lunar eclipses take place only at the full Moon phase, when the Moon is close to one of the nodes of its orbit around the Earth. When the Moon is somewhat to the north or south of the node, it does not cross the shadow centrally and consequently only a partial eclipse can take place. During the eclipses in the shadow, the Moon looks more or less dark, depending especially on the transparency of the terrestrial atmosphere. The Sun's light refraction through the atmosphere on the eclipsed Moon produces sometimes a red colouring, while the darker eclipses may appear grey. Coloured fringes can be seen around the shadow edge during the partial phases. A lunar eclipse is visible from the entire hemisphere where the Moon is above the horizon. The maximum duration of a lunar eclipse totality, when the Moon passes through the shadow centrally, is of 1h 47m.

@**lunation** - a period of time between two identical Moon phases. It is the same as the *synodic month*.

M

@**magnetopause** - the limit between a planetary magnetosphere and the external magnetic field of the solar wind. The magnetopause (in the opposite direction to the wind) is usually beyond an impact arch, whose distance from the planet depends on the solar wind intensity and on the field direction. The terrestrial magnetosphere is at about 64,000 km (10 terrestrial radii), but it can also be closer, depending on the perturbations suffered from the solar wind, following some eruptions or coronal mass ejections.

@**magnetosphere** - the space around a planet in which its magnetic field dominates the external magnetic fields. Important magnetospheres are around the planets Mercury, Earth, Jupiter, Saturn, Uranus and Neptune. The solar wind compresses the planetary magnetosphere in the direction to the Sun and directs it into the shape of a magnetic tail.

@**main sequence** - the diagonal band from the Hertzsprung - Russel diagram. They say that a star belongs to the main sequence when it is at that stage of its life when it radiates by transforming 4 atoms of hydrogen into 1 atom of helium. The position of a star on this sequence depends on its mass, the most massive stars being in the upper - left part and the less massive ones in the lower - right part. The Sun - an average star - is at about the middle of this sequence. Irrespective of its mass, a star on the main sequence ends its days as a dwarf star. The stars spend the greatest part of their lives on this sequence, when they keep almost constant their temperature and luminosity. However, the time spent on this sequence depends on their mass. The more massive the star, the shorter is its life.

@**Maunder minimum** - the period between 1645 and 1715, when only a very few solar spot or aurorae were observed. E.W. Maunder (and G.F.W. Spörer before him) concluded that it was a genuine decline in the Sun's activity. This minimum can be emphasised also through the increased content of carbon 14 in the tree rings in that period, because the cosmic rays which produce carbon 14 reach the Earth in a greater number when there is weak solar activity. A period of cooling of the terrestrial globe was also observed between 1550 and 1700, called the little Ice Age, which corresponds very well with the period including the Maunder minimum and the preceding minimum of Spörer. A drop of the solar constant by 1% can explain this cold period.

@**metonic cycle** - a period of 19 years, after which the Moon's phases repeat at approximately the same calendar data. The cycle was discovered by the Greek astronomer Meton in the 5th century BC and is used in the construction of lunar-solar calendars. It is determined by the fact that 235 synodic months (lunations) take place in 19 tropical years.

@**month** - a time period established on the basis of the Moon's motion around the Earth. The *synodic month* is equivalent to a lunation, the time in which the Moon passes through a cycle of its phases; it has 29.53059 days. The *anomalistic month* is the time interval between two successive passages of the Moon through the perigee; it lasts for 27.55464 days. The *sidereal month* is the time when the Moon comes back to the same position relative to the stars; it lasts for 27.32166 days. The *tropical month* is the time interval between two successive passages of the Moon at the hour circle of the vernal point; it lasts for 27.32158 days. The *draconic month* is the time between two successive passages of the Moon through the ascending node; it lasts for 27.2122 days. The calendar month is an artificial unit, consisting of a whole number of days.

@**Moon** - the unique natural satellite of the Earth. The Moon's magnitude, at full Moon phase is 12.7, but its surface is actually dark, with a mean geometrical albedo of only 0.12, smaller than that of all other planets (with the exception of Mercury). It is the fifth larger satellite in solar system (the diameter is of 3,476 km, about a quarter of the Earth's diameter), but its mass is of 1/81 of the terrestrial mass. Being so similar in dimensions, the Earth and the Moon are often considered as a double planet. The sidereal period of the Moon's rotation, 27.322 days, is identical with its orbital period, so that it always shows the same side. Its equator is inclined by 1.53^0 against the ecliptic plane. The temperatures at the surface vary between extremes, from 123^0 C during the day to -233^0 C at night. The usual values are of 107^0C (daytime) and -153^0 C (night-time). The Moon has two distinct types of soils, with very different densities from the impact craters: luminous heights and dark valleys. The first ones have an albedo of 0.11 - 0.18 and are full of large craters, with diameters of over 50 km. The seas have an albedo of 0.07 - 0.10- they are younger soils of basaltic rock, with few large craters. Besides basalt there are also iron and titanium; the seas also have pyroxene. The mountain rocks differ chemically from those of the seas, being rich in calcium and aluminum and consisting especially of feldspar. The mountains date back to 4 billion years ago, while most of the seas formed 2 up to 3.9 billion years ago. The invisible side of the Moon has few zones with dark seas. The predominance of the seas on the visible side can be due to the impact, which created the Imbrium Sea, which produced a deep fracture in the Moon, from where lava later flowed. On the Moon there is practically neither atmosphere nor water, so that the main erosive processes are the impacts which gave birth to the craters. The lunar craters vary in dimensions from some narrow pits, of less than 1 mm width, up to large impact basins, with diameters of over 1,000 km. The young impact craters, like Tycho, are very bright, with prominent central peaks, terraced walls and luminous rays extending far away over the surface. The old craters are worn out and smoothed as a result of some small impacts, or dark, following other, greater impacts, or flooded with lava. The constant presence of small impacts on the surface created a soil stratum, or a regolith, of 5 - 15 m breadths over the entire Moon.

The lunar volcanic craters are rare and relatively small, most of them of only several kilometres. The lunar domes, with small slopes and peak pits, seem to be equivalent to shield volcanoes on Earth. There are several small, grey cones, plus several larger collapse fosses and hollows. Many of these are the origin of sinuous channels, which took the place of the fluid lava from the great plateaux. Pleated chains are a proof of the compression and tension forces on the Moon. They are found most often in concentric formations, around or inside the impact basins.

The Moon interior consists of a thick lithosphere, which descends to a depth of 800 km. Under it, there is the aesthenosphere and, maybe, a small nucleus, which occupies 2% of the Moon volume. Lunar earthquakes are minor events by comparison with the terrestrial ones and they take place regularly, in the same places, every month, as a result of the tidal forces. There is no significant magnetic field.

The Moon may have formed during an impact of a body with the Earth, which, in its passage through the solar system, threw the debris into orbit, where accretion took place, leading to the Moon' birth. According to less likely hypotheses the Moon formed somewhere in the solar system and was then captured, or that the Moon and the Earth formed together through accretion, almost at the same time.

N

@**NASA** (National Aeronautics and Space Administration) - an American governmental agency, founded in 1958 for civil aeronautical research and space exploration. Its headquarters are in Washington D.C.

@**neutrino** - an elementary particle of zero charge and very small rest mass (maybe even zero). Neutrinos travel with very great velocities, which, if their rest mass were zero, is equal to the speed of light. Three types of neutrinos are known: the muon *neutrino*, *electron neutrino* and *tau neutrino*. Neutrinos have only a weak interaction with matter and therefore the neutrinos produced in nuclear reactions in the star centers can escape without interacting with the surrounding matter. It may be that a part of the missing mass of the Universe consis of these neutrinos, if they were of non-zero mass. The neutrinos are leptons.

@**new Moon** - a lunar phase when none of the Moon's illuminated face is seen from Earth. At this phase, the Moon has the same longitude as the Sun.

@**node** - one of the two points in which an orbit intersects the reference plane (or the fundamental plane), such as the ecliptic's plane or the celestial equator's plane. The line that unites these two points is called *the line of nodes*. At the *ascending node,* a body on the orbit moves from south to north against the reference plane; at the *descending node* it moves from north to south.

O

@**occultation** - the passage of a celestial body in front of another one, usually the covering of a star by the Moon. Strictly speaking, a solar eclipse (when the Moon passes in front of the Sun) is a particular case of occultation. The determination of the stellar occultation moments by the Moon helps us know better the lunar orbit. The stars can be occulted by asteroids or planetary satellites, which can lead to a better knowledge of the occulting bodies' diameters. It seems that the best observed event of this type was the occultation of the star 28 Sagittarii by Titan, Saturn's satellite, in 1989. The planet regularly occults Jupiter's Galilean satellites. Jupiter's satellites can occult each other when the Earth is in the neighborhood of their orbital plane. Occultation of the stars by the Moon allows the evaluation of the stellar diameter.

@**ocular** - a lens or lens combination, used to increase the image formed by the objective of the telescope. The simplest ocular is a convergent lens, of short focal distance, but this suffers a strong aberration, with the exception of its center of field of view. Practically, an ocular has at least two elements. A field lens, in front of the objective or mirror, captures light on a larger field than a single lens, while the lens at the eye level, through which the observer looks, gives the increase. The combination gives a good view field, while controlling the aberration. A field stop (a diaphragm placed so that it should be in the focus, as it is seen through the eye lens) indicates the limits of the view field. To increase the performances, many other elements can be added.

@**opposition** - the situation when a body of the solar system is in the sky in the opposite part of the Sun relative to the Earth and has, therefore, the celestial longitude 180° out of phase relative to that of the Sun. At the opposition, the body is situated to the south at midnight and is visible all night. It is the best time to observe the exterior planets, because they are then closest to the Earth. The inner planets, Mercury and Venus, can never be in opposition.

@**orbit** - the route followed by a celestial body. The planets, in their motion around the Sun, and the satellites that move around the planets follow orbits which are approximately ellipses, governed by Kepler's laws. The orbits can also be parabolas or hyperbolas. The dimension and the shape of an orbit are defined through its elements. The modification of these elements in time, due to the perturbing forces, such as the gravitational influence of other bodies, can be predicted by celestial mechanics.

@**orbital period** (symbol P) - the time taken by a celestial body to cross a complete orbit around another body. The time between two successive passages through the periastron (perihelion with the Sun, perigee with the Earth) is called *anomalistic period*. The time when the orbiting body completes 360° is called *the sidereal period*. This can be a *nodal* or a *draconic period*, if the 360° is measured from the ascending node, *quasinodal* if it is measured from the intersection with a plane parallel to the fundamental plane etc. These two periods differ if other forces than the mutual gravitational attraction perturb the orbit.

P

@**parsec** (symbol pc) - a basic unit for stellar distances, corresponding to the trigonometric parallax of an arcsecond (1"). In other words, it is the distance at which an astronomical unit suttends an angle of an arcsecond. A parsec is equal to 3.2616 light years, 206.265 astronomical units, or 30,857 x 10^{12} km. For distances at the galactic and intergalactic scale, the kiloparsec (kpc), megaparsec (Mpc), and gigaparsec (Gpc) are also used.

@**partial eclipse** - a solar eclipse in which the Moon does not cover the Sun's disk completely, which then appears as a crescent; or a lunar eclipse in which the Moon does not enter the Earth's shadow completely, so that a part of the Moon remains illuminated by the Sun.

@**Peiresc**, Nicolas-Claude Fabri (1580 -1637) - a pupil of Galileo Galilei. He successfully organised an observation network of the lunar eclipse of August 28, 1635. The observations permitted the correction of a great error (about 1,000 km) on the maps of the Oriental Mediterranean. He drew up the first map of the Moon (engraved in 1636).

@**penumbra** - 1. The exterior region of the shadow left in space by a planet or satellite; an observer situated in the penumbra can witness a partial eclipse. The penumbra surrounds the narrower, dark shadow, in which the Sun is completely covered. The penumbra is darker the closer it is to the umbra. During a lunar eclipse, the Moon passes through the penumbra of the terrestrial shadow before and after it passes through the umbra. 2. External region, relatively bright, of a sunspot, with temperatures of about 5500 K. Small sunspots do not usually have penumbra, but, for mature ones, the penumbra is usually well developed and represents about 70% of the surface of the sunspot. It consists of filaments, which radiate from the central umbra. The filaments are brighter than the umbra, but less bright than the surrounding photosphere. There are also bright points, which last about one hour and which move to the umbra, where they become points of the umbra, a sort of small grain of the photospheric granules. The radial flow of gas, the Evershed effect, occurs in the penumbra and a little over it. The intensity of the magnetic field is of about 0.1 tesla (smaller than in the umbra); the alignment is close to the horizontal.

@ **penumbral eclipse -** a lunar eclipse when the Moon passes easily to the north or south of the umbra and only through the less intense part of the exterior region (penumbra) of the Earth's shadow, presenting, generally, only negligible darkening. When the Earth's atmosphere is loaded with dust (following volcanic eruptions, for example), the penumbra can be darker than usual.

@**perigee -** a point on the circumterrestrial orbit, situated at the closest distance from the Earth center.

@**perigee eclipse -** a solar or lunar eclipse that takes place when the Moon is at the perigee of its orbit. The maximum duration of a solar perigee eclipse is of 5h 14m (between first and the fourth contact). The maximum duration of a lunar perigee eclipse, between the two exterior contacts of the Moon with the penumbra, is of 5h 16m (the maximum totality being 1h 40m).

@**perihelion -** a point on a circumsolar orbit, situated at the closest distance from the Sun center.

@**phase** - 1. Visible proportion of the Moon or a planetary disk, illuminated as we see it from Earth. 2. A measure of the position throughout a graph varying cyclically, like a wave or a periodical variation. The phase is measured like an angle, when a complete cycle is equivalent to a phase of 360° (or 2π radians), or, sometimes, as a number between 0 and 1. One says that two or more waves of the same frequency are *in phase* when their maxima and minima take place at the same moments. Otherwise, they are said to be *dephased* or that they have a *phase difference*.

@**photon** - an electromagnetic radiation particle. A photon has zero rest mass, has zero charge, and propagates with the speed of light in a vacuum. The energy E of a photon is connected to its frequency f, through the formula $E = hf$, where h is Planck's constant. Consequently, a photon at a radio frequency is of a much smaller energy than a gamma-ray photon.

@**photosphere -** the visible surface of a star, from which a great part of the energy is emitted in the form of visible and infrared radiation. The *solar photosphere* is a thin layer of approx. 500 km breadth. Its temperature decreases constantly from 6,400 K at its basis to 4,400 K at the temperature minimum, where it merges with the chromosphere situated above it. This temperature drop with height is the cause of the darkening at the disk's border. The photosphere has a texture similar to the rice seeds, called *granulation*, caused by convection cells of the hot gas. Other characteristics of the photosphere are the sunspots, faculae and filigree structures, the legs of the magnetic tubes. Almost all the characteristics of the sun's visible spectrum originate in the photosphere, the dark Fraunhofer lines included.

@**plage** - a hotter and brighter spot in the solar chromosphere, visible in Hα light and in the K line of calcium. The plage is the chromospheric equivalent of the facula on the photosphere, as it can be seen when an active region is near the limb. It is a remarkably strong magnetic field region.

@**planetary transit** - the passage of a body in front of another, of a bigger apparent diameter (such as Mercury or Venus's passages in front of the Sun), or the passage of a satellite in front of a planet. Mercury and Venus pass in front of the Sun only when they are close to one of the nodes of their orbit, at inferior conjunction. With Mercury this takes place at the beginning of November (the ascending node) or at the beginning of May (the descending node), while with Venus it takes place at the beginning of December (the ascending node) or at the beginning of June (the descending node). Mercury's transits take place much more often than those of Venus. Other transits of Mercury will take place on May 7, 2003 and November 8, 2006. The next transits of Venus will be on June 7, 2004 and June 5, 2012.

@**plasma** - a matter state, consisting of ions and electrons that move freely. The stars are made of plasma. Plasma exists in interstellar space. The solar wind, so as the solar gas, is plasma. Because plasma is strongly ionised, its behavior differs from that of the normal gas. The external magnetic and electric fields can affect plasma and the loaded particles can interact magnetically and electrically.

@**Poseidonios of Apamea** (135 - 50 BC) - renowned stoic Greek philosopher, who calculated the values closest to reality of the Sun's diameter and of the distance Earth -Sun ever found in antiquity. He discovered atmospheric refraction, a phenomenon that explains the "horizontal" lunar eclipses.

@**precession** - an oscillation motion through which a body's rotation axis describes a conical surface. The terrestrial axis undergoes a slow precession, due to the combined attraction of the Sun, Moon and planets. The terrestrial pole describes a complete circle on the celestial sphere in about 25,800 years; this circle has the radius of approx. 23.5°, i.e. the terrestrial axis inclination. The equinoxes describe a circuit of the ecliptic in the same time interval. Right ascension and declination of stars change in time as a result of precession so that the epoch at which these are given has to be specified. It was observed for the first time by the Greek astronomer Hipparcos, about 130 BC, who found out the apparent growth of the stars' celestial longitude. It is of approx. 50.3" per year.

@**prominence** - a formation with the aspect of a cloud, visible especially in Hα light, situated in the solar corona, but colder and denser than it. The prominences have temperatures of approx. 10,000 K, typical of the solar chromosphere, and densities 100 times greater than the corona. They are often seen around the solar limb at total solar eclipses. In Hα light, they can be seen projected against the Sun's disk, and are then called *filaments*. There are *quiescent prominences* and *active prominences*, depending on their behaviour. The regions of active prominences have rapid motions and last only for several days, while the quiescent prominences last for at least a month (a solar rotation). Between the relatively cold matter of the prominence and the hot corona there is a *transition region*, where the temperatures vary between 15,000 and 1,000,000 K. Prominences follow closely the magnetic inversion lines and they are maintained against gravity by magnetic fields.

@**protosun** - the Sun in the initial stage of its formation, over 5 billion years ago. The protosun had a smaller mass than that of the present Sun and was bigger, with radius comparable with that of the orbits of the intern planets. After almost 1 billion years the protosun's mass grew by capturing the gas in the surrounding disk, the solar nebula, while the weight of this falling matter made it shrink to only several times its present dimension.

Q

@ **quiescent prominence** - a long lasting solar prominence, which persists for several months and modifies only a little. It has the shape of an arch, long of several hundred thousands kilometres, thick of several thousands kilometres and high of about 50,000 km. When seen projected against the solar disk it appears as a dark formation, called a filament. The quiescent prominences are in the zone of the active regions situated near the poles. Throughout the cycle of 11 years, part of the prominences migrates gradually towards higher latitudes, forming a *polar corona* during sunspot minimum. The rest migrate to the equator.

@ **quiet Sun** - the Sun, in the neighbourhood of its activity minimum, during the cycle of 11 years, when the number of sunspots and active regions is the lowest. Then the activity is still present in the form of small luminous points in X radiation, prominences and some coronal formations.

R

@**radiation pressure** - the pressure exerted by photons on an illuminated surface. It can be direct, when the photons come from an electromagnetic radiation source, and re-emitted when the radiation is reflected or diffused by an intermediary body. Radiation pressure is insignificant in the case of big and massive bodies, but it has considerable effects on small dust particles rotating around the Sun. The dust particles forming "the zodiacal light", of less than 1 micron dimensions, are refulled by the solar radiation; this phenomenon is nevertheless counteracted by the Poynting-Robertson effect, of solar radiation on small particles orbiting the Sun, which causes them to spiral slowly in. Radiation pressure also influences the motion of dust particles in comet tails.

@**relative sunspot number** (symbol R) - a certain measure of the number of spots on the Sun. It was introduced in 1848 by J. R. Wolf and it is also known as *Wolf's* *number* or *the relative number of Zürich sunspots*. It is calculated taking into consideration both the total number of individual spots (f) and the number of spots groups (g), plus a k factor representing the observer and the telescope's efficiency, R = k (10g÷f). The factor k is equal to 1 for Wolf's observations in Zürich. The relative number of sunspots used today is based on the observations made at a network of 25 observation stations; IRSOL (Istituto Ricerche Solari Locarno), from Switzerland, acts as a reference station to keep the continuity of the Wolf numbers. The values are published by *Sunspot Index Data Centre* in Brussels.

@**rest mass** - the mass of an atomic particle, which is at rest relative to an observer. A particle, that moves relative to an observer becomes more massive, especially if its speed comes close to that of light. (In this case its mass is called *relativistic mass.*)

@**reversing layer** - a thin layer, traditionally situated at the basis of the chromosphere, where the chromospheric emission lines are produced. These lines appear as emission lines only in the short time interval of the flash spectrum. C. A. Young localized the reversing layer in the solar atmosphere in the 19^{th} c., though it is now known that the formation of the lines actually occurs over a wider range of depths than had been believed.

@**revolution** - the motion of a body around another or around the common center of mass, such as the monthly revolution of the Moon around the Earth or the annual revolution of the Earth around the Sun. For artificial satellites, the revolutions are calculated with reference to a given point on the planet's surface. Because the Earth rotates from west to east, a satellite on a west-east orbit will need more time to carry out a revolution around the Earth than to complete a whole orbit with reference to a fixed point in space. For instance, a spacecraft like a Space Shuttle can complete 16 sidereal orbits in one day, but only 15 revolutions.

@**right ascension** (symbol α) - a coordinate on the celestial sphere, equivalent to the longitude on Earth. It is measured on the celestial equator in hours, minutes and seconds of sidereal time beginning with 0h at the vernal equinox, counter-clockwise. Line 0 h of right ascension is the celestial equivalent of the Greenwich meridian. An hour of right ascension is equivalent to 15^0, so that 24h of right ascension are equivalent to 360^0. It is an equatorial coordinate.

@**rising** - the moment when a celestial body appears above the observer's horizon. For bodies that have an observable disk, especially the Sun and the Moon, the rising is considered to be the moment when the observed limb is tangent above the observer's horizon. Refraction in the terrestrial atmosphere makes a body seem to have risen before it actually does it; this effect has to be taken into consideration in the estimates of the rising and setting moments.

@**rotation** - the motion of a body around its axis, such as the daily rotation of the Earth. It is usually measured with reference to the stars and is then called the sidereal period of the axial rotation.

S

@**Saros** - the interval of 18 years 11.3 days (or 10.3 days, depending on the number of leap years), equivalent to 223 lunations, following which the Sun, Moon and Earth come back almost to the same alignment. Solar eclipses return after each Saros, but in different geometrical places. A Saros period is almost the same thing as 19 eclipse-years; the small difference makes the eclipses in a Saros series take place gradually more to the north or to the south, until, after approx. 70 eclipses (1,262 years), they no longer reach the Earth's surface.

@**second** (symbol *s*) - a fundamental unit in the SI system. It is defined as the duration of 9,192,631,770 periods of the transition radiation between two hyperfine levels of fundamental states of caesium 133. It was defined so that an average solar day has 86,400 *s*.

@**second contact** - at a total solar eclipse, the moment when the eastern limb of the Moon touches the eastern limb of the Sun and totality begins; or, at a total lunar eclipse, the point when the lunar advancing limb enters completely into the Earth's shadow. Second contact at a total solar eclipse is immediately preceded by the appearance of Baily's Beads, and by the diamond ring. At an annular eclipse, second contact refers to the moment when the western limb of the Moon leaves the western limb of the Sun, so that the entire lunar disk is silhouetted by the Sun.

@**shadow bands** - an optical phenomenon seen around the beginning of totality, at a solar eclipse, consisting of the slow motion of the weak wave, of light and darkness, only a few centimetres wide, seen on surfaces such as the ground. It is assumed that they are due to differential refraction of light from solar crescent in the cooling, upper atmosphere, around the time of a total eclipse.

@**sidereal period** - the time taken by a planet or satellite to describe a complete orbit, referred to the stars. For example, the sidereal period of the Earth is a *sidereal year*, and the sidereal period of the Moon is a *sidereal month*. The rotation of a body around its axis can also be measured against the stars; this is called *the sidereal rotation period*; the terrestrial sidereal period of the rotation axis is a *sidereal day*.

@**sidereal time** - time measured with reference to the stars; technically it is the hour angle of the vernal equinox. The sidereal time is the same as the right ascension of the stars at the observer's meridian. More generally, the sidereal time is the sum of the right ascension and the hour angle of any celestial body and therefore the connection between these two coordinates. Depending on the equinox (real or average) used as a reference point, the result for the sidereal time is known under the name of *average sidereal time*. Their difference, sometimes of over one time second, is called the *equinox equation*.

@**sidereal year** - a period of the Earth's orbital revolution around the Sun relative to the stars. The sidereal year lasts for 365.25636 days.

@**SMM** (Solar Maximum Mission) - a NASA satellite that observed the solar activity from gamma rays up to white light. SMM, also known as Solar Max, was active between February 1980 and December 1989. The mission led to a better understanding of the energy liberation mechanisms during solar flares and the phenomena connected to it.

@**SOHO** (Solar and Heliospheric Observatory) - ESA-NASA space mission, launched in December 1995, to observe the Sun in the visible and ultraviolet spectrum and to study the solar wind and measure the small oscillations on the Sun's surface. It is on an orbit in the vicinity of the Lagrangian interior point (L_1) between the Sun and the Earth, at about 1.5 million km from the Earth, in the direction toward the Sun, so that the Sun can be observed continuously.

@**solar activity** - collective name for all active phenomena on the Sun, sunspots, faculae, active regions, beaches, active prominences and flares included. The solar activity is closely associated with the magnetic fields, which seem to originate in the action of the solar dynamo. Solar activity increases and decreases within a cycle that lasts for approximately 11 years.

@**solar antapex** - the direction on the sky towards which an observed body seems to be moving, because of the solar system motion relative to the body. This direction cannot be precisely defined because of the random motions of the stars and differs depending on the spectral type, but its approximate position is $\alpha = 6$ h, $\delta = -30^{0}$.

@**solar apex** - the direction in which the solar system moves relative to its inertial local reference point. Its approximate position is $\alpha = 18$ h, $\delta = +30^{0}$. As a result of this movement, the motions of the stars seem to converge on a point situated in the opposite direction, namely *the solar antapex*.

@**solar atmosphere** - a region around the Sun consisting of the photosphere, chromosphere, the transition region and the corona. The solar atmosphere's temperature varies with height, decreasing at the beginning to a region with a minimum of temperature and then increasing rapidly in the transition region. The temperature rise seems to be due to wave dissipation, both of sound waves (in the low chromosphere) and of magnetohydrodynamic waves (in the rest of the chromosphere and corona).

@**solar constant** - the solar energy, in all wavelengths, that falls on a given surface at the top of the terrestrial atmosphere. The solar constant actually varies by 0.3% throughout a solar cycle, maybe even more over longer periods, so that a more appropriate term would be *solar irradiance*. Modern measurements by the space probes indicate a solar irradiance of 1.368 W/m^2, varying by a fraction of a percent over the solar cycle.

@**solar cycle** - the variation in the number of sunspots and of other forms of solar activity with a period of about 11 years. In each successive cycle the north and south magnetic polarities reverse, so that there is a magnetic cycle of 22 years. The lunar averages of the relative number of sunspots are about 6 in a year of solar minimum and of 116 at the solar maximum. There are variations in the number of spots, active regions and flares, as well as in the level of the various emissions (such as the ultraviolet or radio spectrums) associated with such regions. It is believed that the periodicity of 11 years is due to the solar dynamo action. The sunspot cycle may not have always acted as it does today, as the existence of the Maunder minimum suggests.

@**solar day** - the interval between two successive passages of the Sun at the observer's meridian, namely, a rotation of the Earth with respect to the Sun. This is actually an *apparent solar day,* which varies a little during a year, because of the equation of time. Its average duration, the *average solar day*, is of 24h or 86,400 s. Due to the orbital motion of the Earth around the Sun, the solar day is with almost 4 minutes longer than the sidereal day, a discrepancy which sums up to a whole day in a year.

@**solar dynamo** - an action inside the Sun, through which the kinetic energy of the strongly ionised, hot gas, from inside the Sun, is converted into a magnetic field, which leads to the increase of the solar activity. The magnetic field lines beneath the photosphere, which run from one pole to another (the *poloidal* field) are directed parallel to the equator (the *toroidal* field) by the Sun's differential rotation. It is believed that the active regions (the sunspots included) were generated as magnetic field distorted lines, which appear under the photosphere. The convection streams gradually change the toroidal field into a poloidal one of reversed direction, for the next cycle.

@**solar eclipse** - the passage of the Moon over the Sun's disk. The solar eclipse takes place only at the new Moon, when the Moon is close to one of its nodes around the Earth. They do not take place very month, because the new Moon is usually either to the north of south of the node, due to the Moon's orbit inclination. *The total solar eclipses* are rare in one place on Earth because the Moon's shadow falls only on a limited surface. The theoretical maximum duration of totality is of 7m 31s, but usually it is not longer than 3 -4 minutes. Around the totality a series of interesting phenomena take place, such as the shadow bands or Baily's Beads. During the totality the solar prominences and corona can be seen. The solar eclipses, which take place around the lunar apogee, can be *annular eclipses*. A *partial eclipse* is visible from each side of the ground band, from where a total or an annular eclipse is seen. During the partial eclipses the light becomes hardly perceptible only if more then 90% of the Sun's disk is covered.

@**solar flare** - sudden energy growth in the solar corona, which can last for several hours. The flares emit radiation in the entire spectrum, from gamma rays to radio waves. They also send out high speed particles (electrons, protons and atomic nuclei) at speeds of approx. 70% of the light speed, which reach the Earth in about 15 minutes, depending on their trajectory. The most energetic ones, when enter in the chromosphere produce flares and are visible in white light. The solar flares take place in active regions, with complex magnetic fields, the biggest ones being in the most complex regions. The greatest part of the energy is liberated in the first minutes, the impulsive stage, which can last for several seconds. The total energy liberated can reach up to 10^{27} J; there is not a well-defined low energy limit, 10^{21} J being the smallest ones.
The solar flares are classified in two ways: by their appearance in the Hα light and by the emission of soft X radiations. In Hα the name of *subflares* is given to the small events, for which the scale runs between 1 and 4 with the area growing. A luminosity

code is also associated with them, which goes from weak (f), via normal (n), to bright (b). In the soft X radiations (0.1 - 0.8 nm) they are classified as C, M or X, according to the increased intensity, with subdivisions from 1 to 9.
In Hα the flare may began with the disappearance of a filament (namely of a prominence projection on the solar disk), luminous zones developing in bands on both sides of the magnetic inversion line. There a rapid development stage takes place, also called the *flash phase*. There are often tough X radiations and radio explosions in microwaves, forming a stage in precocious impulses, with soft X radiations, which grow gradually to the maximum several minutes later and are followed by a decline (the cooling phase). They take their energy from the energy stocked in the magnetic fields, although the exact mechanism is not very well known yet.

@**solar interior** - a part of the Sun situated under the deepest visible stratum of the photosphere. The solar interior cannot be observed directly, but its structure can be deduced from the solar standard models. Such models can be verified through the observation of the global observations, where the concordance is quite good, but also by the number of solar neutrons, where a considerable disagreement appears, the models implying more neutrons than are observed today.

@**solar mass** (symbol M_o) - a mass unit used in stellar and galactic astronomy, equivalent to the Sun's mass, $1{,}989 \cdot 10^{30}$ kg.

@**solar maximum** - a time period from a solar cycle, when the sunspots and other activity manifestations are most frequent.

@**solar minimum** - a time period when the sunspots and other types of solar activity are less frequent, although not necessarily absent.

@**solar motion** - the linear speed of the solar system in space, relative to the local inertial reference point. It is usually defined under the form of three components, in a system of galactic or equatorial coordinate axes; it can also be expressed as the speed to the solar apex, of about 19.5 km/s or 4 AU/year.

@**solar nebula** - a cloud of gas and dust, from which the solar system formed about 5 billions of years ago. It is believed that the cloud was of the shape of a disk and that it could have been dispersed by the wind of type T Tauri, which was blowing from the young Sun. The comets, asteroids and meteorites give important information on the solar nebula composition. Similar gas and dust disks were detected around several close, young stars, such as Beta Pictoris.

@**solar parallax** - the angle from which the terrestrial equatorial radius is seen from the Sun's centre, when the Earth is at the distance of 1 AU. Its value is of 8.794148". The solar parallax was the first quantity, which gave the linear scale of the solar system, and was initially deduced from the passage of Mercury and Venus over the Sun's disk. At present it is deduced from direct distance measurements in the solar system, with radar and space mission transmissions.

@**solar wind** - a flux of atomic particles ejected from the solar corona. It consists of electrons, protons and nuclei of other elements, such as helium (to the smallest extent). Because the gas is diffused in the interplanetary space, it bears magnetic field lines, of a spiral shape, because the Sun rotates. The solar wind speed grows from almost 50 km/s at several solar radii up to hundreds of kilometres per second at the Earth distance. The particles densities are very small (about 5 millions of particles per stere) at the Earth distance. The solar wind speed varies a lot. The average speed is of 300 km/s. In the solar minimum period streams with speeds of over 750 km/s are observed. They flow from the coronal holes and cross the Earth once every 27 days (also because the Sun rotates). Streams of high speeds are emanated continuously from each pole of the Sun. The wind speeds, particles densities and magnetic field intensity (usually of 5.10^{-9} tesla) become very great because of the interplanetary perturbations, which can be identified with the coronal mass ejections. The solar wind interacts with the Earth and other planets, which have a magnetic field to produce the magnetosphere. The solar wind can "blow" even from a distance of 100AU from the Sun. Its limit is marked by the heliopause.

@**solar system** - a generic name for the system consisting of the Sun and all the bodies which gravitate around it. It includes 9 major planets and the 61 satellites known so far, plus asteroids, comets, meteoroids and dust. The aphelion of Pluto's orbit (over 7.3 billions kilometres from the Sun) marks the exterior limit of the planetary system known today, but many of the bodies in Kuiper's belt are beyond this and some long period comets may travel up to the middle of the distance to the closest star.

@**solar telescope** - a special telescope made to study the Sun. Lenses or mirrors with very great focal distances are used, so that as many details of the Sun as possible can be observed. Many great solar telescopes, such as McMath-Pierce Solar Telescope, are situated at great heights, to reduce the atmospheric turbulence and avoid the cloud coverage. Even better conditions are obtained at the observatories surrounded by waters, such as Big Bear Observatory in California.

@**solar-terrestrial relations** - the effects of the solar activity on the Earth and its magnetic field. The most important effects originate in the magnetic perturbations due to the solar activity; they produce geomagnetic storms when they interact with the terrestrial magnetosphere. A sudden growth of the terrestrial magnetic field intensity at the beginning of a storm is the result of the field compression on the part from the Sun. The perturbations take place everywhere and can last even for a day. The magnetic substorms are much more localised, taking place near the geomagnetic poles and being associated with the auroras. It seems that there is a connection between the solar activity and the terrestrial weather, especially during the Maunder minimum.

@**solar time** - the time measured relative to the Sun, more exactly the hour angle of the Sun plus 12 hours, added to make the day begin at midnight and not at noon. The Sun is the basis of the apparent solar time, such as it is seen on the solar panels. However, this time flows irregularly, because the terrestrial orbit is not circular and the ecliptic is inclined against the celestial equator. For more rigorous time conservation, *the average solar time* is used, based on the hour angle of a fictitious average Sun. The solar time, which is the basis of all civil timekeepers, loses about 4 minutes per day against the sidereal time, so that a star rises with almost 4 min earlier every night.

@**solar tower** - a solar telescope which collects the light fascicle at the height of the tower, before it is perturbed at the ground. In the upper part is mounted a heliostat which is directing vertically downwards the light, where a telescope forms an image of the Sun. Usually, the telescope is followed by a spectrograph, whose optical part is mounted on a high tower, to avoid the air turbulence on the ground. Such are for example the two solar towers in Mount Wilson, California. They can be cooled to reduce the convection streams. In a solar tower with vacuum the tower is void to prevent the air turbulence, such as Vacuum Tower Telescope from Sacramento Peak Observatory.

@**solar year** - a year from a calendar, set up so that it comes as closely as possible to the cycle of the seasons; it is also called *tropical year*. Not all calendars use the solar year. For example, the Islamic calendar is connected with the Moon's phases and the calendar year regresses in keeping with the seasons.

@**solstice** - one of the two points on the ecliptic in which the Sun reaches the greatest northern or southern declination every year, referred to the celestial equator; or the dates when this happens, around June,21 (the summer solstice in the northern hemisphere and the winter solstice in the southern hemisphere) and around December,22 (vice versa).

@**space speed** - the speed of a star relative to the Sun. It can be determined by measuring the radial speed and the tangent speed of the star.

@**spectroheliogram** - a picture of the Sun, taken in the light of a strong Fraunhofer line (or a part of the line). The most commonly chosen for spectroheliograms are the lines Hα and calcium K, which emphasise the chromospherical characteristics. A spectroheliogram is produced by means of a spectroheliograph; if filters are used to select the wavelength, then the result is a *filtergram* .

@**spectroheliograph** - an instrument to photograph the Sun in the wavelengths of a strong Fraunhofer line. An image of the Sun produced by a telescope is focussed through a primary slit and the light from this passes through a grate or prism. The dispersed light, formed in this way, is then intercepted by a second slit, placed at the desired wavelength (for instance, a part of an Hα line) and the photographic plate is placed behind this slit. The primary slit is then shifted over the Sun's image and the secondary slit is displaced to maintain its spectral positioning, producing a spectroheliogram on the photographic plate.

@**spectrohelioscope** - an instrument with which the Sun can be observed visually at the wavelength of a certain spectral line. The principle is very much similar to that of the spectroheliograph, except for the slits (primary and secondary), which are shifted rapidly forward and backward over the solar image, so rapidly that the eye cannot see the movement.

@**spicules** - eared jets in the superior chromosphere of the Sun, visible especially in the Hαlight. The spicules evolve towards the corona exterior with speeds of almost 30 km/s, reaching altitudes of 9,000 km in about 90s. They last for almost 15 min and end their lives by the ionisation in the corona. They tend to form groups, which create the impression of hair tufts on the solar limb. Seen on the disk, in Hα, they look like a very fine granulation; they are luminous on the limb and bright on the disk, when observed in the red light part of the Hα line). The spicules form in the chromospheric network. At the centre of the solar disk groups of spicules make up formations with the shape of rays, called rosettes.

@**Spörer's law** - the displacement of the solar spots' average latitude to the solar equator during the 11 years solar cycle. The spots of a new cycle are generally situated at latitudes of 30^0 - 40^0 north or south, but during a cycle the average latitude drops to 5^0 - 10^0, as the butterfly diagram shows. The law bears the name of G.F. Spörer, although it was set forth for the first time by R.C. Carrington.

@**Spörer minimum** - a period between 1450 and 1550, when the Sun's activity seems to have been unusually weak, according to the historical records of the solar spots and auroras observations and to the measurement of carbon 14 in the tree rings. The Spörer minimum and the similar Maunder minimum, coincide with the period of the lower temperatures on Earth, known as the small ice age. It was discovered by the American John Allan Eddy (born 1931), who named it after G.F.W. Spörer.

@**standard epoch** - the date at which the stars coordinates and other data in a stellar catalogue are calculated; it is also known as the *fundamental epoch*. The standard position of a star is given by the right ascent and by the declination relative to the equator and average equinox at a given epoch. By referring all stars positions to a standard date the effects of the proper motions, precession and nutation, are eliminated. The standard epoch used at present is the Julian epoch J2000,0, which corresponds to the date of 1.5 January 2000 TDB.

@**standard solar model** - mathematical description of the inner solar structure, which gives the variation of pressure, temperature and of other quantities with the radius, between the centre and the surface. It is obtained considering how a gas mass, simulating the Sun at its birth, evolves up to its present state, with the radius and luminosity in keeping with measured values. The most recent models give a nucleus temperature of 15.6 millions K and a density of 148,000 kg/m^3.

@**sublunar point** - a point on the Earth where the Moon is exactly at the zenith, at a given moment.

@**subsolar point** - a point on the Earth where the Sun is exactly at the zenith, at a given moment.

@**Sun** - the central body of the solar system and the closest star to us, mankind - the only one that can be studied in detail. It is classified as a G2V star: a yellow star with an actual temperature of 5,770 K (of spectral type G2) and a dwarf star in the main sequence (luminosity class V). Its apparent visual magnitude is of -26.7, but its absolute magnitude is of only +4.83. The Sun is mostly made up of hydrogen (71% of its mass), helium (27 %) and several heavy elements (2%). It has an age of about 4.6 billions years. The energy produced by the nuclear reactions in its nucleus is transferred to the surface or the photosphere by the radiation, the interior part

corresponding to two thirds of the ray and hence, by convection, through the third exterior part. The energy transfer from the nucleus to the surface is made in about 10 billions years. It is estimated that the temperature at the centre is of 15.6 billions K and the density of 148,000 kg/m^3. The greatest part of its energy evades into the space, from the photosphere. The photosphere is marked by granulation and supergranulation, both of them being manifestations of some convection streams of a relatively small scale; they are connected to the solar activity, such as sunspots and faculae, which are associated with the regions of intense magnetic field. The Sun's period of sidereal rotation is of about 25 days at the equator, and 27 - 28 days at the latitude of 40o; near to the poles the period is of 33.5 days. The average value adopted, corresponding to the latitude of 17o, is of 25.38 days.
Physical data: diameter = 1,392, 530 km; the equator inclination against the ecliptic = 7.25^0; period of average axial rotation (sidereal) = 25.38 days; average density = 1.41 g/cm^3; mass = 1,989.10^{30} kg; luminosity = 3.85.10^{26} W; volume = 1.4138.10^{27} m^3; escape velocity = 617.3 km/s.
The photosphere has a breadth of only several hundreds kilometers and its temperature decreases constantly with the height to almost 4,400 K, at the temperature minimum. Above it, there is the chromosphere, where the temperature is between that of the minimum temperature region and approx. 20,000 K. It is a rapid temperature growth with the height - in the transition region - towards the corona, where the temperature is of over 2 millions K.
The number of active regions on the Sun follows a cycle of 11 years. The magnetic polarities of the sunspots are reversed at each successive solar cycle, so that there is forming a magnetic cycle of 22 years. A continuous flux of particles - the solar wind - flows to the exterior, in the interplanetary space, with 300 ÷ 750 km/s, under the form of great speed streams, issued from the coronal holes.

@**sunrise** - the moment when the superior limb of the Sun appears above the horizon. At this moment, the real zenith distance of the solar disk centre is of almost 90^0 50', because the solar centre is with 16' lower than the superior limb and the atmospheric refraction at the horizon is of about 34'.

@**sunset** - the moment when the superior limb of the Sun disappears under the horizon.

@**sunspot** - a dark area on the solar photosphere, colder than the zone around it, associated with very strong magnetic fields (0.4 tesla). The spots generally appear in pairs or groups, the first and the latter ones having opposite magnetic polarities. The spot dimensions vary from small pores, of 300 km diameter, to groups stretching well over 100,000 km. The great spots usually last the most, namely over 3 months; some small pores can last for less than an hour. The spots are usually in the active centres, on both sides of the equator, between 40^0 and 5^0 northern and southern latitudes, appearing at greater latitudes at the beginning of a solar cycle and then moving towards the Sun's equator, as the cycle evolves. The well-developed spots have a darker interior - umbra, of almost 1,600 K colder than the photosphere and a more luminous exterior part - penumbra, which represents over 70% of the spot area and is with almost 500K colder than the photosphere. All sunspots begin their existence as small, dark pores and can later develop into small spots without penumbra, disposed in pairs. In a developing group the spots become much greater and more separate in the first two days, reaching the maximum area and complexity in about ten days. Large categories of spots groups can be defined. In the McIntosh scheme (which replaced the old Zürich scheme), a code of three letters describes the class of spots groups (single, pair, complex), the development of the penumbra at the great spot and the group compactness. The Mount Wilson scheme is used to describe the magnetic field structure, which can be simple (bipolar or unipolar, if there is a single spot) or complex. The spots, which give birth to flares, tend to be very complex in appearance and magnetic field structure.

@**synodic period** - the average interval necessary to a planet to return to the same position relative to the Sun, such as it is seen from the Earth, for instance from one opposition to another; or the average time taken by a satellite to come back to the same position relative to the Sun, as it is seen from the planet around which it orbits, such as from a new Moon to another.

T

@**temperature minimum** - a region of the Sun's atmosphere, marking the limit between the photosphere and the chromosphere. It is placed at about 550 km from the photosphere basis, where the temperature reaches a minimum of 4,400 K. Above the temperature minimum, the temperature rises constantly, approx. up to 6,000 K at the height of 1,000 km and then more rapidly higher and higher.

@**terminator** - the separation line between the illuminated and the dark parts of a planet or satellite.

@**terrestrial dynamic time** (TDT) - a name used in the beginning for the terrestrial time. It was introduced in 1984. In 1991 the word "dynamic" was eliminated; the other two scales are absolutely equivalent, except for the name.

@**terrestrial time** (TT) - a time scale used to calculate the precise geocentric positions of the bodies in the solar system. It is a continuation of the ephemerides time. TT was introduced in 1984, under the name of terrestrial dynamic time (TDT), but it was renamed in 1991. The fundamental unit of TT is the day of 86,400 s SI. TT is connected to the international atomic time (TAI), and is defined so that 1.0 January 1977 TAI should correspond to 1.0003725 January 1977 TT. This means that TT is advanced with 32.184 s relative to TAI.

@**third contact** - at a total solar eclipse is the moment when the western limb of the Moon coincides with the western limb of the Sun and totality ends; or, at a total lunar eclipse, the point where the front limb of the Moon touches the eastern edge of the Earth's shadow and totality ends. Immediately after the third contact, at a total solar eclipse, the diamond ring or Baily's Beads can be seen. At an annular eclipse, the third contact refers to the moment when the front (eastern) limb of the Moon leaves the eastern limb of the Sun and ends the annular phase.

@**total eclipse** - a solar eclipse when the Moon covers the visible solar disk completely; or a lunar eclipse when the Moon enters the Earth's shadow completely.

@**total solar eclipse of August 11, 1999 -** the last eclipse of the Millennium 2, which maximum was in Romania (2m 23s); it was the most mediatizated eclipse of the world; the first transmission from the space (space mission MIR).

@**totality** - at a total solar eclipse it is the period when the Sun's disk is completely covered by the Moon. At a total lunar eclipse it is the period when the Moon is completely immersed in the Earth's shadow. At a solar eclipse the totality can last from only several fractions of a second to a theoretical maximum of 7m 31s, depending on the distance from the Moon to the Earth. Around the perigee the Moon appears bigger and needs more time to cross the solar disk. At a lunar eclipse totality can last up to 1h 47m, also depending on the distance from the Moon to the Earth and on its passage through the shadow.

@**TRACE** (Transition Region and Coronal Explorer) - a NASA satellite, endowed with an ultraviolet telescope of 0.3 m diameter, made for the study of the solar corona and transition region, where the solar atmosphere temperature grows very much.

@**transition region** - a region of the solar atmosphere, between the superior chromosphere and the corona, where the temperature grows rapidly, from approx. 15,000 to 1,000,000 K. Its altitude depends on the intensity of the local magnetic field, but it is of about 2,500 km above the photosphere basis.

@**twilight** - a period before the sunrise or after the sunset, when the sky is not completely dark. There are three types of twilight, defined depending on how far the Sun is situated under the horizon. At the civil twilight, the Sun's centre is at 6^0 under the horizon, at the nautic one between 6^0 and 12^0, and at the astronomical one between 12^0 and 18^0.

U

@**Ulysses** - an ESA -NASA space mission, launched in October, 1990, to study the solar wind, the unexplored regions around the Sun's poles in particular. It passed by Jupiter in February 1992, who relaunched it on a trajectory towards the solar poles. It crossed the solar wind, dominated by the southern polar coronal hole and measured the wind speed in the region, of 700 km/s, in June -November, 1994 and the region corresponding to the northern pole of the Sun in June -September, 1995.

@**umbra** - 1. Darkness cone, in the direction opposite to the Sun, coming from a planet or a satellite, in which the Sun's disk is completely hidden. The passage of a body through this shadow has as result its eclipsing (such as when the Moon crosses the Earth's shadow). The dark umbra is surrounded by a penumbra, which is much larger and in which the solar disk is only partially hidden.
2. The central, darkest part of a sunspot. It is also the coldest part, with temperatures of about 4,200 K. The umbras are not evenly dark; they also contain light points, which are greater versions of the photospherical granules, and last a little more than the granules, about 25 min.

@**universal coordinated time** (UTC) - a time scale given by the hour signals, which lies at the basis of any civil hour. This standard time should be the universal time (UT), but the latter one contains unpredictable irregularities due to the non-uniform rotation of the Earth. Consequently, UTC is connected to the international atomic time (IAT), which is adjusted from time to time, through the so-called "second jumps", so that it does not move off more than 0.9s from UT. The well-known GMT is also present in UTC.

@**universal time** (UT) - the most common standard time scale, the same with GMT (Greenwich Mean Time). The universal time is the solar average time at the Greenwich meridian. It is defined as the Greenwich hour angle of the average Sun, plus 12 hours, so that the day begins at midnight and not at noon. It is closely connected to the Greenwich mean sidereal time (GMST), because the mean sidereal day is a well-known fraction from the average solar day. Practically, UT is determined by a formula from GMST, which in its turn is determined by the observations of the star passages at the meridian. UT deduced directly from this kind of observations is noted with UT0 (which depends a little on the observation place). Corrected by the longitude variation due to the Chandler oscillation, UT0 becomes UT1, which has a large application. Compared to the international atomic time (IAT), UT1 loses approx. a second per year against the former. The hour signals broadcast on the radio use another time scale, known as the universal coordinated time (UTC). This is actually IAT corrected by a whole number of seconds. The correction is applied, whenever necessary, by introducing an interposed second and UTC is always kept with a difference of 0.9s at the most against UT1.

V

@**vernal equinox** (γ) - a point on the celestial sphere through which the Sun passes every year from the southern celestial hemisphere to the northern one. It is also known as the *spring equinox* or *the first point of Aries*. The moment when the Sun reaches this point occurs around the date of March 21. At the vernal equinox, like at the autumn one, six months later, the day is equal to the night all over the globe. The right ascension is measured from the vernal equinox, which has, by definition, right ascension and zero declination.

@**Wolf**, (Johann) Rudolf (1816 -1893) - Swiss astronomer. After the discovery of the solar cycle by S.H. Schwabe, Wolf began to gather all the accessible data for the numbers of sunspots. He set up the dates of all sunspot maxima and minima until 1610 and established that the duration of the solar cycle is of 11.1 years. He divided the measurement system of the solar activity according to the number of spots. Wolf was one of the astronomers who remarked that the variations of the terrestrial magnetism and the aurora activity reflect in the solar cycle.

@**Wolf sunspot number** - older name of the relative number of sunspots.

@**Wollaston**, William Hyde (1766 - 1828) - English physicist. He discovered the absorption lines in the spectrum of the solar atmosphere.

Y

@**year** - the period of the Earth's orbital revolution around the Sun, and by extension, the orbital period of any planet. From the astronomical point of view, the terrestrial year can be defined in several ways. The present orbital period, referred to a fixed star, is the *sidereal year*, of 365.25636 days. However, the star positions change progressively, due to precession. The interval between two consecutive passages of the Sun's centre through the average vernal point is the *tropical year*, of 365.34219 days, when precession is taken into account. This is the most widely accepted definition of the year, because it is the only one, which connects it directly to the change of the seasons. Another kind of year is the *anomalistic year*, which is the average interval between two successive passages of the Earth through the perihelion of its elliptical orbit, of 365.25964 days. The latter one differs a little from the sidereal year, due to small perturbations of the terrestrial orbit caused by the gravitational influence of other planets. Another definition of the year used in astronomy is *the year of eclipses*, of 346.62003 days. This is the average interval between two successive passages of the Sun through a node of the Moon's orbit.

@**year of eclipses** - the time interval between two successive passages of the Sun through the same node of the lunar orbit, when eclipses take place. It lasts for 346.62 days, namely for two eclipse seasons. An eclipse year is shorter than a sidereal year, because the lunar orbit nodes regress to the west around the elliptic with almost 19^0 per year. 19 years of eclipses make up a Saros.

@**Yohkoh** - Japanese satellite, launched in August 1991, and lost on December 14, 2001, to study the flares and other manifestations of the solar activity in X and gamma wavelengths. Its telescope with X radiation produces images with a far better resolution than the preceding space probe. Its name means "*Sun ray*" in Japanese.

Z

@**zenith** - a point on the celestial sphere, situated exactly above the observer's head. The direction to the zenith is perpendicular to the horizontal plane. The opposite of the zenith is the *nadir*. This definition refers only to the astronomical zenith because there can be two other types of zenith, namely 1: the *geocentric zenith*, situated in the continuation of the direction from the Earth's centre to the observer and 2: the *geodetic zenith*, situated on the direction of the normal to the geode, in the point where the observer is placed. All three types of zenith differ a little, because of the non-spherical shape of the Earth. Unless specified otherwise, zenith refers to the astronomical zenith.

@**zenith distance** (symbol z) - the angular distance of a celestial body, measured from the zenith. The zenith distance is of 90^0 minus the elevation of the body above the horizon (namely the height complement).