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UNLIMITED

TR 67158

JULY 1967

AD 666523

ROYAL AIRCRAFT ESTABLISHMENT

TECHNICAL REPORT 67158

SOLAR-TERRESTRIAL PHYSICS:

A GLOSSARY OF TERMS AND ABBREVIATIONS

by

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MINISTRY OF TECHNOLOGY

FARNBOROUGH HANTS

215

U.D.C. 413.164 : 521.03

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SUMMARY

A glossary of terms, abbreviations, and symbols commonly encountered in solar-terrestrial physics and related fields has been prepared, to serve as a centralized reference and guide for users of the literature.

Departmental Reference: Mat.2

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1 INTRODUCTION

In the last few years a great many people have begun to take an interest in the sun and its effects on our environment. Unfortunately, the newcomer to the field is faced with a wealth of technical jargon which is not easily interpreted without a careful search of the literature. This report has been written to provide a short-cut to understanding by collecting together the definitions of a large number of commonly-encountered terms, symbols, and abbreviations.

The idea of compiling this glossary was suggested by the late Professor M.A. Ellison, of the Dublin Institute of Advanced Studies, when he was engaged in preparing a literature survey on solar flares for the Ministry of Aviation (Byrne, Ellison and Reid, B.3.2 and B.3.3). The completed survey itself contained a glossary of some dozen terms which served as a nucleus for the present work.

At first it was intended to list only terms directly related to "solar-terrestrial physics" - the physics of the sun and its relationship with the earth. However, so many unfamiliar terms from other disciplines were encountered during the compilation that it was decided to include them as well. As a result, the glossary contains a patchwork selection of terms from astrophysics, atmospheric physics, geomagnetism, radiation physics, nuclear physics, and so on. Obviously no claim to complete coverage in all these fields can be made. However, it is hoped that the inclusion of "borderline" terms will help to make the glossary a useful addition to the literature.

2 USE OF THE GLOSSARY

2.1 Acronyms and other abbreviations

A great many of the terms listed in the glossary have abbreviated forms. These terms fall into three broad categories: terms which have been replaced in common usage by their abbreviations; terms which are interchangeable with their abbreviations; and terms whose abbreviations are rarely used.

The first category consists mainly of the names of organizations, international projects, and satellites. In these cases the abbreviation is treated as the main glossary entry and the full spelling is listed separately only if it is widely used. For example, "International Council of Scientific Unions Scientific Committee on Space Research" is not listed; the reader must look under "COSPAR". On the other hand, "INTERNATIONAL GEOPHYSICAL YEAR" is listed, but the main entry is under "IGY".

Most terms with abbreviations fall into the second and third categories. In order to achieve some kind of consistency, both the full and the abbreviated forms of each term are listed, and the definition is given with the full spelling. Thus, for example, the reader who looks under "PCA" will be referred to "POLAR CAP ABSORPTION".

2.2 Synonyms

Whenever possible, synonyms are cross-referenced. In most cases one alternative is more commonly used than the others and the main entry is to be found under that term. Sometimes, however, no clear preference exists, and an arbitrary decision has been made in placing the definition. For example, anyone who looks up "IPDP" is referred to the entry under "SOLAR WHISTLE".

2.3 Cross-referencing within the glossary

A term printed in capital letters in the text of a definition is one for which there is a separate glossary entry. Sometimes this "separate entry" will be nothing more than a reference back to the definition originally consulted. More often, however, the entry will contain supplementary information of interest to the reader.

The relative importance of a cross-reference placed at the end of a definition is more clearly established. A reference preceded by the words "see also" may well be worth consulting. If the words "also known as ..." are used, the cross-referenced term is usually a less-favoured alternative which has no full entry of its own.

In general, a term is only capitalized on its first appearance in a definition. It may therefore be necessary to check back through the text of the definition to discover whether a given term is cross-referenced or not.

2.4 The ordering of glossary entries

Whenever possible entries have been listed alphabetically, with subscripts and superscripts considered on the same footing as other letters. A lower-case subscript (or superscript) precedes other forms of the same letter: thus "S_i" comes between "SHOWER METEOR" and "SI".

Letters with Greek subscripts are listed at the beginning of each alphabetical section (for example "Hα" comes at the beginning of the "H's"). When a Greek letter occurs on its own (e.g. "κ", "Λ") it is placed in a special Greek-letter section at the beginning of the glossary.

Non-alphabetic symbols occurring in abbreviations are listed so as to keep related groups of symbols together. Thus "SC*" is placed immediately after "SC", and before "SCAR", similarly "U_1" is grouped with "U".

2.5 Literature references

The reference list at the end of the glossary has been arranged topically in six major sections, each of which has been divided into numbered subsections. The references in each subsection are arranged in rough alphabetical order by author, and are numbered. The scheme of classification is outlined below:

A. Important general references

- A.1 Proceedings of symposia and conferences; collections of review articles.
- A.2 International organizations; programmes of international co-operation.

B. Solar physics

- B.1 The general nature and properties of the sun and the solar atmosphere.
- B.2 Solar activity - general references.
- B.3 Solar flares.
- B.4 Radio, ultra-violet, and x-ray emissions from the sun.

C. Interplanetary physics, and cosmic rays

- C.1 Satellites, spacecraft, and instrumentation.
- C.2 Solar particles and plasmas, and their guidance by interplanetary magnetic fields.
- C.3 Solar cosmic rays.
- C.4 Solar-terrestrial relationships.
- C.5 Galactic cosmic rays, and their interactions with the earth's atmosphere.

D. Exospheric and magnetospheric phenomena

- D.1 The earth's exosphere.

D.2 The geomagnetic field.

D.3 Charged particles in the geomagnetic field.

D.4 Geomagnetic disturbances and aurorae.

D.5 Micropulsations and geomagnetic fluctuations.

D.6 Whistlers and VLF noise.

E. <u>Other atmospheric phenomena</u>

E.1 The earth's upper atmosphere - general references.

E.2 The structure and properties of the earth's ionosphere.

E.3 Sudden ionospheric disturbances, and polar cap absorption.

E.4 Airglow.

E.5 Meteorites, atmospheric electricity, and other specialised topics.

F. <u>Subjects related to solar-terrestrial physics</u>

F.1 Theoretical and observational astronomy.

F.2 Plasma physics.

F.3 Radiation physics.

F.4 General physics and chemistry.

For the sake of completeness, literature references in the glossary have been put into the form: ([main section], [subsection], [number in sub-section], [page(s)]). For example, (A.2.16,21,93) refers to pages 21 and 93 of the sixteenth entry in subsection A.2. In some cases several works are referred to: for example, (D.1.1,15; D.3.4; E.1.7,196) refers to page 15 of the first entry in subsection D.1, the fourth entry in subsection D.3 (no page specified), and to page 196 of the seventh entry in subsection E.1.

In the reference list itself, articles from the works listed in section A are entered separately in the appropriate subsections. Full publication details are given only with the main entry, and a cross-reference is given with each of the separate titles.

In the glossary, literature references are not usually given with abbreviations and less-favoured synonyms. In the case of obsolescent terms, however, this rule is ignored: for example, a reference is given with "SOLAR HYDROGEN BOMB", even though the reader must look under "MOUSTACHE" to find a definition. Similarly when the definitions of several terms are included in a long general entry literature references are given with the entries for the individual terms: for example, references are given with "EGO" and "POGO" although the main entry is found under "OGO".

2.6 Physical constants and conversion factors

A brief table of important physical constants and conversion factors has been appended for the convenience of glossary users. The values listed have been taken from Allen's "Astrophysical Quantities" (F.1.1), from Kaye and Laby's "Physical and Chemical Constants", 12th Edition (F.4.18), and from the article by Dumond and Cohen in Menzel's "Fundamental Formulas of Physics" (F.4.19).

3 ACKNOWLEDGMENTS

I should like to thank Mr. D.M. Gilbey most sincerely for his assistance in compiling the glossary. Thanks are also due to Professor H. Elliot of Imperial College, Professor P.H. Fowler of the University of Bristol, and Drs. D.G. King-Hele and B. Burgess of the Royal Aircraft Establishment, all of whom have read the manuscript and offered helpful suggestions.

4 GLOSSARY

Greek symbols

γ	see GAMMA
γ-RAYS	see GAMMA RAYS
θ	see MAGNETIC CO-LATITUDE; POLAR ANGLE
κ	see OPACITY
$\kappa_\lambda, \kappa_\nu$	see MASS ABSORPTION COEFFICIENT
Λ	(INVARIANT LATITUDE) see MAGNETIC SHELL PARAMETER (L)
μ	see MAGNETIC MOMENT; MICRON
τ_λ	see OPTICAL DEPTH
Φ	see GEOMAGNETIC LATITUDE
Φ'	see DIP LATITUDE
ψ	see GARDEN HOSE ANGLE
ω_c	see CYCLOTRON FREQUENCY
ω_L	(LARMOR FREQUENCY) see LARMOR PRECESSION

Å see ÅNGSTROM

a, A see AMPLITUDES

ABSOLUTE MAGNITUDE see MAGNITUDE

ABSORBED DOSE

The amount of energy imparted to matter by IONIZING RADIATION per unit mass of irradiated material at the position of interest. The unit of absorbed dose is the RAD = 100 ergs per gram of tissue. (F.3.7,107,382)

ABSORPTION COEFFICIENT (k_λ, k_ν)

If radiation of intensity I_ν ergs/cm^2/sec in the frequency range (ν, $\nu + d\nu$) is incident on a material, a certain fraction of the incident energy will be absorbed by the material as the radiation passes through it. In many cases the rate of change of intensity with depth of penetration, $\frac{dI_\nu}{dx}$, may be assumed proportional to the intensity, $I_\nu(x)$, at the point considered. The coefficient of proportionality, k_ν, is known as the ABSORPTION COEFFICIENT, or COEFFICIENT OF ABSORPTION.

$$k_\nu = \frac{1}{I_\nu} \frac{dI_\nu}{dx}$$

If the intensity is quoted for a range of wavelengths (λ, $\lambda + d\lambda$) instead of for a range of frequencies, the absorption coefficient is denoted by k_λ instead of by k_ν.

k_ν is also referred to as the VOLUME ABSORPTION COEFFICIENT to distinguish it from the MASS ABSORPTION COEFFICIENT, κ_ν (or κ_λ). The mass absorption coefficient, which is equal to $\frac{1}{\rho} k_\nu$ where ρ is the density of the material, is defined with respect to the mass dm traversed in distance dx by a beam of unit cross-section. (B.3.14,3)

ABSORPTION LINE

A sharp resonance in an ABSORPTION SPECTRUM, corresponding to an atomic transition from one state to another of higher energy.

ABSORPTION MARKINGS another name for FILAMENTS (B.1.2,224)

ABSORPTION SPECTRUM

A system of lines, bands, and continua showing the absorption of electromagnetic radiation in a given medium as a function of wavelength.

ACCELERATION MECHANISMS

Ways in which cosmic ray and solar flare particles may have acquired their high energies. See BETATRON MECHANISM, FERMI MECHANISM.

ACCUMULATED DOSE

The total ABSORBED DOSE, over a period of time.

ACHONDRITE

A stony METEORITE not containing CHONDRULES. Achondrites are silicates, similar to terrestrial rocks. About 10% of the stony meteorites (AEROLITES) are of this form. (E.5.3,104; F.1.12,562)

ACTIVATION see PROMINENCE ACTIVATION

ACTIVE CENTRE (CENTRE OF ACTIVITY)

A localized, transient region of the SOLAR ATMOSPHERE, in which SUNSPOTS, FACULAE, PLAGES, PROMINENCES, SOLAR FLARES, etc. are observed. Active centres are characterized by local enhancements of the solar magnetic field. (B.3.14,11)

ACTIVE DARK FLOCCULUS see DARK SURGE ON DISK (DSD)

ACTIVE PROMINENCE

A PROMINENCE associated with a CENTRE OF ACTIVITY.
See PROMINENCE; SPOT PROMINENCE.

ACTIVE PROMINENCE REGION (APR)

Portions of the solar LIMB displaying ACTIVE PROMINENCES, characterized by down-flowing "knots" and "streamers", SPRAYS, frequent SURGES, and curved LOOPS. (B.2.4,277)

ACTIVE REGION

A localized, transient, non-uniform region on the sun's surface, penetrating well down into the lower CHROMOSPHERE. FLARES, SUNSPOTS, PLAGES, FACULAE, and FILAMENTS are typical elements of active regions. Associated magnetic fields (antedating and surviving PLAGES and FACULAE) may represent the most significant observable property of these regions. Active regions rarely occur on the equator of the sun, or at latitudes higher than ±45°.

ADALERT

An "advance alert" issued by a REGIONAL WARNING CENTRE to give rapid warning of a change in SOLAR ACTIVITY. See IUWDS.

ADIABATIC INVARIANTS

For a charged particle moving in an electromagnetic field, an ADIABATIC INVARIANT is a constant of the motion which is unaffected by temporal and spatial field variations whose scale is very large compared with the particle's unperturbed orbit.

If a particle's motion is separable into a number of oscillatory components (see GUIDING-CENTER APPROXIMATION), an adiabatic invariant may be defined with respect to each component.

For gyration about a line of force, the MAGNETIC MOMENT $\mu = mv_{\perp}^2/2B$ is an adiabatic invariant (TRANSVERSE INVARIANT) with respect to the LARMOR ORBIT (m = particle mass: $v_{\perp}$ = velocity perpendicular to magnetic field $\vec{B}$).

For a particle bouncing between MIRROR POINTS, the action integral

$$J = \oint mv_{\parallel}\, dl$$

is an adiabatic invariant (LONGITUDINAL INVARIANT) with respect to the "bounce" oscillation. ($v_{\parallel}$ = velocity parallel to $\vec{B}$; integral evaluated along a line of force between mirror points.)

For longitudinal drift on an ELECTRO-ORBITAL SURFACE (J = constant), the magnetic flux through the surface's cross-section is an adiabatic invariant (FLUX INVARIANT) with respect to the period of longitudinal drift.

ADVANCED OSO see OSO

AEROLITE

A stony METEORITE. Aerolites constitute about 90% of the meteoritic mass striking the earth. They normally contain CHONDRULES (only 10% are ACHONDRITIC), but are otherwise similar to terrestrial rocks.

(E.5.3,2; F.1.12,560)

AFCRC, AFCRL (AIR FORCE CAMBRIDGE RESEARCH CENTER: AIR FORCE CAMBRIDGE RESEARCH LABORATORIES, Bedford, Mass., U.S.A.)

AGIWARN (WORLD WARNING AGENCY) see IUWDS

AIR DISCHARGE

A LIGHTNING discharge which progresses toward the earth from a cloud without reaching the ground. Strokes of this type may be discharges to heavy space-charge concentrations below the cloud; alternatively they may be lightning strokes arrested by the collapse of the electric field (e.g. because of neighbouring discharges). (E.5.4,333)

AIRGLOW

The extremely feeble non-AURORAL radiation emitted by the earth's upper atmosphere. The airglow is subdivided into the NIGHTGLOW, DAYGLOW and TWILIGHTGLOW, according to the time at which the emission is observed. The airglow results from a wide variety of excitation processes in the upper atmosphere (e.g. collision, fluorescence, chemiluminescence, etc.).

(D.4.6,345; E.4.2,303; E.4.3,219)

AIR SHOWER see EXTENSIVE AIR SHOWER, PENETRATING SHOWER, SHOWER

a_K (EQUIVALENT AMPLITUDE) see AMPLITUDES

A_K (EQUIVALENT DAILY AMPLITUDE) see AMPLITUDES

ALBEDO

The ratio of the LUMINOUS FLUX reflected by the entire lighted side of an opaque body to the total flux incident on the body. (F.1.5,253)

ALBEDO NEUTRONS, ALBEDO PARTICLES

Neutrons or other particles, such as electrons or protons, which leave the earth's atmosphere, after having been produced by nuclear interactions of energetic particles within the atmosphere.

ALFVÉN CENTRE see GUIDING CENTRE

ALFVÉN SPEED (v_A) see ALFVÉN WAVES

ALFVÉN VELOCITY ($\vec{v}_A$) see ALFVÉN WAVES

ALFVÉN WAVES

Transverse waves in an electrically conducting fluid, propagating along the field lines of a steady magnetic field. More loosely, any wave motion in which the energy appears alternatively as kinetic energy of the fluid or as energy of deformation of a magnetic field H, and which consequently propagates at the ALFVÉN SPEED $H/\sqrt{4\pi\rho}$ where ρ is the density. ($H/\sqrt{4\pi\rho}$ is also referred to as the ALFVÉN VELOCITY.)

AMPLITUDES (a, a_K, A_K, a_p, A_p)

Linear indices of GEOMAGNETIC ACTIVITY.

a is the AMPLITUDE IN GAMMAS of the variation in the most disturbed field component during a 3-hour interval. This value is used in calculating the K-index (see K).

THE EQUIVALENT AMPLITUDE, a_K, is a reconversion of K to a linear scale, with units of 2γ, and range 0-400. Values $\gtrsim 50$ (100γ) indicate a severe disturbance.

A_K, the EQUIVALENT DAILY AMPLITUDE, is the average of the 8 three-hourly a_K values.

a_p, the three-hourly EQUIVALENT PLANETARY AMPLITUDE, bears the same relationship to K_p as a_K does to K.

A_p, the DAILY EQUIVALENT PLANETARY AMPLITUDE, is the average of the 8 three-hourly a_p values. (C.4.1,229)

ÅNGSTROM (Å)

A unit of length = 1×10^{-8} centimeter.

ANTI-MERIDIAN see CELESTIAL MERIDIAN

a_p (EQUIVALENT PLANETARY AMPLITUDE) see AMPLITUDES

A_p (DAILY EQUIVALENT PLANETARY AMPLITUDE) see AMPLITUDES

APPARENT PATH see GROUP PATH

APPARENT SOLAR TIME see LOCAL TIME

APR see ACTIVE PROMINENCE REGION

APT (AUTOMATIC PICTURE TRANSMISSION SYSTEM)
Satellite camera system used in TIROS satellites. (A.2.19,18)

ARC see AURORA (FORMS)

AREA

The AREA of a SOLAR FLARE is defined as the extent of the region over which enhancement of the Hα-LINE is observed. Away from the centre of the DISK, the measurement of "plan" areas is complicated by geometrical fore-shortening and by the upward extent of flares in the SOLAR ATMOSPHERE. No standard method of correction has yet been agreed upon.

Basic units of flare area are the SQUARE DEGREE = one square degree in heliographic co-ordinates at the centre of the solar disk; and 1/(48.5) of a square degree = one millionth of the visible solar hemisphere. One square degree is equal to $(1.214 \times 10^4 \text{ km})^2$. (B.3.14,42,58)

ARIEL

A series of satellites launched for Britain by the U.S.A. The U.S. is responsible for vehicle technology and design; the U.K. is responsible for the experiments carried.

Ariel 1 (UK-1; 1962o) was launched in April 1962.
Ariel 2 (UK-2; 1964-15A) was launched in March 1964.
Ariel 3 (UK-3) was launched on May 5th 1967. (C.1.6,7; C.1.10,1)

ARTIFICIAL RADIATION

A flux of energetic charged particles, of "man-made" origin, TRAPPED in the GEOMAGNETIC FIELD. Artificial radiation is due mainly to high-altitude nuclear explosions.

Regions of the field in which artificial radiation is trapped are known as ARTIFICIAL RADIATION BELTS. (D.3.10,573)

AS see EXTENSIVE AIR SHOWER; SHOWER (C.5.1,215)

ASSOCIATED CORPUSCULAR EMISSION

The full complement of SECONDARY charged particles associated with the passage of an X or GAMMA-RAY beam through air. This complement is attained after the beam has traversed sufficient air to establish an equilibrium ratio between the numbers of PRIMARY photons and SECONDARY electrons. Equilibrium with SECONDARY photons is deliberately excluded.

See RÖNTGEN (F.3.7,382)

ASTRONOMICAL UNIT (a.u., A.U., AU)

The radius of the circular orbit described around the sun by a planet of negligible mass, free of all perturbations, having a mean period of revolution of 365.2568983263 days.

For practical purposes, the a.u. is taken as the mean earth-sun distance; or, more exactly, as the semi-major axis of the earth's orbit (1.00000023 a.u.). The semi-minor axis of the earth's orbit is 0.999865107 a.u.

Numerically, the a.u. may be taken as 1.4960×10^{13} cm.

(F.1.1,15; F.1.10,332)

ASYMPTOTIC CONE OF ACCEPTANCE

The solid angle in the CELESTIAL SPHERE from which particles have to come in order to contribute significantly to the counting rate of a given NEUTRON MONITOR on the surface of the earth.

See also MEAN ASYMPTOTIC DIRECTION OF VIEWING. (C.3.8,492)

ASYMPTOTIC DIRECTION OF ARRIVAL

The direction at infinity of a positively-charged particle, with given RIGIDITY, which impinges in a given direction at a given point on the surface of the earth, after passing through the GEOMAGNETIC FIELD.

(C.3.8,491)

ATMOSPHERE, SOLAR see SOLAR ATMOSPHERE

ATMOSPHERICS

Transient radio waves produced by naturally-occurring electric discharges in the earth's atmosphere (e.g. LIGHTNING). The spectrum of atmospherics is generally weighted toward long radio waves, but it may contain audio frequencies.

During a GEOMAGNETIC STORM, the long-wave reflectivity of the D-REGION is improved, so that atmospherics may propagate over long distances by ionospheric reflection.

Atmospherics are commonly referred to as SFERICS (or SPHERICS).

See SUDDEN ENHANCEMENT OF ATMOSPHERICS; DAWN CHORUS; TWEEKS; WHISTLERS. (D.6.8,315; E.5.2,114)

a.u., A.U., AU see ASTRONOMICAL UNIT

AURORA (or AURORA POLARIS)

A large-scale luminous disturbance of the earth's upper atmosphere. Auroras are observed chiefly at night in or near the AURORAL ZONES (around MAGNETIC LATITUDE 67°).

Although no two auroras are identical, the number of general forms is limited (see AURORA (FORMS) and D.4.5,271). The lower border lies, on average, at 105 km altitude, and the upper limit at 150-250 km, according to the type of display. Wide variations about these averages occur - auroras have been observed at altitudes ranging from less than 80 km to more than 1000 km.

Auroras appear to be closely related to the GEOMAGNETIC FIELD. They result from a wide variety of excitation processes, such as energetic-particle collisions, fluorescence, chemiluminescence, etc. The weaker displays are indistinguishable from the AIRGLOW.

Auroral displays observed in the northern AURORAL REGION are called the AURORA BOREALIS or NORTHERN LIGHTS, while those in the southern auroral region are called the AURORA AUSTRALIS.

(D.4.5,269; D.4.6; E.1.3,407; E.4.2,308)

AURORA AUSTRALIS see AURORA

AURORA BOREALIS see AURORA

AURORA (FORMS)

Two basic forms of auroral display may be recognized - "ribbon-like" BANDS, and "cloud-like" SURFACES. The simplest band form is an arch which is uniformly bright along its horizontal extent. This type of display, known as a HOMOGENEOUS ARC, is the fundamental form of the "quiet" aurora. Other forms result from the addition of different degrees of auroral activity. (The list of forms below is in increasing order of activity.)

(1) RAYED ARC - an arc displaying "searchlight-beam" RAY structure.

(2) BAND - an arc displaying "FOLDS".

(3) RAYED BAND - an arc displaying both rays and folds.

(4) DRAPERY - an older term for an arc displaying large-scale rays, folds, and LOOPS.

(5) SCATTERED RAYS - a rayed band broken up by auroral activity.

(6) SCATTERED PATCHES - diffuse, cloud-like PATCHES (a form of SURFACE) covering the sky, after the complete disruption of a quiet form by intense activity.

(D.4.2,498)

AURORAL ABSORPTION EVENT

A large increase in D-REGION electron density and associated radio-signal absorption, caused by electron-bombardment of the atmosphere during an AURORA or a GEOMAGNETIC STORM. These events occur mainly in the AURORAL ZONES, but may be observed at lower latitudes during magnetic storms. The incident electron flux is thought to be due to the release of trapped, intermediate-energy electrons. (D.4.15,771; E.1.7,171)

AURORAL CAPS

The regions surrounding the AURORAL POLES, lying between the poles and the AURORAL ZONES. (D.4.6,101; D.4.7,232)

AURORAL ELECTROJET

An intense electric current in the MAGNETOSPHERE, flowing along the AURORAL ZONES during a POLAR SUBSTORM. The flow is mainly westward, but may be eastward over the noon sector of the earth. During a GEOMAGNETIC STORM, the current develops and decays intermittently. (D.4.7,237)

AURORAL FREQUENCY see AURORAL ISOCHASM

AURORAL ISOCHASM

A line connecting places of equal AURORAL FREQUENCY, averaged over a number of years. The AURORAL FREQUENCY is reckoned as the percentage of nights at each place on which an AURORA is seen, or on which one would be seen if clouds did not interfere.

The isochasms form a series of near-ellipses centred on the AURORAL POLES. Hultqvist has shown that these curves correspond to circles in the equatorial plane projected down to the earth's surface along GEOMAGNETIC FIELD lines. (D.4.7,230; D.4.11,142)

AURORAL POLES

The points on the earth's surface on which the AURORAL ISOCHASMS are centred. The auroral poles coincide approximately with the MAGNETIC-AXIS POLES of the GEOMAGNETIC FIELD. (D.4.7,231)

AURORAL REGION

The region within 30° GEOMAGNETIC LATITUDE of each AURORAL POLE. AURORAS are frequently observed in these regions. (D.4.6,101; D.4.7,232)

AURORAL STORM

A rapid succession of AURORAL SUBSTORMS, occurring in a short period, of the order of a day, during a GEOMAGNETIC STORM. (D.4.2,511)

AURORAL SUBSTORM

A wide-spread disturbance of quiet AURORAL conditions in the polar regions. Each substorm consists of an expansive phase and a recovery phase, and has a lifetime of the order of 1 to 3 hours. (D.4.2,502)

AURORAL ZONE

The auroral zones are the regions of maximum occurrence of the AURORA. They are defined as bands of GEOMAGNETIC LATITUDE, about 4° in width, centred on the north and south maximum AURORAL ISOCHASMS. (The maximum isochasms have mean angular radii of 23° about the AURORAL POLES.)

In the auroral zones, the aurora is visible at some time on nearly every clear night. (D.4.6,101; D.4.7,232)

AURORAL ZONE BLACKOUT

An increase of ionization in the lower IONOSPHERE near the AURORAL ZONE. The occurrence of auroral zone blackouts is correlated with AURORAS and local GEOMAGNETIC DISTURBANCES.

See also POLAR BLACKOUT. (E.2.9,338)

AURORA POLARIS see AURORA

AUSTRAL AXIS POLE

The southern intersection of the GEOMAGNETIC AXIS with the earth's surface. (D.4.7,232)

AUTUMNAL EQUINOX see EQUINOX

AZA (AURORAL ZONE ABSORPTION) see AURORAL ABSORPTION EVENT

BAILY BEADS see ECLIPSE (B.1.2,106)

BALL LIGHTNING

A reddish, luminous ball, 10-20 cm in diameter, which sometimes appears after an ordinary LIGHTNING discharge, and lasts for several seconds.

Also known as a FIREBALL or THUNDERBOLT. (E.5.2,6; E.5.4,335)

BALMER CONTINUUM see BALMER SERIES

BALMER DECREMENT see BALMER SERIES

BALMER DISCONTINUITY see BALMER SERIES

BALMER LIMIT see BALMER SERIES

BALMER LINES see BALMER SERIES

BALMER SERIES

BALMER LINES are the series in the hydrogen-atom spectrum resulting from transitions to or from the second [$n = 2$], or L-shell electron states.

The lines converge to the BALMER LIMIT at $\lambda 3646$ Å, and the BALMER CONTINUUM stretches from this limit to shorter wavelengths. In stellar spectra there is often an abrupt change of intensity at the Balmer limit, known as the BALMER DISCONTINUITY. The magnitude, D, of this discontinuity is defined to be $\{\log I_{3646+} - \log I_{3646-}\}$.

The ratio of the intensities of successive Balmer lines is known as the BALMER DECREMENT. During the FLASH PHASE of SOLAR FLARES the observed decrement varies markedly from its normal value, becoming ANOMALOUS.

BAND

One of the two basic forms of auroral display.
See AURORA (FORMS).

BAROMETRIC EQUATION

An equation which expresses the variation of atmospheric pressure (or density) with height as an exponential decrease. (E.1.7,196)

BARYON see PARTICLES

BAY see MAGNETIC BAY

BEAD LIGHTNING

A form of LIGHTNING in which the discharge-channel luminosity persists, with some portions of the channel remaining visible longer than others. Typically, the "beads" last for around $\frac{1}{2}$ a second. (E.5.4,335)

BETATRON MECHANISM

The mechanism by which electrons are accelerated in the betatron. A charged particle travelling in a closed or helical orbit is accelerated by the tangential electric field induced when the magnetic flux through the orbit is changed.

The betatron mechanism is a form of TRANSIT ACCELERATION.

BIPOLAR MAGNETIC REGION (BM REGION)

A region of the solar PHOTOSPHERE containing two neighbouring MAGNETIC FIELD STRENGTH MAXIMA of opposite polarity, obeying the POLARITY LAW. In general there is approximate equality of positive and negative magnetic fluxes. BM REGIONS do not occur at high latitudes.

SUNSPOTS develop in strong, young BM REGIONS, then disappear as the region ages. FACULAE are always associated with BM regions when the field intensity is greater than 2 gauss.

<u>BIPOLAR SUNSPOT GROUP</u> see SUNSPOT GROUP CLASSIFICATION

<u>BIREFRINGENT FILTER</u> see LYOT FILTER; SOLC FILTER

<u>BM</u> (BIPOLAR MAGNETIC) see BIPOLAR MAGNETIC REGION

<u>BODY BURDEN</u> (q) see MAXIMUM PERMISSIBLE BODY BURDEN

<u>BOLIDE</u>

A large METEOR which explodes during its passage through the earth's atmosphere. Bolides are probably of ASTEROIDAL origin.

(F.1.5,98; F.1.12,558)

<u>BOMBS</u> another name for MOUSTACHES

<u>BOREAL AXIS POLE</u>

The northern intersection of the GEOMAGNETIC AXIS with the earth's surface, in the north-western corner of Greenland. (D.4.7,232)

<u>BORON TRIFLUORIDE COUNTER</u>

A PROPORTIONAL COUNTER, filled with boron trifluoride gas, used to detect neutrons. The counter measures the ionizing effects of alpha particles produced by the reaction $B^{10}(n,\alpha)Li^{6}$. Counters of this type are widely used in COSMIC RAY neutron monitors.

See SIMPSON PILE.

<u>BOTTOMSIDE</u>

The lower "side" of the IONOSPHERE. (In most cases, the term refers specifically to the lower part of the F-REGION.) (E.1.7,190)

<u>bps</u> (BAY PULSATIONS) see IRREGULAR PULSATIONS (D.5.1,565; D.5.10,27)

BREAKUP

The disruption of a "quiet" auroral form by intense auroral activity. See AURORA (FORMS); PSEUDO BREAKUP.

BREMSSTRAHLUNG

Radiation emitted by an electron deflected by the Coulomb field of a nucleus. (More precisely, the electron, interacting with the radiation field, emits a photon when influenced by the nucleus.) Bremsstrahlung is also referred to as "collision", "deceleration", or "braking" radiation.

MAGNETIC BREMSSTRAHLUNG is another name for SYNCHROTRON RADIATION.

BRIGHT LIMB EVENT

A term used in place of LIMB FLARE, in order to avoid the problem of deciding which limb phenomena would actually appear as SOLAR FLARES if seen on the DISK. (B.3.14,126)

BRIGHTNESS

The LUMINOUS INTENSITY per unit "effective" area of a surface element viewed in a given direction. The "effective" area of an element dS viewed at angle θ to the normal is $dS \cos \theta$. If the element's luminous intensity in this direction is dI_θ, the BRIGHTNESS is $\frac{dI_\theta}{dS \cos \theta}$.

The PHOTOMETRIC BRIGHTNESS (or LUMINANCE) thus defined should not be confused with the VISUAL BRIGHTNESS, which depends on observational conditions.

The MONOCHROMATIC or SPECTRAL BRIGHTNESS at a given wavelength is the brightness defined with respect to the MONOCHROMATIC INTENSITY of the source at that wavelength. (F.1.10,121; F.4.15,350)

BRIGHTNESS TEMPERATURE

The temperature of a black body which radiates the same amount of energy as the body in question over an interval $d\lambda$ at a specified wavelength.

BRIGHT RING

A bright irregular structure surrounding the PENUMBRA of some medium and large SUNSPOTS. When observed at the centre of the DISK, the "ring" is 2-3% brighter than the PHOTOSPHERIC background. This enhancement falls off to zero at the LIMB. (B.1.2,152)

BRIGHT SURGE AT LIMB (BSL)

A SURGE observed at the solar LIMB. Typical characteristics are high intensity and narrow shape. (B.2.4,277)

BRUSH

A type of fine structure observed in the monochromatic CORONA.

A POLAR BRUSH is an aggregate of fine, slightly bent RAYS in polar regions of the corona. (B.1.16; B.3.14,11)

BSL see BRIGHT SURGE AT LIMB

BURST

A transient enhancement of the SOLAR RADIO EMISSION, usually associated with an ACTIVE REGION.

TYPE I - STORM BURSTS, associated with NOISE STORMS.

TYPE II - SLOW-DRIFT BURSTS, usually associated with SOLAR FLARES.

TYPE III - FAST-DRIFT BURSTS, often associated with SOLAR FLARES.

TYPE IV - CONTINUUM BURSTS, usually associated with SOLAR FLARES, and often preceded by TYPE II.

TYPE V - Short-lived CONTINUUM BURSTS, occasionally following TYPE III.

M-BURST - An intense, impulsive burst sometimes preceding TYPE IV.

U-BURST - A FAST-DRIFT BURST in which the frequency drift changes its direction.

MICROWAVE BURST - A burst at centimeter wavelengths.

BUTTERFLY DIAGRAM

A diagram, first used by MAUNDER, showing the drift of SOLAR ACTIVITY from high to low latitudes during a SUNSPOT CYCLE. Contours are drawn connecting equal annual SUNSPOT NUMBERS, on a plot of solar latitude vs. time. These contours have a "butterfly" shape, roughly symmetrical about the equator, with one "butterfly" per sunspot cycle. (B.1.2,326)

C (DAILY MAGNETIC CHARACTER FIGURE)

A daily index of the GEOMAGNETIC ACTIVITY observed at each place on earth. C may have the values:- 0 - quiet
1 - moderately disturbed
2 - heavily disturbed.

The daily world-wide average of C is known as the DAILY INTERNATIONAL MAGNETIC CHARACTER FIGURE (C_i).

A third index, C_p (DAILY PLANETARY MAGNETIC CHARACTER FIGURE), is derived from the sum of the 3-hourly EQUIVALENT PLANETARY AMPLITUDES a_p (see AMPLITUDES), by means of a tabulated rule. (C.4.1,230)

CA (CORONAL ACTIVITY CENTRE)

CASCADE

A long sequence of reactions initiated by high energy particles interacting with matter. The ELECTROMAGNETIC CASCADE consists of alternate and multiplicative production of electrons and photons by PAIR PRODUCTION and BREMSSTRAHLUNG. The NUCLEONIC CASCADE consists of a sequence of nuclear interactions in which high-energy NUCLEONS, colliding with target nuclei, liberate still more high-energy nucleons.

CCIF (INTERNATIONAL TELEPHONE CONSULTATIVE COMMITTEE) see CCITT

CCIR (COMITÉ CONSULTATIF INTERNATIONAL DES RADIOCOMMUNICATIONS)

A permanent organ of the ITU, founded in 1927 to examine and issue recommendations on technical and operating radio questions.

(A.2.14,479; A.2.19,8)

CCIT (INTERNATIONAL TELEGRAPH CONSULTATIVE COMMITTEE) see CCITT

CCITT (INTERNATIONAL TELEGRAPH AND TELEPHONE CONSULTATIVE COMMITTEE)

An organization within the ITU. The CCITT was created in January 1957 by the fusion of the INTERNATIONAL TELEGRAPH CONSULTATIVE COMMITTEE (CCIT, formed 1925) and the INTERNATIONAL TELEPHONE CONSULTATIVE COMMITTEE (CCIF, formed 1924).

(A.2.14,479; A.2.19,8)

CELESTIAL EQUATOR see CELESTIAL SPHERE (F.1.5,254)

CELESTIAL LATITUDE see ECLIPTIC

CELESTIAL LONGITUDE see ECLIPTIC

CELESTIAL MERIDIAN

The "visible" half of the great circle passing through the ZENITH and the CELESTIAL POLES. The "invisible" half of this circle, passing through the NADIR, is known as the ANTI-MERIDIAN. (F.1.5,256)

CELESTIAL POLES see CELESTIAL SPHERE (F.1.5,254)

CELESTIAL SPHERE

An imaginary sphere of infinite radius, centred on the observer's position in space. For many astronomical purposes, celestial objects are considered as though they were located on the surface of this sphere.

The projections of the earth's (geographical) equator and poles onto the celestial sphere are known as the CELESTIAL EQUATOR and the CELESTIAL POLES. (F.1.5,254)

CENTRAL MERIDIAN PASSAGE (CMP)

The passage of a solar ACTIVE REGION across the central meridian of the solar DISK.

CENTRAL REVERSAL see SELF REVERSAL

CENTRE OF ACTIVITY see ACTIVE CENTRE

CENTRE-TO-LIMB VARIATION

A change in the observed value of a solar quantity as the point observed moves from the centre of the DISK to the LIMB.

ČERENKOV DETECTOR

A device which detects fast charged particles by counting the flashes of ČERENKOV RADIATION emitted as the particles pass through a transparent dielectric (e.g. Lucite). (F.4.5,202)

ČERENKOV RADIATION

ELECTROMAGNETIC RADIATION emitted by a charged particle moving uniformly through a dielectric medium at a speed greater than the phase velocity of electromagnetic radiation in the medium.

Čerenkov radiation is an electromagnetic analogue of the supersonic "bang". (F.4.7,419; F.4.12,309)

CERN (CENTRE EUROPÉEN POUR LA RECHERCHE NUCLÉAIRE, at Geneva)

CHARACTER FIGURES see C

CHONDRITE

A stony METEORITE (AEROLITE) containing CHONDRULES. The majority of aerolites are chondritic. (E.5.3,70; F.1.12,562)

CHONDRULES

Small spheres or spheroids of silica (or other minerals) less than 3 mm in diameter, occurring as inclusions in the majority of stony METEORITES (AEROLITES). Aerolites are classed as CHONDRITES or ACHONDRITES, according to whether or not they contain chondrules. Terrestrial rocks are achondritic. (E.5.3,82; F.1.12,562)

CHORUS see DAWN CHORUS; RADIO NOISE: VLF EMISSION

CHREE DIAGRAM see SUPERPOSED EPOCH ANALYSIS

CHROMOSPHERE

The layer of the SOLAR ATMOSPHERE lying between the PHOTOSPHERE and the CORONA. The base of the CHROMOSPHERE is arbitrarily assumed to coincide with the LIMB, as observed at 5000 Å; the overall height of the layer is about 10,000 km.

The chromospheric spectrum consists of the EMISSION LINES of the FLASH SPECTRUM, superimposed on a weaker CONTINUUM. The lower chromosphere appears uniform at the limb; emission from the upper chromosphere is mainly from the SPICULES.

CHROMOSPHERIC EMISSION LINES see CHROMOSPHERE; FLASH SPECTRUM

CHROMOSPHERIC ERUPTION another name for SOLAR FLARE

CHROMOSPHERIC FACULA another name for PLAGE

CHROMOSPHERIC GRANULES see MOTTLES

CHROMOSPHERIC MOTTLES see MOTTLES

CHROMOSPHERIC STRIATIONS

Another name for FIBRILLES, introduced by Ellison, et al, Observatory 80, 149 (1960). (B.3.14,23)

C_i (DAILY INTERNATIONAL MAGNETIC CHARACTER FIGURE) see C

CIG (COMITÉ INTERNATIONAL DE GÉOPHYSIQUE)

A committee set up in 1959 by the ICSU to replace the CSG in carrying on the work of the CSAGI. Its duties have included the publication of IGY results, and the continuation of reduced programmes of international co-operation. (A.2.14,316; A.2.19,44)

CIRA (COSPAR INTERNATIONAL REFERENCE ATMOSPHERE)

The first edition of CIRA was published in 1961. An improved version, CIRA 1965, was published in 1965. (E.1.8; E.1.9)

CIRCUMFACULAIRE

A "dark ellipse" around a PLAGE viewed in the light of the K-LINE. This ellipse is most clearly visible when the plage is at its maximum brightness. (B.2.2,1495)

CIRST

The French information centre on solar-terrestrial relationships. (A.2.19,83)

C-LAYER

A region of ionization in the earth's atmosphere, lying below the D-LAYER. The C-layer electron density grows rapidly just before dawn, remains nearly constant during the daylight hours, and decays gradually after sunset. This behaviour is probably due to the combination of a constant source of ionization - such as COSMIC RADIATION - and a variable electron-removal process. At night, electrons can be removed by attachment, forming negative ions. As these ions are unstable in the presence of visible sunlight, this removal process cannot operate effectively during the day.

Also known as C-REGION. (E.2.16)

CMP see CENTRAL MERIDIAN PASSAGE

CNA (COSMIC NOISE ABSORPTION)
see COSMIC NOISE; SUDDEN COSMIC NOISE ABSORPTION

CNES

The French National Space Research Centre. (A.2.19,79)

COARSE MOTTLES see MOTTLES

COEFFICIENT OF ABSORPTION see ABSORPTION COEFFICIENT

COELOSTAT

A plane mirror carried on an axis which is parallel to the earth's axis of rotation and which rotates once in 48 hours. The COELOSTAT mirror reflects sunlight in a fixed direction, determined in part by the SUN's declination. (F.1.8,610)

COINCIDENCE TELESCOPE

Two or more IONIZING PARTICLE detectors (e.g. GEIGER-MÜLLER COUNTERS) arranged in a series, with their outputs connected to a coincidence circuit. Ideally, the coincidence counter will produce a response only when a single particle passes through all the detectors. The device thus defines an "acceptance" solid angle for single particles.

COLLISION BROADENING see COLLISION DAMPING

COLLISION DAMPING (COLLISION BROADENING)

"Spreading" of spectral LINE PROFILES, caused by gas-phase collisions between the emitting (or absorbing) atoms.

When two atoms come close together, VAN DER WAALS FORCES, electrical forces, etc. perturb the atomic energy levels and produce frequency shifts in the observed spectra. The distribution of IMPACT PARAMETERS in gas-phase collisions produces a smooth spread of frequencies around each "unbroadened" line. In addition, collisions may induce transitions to the ground level, thus shortening the lives of excited states and increasing the natural breadth of lines (see RADIATION DAMPING).

Collision broadening is also referred to as PRESSURE BROADENING, since the frequency of collisions depends on gas-density, and hence on pressure. See also RESONANCE BROADENING; STARK BROADENING.

(B.3.14,5; F.4.6,187)

COLLISION PARAMETER another name for IMPACT PARAMETER

COMITÉ INTERNATIONALE DE GÉOPHYSIQUE see CIG

COMITÉ SPECIAL DE L'ANNÉE GÉOPHYSIQUE INTERNATIONALE see CSAGI

COMPLEX PCA EVENT see POLAR CAP ABSORPTION

COMPTON EFFECT

The scattering of photons by free electrons. Recoil energy is transferred from the photon to the electron during a collision, so that the photon is degraded to longer wavelengths.

COMPTON-GETTING EFFECT

An anisotropy of the extragalactic COSMIC RADIATION incident upon the earth, caused by rotation of the galaxy about its centre. Rays arriving from the direction toward which we are moving should be more abundant than those from the "trailing" direction. (C.5.1,270; C.5.2; F.4.5,444)

COMPTON SCATTERING

The scattering of light by electrons, involving an interchange of momentum between a photon and an electron.

CONDENSATION see CORONAL CONDENSATION

CONE OF AVOIDANCE

The region above a solar ACTIVE REGION in a model proposed by Pecker and Roberts. In this model, particles emitted from an active region are systematically deflected away from the radial direction. Particularly intense emission therefore occurs just before and after CENTRAL MERIDIAN PASSAGE of the region, while just at CMP particle radiation is at a minimum. (C.4.4)

CONJUGATE POINTS

Two points on the earth's surface, at opposite ends of a GEOMAGNETIC FIELD line. Each line of force of the field defines a pair of conjugate points. (D.4.7,239; D.4.8,384)

CONTINUOUS EMISSION

Emission of electromagnetic radiation with relatively uniform intensity over wide ranges of the spectrum - as opposed to LINE EMISSION, in which the intensity is sharply peaked at characteristic wavelengths.

CONTINUOUS PULSATIONS (Pc)

MICROPULSATIONS of a regular and mainly continuous nature, with a wide range of periods. Pc's are grouped, according to their physical and morphological properties, into five categories.

Pc1 (HM EMISSIONS, PP, PEARLS, PEARL-TYPE PULSATIONS, TYPE A OSCILLATIONS:- periods 0.2-5 sec) may occur in burst ("pearls"), or in consecutive groups of pulsations with sharply decreasing frequency. They may be due to oscillations of bunches of monoenergetic particles trapped in the MAGNETOSPHERE; alternatively, they may represent standing HYDROMAGNETIC WAVES in the cavity between the earth and the layer of maximum ALFVÉN SPEED (v_A).

Pc2 (periods 5-10 sec) do not seem to be physically related to Pc1 or Pc3.

Pc3 (Pc-1, Pc, TYPE C OSCILLATIONS:- periods 10-45 sec) are thought to represent standing poloidal hydromagnetic waves in the cavity between the IONOSPHERE and the layer of maximum v_A. They occur over a wide range of latitude.

Pc4 (Pc-II, Pc°:- periods 45-150 sec) and Pc5 (Lpc, LPc, Pg, Pc-III, GIANT MICROPULSATIONS:- periods 150-600 sec) are thought to represent standing toroidal hydromagnetic oscillations propagating along geomagnetic field lines. (D.5.6; D.5.12,488,508)

CONTINUOUS SPECTRUM see CONTINUOUS EMISSION

CONTINUUM BURST see BURST; TYPES IV and V RADIO BURSTS

CONTINUUM RADIATION

Electromagnetic radiation in which the intensity varies smoothly with frequency over a wide range.

CONTINUUM STORM

An intense solar RADIO BURST in the meter and decimeter wavelengths, lasting for hours or even days. Also known as TYPE IV-C BURST.

Type IV-C bursts occur comparatively rarely, and follow TYPE IV-B BURSTS. IV-C bursts are small compared to IV-B, originate lower in the corona, and are stationary. They seem to occur only when the associated flare is near the centre of the solar disk. (B.3.14,195)

COPERS (EUROPEAN PREPARATORY COMMISSION FOR SPACE RESEARCH) (A.2.19,35)

CORONA

The greatly extended region of low density [$<10^9$ cm^{-3}] and high temperature [2×10^6 °K] which forms the outermost layer of the SOLAR ATMOSPHERE. The corona is extended far out into interplanetary space by the SOLAR WIND - a steady outward streaming of coronal material.

CORONAL EMISSIONS comprise both a CONTINUOUS SPECTRUM and discrete EMISSION LINES. Much of the sun's X-RAY and RADIO EMISSION is due to coronal processes.

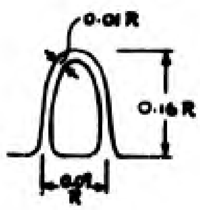
CORONAGRAPH

A device, developed by LYOT, which makes it possible to observe the CORONA and CHROMOSPHERE at times other than during an ECLIPSE. The device consists of a telescope in which a high-quality simple lens focuses the sun onto an occulting disk which, in turn, prevents the light from the solar disk from proceeding further along the optical path. (B.3.14,9)

CORONAL ARCH

A CORONAL CONDENSATION having the shape of a half-ellipse with its centre at the solar limb. Typical dimensions:

(i) height 0.16 R (R = solar radius)
(ii) width 0.09 R
(iii) thickness of "ribbon" 0.01 R



(B.1.16,294)

CORONAL CONDENSATION

Structure or feature in the inner CORONA having high intensity in the CORONAL EMISSION lines. Many condensations are arch-shaped, and many are connected with PROMINENCES or SOLAR FLARES. Condensations occur exclusively in the SUNSPOT ZONE.

Coronal condensations have a greater density and a higher electron temperature than the undisturbed corona. The most active condensations are known as PERMANENT CORONAL CONDENSATIONS, as distinct from SPORADIC CORONAL CONDENSATIONS which are associated with a local decrease of the electron temperature within permanent condensations. The lifetimes of condensations range from several days (in the case of permanent condensations), down to several hours. (B.1.2,189,273)

CORONAL EMISSIONS

The CORONA emits both a CONTINUOUS SPECTRUM - separable into the K-CORONA and the F-CORONA - and discrete EMISSION LINES. The latter are due to transitions in very highly ionized atoms (e.g. iron atoms that have lost 9-14 electrons).

The white-light corona has a non-uniform structure, consisting of STREAMERS, ARCS, etc. The monochromatic corona exhibits fine structure (RAYS, BRUSHES, CONDENSATIONS, etc.) corresponding to variations in temperature and density. The distribution of emission-line intensities agrees only roughly with the intensity distribution of the white-light corona. (B.3.14,10)

CORONAL EXPANSION see SOLAR WIND

CORONAL RAIN

A form of PROMINENCE labelled ANa in the MENZEL-EVANS CLASSIFICATION.

CORONAL RAY see RAY

CORONAL STREAMER

A large-scale structure in the white-light CORONA. The general shape and extent of a streamer depends on the phase of the SOLAR CYCLE.

(B.1.2,280; B.3.14,10)

CORPUSCULAR RADIATION

A flux of elementary particles or atomic nuclei. An example is the COSMIC RADIATION.

COSMIC DUST

The generic term for small, electrically neutral material particles occurring as debris in space. Working outward from the Earth, the cosmic dust may be classified as: TROPOSPHERIC DUST; upper atmospheric dust; INTERPLANETARY DUST (ZODIACAL CLOUD, METEORITIC DUST); GALACTIC DUST: INTERSTELLAR DUST. (F.1.11,528)

COSMIC NOISE

The broad spectrum of RADIO NOISE arriving at the earth from sources outside the solar system.

At frequencies from 15-30 Mc/s, cosmic noise is appreciably absorbed by the IONOSPHERE. If the "source intensity" is assumed constant with time, the noise power received at ground-level may be taken as a measure of ionospheric absorption.

See INDIRECT FLARE DETECTOR; POLAR CAP ABSORPTION; RIOMETER; SUDDEN COSMIC NOISE ABSORPTION.

COSMIC NOISE ABSORPTION (CNA)

See COSMIC NOISE; SUDDEN COSMIC NOISE ABSORPTION.

COSMIC RADIATION

A flux of high-energy CORPUSCULAR RADIATION believed to permeate interstellar space. The flux incident on the earth's atmosphere is known as the PRIMARY COSMIC RADIATION. The lower-energy particles produced when primary particles collide with atmospheric nuclei are known as SECONDARIES, or SECONDARY COSMIC RADIATION.

In the neighbourhood of the earth the primary radiation has two main components: the background GALACTIC COSMIC RADIATION (mean energy = 2 BeV/particle; average flux = 0.4 nucleon/cm^2/ster.), and the less energetic intermittent SOLAR COSMIC RADIATION generated in SOLAR FLARES. Both classes of radiation consist almost entirely of nuclei of elements ranging from hydrogen to iron.

The secondary radiation observed deep in the atmosphere may be split up into the SOFT COMPONENT (electrons and photons), which is almost completely removed by 10 cm of lead, and the HARD COMPONENT, or PENETRATING COMPONENT (muons and nucleons). The muons of the hard component penetrate to a great depth in the earth's crust. (C.3; C.5)

COSMIC RADIO NOISE see COSMIC NOISE

COSPAR (SCIENTIFIC COMMITTEE ON SPACE RESEARCH)

A committee within ICSU, set up in 1958 to further, at international level, the progress of scientific knowledge regarding the use of rockets and space vehicles. COSPAR is concerned with fundamental research rather than technological problems. (A.2.14,316; A.2.18,234; A.2.19,43)

C_p (DAILY PLANETARY MAGNETIC CHARACTER FIGURE) see C

C-REGION

An ACTIVE CENTRE in the CORONA characterized by QUIESCENT PROMINENCES and intense monochromatic CORONAL EMISSIONS even after its associated SUNSPOTS have disappeared.

Also known as a WALDMEIER C-REGION. (B.3.14,236)

C-REGION may also refer to a portion of the earth's IONOSPHERE. See C-LAYER.

CRITICAL BODY ORGAN

The organ which is responsible for the greatest body damage after the body has been irradiated with a given radio-nuclide. Usually the critical body organ will be the one in which the highest concentration of the nuclide accumulates. (F.3.9,569)

CRITICAL FREQUENCY

If an IONOSPHERIC layer possesses a distinct maximum of ionization, a radio frequency capable of just penetrating to this height is called a "critical frequency" of the layer. Strictly speaking this frequency is not reflected by the layer, but is infinitely retarded and absorbed. It may be identified, however, as the frequency to which the VIRTUAL HEIGHT vs. frequency curve becomes asymptotic.

If an ionospheric layer does not possess a definite maximum of ionization, it will not have a true critical frequency. In some cases it is possible to identify the frequency at a cusp on the virtual height/frequency curve as a "quasi-critical" frequency.

In discussing models of ionospheric layers, some authors use the term PENETRATION FREQUENCY instead of "critical frequency". "Penetration frequency" is also used to refer to the lowest frequency which will penetrate a given layer and give echoes from one of the higher layers.

The ORDINARY RAY critical frequency for a given ionospheric layer is denoted by the symbol f_o plus the name of the layer (e.g. f_oE, f_oF1, f_oF2, etc.). Similarly, the EXTRAORDINARY RAY critical frequency is denoted by f_x (e.g. f_xE, f_xF1, f_xF2, etc.). Several other symbols are used in special cases - e.g. fEs (the maximum frequency of the SPORADIC E trace), f_bEs (the lowest ordinary-wave frequency at which Es is effectively transparent), etc.

The symbol f-min properly refers to the lowest frequency at which echoes are observed on an ionogram. Some authors, however, use f_{min} (or f_m) to denote critical frequencies.

See also CUT-OFF FREQUENCY.

(E.2.14,112-117; see also E.2.1,190; E.2.11,398; E.2.18,153)

CROCHET

A change in the GEOMAGNETIC FIELD, similar to a small-scale MAGNETIC BAY, associated with the FLASH PHASE of a SOLAR FLARE.

Crochets are caused by electric currents set up in the lower IONOSPHERE after flare-induced increases of ionization and conductivity. These currents, and their field, are denoted by Sqa. Crochets are often associated with SUDDEN IONOSPHERIC DISTURBANCES (although the correlation is imperfect).

Characteristically, H or V increases sharply by about 30γ, then decays gradually to its previous level in about 30 min. A crochet and its associated flare start and peak together; however the crochet is shorter-lived than the flare and its associated SID.

Also known as SOLAR FLARE EFFECT (SFE) (B.1.2,351; B.3.14,232)

CRPL (CENTRAL RADIO PROPAGATION LABORATORY, National Bureau of Standards, Boulder, Colorado)

Now known as the INSTITUTE OF TELECOMMUNICATION SCIENCES AND AERONOMY (ITSA). The activities of CRPL as a WORLD DATA CENTRE A: SOLAR ACTIVITY are now the responsibility of the ENVIRONMENTAL SCIENCE-SERVICES ADMINISTRATION (ESSA) of the ITSA.

CSAGI (COMITÉ SPECIAL DE L'ANNÉE GÉOPHYSIQUE INTERNATIONALE)

A committee set up in 1952 by the ICSU, in co-operation with the WMO, the CCIR and other bodies, to co-ordinate research during the INTERNATIONAL GEOPHYSICAL YEAR (IGY). The CSAGI was replaced in 1959 by the CSG, which was in turn replaced by the CIG, in the same year. (A.2.14,316)

<u>CSIRO</u> (COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, Sydney, Australia)

<u>C-TYPE OSCILLATIONS</u> see RAPID IRREGULAR PULSATIONS (SIP)

(D.5.2; D.5.12,504)

<u>CURIE</u>

The unit of strength of a radioactive source. A source has a strength of one curie when 3.700×10^{10} atoms disintegrate per second.

(F.3.11,304)

<u>CUT-OFF FREQUENCY</u>

A frequency at which the phase velocity becomes infinite for a given mode of plane-wave propagation in a PLASMA.

At a cut-off frequency, both the plane-wave index of refraction and the group velocity vanish. A wave is generally reflected from a region in which the cut-off frequency is greater than the frequency of propagation.

<u>CYCLOTRON FREQUENCY</u> ($\vec{\omega}_c$)

The angular frequency at which a particle of charge q and mass m gyrates in a magnetic field $\vec{B}$:

$$\vec{\omega}_c = \frac{q\vec{B}}{m} .$$

Some authors refer to ω_c as the LARMOR FREQUENCY, although the true Larmor frequency has the magnitude $\frac{1}{2}\omega_c$.

Strictly speaking ω_c is the <u>angular</u> cyclotron frequency and $f_c = \omega_c/2\pi$ is the cyclotron frequency.

Also known as GYROFREQUENCY. (B.4.9,337; F.2.5,2)

<u>CYCLOTRON RESONANCE</u>

A propagation resonance occurring when the frequency of a circularly-polarized wave passing through a magnetic PLASMA is equal to the CYCLOTRON FREQUENCY of one of the species of particles present.

D see GEOMAGNETIC DISTURBANCE

D, d°

The DECLINATION angle of the GEOMAGNETIC FIELD.

$$D = \tan^{-1} Y/X \quad .$$

See GEOMAGNETIC ELEMENTS.

DARK FILAMENT

A PROMINENCE viewed in projection against the solar DISK. See FILAMENT.

DARK FLOCCULI, DARK MARKINGS see FILAMENTS (B.1.2,224)

DARK SURGE ON DISK (DSD)

A SURGE observed on the solar DISK, having a brush-like or streamer-like shape, or appearing as a very dark cloud.

Also known as ACTIVE DARK FLOCCULUS. (B.2.4,277)

DAWN CHORUS

A form of RADIO NOISE, or VLF EMISSION, consisting of overlapping, rising tones, generally confined to frequencies in the mid-audio range (1-3 kc/s). The name "dawn chorus", or CHORUS, was introduced because of similarities to the morning twittering of a flock of birds. A typical constituent tone rises at first slowly, then rapidly, then slowly again, lasting about 0.5 sec in all. Dawn chorus frequently begins as sporadic "chirps", which built up to an intense chorus by dawn. This chorus may last for 1-2 hours, and may recur briefly later in the day. Chorus is generally accompanied by HISS in the 1-3 kc/s range. (D.6.8,320; E.2.7,366)

DAYGLOW The day-time AIRGLOW (D.4.6,376; E.4.3,260)

DCF (DISTURBANCE-CORPUSCULAR FLUX)

A transient perturbation on the GEOMAGNETIC FIELD, due to currents set up at the surface of the MAGNETOSPHERE by impinging SOLAR PLASMA during a GEOMAGNETIC STORM.

The DCF field increases H at the earth's surface in low latitudes. This effect is more important over the sunlit hemisphere than over the dark, as the DCF currents occur mainly on the sunward side of the earth.

The DCF current is also referred to as the SUDDEN COMMENCEMENT current.

(D.4.3,364; D.4.7,236; D.4.8,394)

D_e, D^e ("EXTERNAL" GEOMAGNETIC DISTURBANCE) see GEOMAGNETIC DISTURBANCE (D)

DEBYE LENGTH

An exponential decay factor defining the rate at which effects of an extraneous charge in a PLASMA attenuate with distance. The Debye length may be regarded as the scale length for an "atmosphere" around the charge, within which electroneutrality is disturbed. This "atmosphere" is known as the DEBYE SPHERE.

The concept of the Debye length is borrowed from the Debye-Hückel theory of strong electrolytic solutions.

Also known as DEBYE SHIELDING DISTANCE.

DEBYE SHIELDING DISTANCE see DEBYE LENGTH

DEBYE SPHERE see DEBYE LENGTH

DECAY TIME (1)

The duration of a SOLAR FLARE after reaching its maximum phase. The total lifetime of a flare is given by the sum of its RISE TIME and its DECAY TIME. (B.3.14,102)

DECAY TIME (2)

The time during which the intensity of the energetic solar-particle flux arriving at earth after a SOLAR FLARE decays from its maximum value. The decay time is generally much longer than the RISE TIME.

See also TRANSIT TIME.

DECEMBER ANOMALY

An asymmetry between summer-solstice and winter-solstice values of the CRITICAL FREQUENCY of the F_2-LAYER, consisting of a systematic enhancement during November, December and January, in non-polar latitudes. In the northern hemisphere, the DECEMBER and WINTER ANOMALIES are in phase; in the southern hemisphere they are 6 months out of phase. (E.1.7,187)

DECLINATION (1)

The angular distance of an astronomical body north (+) or south (-) of the CELESTIAL EQUATOR. (F.1.5,254)

DECLINATION (D, d°) (2)

The angle between true North and the horizontal component, H, of the GEOMAGNETIC FIELD.

$$D = \tan^{-1} Y/X \;.$$

Also known as MAGNETIC DECLINATION.

DEPTH-DOSE DISTRIBUTION

A plot of the dose of a given IONIZING RADIATION absorbed by the body tissues as a function of depth of penetration into the body.

DETACHED FLARE

A LIMB FLARE which appears separated from the LIMB. (B.3.14,90)

DEVELOPMENT CURVE

A plot of Hα LINE WIDTH against time for the emission from a SOLAR FLARE.

See also GROWTH CURVE AND LIGHT CURVE. (B.3.14,96)

D_i, D^i ("INTERNAL" GEOMAGNETIC DISTURBANCE) see GEOMAGNETIC DISTURBANCE (D)

Di (IRREGULAR GEOMAGNETIC DISTURBANCE) see GEOMAGNETIC DISTURBANCE (D)

DIFFERENTIAL ENERGY SPECTRUM see ENERGY SPECTRUM

DIFFUSOSPHERE

A name sometimes used for the region of the atmosphere (above the TURBOPAUSE) in which diffusive separation of atmospheric constituents is dominant. In this region, each constituent obeys its own BAROMETRIC EQUATION.

The diffusosphere stretches upward from 100-120 km to the base of the EXOSPHERE, at 500-700 km. (E.1.7,201)

DIP (I)

The geomagnetic INCLINATION angle:

$$\tan I = Z/H \quad .$$

See GEOMAGNETIC ELEMENTS; INCLINATION.

DIP EQUATOR see MAGNETIC CO-ORDINATES

DIP LATITUDE (Φ') see MAGNETIC CO-ORDINATES

DISK

The circular aspect presented by the SUN, observed in integrated light. The sharply defined boundary (LIMB) of the disk, at a radius of 7×10^5 km, indicates the extent of the solar PHOTOSPHERE.

DISK FLARE

A SOLAR FLARE seen against the solar DISK. Thus observed, a flare appears as a brightening of essentially stationary CHROMOSPHERIC material. In most cases, the existing STRIATIONS brighten to form ribbons and nodules, either isolated, or embedded in a less bright, diffuse envelope.

(B.3.14,79)

DISK SURGE see SURGE

DISPARITION BRUSQUE

The SUDDEN DISAPPEARANCE of a dark FILAMENT observed on the solar DISK. See PROMINENCE ACTIVATION.

DISTURBANCE DIURNAL VARIATION (Ds, DS)

See GEOMAGNETIC DISTURBANCE; IONOSPHERIC STORM.

DISTURBANCE VARIATIONS

Fluctuations in the GEOMAGNETIC FIELD, associated with a GEOMAGNETIC STORM.

See GEOMAGNETIC DISTURBANCE; SUDDEN COMMENCEMENT.

DISTURBED DAYS (d)

The 5 days in each month with the highest INTERNATIONAL MAGNETIC CHARACTER FIGURES, C_i.

See C; SOLAR DAILY VARIATION (S).

DIURNAL

Daily; occupying one day.

DIURNAL VARIATIONS

Regular variations, with a period of one solar or lunar day. Diurnal variations are observed in local values of the GEOMAGNETIC FIELD (see S), and in the intensity of COSMIC RAYS arriving at each point on earth.
(C.2.10; D.2.1,308; D.2.2)

D-LAYER see D-REGION

D_m (MEAN STORM TIME VARIATION) see STORM TIME VARIATION (D_{st})

DOPPLER BROADENING

The "spreading" of a LINE PROFILE which is observed when the emitting atoms possess random thermal or turbulent motions. The wavelength of the "signal" from each atom is shifted by the DOPPLER EFFECT, the random velocity distribution producing a smooth distribution of wavelengths about the "unbroadened" value.

THERMAL BROADENING and TURBULENCE BROADENING refer to the Doppler broadening due to thermal and turbulent motions, respectively. (B.3.14,5)

DOPPLER EFFECT see DOPPLER SHIFT

DOPPLER SHIFT

A shift in the observed frequency of a radiated signal, caused by relative motion of the emitter and the receiver.

Also referred to as the DOPPLER EFFECT.

DOSE EQUIVALENT

A measure of radiation dosage which takes into account the QUALITY FACTORS (QF) for a given situation.

DOSE EQUIVALENT (in REM) = total ABSORBED DOSE (in RADS) $\times QF_1 \times QF_2 \times \ldots$

QF_1 is the quality factor associated with the LINEAR ENERGY TRANSFER of the radiation concerned; QF_2 is the RELATIVE DAMAGE FACTOR, n; etc. The term "dose equivalent" was introduced to replace RBE DOSE in radiation protection work. (F.3.6; F.3.9,568)

DOSE RATE

The rate at which radiation-energy is absorbed in living tissue, expressed in REM or RAD per unit time.

DOSIMETER

A device designed to measure the ABSORBED DOSE of IONIZING RADIATION.

DOUBLE LIMB

A phenomenon observed in Hα FILTERGRAMS and SPECTROHELIOGRAMS. A bright, sharp "inner limb" and a faint, coarse "outer limb" are seen, forming a two-level structure. Surprisingly, the sharp inner limb is spurious. It may be eliminated by improving the MONOCHROMATIC PURITY of the filter transmissions, and choosing the emulsion used to minimize artificial contrasts. (B.1.13)

DP (DISTURBANCE - POLAR)

A transient, world-wide perturbation on the GEOMAGNETIC FIELD, due to currents driven by electromotive forces set up in the polar regions during a GEOMAGNETIC STORM.

The DP field is strongest near the AURORAL ZONES and over the polar caps, but is also amplified along the magnetic equator (c.f. EQUATORIAL ELECTROJET). The current-system and field often fluctuate greatly during a storm (see POLAR SUBSTORM).

The DP current is most intense in the AURORAL ELECTROJET, with the circuit being completed mainly over the polar cap, but also in the SUB-AURORAL and MINAURORAL BELTS. (D.4.7,237; D.4.8,390)

DR1-BELT, DR2-BELT see DR

DR (DISTURBANCE - RING CURRENT)

A transient change in the RING CURRENT component (R) of the GEOMAGNETIC FIELD during a GEOMAGNETIC STORM, giving rise to the storm's MAIN PHASE.

In contrast to the DCF-field, the DR-field develops gradually, and decreases the earth's surface field in low latitudes by an amount which is nearly the same all round the earth.

There are thought to be two "disturbance belts", DR-1 (1.5-2.0 earth radii) and DR-2 (4-6 earth radii), separated by a gap.
(D.4.8,394; D.4.16)

DRAPERY see AURORA (FORMS)

D-REGION (D-LAYER)

A layer of the IONOSPHERE lying at approximately 50-90 km altitude and composed mainly of NO^+ and O_2^- ions. The normal D-LAYER is due mainly to ionization of trace-constituent NO by solar LYMAN-α radiation, which reaches low atmospheric levels through the 1 Å-wide absorption-window at λ1215 Å.

During SOLAR FLARES, the D-layer may be lowered as much as 15 km by a greatly enhanced flux of X-RAYS (λ < 10-16 Å) capable of ionizing all the ionospheric constituents. (B.1.2,353; E.1.7,166; E.2.15,15,47)

DRIFT see GUIDING CENTRE

Ds; DS see GEOMAGNETIC DISTURBANCE (D); IONOSPHERIC STORMS

DSD see DARK SURGE ON DISK

DS_e, DS_i, DS^e, DS^i see GEOMAGNETIC DISTURBANCE (D)

DSM (DISTURBANCE - SOLAR MAGNETISM)

A transient perturbation on the GEOMAGNETIC FIELD, due to solar magnetic fields "frozen" into the PLASMA impinging on the MAGNETOSPHERE during a GEOMAGNETIC STORM. (D.4.3,364)

D_{st}, D_{st_e}, D_{st_i}, D^e_{st}, D^i_{st}, Dst

See STORM-TIME VARIATION; IONOSPHERIC STORMS.

DURATION

The "lifetime" of a SOLAR FLARE. The measurement of flare lifetimes is difficult, as it is often impossible to assign precise times of "starting" and "ending" to a flare.

DWARF NOVA see NOVA

DYNAMO CURRENT

A global system of electric currents occurring at altitudes of 100-150 km in the IONOSPHERE, and believed responsible for the Sq and L GEOMAGNETIC VARIATIONS.

Solar heating, along with solar and lunar tidal forces, causes horizontal motions of the ionospheric medium across the vertical component of the GEOMAGNETIC FIELD. Horizontal electric currents are thus induced in the ionosphere. (B.1.2,351; D.2.1,310)

DYNAMO EFFECT

A mechanism whereby the electric field induced by the motion of a conducting medium in an existing magnetic field maintains the magnetic field against ohmic loss. The name "dynamo" effect was introduced because of the resemblance of the process to a self-excited dynamo.

(F.2.2,77; F.2.3,39)

EARLY EFFECT

An effect observed at LF and VLF in the dark hemisphere of the earth at the time of a POLAR CAP ABSORPTION. (C.2.6,525)

EARTH CURRENTS

Electric currents flowing in the earth's crust, presumably induced by currents in the IONOSPHERE and MAGNETOSPHERE.

EARTHLIGHT see NIGHTGLOW (D.4.6,347)

EAS see EXTENSIVE AIR SHOWER

EBERHARD EFFECT (EBERHARDT EFFECT)

A spurious enhancement of contrasts, arising during development, along the boundaries between regions of different intensity on a photographic plate.

The exhausted developer over a high-intensity region is exchanged by diffusion for active developer from neighbouring low-intensity regions. Thus in a region near the boundary the developing process "goes" further in the high-density region than in the low. The effect may be noticeable up to 1.5 mm from such a boundary.

The Eberhard effect is most important when a large number of different intensities are recorded in a restricted area - as in stellar spectra.

(F.4.3)

ECLIPSE

A SOLAR ECLIPSE occurs when the moon comes between the earth and the sun. For a PARTIAL ECLIPSE (solar DISK only partly obscured), "first and last contacts" are defined as the times of tangency of the solar and lunar disks. A TOTAL ECLIPSE (sun completely obscured) has two additional times of tangency - "second contact", when totality begins, and "third contact", when it ends. The last glimpses of the sun through the lunar valleys, just before second contact, are known as the BAILY BEADS.

A LUNAR ECLIPSE occurs when the moon enters the shadow cast by the earth.

See also OCCULTATION.

ECLIPTIC

The great circle made by the intersection of the plane of the earth's orbit with the CELESTIAL SPHERE. (Less properly, the apparent path of the sun around the sky during the year.)

A system of CELESTIAL LATITUDE and LONGITUDE may be defined by taking the ecliptic as the "equatorial" line. In this system, the poles are known as ECLIPTIC POLES. Latitude is measured north (+) and south (-) of the ecliptic; longitude is measured from the VERNAL EQUINOX in the direction of the sun's apparent motion round the ecliptic.

ECLIPTIC POLE see ECLIPTIC (F.1.5,254)

EGO (ECCENTRIC ORBIT GEOPHYSICAL OBSERVATORY) see OGO

(A.2.7,3; C.1.11,175)

E-LAYER see E-REGION

ELDO (EUROPEAN SPACE VEHICLE LAUNCHER DEVELOPMENT ORGANIZATION)
(A.2.18,155; A.2.19,31)

ELECTROACOUSTIC WAVE

A longitudinal PLASMA wave in which the electronic and ionic motions are coupled so that electrical neutrality is preserved throughout. At low frequencies, this mode of propagation corresponds to an acoustic wave.

In order for the coupling to be maintained in spite of the large disparity between electron and ion inertia, an oscillating electrostalic field must be set up in the wave. Hence the name "electroacoustic wave".

Also known as POSITIVE-ION OSCILLATIONS.

ELECTROJET see EQUATORIAL ELECTROJET

ELECTROMAGNETIC CASCASE see CASCADE

ELECTROMAGNETIC RADIATION

Propagating wave solutions of Maxwell's equations for the electromagnetic field. These waves may be classified, according to wavelength, as GAMMA RAYS ($\lambda < 6 \times 10^{-10}$ cm); X-RAYS ($6 \times 10^{-10} < \lambda < 5 \times 10^{-7}$ cm); ULTRA-VIOLET LIGHT ($5 \times 10^{-7} < \lambda < 4 \times 10^{-5}$ cm); VISIBLE LIGHT ($4 \times 10^{-5} < \lambda < 7.2 \times 10^{-5}$ cm); INFRARED LIGHT ($7.2 \times 10^{-5} < \lambda < 4 \times 10^{-2}$ cm); and RADIO WAVES ($\lambda > 4 \times 10^{-2}$ cm). The boundaries between different classifications are arbitrary; for practical convenience, the regions are often considered to overlap.

ELECTRON CORONA see K-CORONA

ELECTRO-ORBITAL SURFACES (MAGNETIC SHELLS)

The surfaces on which the paths of MIRRORING charged particles move, as the particles drift (in longitude) across the magnetic field.

For each particle, the LONGITUDINAL INVARIANT J = constant $\equiv J_o$ on a magnetic shell, where J_o is a function of the mirror field strength B_m. In an axially symmetric field, a magnetic shell is generated by revolving a line of force about the field axis. In a non-symmetric field, the family of lines connecting the MIRROR POINT loci $(J,B) = (J_o, B_m)$ lies roughly on a magnetic shell.

The MAGNETIC SHELL PARAMETER L is widely used to characterize the electro-orbital surfaces of the GEOMAGNETIC FIELD, which is non-symmetric. (D.3.5,169; D.3.6,161; D.3.11; D.3.13,514)

ELEMENTARY PARTICLES see PARTICLES

ELONGATION

The angular displacement in the plane of the ECLIPTIC between a given direction and the Earth-Sun line.

EMISSION LINE

A sharp resonance in an EMISSION SPECTRUM, corresponding to an atomic transition from one state to another of lower energy.

EMISSION SPECTRUM

A system of EMISSION LINES, bands and continua, showing the emission of ELECTROMAGNETIC RADIATION as a function of wavelength for a given medium.

EMISSION STRIPS

Another name for GRAINS OF CONTINUOUS EMISSION. (B.5.14,149)

ENERGETIC STORM-PARTICLE EVENT

A burst of low-energy SOLAR COSMIC RAYS ($\lesssim$ 15 MeV) arriving at earth at the beginning of a GEOMAGNETIC STORM. These particles are thought to have been trapped in the cloud of solar PLASMA causing the storm. (C.3.2)

ENERGY SPECTRUM

The DIFFERENTIAL ENERGY SPECTRUM of a stream of energetic PARTICLES is a plot of the flux per unit energy, n(E), as a function of particle energy, E.

The form of INTEGRAL ENERGY SPECTRUM generally used expresses the flux of particles with energies greater than E as a function of E:

$$N(>E) = \int_E^\infty n(E)\, dE \quad .$$

EQUATORIAL ELECTROJET

An enhancement of the Sq DYNAMO CURRENT system in a narrow strip along the MAGNETIC DIP EQUATOR.

Near the dip equator, the GEOMAGNETIC FIELD is parallel to the earth's surface. As the Sq current flows eastward across the field, Lorentz forces set up a vertical Hall current, until the conducting layer becomes sufficiently polarized to cancel the Lorentz forces. The effective IONOSPHERIC conductivity then approaches its field-aligned value, as the current flows unimpeded across the magnetic field. Away from the dip equator, the field is no longer horizontal, and enhancement of the current does not occur.

(D.2.1,313)

EQUINOX

One of the two points of intersection of the CELESTIAL EQUATOR and the ECLIPTIC. The sun passes through the VERNAL EQUINOX on about March 21; and through the AUTUMNAL EQUINOX on about September 22. (F.1.5,255)

EQUIVALENT PATH see GROUP PATH

EQUIVALENT RESIDUAL DOSE (ERD)

Because a living organism is able to repair damage to itself, when the damage is not too serious, the effects of a sub-lethal dose of IONIZING RADIATION become less pronounced with the passage of time after irradiation. At time t after an "acute dose" D_i (see note below) is administered, the biological damage that remains may be considered equal to the immediate effect of an "equivalent" dose, ERD(t), administered at time t. ERD(t) is known as the EQUIVALENT RESIDUAL DOSE, and is given approximately by:

$$\mathrm{ERD}(t) = K_1 D_i + K_2 D_i^{-\alpha t}$$

where K_1, K_2 and α are empirical constants, and the doses are given in REM-units.

The ERD for a "chronic dose" (see note below) is found by integrating ERD(t) with respect to time.

NOTE:

"acute dose" = dose due to a short, sharp burst of ionizing radiation.
"chronic dose" = dose due to continuous irradiation.

(F.3.4,1; F.3.12,393)

ERD see EQUIVALENT RESIDUAL DOSE

E-REGION (E-LAYER)

The IONOSPHERIC region from 90 km out to 120-140 km, due to the photo-ionization of all atmospheric constituents by λ44-105 Å X-RAYS, and of O_2 by λ912-1030 Å ULTRAVIOLET LIGHT.

In daylight, the electron-density curve peaks at 100 km, with maximum density almost entirely dependent on SOLAR ACTIVITY and SOLAR ZENITH ANGLE. At night, this well-defined "layer" disappears.

The E-region usually exhibits a number of CRITICAL FREQUENCIES. One of these varies in an irregular way with local time, and is said to represent "SPORADIC E" (E_s).

The day-time E-region is remarkably stable.

(E.1.7,166; E.2.8,286; E.2.11,414; E.2.15,44)

E_s see SPORADIC E

ESDAC (EUROPEAN SPACE DATA CENTRE)

The ESRO computing centre at Darmstadt, Germany.

(A.2.18,148; A.2.19,37)

ESLAB (EUROPEAN SPACE LABORATORY)

A small laboratory linked with ESTEC and designed for use by specialists from the national agencies of countries belonging to ESRO.

(A.2.18,148; A.2.19,37)

ESRANGE (EUROPEAN SPACE LAUNCHING RANGE)

An ESRO facility, established at Kiruna, Sweden. (A.2.18,149)

ESRIN (EUROPEAN SPACE RESEARCH INSTITUTE)

An ESRO establishment devoted to fundamental research. ESRIN is located at Frascati in Italy. (A.2.18,149; A.2.19,37)

ESRO (EUROPEAN SPACE RESEARCH ORGANIZATION)

Headquarters: 36, rue la Pérouse, Paris XVIe, France.

(A.2.18,147; A.2.19,34)

<u>ESSA OF THE ITSA</u> (ENVIRONMENTAL SCIENCE-SERVICES ADMINISTRATION OF THE INSTITUTE OF TELECOMMUNICATION SCIENCES AND AERONOMY, Boulder, Colorado, U.S.A.)

The successor to the CENTRAL RADIO PROPAGATION LABORATORY (CRPL) as a WORLD DATA CENTRE A: SOLAR ACTIVITY.

<u>ESTEC</u> (EUROPEAN SPACE TECHNOLOGY CENTRE)

The principal scientific establishment of ESRO, situated at Noordwijk, Netherlands. (A.2.18,148; A.2.19,37)

<u>ESTRACK</u> (EUROPEAN SPACE TRACKING SYSTEM)

An ESRO facility. (A.2.18,149)

<u>EVERSHED EFFECT</u>

Horizontal motion of the solar atmosphere near a SUNSPOT, with velocities of a few km/sec. In the PHOTOSPHERE matter streams outward, away from the UMBRA, while at heights greater than 2000 km the direction of flow is reversed. Maximum velocities occur near the edge of the PENUMBRA; little or no motion is observed within the UMBRA. (B.1.2,162)

<u>EXOSPHERE</u>

The earth's atmosphere above 500-600 km altitude. In this region neutral-particle collisions are so rare that a neutral particle with sufficient momentum is virtually certain to escape from the earth's gravitational field - hence the name "exosphere".

The level above which neutral-particle collisions may be neglected is referred to as the "critical level". Its exact position depends on the atmospheric model being discussed.

(D.1.3,505; D.1.4,522; E.1.4,267; E.1.6,242)

<u>EXPLOSIVE PHASE</u>

The pre-maximum growth phase of a SOLAR FLARE. The EXPLOSIVE PHASE includes the FLASH PHASE as a special case. (B.3.1; B.3.10)

<u>EXPOSURE DOSE</u>

A measure of the flux of X or GAMMA RADIATION, based on its ability to produce ionization at the position of interest. Exposure dose is expressed in RÖNTGENS. (F.3.7,107,382)

EXTENSIVE AIR SHOWER (AS, EAS)

The chain of events initiated by a PRIMARY COSMIC RAY particle with energy greater than 10^{15} eV interacting with air nuclei in the upper atmosphere.

Of the particles present in an EAS at the surface of the earth, about 95% are electrons and photons, 4% are muons, and 1% are heavy "nuclear-active" particles. The heavy particles form the "core" of the shower; the photons, electrons, and muons are all SECONDARIES.

To be classed as an EAS, a SHOWER must give rise to $\gtrsim 10^5$ charged particles at sea level. (C.5.1,215; C.5.7,194)

EXTRAORDINARY RAY

One of the two modes of propagation of electromagnetic waves in a magnetic plasma. For propagation along the direction of the magnetic field, it is the mode whose electric vector rotates in the same sense as the electrons gyrate (circularly polarized transverse waves). For propagation perpendicular to the direction of the magnetic field, it is the mode whose electric vector is perpendicular to the magnetic field. Of the two modes, the EXTRAORDINARY RAY is the one whose propagation is the more affected by the magnetic field. (cf. ORDINARY RAY)

F_1-LAYER (F1-LAYER); F_2-LAYER (F2-LAYER) see F-REGION

f, f_o, f_x see CRITICAL FREQUENCY

F

The total intensity of the GEOMAGNETIC FIELD.
See GEOMAGNETIC ELEMENTS.

FACULA

A bright region of the solar PHOTOSPHERE, seen in white light. A large percentage of faculae in SUNSPOT ZONES contain SUNSPOTS; those that do not are usually fainter, smaller, and of shorter duration. POLAR FACULAE, occurring at solar latitudes above 70° are smaller still, more round, and of much shorter duration. Faculae are most easily seen near the LIMB; at the centre of the disk they are usually invisible.

The term CHROMOSPHERIC FACULA (or simply FACULA) is often used to refer to a PLAGE. It is, however, more common to reserve "FACULA" for the PHOTOSPHERIC FACULA. PLAGES and FACULAE are essentially the same phenomena, observed at different levels of the solar atmosphere.

(B.1.2,173; B.3.14,17)

FACULAR MOTTLES see MOTTLES

FAGS (FEDERATION OF ASTRONOMICAL AND GEOPHYSICAL PERMANENT SERVICES, 53, av.de Breteuil, Paris 7e, France.)

An organization established within the framework of ICSU in 1956 to co-ordinate the support of service organizations disseminating observational data. Among the members of the federation are: IUWDS (administered by URSI, IAU and IUGG); the Permanent Service of Geomagnetic Indices (administered by IUGG); and the Quarterly Bulletin of Solar Activity (administered by IAU).

(A.2.14,139)

FAN

A large CORONAL streamer, wide at its base and narrowing as it stretches outward in the SOLAR ATMOSPHERE.

Also known as a HELMET. (B.1.2,280; B.1.16,296)

FARADAY EFFECT (FARADAY ROTATION)

A rotation of the plane of polarization which occurs when a beam of plane-polarized light passes through a medium in the direction of an applied magnetic field.

The angle of rotation $\theta = VHl$, where H is the field strength, l is the length of path in the medium, and V is the VERDET CONSTANT of the medium.

(F.4.7,596)

FAST-DRIFT BURST see BURST; TYPE III RADIO BURST; U-BURST

FAST FLARE

A SOLAR FLARE whose RISE TIME is less than or equal to 40% of its total DURATION.

The LIGHT CURVES of "fast flares" resemble those of FAST NOVAE; hence the name.

(B.3.12)

FAST NOVA see NOVA

F-CORONA ("FRAUNHOFER" CORONA)

The nearly unpolarized component of the white-light CORONA, exhibiting the FRAUNHOFER SPECTRUM at normal strength. The F-corona is generally assumed to be the ZODIACAL LIGHT in line-of-sight close to the sun, due to diffraction of sunlight by INTERPLANETARY DUST. (Some authors, however - e.g. Dauvillier - reject the "dust" hypothesis, and attribute the F-corona to scattering by electrons.) (B.3.14,10; F.1.11,525; C.4.2, Chapter V)

FEDERATION OF ASTRONOMICAL AND GEOPHYSICAL PERMANENT SERVICES see FAGS

FERMI MECHANISM

The acceleration (or deceleration) of an energetic charged particle by repeated reflection in a magnetized PLASMA. Two simple configurations are often considered - that in which a particle is trapped between two MAGNETIC MIRRORS approaching (or receding from) one another; and that in which the particle diffuses through a chaotically-magnetized plasma. (C.5.5,26)

FIBRILLES

Fine-structure features of the Hα PLAGES in the CHROMOSPHERE.

FIBRILLES are usually seen as elongated streaks in cyclonic configurations known as WHIRLS. Large fibrilles may be of the order of 2000 km wide by 13,000 km long, the length varying considerably with time. Fibrilles are observed to move randomly with velocities of about 7 km/sec, and average displacements of 2500 km.

Also known as CHROMOSPHERIC STRIATIONS; see also MOTTLES. (B.3.14,25)

FILAMENT

A solar PROMINENCE, seen in projection against the DISK as a dark, ribbon-like absorption structure (when viewed in the core of an appropriate FRAUNHOFER LINE).

Filaments are also referred to as ABSORPTION MARKINGS, DARK FILAMENTS, DARK FLOCCULI, DARK MARKINGS. (B.1.2,224; B.3.14,26,105)

FILTERGRAM

A photograph of the sun taken through a filter (e.g. a LYOT FILTER).

FILTER HELIOGRAPH

An instrument designed to produce a monochromatic image of the SUN on a photographic plate, using a BIREFRINGENT FILTER to provide the required MONOCHROMATIC PURITY.

See LYOT HELIOGRAPH.

FILTER PURITY see MONOCHROMATIC PURITY

FINE MOTTLES see MOTTLES

FIREBALL (1) see BALL LIGHTNING

FIREBALL (2)

A METEOR whose brightness is greater than that of Jupiter or Venus (and which therefore would be visible in daylight). Great fireballs may appear many times larger and brighter than the full moon. Fireballs are probably of ASTEROIDAL origin. (F.1.5,98; F.1.12,558)

FISSION CHAMBER

An IONIZATION CHAMBER containing fissile material (deposited on the walls and internal partitions), used for the detection of neutrons with energy greater than the threshold for the fissile material (e.g. the threshold for bismuth is 20 MeV). (F.3.13)

FLARE see SOLAR FLARE

FLARE AREA see AREA

FLARE CLASSIFICATION

On January 1, 1966, a revised system of flare classification was introduced. In this system, each SOLAR FLARE is assigned an IMPORTANCE (based on corrected area), and a "relative intensity" index (based on maximum BRIGHTNESS in Hα). The old scale of IMPORTANCES: 1^-, 1, 2, 3, 3^+ has been re-labelled: S, 1, 2, 3, 4. "Relative intensity" indices used are: "f" (faint), "n" (normal), and "b" (brilliant). A very bright SUBFLARE would thus be classed as "Sb", while a faint class 2 flare would be listed as "2f".

FLARE GROWTH CURVE see GROWTH CURVE

FLARE PATROL

A programme of frequent routine observations of the solar DISK in the light of a CHROMOSPHERIC EMISSION LINE.

The methods used for observing the SUN and the frequencies of observation vary from station to station. "Cinematographic" stations photograph the sun in the Hα LINE at intervals varying between 30 sec (or less) and 5 min; "visual" stations observe the sun at fixed hours, using SPECTROHELIOSCOPES or LYOT FILTERS; still other stations take Hα SPECTROHELIOGRAMS at varying intervals. The majority of cinematographic stations use Lyot filters with bandwidths of 0.5 - 0.75 Å.

The data obtained from flare patrols permit detailed study of short-lived SOLAR ACTIVITY, particularly SOLAR FLARES. (B.3.9,44; B.3.14,34)

FLARE PROFILES

LINE PROFILES observed in the EMISSION SPECTRA of SOLAR FLARES.

FLARE PROMINENCE alternative name for SURGE or ROCKET

FLARE PUFF see PUFF

FLARE SPRAY see SPRAY

FLARE SURGE see SURGE

FLASH FLARE

A SOLAR FLARE, of IMPORTANCE 1 or S, whose DURATION is 5 minutes or less. (B.3.12)

FLASH NOVA see NOVA

FLASH PHASE

The initial growth phase of a SOLAR FLARE which exhibits a rapid rise to maximum BRIGHTNESS and AREA.

The more general term EXPLOSIVE PHASE has been proposed to describe the initial stages of all flares, regardless of their RISE RATIOS. (B.3.8)

FLASH SPECTRUM

The faint chromospheric EMISSION SPECTRUM which briefly replaces the FRAUNHOFER SPECTRUM when the photospheric emission is obscured during an ECLIPSE. (Most of the FLASH SPECTRUM is only visible just after second contact and again just before third contact. See ECLIPSE.) Neutral lines have the same relative intensities as in the Fraunhofer spectrum, but the lines of ionized atoms are enhanced. (B.1.2,106; B.3.14,7)

F-LAYER (F_1-LAYER; F_2-LAYER) see F-REGION

FLOCCULUS

In the older literature, the coarse MOTTLING of the CHROMOSPHERE is often referred to as "bright Ca^+ FLOCCULI".

HALE used the term "FLOCCULI" in place of "PLAGES".

A DSD (Dark Surge on Disk) is also termed an ACTIVE DARK FLOCCULUS by some observers. (A.2.11,277; B.1.2,130; B.3.14,17)

FLUX INVARIANT

The magnetic flux through the cross-section of an ELECTRO-ORBITAL SURFACE. This quantity is an ADIABATIC INVARIANT for a charged particle drifting longitudinally on the surface, provided that the magnetic field changes very little in a time comparable with the period of drift.

For particles in the GEOMAGNETIC FIELD, the drift period is in the order of minutes. (D.3.13,515)

f-min see CRITICAL FREQUENCY

FOLD see AURORA (FORMS)

FORBUSH DECREASE

A world-wide (aperiodic) decrease in the observed flux of PRIMARY COSMIC RADIATION, occurring when the earth becomes enveloped by a cloud of solar PLASMA. The decrease starts fairly suddenly, and may be as large as 30-40%. Recovery occurs over a period of several days. (B.1.2,216; B.3.14,216)

FRAUNHOFER CORONA see F-CORONA

FRAUNHOFER LINES

The system of dark ABSORPTION LINES superimposed on the continuous solar spectrum, due to absorption in the solar and terrestrial atmospheres. Most of the solar lines are formed in the upper PHOTOSPHERE, although the centres of some strong lines (e.g. BALMER LINES; H and K-LINES of calcium) are formed in the CHROMOSPHERE.

The terrestrial, or TELLURIC LINES are due chiefly to water vapour and molecular oxygen in the earth's atmosphere, and are most noticeable in the infrared.

The system of Fraunhofer lines is referred to as the FRAUNHOFER SPECTRUM. (B.1.3,4; B.1.11,187)

FRAUNHOFER SPECTRUM see FRAUNHOFER LINES

FRC (FEDERAL RADIATION COUNCIL)

A body set up in 1959 by the Congress of the United States to advise the President with respect to radiation matters directly or indirectly affecting health. (F.3.9,566)

F-REGION (F-LAYER)

The ionospheric region stretching from 120-140 km out to 600-1500 km altitude. The F-region is subdivided into the F_2-LAYER (F2-LAYER) and the F_1-LAYER (F1-LAYER).

The F_2-LAYER, due chiefly to photoionization of O by ULTRAVIOLET LIGHT (λ105-912 Å), is usually the densest region of the IONOSPHERE; its electron-density peak (10^4 - 8 x 10^6 electrons/cm^3) lies at an altitude of 200-600 km. During IONOSPHERIC STORMS the maximum electron density decreases markedly at high MAGNETIC LATITUDES, and (usually) increases near the equator. The electron distribution exhibits large and rapid changes with place, time of day, time of month, and SOLAR ACTIVITY. The layer persists through the night.

The F_1-LAYER, a "ledge" in the electron density curve at the bottom of the F_2-LAYER, occurs only in daylight (times of appearance and disappearance vary). The layer is composed mainly of O^+ and NO^+ due to photoionization of O and N_2 by λ105-912 Å. Because of the effects of variations in molecular recombination rate, atom-ion exchange rate, molecular density, and electron density in the region of maximum photoionization, the F_1-layer is enhanced by decreases in SOLAR ACTIVITY, by solar ECLIPSES, and by IONOSPHERIC STORMS. (E.1.7,185,217; E.2.9,337; E.2.15,14,25,28)

<u>F-TYPE EVENT; F*-TYPE EVENT</u> see POLAR CAP ABSORPTION

<u>FUNDAMENTAL PARTICLES</u> so-called, see PARTICLES

<u>FUNNEL</u>

A form of PROMINENCE labelled ASf in the MENZEL-EVANS CLASSIFICATION.

<u>GALACTIC COSMIC RADIATION</u> see COSMIC RADIATION

<u>GALACTIC DUST</u>

Interstellar COSMIC DUST concentrated in or near the plane of the galaxy. Absorption and scattering of light by the galactic dust severely limits astronomical observations in the galactic plane. (F.1.11,327)

<u>GALACTIC LIGHT</u>

The contribution of STARLIGHT, scattered by GALACTIC DUST, to the LIGHT OF THE NIGHT SKY. The reality of this contribution is not yet firmly established. (F.1.11,522)

<u>GAMMA</u> (γ)

A unit of magnetic field intensity, defined as 1×10^{-5} OERSTED. Workers in geomagnetism frequently take the gamma to equal 1×10^{-5} GAUSS, since the permeability of air in c.g.s. (e.m.u.) is negligibly different from one gauss per oersted. (D.2.3,v.1,4; D.2.5,2)

<u>GAMMA RAYS</u> (γ-RAYS)

ELECTROMAGNETIC RADIATION at wavelengths shorter than 6×10^{-10} cm (0.06 Å). Gamma radiation is most commonly generated by nuclear processes.

<u>GARDEN-HOSE ANGLE</u>

The STREAM ANGLE (ψ) which a magnetic field line, carried out from the SUN by the SOLAR WIND, makes with the radius vector from the sun at any point.

$$\psi = \tan^{-1} B_\phi/B_r = \tan^{-1} \frac{\Omega r}{V}$$

(B_r, B_ϕ = radial and azimuthal magnetic field components; Ω is the sun's angular velocity of rotation; V is the solar wind velocity; and r is the radial distance from the sun.) (C.2.11,360)

GAUSS (Γ)

Formerly a unit of magnetic field intensity, the GAUSS was redefined ir 1932 as the unit of magnetic induction (flux density) in the c.g.s. (e.m.u.) system. An induction field of one gauss produces an e.m.f. of one abvolt in a straight wire one centimeter long and perpendicular to the field, when the wire moves at right angles to the field, and to its own length, at the rate of one centimeter per second. One gauss is equivalent to 1×10^{-4} weber/metre^2 in the m.k.s. system of units.

As the permeability of air is negligibly different from 1 gauss/oersted in c.g.s. (e.m.u.), workers in geomagnetism still use the gauss as a unit of magnetic field intensity, in place of the OERSTED. Thus 1 GAMMA is often equated to 1×10^{-5} gauss, instead of to 1×10^{-5} oersted. (D.2.3,v.1,4,23; D.2.5,2)

GCA (GUIDING CENTRE APPROXIMATION) see GUIDING CENTRE

GCT see GREENWICH CIVIL TIME; UNIVERSAL TIME

GEGENSCHEIN see ZODIACAL LIGHT

GEIGER-MÜLLER COUNTER

A sensitive device for measuring IONIZING RADIATION. The device consists essentially of two concentric cylindrical electrodes separated by a gas. Because of the large potential difference maintained between the electrodes, even a single ion pair produced by an ionizing particle can initiate an electron-avalanche current. The resulting voltage-drop in an external circuit can be amplified to trigger a recording system.

For a range of potential differences between the electrodes, the current produced is proportional to the ionization. The device may then be used as a PROPORTIONAL COUNTER, to distinguish between particles of different energies, or of different charges. (B.3.14,214; F.4.5,170)

GEOALERT

A message broadcast round the world by the IUWDS WORLD WARNING AGENCY (AGIWARN) to announce changes in SOLAR ACTIVITY, GEOMAGNETIC ACTIVITY, stratospheric temperature, etc. (A.2.6,5; C.4.5)

GEOCOMA

A hypothetical extension of the GEOCORONA, caused by the interaction of the SOLAR WIND with the earth's outer atmosphere. The escaping component of terrestrial hydrogen is thought to be swept down-wind to form a gaseous "tail". (D.1.1; D.1.2,192)

GEOCORONA

The outer regions of the earth's atmosphere, lying above the THERMOSPHERE, and composed mainly of hydrogen. The geocorona comprises the METASPHERE and the PROTOSPHERE. (D.1.2; E.1.5,21)

GEOMAGNETIC ACTIVITY

Disturbance variations of the GEOMAGNETIC FIELD.

See D; Dst; GEOMAGNETIC STORM; GEOMAGNETIC VARIATIONS; SUDDEN COMMENCEMENT.

GEOMAGNETIC AXIS

The magnetic dipole axis of the REGULAR GEOMAGNETIC FIELD. The points at which this axis intersect the earth's surface are known as the MAGNETIC AXIS POLES. The magnetic axis is inclined to the earth's axis of rotation by an angle of about 11.5°. (D.2.2,19,22)

GEOMAGNETIC CAVITY see MAGNETOSPHERE

GEOMAGNETIC CO-ORDINATES see MAGNETIC CO-ORDINATES

GEOMAGNETIC CUT-OFF RIGIDITY see THRESHOLD RIGIDITY

GEOMAGNETIC DISTURBANCE (D)

The symbol "D" is used for both the transient perturbations of the GEOMAGNETIC FIELD which occur during a GEOMAGNETIC STORM, and the current systems giving rise to these fluctuations.

For the horizontal component (H),

$$D(H) = Dst(H;T,\theta) + DS(H;T,\theta,\phi) \quad .$$

The STORM TIME VARIATION (Dst) depends only on STORM TIME (T) and MAGNETIC CO-LATITUDE (θ). The remaining disturbance (DS or Ds) depends also on longitude (ϕ) and has zero mean value round each circle of latitude.

At each location, DS (or Ds) may be expressed as the sum of the mean DIURNAL VARIATION S_D (or SD) and an irregular disturbance Di. Thus:

$$D = Dst + S_D + Di \quad .$$

The D-field may also be split into a component due to current systems above the earth's surface ("external"), and one due to EARTH CURRENTS ("internal") induced by changes in the external currents:

$$D = D_e + D_i = Dst_e + DS_e + Dst_i + DS_i \quad .$$

Finally, D may be split into components due to different types of current systems:-

$$D = DCF + DP + DR + DSM \text{ (q.v.)} \quad .$$

(D.4.8,467)

GEOMAGNETIC ELEMENTS

The components of the GEOMAGNETIC FIELD at the surface of the earth. These components are denoted by:

X - the northward component.
Y - the eastward component.
W - the westward component (= -Y).
Z - the vertical component, reckoned positive downwards.
V - the magnitude of Z.
H - the horizontal component, of magnitude $\sqrt{X^2 + Y^2}$.
F - the total intensity $\sqrt{H^2 + V^2}$.
I - the INCLINATION (or DIP) angle, $\tan^{-1}(Z/H)$.
D - the DECLINATION angle, $\tan^{-1}(Y/X)$.

(D.2.2,1; D.2.3,v.1,2; D.4.8,380)

GEOMAGNETIC FIELD

The magnetic field observed in the neighbourhood of the earth.

The MAIN FIELD (M), thought to be due to DYNAMO CURRENTS in the earth's molten metallic core, is approximately that of a uniformly magnetized sphere (REGULAR GEOMAGNETIC FIELD). Deviations from this approximation constitute the IRREGULAR GEOMAGNETIC FIELD. The strength of M at the earth's surface near the equator is about 3×10^4 GAMMAS. Both long-term and short-term variations are superimposed on M. (See GEOMAGNETIC VARIATIONS.)

The components of the geomagnetic field at the earth's surface are known as GEOMAGNETIC ELEMENTS, or MAGNETIC ELEMENTS (D, F, H, I, V, W, X, Y, Z).

(D.2.1; D.2.2; D.2.3)

GEOMAGNETIC INCLINATION (I) see INCLINATION

GEOMAGNETIC INDEX see MAGNETIC INDEX

GEOMAGNETIC LATITUDE (Φ) see MAGNETIC CO-ORDINATES

GEOMAGNETIC MICROPULSATIONS see MICROPULSATIONS

GEOMAGNETIC POLES see MAGNETIC CO-ORDINATES

GEOMAGNETIC STORM

A world-wide disturbance of the GEOMAGNETIC FIELD, distinct from the regular DIURNAL VARIATIONS, and most readily observed in the horizontal component (H).

Many storms exhibit SUDDEN COMMENCEMENTS (SC). Typically, a storm of this type begins with an abrupt increase of H (as much as 25γ in a few minutes). H remains above normal for a few hours, then sharply decreases to a minimum tens to hundreds of GAMMAS below normal. This decrease may take from half a day (great storms) to a few days (weak storms). Recovery from the minimum begins rapidly, then slows down considerably, and continues for many days.

STORM TIME (reckoned from the SC) may be divided into 3 phases. The period when H is above normal is the INITIAL PHASE. The MAIN PHASE follows, lasting until the rate of recovery decreases. The ensuing slow recovery is the LAST (RECOVERY) PHASE of the storm. STORM TIME VARIATION depends only on storm time and MAGNETIC LATITUDE. The MAGNETIC ELEMENTS D and Z vary much less than H during a storm. (V varies in the opposite sense to H.)

In general, a magnetic storm is due to electric current-systems set up in the earth's atmosphere when an enhanced stream of solar PLASMA strikes the MAGNETOSPHERE (see D; DCF; DP; DR; DSM). SOLAR FLARES and SUNSPOTS are two possible sources of these enhanced streams. Many weak, non-SC storms, however, are associated with neither spots nor flares; the unidentified solar centres generating these "M-STORMS" are called M-REGIONS.

See also GRADUALLY COMMENCING STORM.

(B.3.14,232; D.4.8,465; E.1.3,387; F.2.3,132)

<u>GEOMAGNETIC TIME</u> see MAGNETIC LOCAL TIME (D.4.6)

<u>GEOMAGNETIC VARIATIONS</u>

Variations in the GEOMAGNETIC FIELD, due to long-term HYDROMAGNETIC processes in the earth's core (SECULAR VARIATIONS); changes in the relative positions of earth, sun, and moon (DIURNAL VARIATIONS); and short-term transient disturbances.

See CROCHET; D; Dst; GEOMAGNETIC STORM; L; MAGNETIC BAY; MICROPULSATIONS; S; SUDDEN COMMENCEMENT. (D.2.3,v.1)

<u>GIANT FLARE</u>

A very large SOLAR FLARE, of IMPORTANCE class 3 or 4 (i.e. AREA >600 millionths of the solar disk).

See also SUPERFLARE.

<u>GLE</u> see GROUND LEVEL EFFECT

<u>GMT</u> see GREENWICH MEAN TIME

<u>GRADUAL BURST</u> see MICROWAVE BURST, Type C

<u>GRADUALLY COMMENCING STORM</u> (Sg)

A GEOMAGNETIC STORM characterized by the growth of a considerable DR field without any sudden increase of the DCF component. Field variations of this type are symbolized by Sg.

GRAINS

Small, non-stationary formations appearing at low CHROMOSPHERIC heights in a solar ACTIVE REGION. Grains have diameters of a few hundred km and lifetimes of the order of 10 minutes. They are observed through their emission in MOUSTACHES.

See also GRAINS OF CONTINUOUS EMISSION. (B.3.14,145,150)

GRAINS OF CONTINUOUS EMISSION

Small, non-stationary formations in the upper PHOTOSPHERE and lower CHROMOSPHERE producing CONTINUOUS EMISSION spectra. These grains may occur in the absence of any other sporadic SOLAR ACTIVITY.

Grains of continuous emission (or EMISSION STRIPS) are slightly larger than MOUSTACHES, and slightly longer-lived. Moustaches are nearly always accompanied by emission strips.

The intensity of emission strips increases towards the violet, reaching a maximum below 5000 Å. The strips disappear in strong FRAUNHOFER LINES. Severny (1957) has estimated that the energy emitted per unit volume by a typical optically thin continuous-emission grain is 400 ergs/cm^3/sec.

(B.2.5; B.3.14,149)

GRAM RAD

International unit of INTEGRAL ABSORBED DOSE, equal to 100 ergs.

GRANULATION

Small-scale inhomogeneities in the BRIGHTNESS of the normal PHOTOSPHERE. The granulation consists of small, bright, roundish "blotches" (GRANULES) on a darker background. Its behaviour indicates the presence of vertical gas motions, probably related to convective currents in the lower photosphere.

Granulation is also observed in FACULAE. This FACULAR GRANULATION is brighter than the photospheric granulation.

See also SUPERGRANULATION. (B.1.2,80; B.3.14,18)

GRANULE

An element of the photospheric GRANULATION, which consists of small, bright "blotches" on a dark background. Granules range in size from 200-1800 km (average = 700 km), and last from 1-10 minutes (average = 8.5 minutes).

Granules are also observed in FACULAE. In general, FACULAR GRANULES are brighter than the photospheric granules.

See also SUPERGRANULATION. (B.1.2,80; B.3.14,6,18)

GREENWICH CIVIL TIME (GCT)

The LOCAL CIVIL TIME on the meridian of Greenwich. GCT thus refers to the day beginning at midnight.

GCT is also referred to as UNIVERSAL TIME. (F.1.5,174)

GREENWICH MEAN TIME (GMT)

The LOCAL MEAN TIME on the meridian of Greenwich. GMT thus refers to the day beginning at noon.

See also GREENWICH CIVIL TIME; UNIVERSAL TIME. (F.1.5,174)

GROUND LEVEL EFFECT (GLE)

An increase of SECONDARY COSMIC RADIATION, detectable at ground level, due to the incidence of solar high-energy particles (SHEP) on the earth's atmosphere. GLE's are detected by NEUTRON and MESON MONITORS, and the like.

Some authors use "GLE" for GROUND LEVEL EVENTS - i.e. solar outbursts giving rise to ground level effects. (B.4.6,436)

GROUP HEIGHT see GROUP PATH

GROUP PATH (P')

The distance a radio pulse would travel in time t if its speed of propagation was equal to that of light travelling in a vacuum.

$$P' = ct \quad .$$

The concept of GROUP PATH (also known as EQUIVALENT PATH or APPARENT PATH) is widely used in work on the IONOSPHERIC propagation of radio waves.

The travel time of a vertically-incident pulse reflected by the ionosphere may be used to calculate the GROUP HEIGHT, or VIRTUAL HEIGHT, h'.

$$h' = \tfrac{1}{2}P' = \tfrac{1}{2}ct \quad .$$

IONOSONDES are used to obtain plots of virtual height against frequency. These curves are known as h'f CURVES or IONOGRAMS.

The group path P' is related to the PHASE PATH P by the equation:

$$P' = P + f\frac{\partial P}{\partial f}.$$

(E.2.7,219; E.2.14,24)

GROUP VELOCITY

Consider a wave train, made up of signals with a very small spread of frequencies, propagating in a dispersive medium with no attenuation. At some point the wave-train amplitude will have a maximum due to phase agreement between the component signals. The velocity at which this maximum-amplitude point propagates through the medium is known as the GROUP VELOCITY.

In general if ω is the angular frequency and $\underset{\sim}{k}$ the wave-number vector of a signal propagating in a dispersive medium, the group velocity is $\nabla_{\underset{\sim}{k}}\omega$, while the PHASE VELOCITY is $(\omega\underset{\sim}{k}/k^2)$. (F.4.10,110)

GROWTH CURVE

A plot of AREA against time for a SOLAR FLARE. In general, the growth curve lags behind the LIGHT CURVE (average time lag ~3 minutes), though the two curves are very similar in shape. (B.3.14,102)

G-SWF see SHORT WAVE FADE-OUT

GUIDING CENTRE

The instantaneous centre of gyration of a charged particle moving in a magnetic field, subject to various perturbations. In the GUIDING CENTRE APPROXIMATION (GCA) the particle motion is separated into two parts - gyration about the guiding centre, and DRIFT of the guiding centre across the magnetic field.

The guiding centre is sometimes referred to as the ALFVÉN CENTRE.

GUIDING CENTRE APPROXIMATION (GCA) see GUIDING CENTRE

GUILLOTINE FACTOR see OPACITY

GYRO-RADIATION

The ELECTROMAGNETIC RADIATION emitted by charged particles of low or moderate energy gyrating in a magnetic field.

At non-relativistic speeds the radiation pattern of a single gyrating particle is similar to that of a radiating dipole with its moment directed toward the centre of the orbit. A distant observer in the orbital plane therefore receives energy in the form of a simple harmonic wave at the GYROFREQUENCY (or CYCLOTRON FREQUENCY).

At relativistic speeds the forward lobe of the particle's radiation pattern becomes longer and narrower, and the backward lobe is diminished. Consequently as the particle's speed is increased the energy received by a distant observer in the orbital plane tends to concentrate in short pulses occurring once a cycle, and the observed spectrum contains harmonics of the (relativistic) gyrofrequency.

As the particle's speed approaches that of light, the radiated energy becomes concentrated in a sharp beam along the particle's direction of motion. In this case the observed radiation is known as SYNCHROTRON RADIATION. (B.4.4,42; B.4.9,351)

GYROFREQUENCY

Another name for CYCLOTRON FREQUENCY.

Hα-LINE

The first line of the BALMER SERIES of the hydrogen-atom spectrum, arising from transitions between the second and third atomic levels (λ6563 Å).

Hα LINE PROFILE see Hα-LINE; LINE PROFILE

Hα LINE WIDTH

The separation in angstroms of the points at which the Hα LINE PROFILE of a SOLAR FLARE merges visually with the normal Hα profile of the quiet DISK. See LINE WIDTH. (B.3.14,119)

h' see GROUP PATH

H

The total horizontal component of the GEOMAGNETIC FIELD. See GEOMAGNETIC ELEMENTS.

HALO

A luminous ring around the SUN or the moon, caused by ice-crystal refraction in the earth's atmosphere. Bright spots called SUN DOGS or MOON DOGS sometimes appear on the ring, at one side. (F.1.9)

HAO (HIGH ALTITUDE OBSERVATORY, University of Colorado, Boulder, Colorado)

The HAO is a WORLD DATA CENTRE A: SOLAR ACTIVITY. Its observing station is at Climax, Colorado (National Centre for Atmospheric Research). (A.1.25,17; A.2.7,2; A.2.17)

HARD COMPONENT see COSMIC RADIATION

HEDGEROW

A form of PROMINENCE labelled ANd in the MENZEL-EVANS CLASSIFICATION.

HELIOSPHERE

The ionized helium component of the MAGNETOSPHERE, or OUTER IONOSPHERE. The heliosphere extends from 600-1500 km altitude at its base out to 1200-5000 km; the number density of helium ions in the region is of the order of 10^4 ions/cm^3. (E.1.7,167,194)

HELMET see FAN

h'f CURVE see GROUP PATH; IONOGRAM

HIGH-SPEED DARK SURGE

A small, dark, active FILAMENT associated with an ACTIVE REGION on the sun. (B.3.14,147)

HISS

A form of audio-frequency RADIO NOISE, or VLF EMISSION, which appears as a continuous series of sounds covering a wide frequency band. (E.2.7,366)

HISS RECORDER

A device used for the continuous monitoring of VLF EMISSIONS. The instrument consists of a spectrum analyzer of the frequency-scanning type coupled to a system which produces a photographic record showing the power density at each frequency as a function of time. (The film co-ordinates are frequency and time; the film exposure gives a measure of power density.) (D.6.9)

H-LINE

A resonance line in the CaII spectrum of ionized calcium, arising from transitions between the first and second atomic levels.

See K-LINE for details of LINE-PROFILE.

HM EMISSION see HYDROMAGNETIC EMISSION

HOMOGENEOUS ARC

The fundamental form of the AURORA.

See AURORA (FORMS).

HOMOLOGOUS FLARES

SOLAR FLARES which occur repetitively in the same ACTIVE REGION, with essentially the same position relative to the SUNSPOT GROUP, and with a common pattern of development.

Regions in which homologous flares occur are said to exhibit HOMOLOGY. (B.3.14,83)

HOMOLOGY see HOMOLOGOUS FLARES

HOUR-ANGLE see HOUR-CIRCLE

HOUR-CIRCLE

A "great circle" passing through the CELESTIAL POLES on the CELESTIAL SPHERE.

The distance from the VERNAL EQUINOX to a given hour-circle, measured eastward round the CELESTIAL EQUATOR, in hours, is known as the circle's RIGHT ASCENSION (R.A.).

The angular distance of a given hour-circle westward from the CELESTIAL MERIDIAN is known as the HOUR-ANGLE, and is measured in hours or degrees (1 hr = 15°). (F.1.5,256)

HYDROMAGNETIC EMISSION

A Pc1 MICROPULSATION at a single frequency, which may vary slowly with time; a PEARL PULSATION may be considered as the superposition of several hydromagnetic emissions.

See also SOLAR WHISTLE. (D.5.9)

HYDROMAGNETIC SHOCK

A SHOCK propagating in a PLASMA in a magnetic field.

Also known as MAGNETOHYDRODYNAMIC SHOCK.

HYPERONS see PARTICLES

I see LONGITUDINAL INVARIANT

I

The INCLINATION, or DIP angle of the GEOMAGNETIC FIELD.

$$I = \tan^{-1} Z/H \ .$$

See GEOMAGNETIC ELEMENTS.

IAEA (INTERNATIONAL ATOMIC ENERGY AGENCY) (A.2.14,239; A.2.19,28)

IAF (INTERNATIONAL ASTRONAUTICAL FEDERATION)

An organization formed in 1950 to stimulate public interest in astronautics, to promote international co-operation in research, and to encourage the development of astronautics for peaceful purposes.

(A.2.14,235; A.2.19,53)

IAGA (INTERNATIONAL ASSOCIATION OF GEOMAGNETISM AND AERONOMY)

An organization first set up in 1919 as the Section of Terrestrial Magnetism and Electricity of the IUGG. The organization's name was changed in 1930 to the INTERNATIONAL ASSOCIATION OF TERRESTRIAL MAGNETISM AND ELECTRICITY (IATME). The present name was adopted in 1954.

The Association co-ordinates efforts to further the sciences of geomagnetism and aeronomy, and arranges co-operation with other branches of science for the solution of problems of mutual interest. (A.2.14,214)

IATME (INTERNATIONAL ASSOCIATION OF TERRESTRIAL MAGNETISM AND ELECTRICITY)
See IAGA.

IAU (INTERNATIONAL ASTRONOMICAL UNION) (A.2.14,236)

ICAO (INTERNATIONAL CIVIL AVIATION ORGANIZATION) (A.2.14,252; A.2.19,24)

ICRP (INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION)

A body set up in 1928 by the 2nd International Congress of Radiology; it was originally known as the International X-Ray and Radium Protection Commission (the present name was adopted in 1950).

The Commission familiarizes itself with progress in the whole field of radiation protection, and prepares and publishes recommendations dealing with the basic principles. It now functions under the auspices of the ISR. (A.2.14,279)

ICRU (INTERNATIONAL COMMISSION ON RADIOLOGICAL UNITS AND MEASUREMENTS)

A body set up in 1925 by the 1st International Congress of Radiology; it was originally known as the International X-Ray Units Committee. The Commission's studies and deliberations have resulted in recommendations on radiation standards for international adoption. Its work is now carried out under the auspices of the ISR. (A.2.14,455)

ICSU (INTERNATIONAL COUNCIL OF SCIENTIFIC UNIONS)

An organization set up in 1931 to replace the INTERNATIONAL RESEARCH COUNCIL. Its purpose is to co-ordinate and facilitate activities of the international scientific unions; and to act as a co-ordinating centre for associated national organizations. The Council is made up of National and Scientific Members; 14 unions and 54 countries are represented.

The unions belonging to ICSU are:

General unions: IAU, IGU, INTERNATIONAL MATHEMATICAL UNION, IUBS, IUGG, IUPAC, IUPAP, INTERNATIONAL GEOLOGICAL CONGRESS, IUPS.

Specialized unions: IUB, IUCr, IUHPS, IUTAM, URSI. (A.2.14,310)

IFRB (INTERNATIONAL FREQUENCY REGISTRATION BOARD)

An organization within the ITU. (A.2.14,479; A.2.19,8)

IGC (INTERNATIONAL GEOPHYSICAL CO-OPERATION)

The period 1 January to 31 December, 1959, during which many programmes of geophysical research initiated during the INTERNATIONAL GEOPHYSICAL YEAR (IGY) were continued. (A.2.14,316)

IGY (INTERNATIONAL GEOPHYSICAL YEAR)

The period 1 July 1957 to 31 December 1958, during which many specially co-ordinated international programmes of geophysical (and related) research were carried out. Planning for the IGY was begun in 1951. The collected results of research carried out during the IGY (and the IGC, which followed) have been published in the Annals of the IGY. (A.2.9; A.2.14,316)

ILLUMINANCE see LUMINOUS FLUX

IMP (INTERPLANETARY MONITORING PLATFORM)

A series of satellites designed to monitor conditions near the MAGNETOPAUSE, and beyond.

IMP-1 (Explorer XVIII; 1963-46A) was launched in November 1963.
IMP-2 (Explorer XXI; 1964-60A) was launched in October 1964.
IMP-3 (Explorer XXVIII; 1965-42A) was launched in May 1965.

(C.1.5; C.1.12,48)

IMPACT PARAMETER

In the classical, one-body treatment of particle scattering in a central force field, the IMPACT PARAMETER is the perpendicular distance between the centre of force and the initial (unperturbed) velocity of an incident particle.

Also known as COLLISION PARAMETER. (F.4.4,81)

IMPACT REGION see IMPACT ZONE

IMPACT ZONE

A region on earth in which an increase in COSMIC RAY intensity should be observed when a flux of particles from a fixed, known source is incident on the GEOMAGNETIC FIELD.

Also referred to as IMPACT REGION. (B.1.2,217; C.3.8,491)

IMPORTANCE

A numerical rating applied to certain types of SOLAR ACTIVITY to indicate the magnitude of the disturbance observed.

Until January 1966, SOLAR FLARES were normally classified according to importance alone. According to rules adopted by the IAU, a flare's importance is determined primarily by its area (corrected for foreshortening) at maximum BRIGHTNESS, as follows:

IMPORTANCE		CORRECTED AREA	
Old scale	New scale	Millionths of visible hemisphere	Square degrees
1^-	S	<100	<2.06
1	1	100 - 250	2.06 - 5.15
2	2	250 - 600	2.15 - 12.4
3	3	600 - 1200	12.4 - 24.7
3^+	4	>1200	>24.7

In the old classification, additional categories (1^+ and 2^+) were used for class 1 and 2 flares whose central intensity in Hα was much greater than normal. Very intense SUBFLARES (class 1^-) were often elevated to class 1, and intense 3^+ flares were sometimes placed in a "class 4". In the new system, however, flares are classified according to both importance and intensity, so that the need for extra categories is removed. (see FLARE CLASSIFICATION).

Similar IMPORTANCE CLASSIFICATIONS are used for SUDDEN DISAPPEARANCES (on the basis of the greatest extension of the filament before activation), SURGES (on the basis of apparent length), and ACTIVE PROMINENCES (on the basis of the amount of activity observed). (B.2.4,264,274,277; B.3.14,45)

IMPULSIVE BURST see MICROWAVE BURST, Type A; M-BURST

INCLINATION (I)

The angle between the GEOMAGNETIC FIELD and the horizontal direction at any point on the earth's surface.

$$I = \tan^{-1} Z/H \; .$$

Also known as DIP; GEOMAGNETIC INCLINATION.

INDIRECT FLARE DETECTOR

A receiver designed to monitor the level of COSMIC RADIO NOISE. A sudden decrease in this level, or SUDDEN COSMIC NOISE ABSORPTION (SCNA), indicates the occurrence of a SUDDEN IONOSPHERIC DISTURBANCE (SID), and hence of a SOLAR FLARE.

See RIOMETER. (B.2.1,54)

INFRARED LIGHT

ELECTROMAGNETIC RADIATION at wavelengths between 7.2×10^{-5} cm and about 4×10^{-2} cm ($0.72 - 400\mu$). Infrared emission is generally associated with thermal sources.

IGU (INTERNATIONAL GEOGRAPHICAL UNION) (A.2.14,372)

INITIAL ENHANCEMENT

An effect observed when using VHF ionospheric-scatter techniques in the dark hemisphere of the earth at the time of a POLAR CAP ABSORPTION.

(C.2.6,525)

INITIAL PHASE

The first phase of a GEOMAGNETIC STORM, during which the magnitude of the horizontal component of the GEOMAGNETIC FIELD (H) is greater than normal.

INNER RADIATION ZONE see VAN ALLEN RADIATION BELTS

INTEGRAL ABSORBED DOSE

The ABSORBED DOSE integrated over a given region of interest, expressed in GRAM RAD.

INTEGRAL ENERGY SPECTRUM see ENERGY SPECTRUM

INTERNAL NOISE see RADIO NOISE

INTERNATIONAL COUNCIL OF SCIENTIFIC UNIONS see ICSU

INTERNATIONAL GEOLOGICAL CONGRESS (A.2.14,374)

INTERNATIONAL GEOPHYSICAL CO-OPERATION see IGC

INTERNATIONAL GEOPHYSICAL YEAR see IGY

INTERNATIONAL MATHEMATICAL UNION (A.2.14,400)

INTERNATIONAL POLAR YEARS see IPY

INTERNATIONAL RESEARCH COUNCIL

An organization set up in 1919 to co-ordinate the activities of international scientific unions. It was re-organized in 1931 as the ICSU (INTERNATIONAL COUNCIL OF SCIENTIFIC UNIONS). (A.2.14,315)

INTERNATIONAL URSIGRAM SERVICE see IUWDS

INTERNATIONAL YEARS OF THE QUIET SUN see IQSY

INTERPLANETARY DUST

MICROMETEORITIC debris in interplanetary space, whose existence may be inferred from the ZODIACAL LIGHT. The interplanetary dust is apparently concentrated near the ECLIPTIC, forming the ZODIACAL CLOUD. Current analyses of the zodiacal light indicate a space density of particles of 5×10^{-21} gram cm^{-3}, and an electron density of 10-50 cm^{-3}. Most of the polarization of the zodiacal light is attributed to the "dust", with only a minor part ascribed to the interplanetary electrons. (F.1.11,524)

INTERSTELLAR DUST

COSMIC DUST observed in interstellar regions.
See also GALACTIC DUST.

INVARIANT LATITUDE (Λ) see MAGNETIC SHELL PARAMETER (L)

INVERTED U-BURST see U-BURST

IONIZATION CHAMBER

A device for measuring IONIZING RADIATION, consisting essentially of a gas-filled chamber and two electrodes, across which an electric field is applied. Ions formed in the gas migrate to the electrodes before recombination can occur, and induce a measurable change in the voltage-drop across the system. (B.3.14,214; F.4.5,170)

IONIZING PARTICLES

Fast-moving, electrically charged PARTICLES (such as α-particles, β-rays and protons) which ionize the media through which they pass by collision with atomic electrons.

More loosely, the term may be taken to include GAMMA RADIATION and neutrons, which also ionize the media through which they pass, although usually to a smaller extent. In these examples the ionization is produced by secondary particles projected by the incident radiation. In the case of MeV neutrons passing through a hydrogenous material such as tissue, much of the ionization is produced by recoil protons. In the case of γ-radiation from typical radioactive sources ($\sim$1 MeV), the ionization is produced by Compton recoil electrons.

IONIZING RADIATION

A flux of electromagnetic radiation, or of IONIZING PARTICLES, which causes ionization in materials through which it passes. Electromagnetic radiation may cause ionization directly, via the PHOTO-ELECTRIC EFFECT and the COMPTON EFFECT (recoil electrons), or indirectly via PAIR PRODUCTION.

IONOGRAM

The trace produced by an IONOSONDE, plotting the GROUP HEIGHT, or VIRTUAL HEIGHT, of reflection of radio waves in the IONOSPHERE as a function of frequency. The curves thus obtained are often referred to as h'f CURVES. (E.2.14)

IONOSONDE

A device used for taking IONOSPHERIC SOUNDINGS. Short radio pulses are transmitted vertically, at frequencies ranging from 0.5-20 Mc/s over a 15 minute cycle. The delay between the transmission of each pulse and the reception of a corresponding IONOSPHERIC "echo" is recorded as a function of the pulse frequency. The trace produced by an ionosonde is known as an IONOGRAM. (B.3.14,238; E.2.8,282)

IONOSPHERE

The portion of the earth's upper atmosphere where ions and electrons are present in quantities sufficient to affect the propagation of radio waves. Normally the ionosphere extends down to about 50 km altitude, but at times it stretches even lower.

Variations of electron density with height have led to the subdivision of the lower ionosphere into the C-,D-,E-, and F-LAYERS (or REGIONS). Satellite measurements indicate that the OUTER IONOSPHERE (or MAGNETOSPHERE) may be split into the HELIOSPHERE and the PROTOSPHERE.

(E.1.7,167; E.2.11,378; E.2.15)

IONOSPHERIC CROSS-MODULATION

Interaction of two signals of different frequencies incident on the same region of the IONOSPHERE. If signal A (the "disturbing wave") has an amplitude modulation, the amount of energy absorbed from it by the ionosphere (and consequently the local collision frequency) will vary with time. As the collision frequency varies, so will the absorption of signal B ("wanted wave"); when A has a large amplitude, B will be more strongly absorbed than when the amplitude of A is small. The modulation of signal A will thus be superimposed on signal B, with its phase shifted by 180°.

Also known as LUXEMBURG EFFECT; WAVE INTERACTION. (E.2.7,264)

IONOSPHERIC SOUNDER see IONOSONDE

IONOSPHERIC SOUNDING

A measurement of the degree of ionization in the IONOSPHERE as a function of height, using the "pulse-echo" technique.

See IONOSONDE; TOPSIDE SOUNDER. (E.2.8,282)

IONOSPHERIC STORM

A disturbance in the F-REGION of the IONOSPHERE, closely associated with a GEOMAGNETIC STORM. During an ionospheric storm the electron densities in the F2-LAYER decrease at high MAGNETIC LATITUDES (particularly near the AURORAL ZONES), and increase near the equator. The disturbance time-variation may be separated into STORM-TIME VARIATION (Dst) and DISTURBANCE DIURNAL VARIATION (Ds), as for a geomagnetic storm. Diurnal control (i.e. large Ds-component) is greatest in middle latitudes.

The changes occurring in the F-region during an ionospheric storm are probably due to a combination of photochemical changes, atmospheric heating, and charged-particle motions in the earth's electromagnetic field.

(E.2.9,344)

IPDP (INTERVAL OF PULSATIONS DIMINISHING IN PERIOD)

See SOLAR WHISTLE. (D.5.11; D.5.13)

IPY (INTERNATIONAL POLAR YEARS)

Two periods of international co-operation in geophysical research - fore-runners of the IGY. The first IPY (IPY I) took place in 1882-3; the second (IPY II) in 1932-3. (A.2.3; A.2.13)

IQSY (INTERNATIONAL YEARS OF THE QUIET SUN)

An enterprise of international scientific collaboration during the period of minimum SOLAR ACTIVITY, 1 January 1964 to 31 December 1965. IQSY, planned to complement the IGY, was co-ordinated by the IQSY committee of the CIG (CIG-IQSY).

The United Kingdom's contribution to IQSY was organized by the Royal Society's British National Committee for Co-operation in Geophysics.

(A.2.1; A.2.5; A.2.19,46)

IRREGULAR GEOMAGNETIC FIELD see GEOMAGNETIC FIELD

IRREGULAR PULSATIONS (Pi)

MICROPULSATIONS of irregular form, correlated with upper atmospheric phenomena, and closely connected with GEOMAGNETIC DISTURBANCES. Pi's are grouped into two categories:

Pi1 (SIP - periods 1-40 sec) see RAPID IRREGULAR PULSATIONS.

Pi2 (Pt, bps, PULSATION TRAINS, NIGHT PULSATIONS, TYPE D OSCILLATIONS:- periods 40-150 sec) These "pulsation trains" are of short duration, and usually exhibit Pi1 micro-structure; they occur mainly near midnight (MAGNETIC LOCAL TIME). Pi2 periods decrease with increasing magnetic activity; their amplitudes decrease with overall SOLAR ACTIVITY. Pi2 are identified with poloidal HYDROMAGNETIC WAVES developing in the inner cavity of the MAGNETOSPHERE. Their excitation has been attributed to hydromagnetic processes in the equatorial plane of the night magnetosphere; and to injections of dense SOLAR PLASMA clouds in the atmosphere.

(D.5.12,499)

ISOAURORAL LINE, or ISOAURORE

A line connecting places of equal average frequency of overhead occurrence of AURORAE. Not to be confused with ISOCHASM. ("Overhead" means within 30° of the ZENITH.) (D.4.7,230)

ISOCERAUNIC LEVEL

The percentage of the days in a year on which thunder is heard at the place in question. (E.5.5,46)

ISOCHASM see AURORAL ISOCHASM

ISOCLINIC LINES see ISOMAGNETIC LINES

ISOCOSM

A line on the earth's surface connecting points of equal COSMIC RAY intensity.

ISODYNAMIC LINES see ISOMAGNETIC LINES

ISOGAUSS

A line connecting points of equal magnetic induction, B (flux density).

ISOGONES see ISOMAGNETIC LINE

ISOGONIC LINES see ISOMAGNETIC LINE

ISOLINES see ISOMAGNETIC LINE

ISOMAGNETIC LINE (ISOLINE)

A line connecting points at which a given MAGNETIC ELEMENT has a specified value.

ISOCLINIC LINES - lines of equal inclination, or DIP (I).
ISODYNAMIC LINES - lines of equal total field intensity (F).
ISOGONIC LINES (ISOGONES) - lines of equal MAGNETIC DECLINATION (D).
See GEOMAGNETIC FIELD.

ISOPHOTE

A line connecting points of equal photometric BRIGHTNESS, or LUMINANCE. See ISOPHOTOMETER.

ISOPHOTOMETER

A device which determines the lines of equal BRIGHTNESS, or ISOPHOTES, on a photographic image of a light-source (e.g. the solar DISK). Essentially, the instrument consists of a microphotometer (microdensitometer) which scans across the image, viewing only a small area at any one time. A recorder scans a record-sheet in synchronism with the detector, but only marks the sheet when the microphotometer sees the prescribed value of film density.

Typically, for Hα FLARE PATROL images, discrimination is $\Delta \log I = 0.05$ and resolution is 15000 km^2. (B.3.14,104)

ISOPOR

A line connecting points on the earth at which a given MAGNETIC ELEMENT has a given annual SECULAR VARIATION during the period under consideration.

Isopors are plotted on ISOPORIC MAPS. (D.2.2,15)

ISOPORIC MAP see ISOPOR; SECULAR VARIATION

ISR (INTERNATIONAL SOCIETY OF RADIOLOGY)

A non-governmental organization first suggested at the 7th International Congress of Radiology in 1953, and finally approved by the 8th International Congress in 1956.

The Society's purpose is to give continuing financial backing to the international commissions originally sponsored by the International Congresses (see ICRP; ICRU). The membership includes the national radiological societies of 34 countries. (A.2.14,453)

ITSA (INSTITUTE OF TELECOMMUNICATION SCIENCES AND AERONOMY, Boulder, Colorado, U.S.A., 80302)

Formerly the CENTRAL RADIO PROPAGATION LABORATORY (CRPL). The ENVIRONMENTAL SCIENCE-SERVICES ADMINISTRATION (ESSA) of the ITSA has taken over the duties of CRPL as a WORLD DATA CENTRE A: SOLAR ACTIVITY.

ITU (INTERNATIONAL TELECOMMUNICATIONS UNION) (A.2.14,468; A.2.19,7)

<u>IUB</u> (INTERNATIONAL UNION OF BIOCHEMISTRY) (A.2.14,498)

<u>IUBS</u> (INTERNATIONAL UNION OF BIOLOGICAL SCIENCE) (A.2.14,499)

<u>IUCAF</u> (INTER-UNION COMMISION OF FREQUENCY ALLOCATIONS FOR RADIO ASTRONOMY AND SPACE SCIENCE)

A commission within ICSU set up to bring proposals before the ITU with a view to securing frequency allocations to meet scientific requirements. The IUCAF is made up of representatives from COSPAR, IAU, and URSI.

(A.2.19,45)

<u>IUCr</u> (INTERNATIONAL UNION OF CRYSTALLOGRAPHY) (A.2.14,502)

<u>IUCSTR</u> (INTER-UNION COMMISSION ON SOLAR AND TERRESTRIAL RELATIONSHIPS)

A commission within ICSU. Although the IUCSTR takes an interest in all solar-terrestrial relationships, its discussions are mainly restricted to the effects and variations of solar optical, ULTRAVIOLET, and X-RAY emissions, and of low and high-energy solar corpuscular emission.

(A.2.19,45)

<u>IUGG</u> (INTERNATIONAL UNION OF GEODESY AND GEOPHYSICS) (A.2.14,506)

<u>IUHPS</u> (INTERNATIONAL UNION OF THE HISTORY AND PHILOSOPHY OF SCIENCE)

(A.2.14,522)

<u>IUPAC</u> (INTERNATIONAL UNION OF PURE AND APPLIED CHEMISTRY) (A.2.14,514)

<u>IUPAP</u> (INTERNATIONAL UNION OF PURE AND APPLIED PHYSICS) (A.2.14,517)

<u>IUPS</u> (INTERNATIONAL UNION OF PHYSIOLOGICAL SCIENCE) (A.2.14,511)

<u>IUTAM</u> (INTERNATIONAL UNION OF THEORETICAL AND APPLIED MECHANICS) (A.2.14,523)

<u>IUWDS</u> (INTERNATIONAL URSIGRAM AND WORLD DAY SERVICE)

A service organization under FAGS, incorporating two former organizations:

INTERNATIONAL URSIGRAM SERVICE, set up in 1931 to provide rapid distribution of observational data in astronomy, geophysics, and radio science from observatories to data centres. The service was later extended to cover COSMIC RADIATION, AURORA, AIRGLOW, and rockets and satellites.

INTERNATIONAL WORLD DAY SERVICE (IWDS), set up in 1958 to alert nations to days on which special events (e.g. SOLAR FLARES) are expected to occur, so that the phenomena may be studied simultaneously throughout the world.

General alerts (GEOALERTS) are broadcast by the WORLD WARNING AGENCY (AGIWARN; CRPL Forecast Centre, Fort Belvoir, Virginia). Regional alerts are issued by REGIONAL WARNING CENTRES. (A.2.6,5; A.2.12; A.2.14,142)

<u>IWDS</u> (INTERNATIONAL WORLD DAY SERVICE) see IUWDS

<u>IZMIRAN</u> see NIZMIR

<u>JET (1)</u>

A maximum in the daily plot of a CORONAL EMISSION LINE'S intensity against solar latitude.

In the older literature some authors use "jet" in place of "SPICULE". See RAY (1).

<u>JET (2)</u>

A term used to denote the highly collimated group of secondary particles produced by the collision of a very high energy COSMIC RAY ($\gtrsim 10^{12}$ eV) with a target nucleus.

<u>k_λ, k_ν</u> (VOLUME ABSORPTION COEFFICIENT) see ABSORPTION COEFFICIENT

<u>K</u> (3-HOUR GEOMAGNETIC INDEX)

A logarithmic measure of the range of the most disturbed component of the GEOMAGNETIC FIELD during a 3-hour interval at a given location (excluding SOLAR FLARE effects). K varies from 0 to 9 on a scale defined separately for each latitude according to the maximum amplitudes observed. The eight daily K-INDICES are reported in the form of an eight-digit number.

K_p, the PLANETARY 3-HOUR INDEX, is the average of the standardized K INDICES for 12 selected observatories. (C.4.1,228)

K-CORONA ("KONTINUUM" CORONA)

The partially polarized component of the white-light CORONA, in which the FRAUNHOFER SPECTRUM is nearly obliterated. The K-corona is attributed to THOMSON SCATTERING of PHOTOSPHERIC light by coronal electrons; the Fraunhofer lines are washed out by the DOPPLER EFFECT of the high thermal velocities of the electrons.

Also known as the ELECTRON CORONA. (B.3.14,10)

K-LINE

A resonance line in the CaII spectrum of ionized calcium, arising from transitions between the first and second atomic levels. This line and the H-LINE of CaII are among the strongest in the visible solar spectrum.

In observations of solar PLAGES, double reversal is found at the centres of the H and K-lines - i.e. in the principal ABSORPTION LINE there is an emission, on which is superimposed a central absorption. The LINE PROFILE details are denoted by subscripts. K_1 or H_1 represents the wide absorption line; $K_2(H_2)$, the central emission peaks; $K_3(H_3)$, the central absorption. The entire central region may be denoted, for example, by K_{232}. Subscripts "r" and "v" may be added to differentiate between the red and violet WINGS of K_1 and K_2. K_1, K_2, and K_3 are formed at successively higher levels in the CHROMOSPHERE. (B.3.14,19)

K_p (PLANETARY 3-HOUR GEOMAGNETIC INDEX) see K

KRAMERS' LAW OF OPACITY see OPACITY

L see LUNAR DAILY VARIATION

L see MAGNETIC SHELL PARAMETER

LARMOR FREQUENCY (ω_L) see LARMOR PRECESSION

LARMOR ORBIT

The circular orbit of a charged particle gyrating in a magnetic field. The radius of the Larmor orbit, or LARMOR RADIUS, is given by

$$r_L = v_\perp/\omega_c ,$$

where $v_\perp$ is the component of particle velocity in the plane normal to the magnetic field, and ω_c is the frequency of gyration, or CYCLOTRON FREQUENCY.

(Some authors refer to the frequency of gyration as the LARMOR FREQUENCY, although the true Larmor frequency has the magnitude $\omega_c/2$.)

LARMOR PRECESSION

The precession, about a uniform magnetic field, of the plane of rotation of an orbiting or spinning charged body.

The angular frequency of precession, or LARMOR FREQUENCY, is given by

$$\vec{\omega}_L = - q\vec{B}/2m \quad ,$$

where q and m are the charge and mass of the orbiting body, and $\vec{B}$ is the magnetic field. The magnitude of the Larmor frequency is thus half that of the CYCLOTRON FREQUENCY. Some plasma physicists, however, use the term "Larmor frequency" to denote the cyclotron frequency.

LARMOR RADIUS see LARMOR ORBIT

LAST PHASE

The final, slow-recovery phase of a GEOMAGNETIC STORM.
Also known as RECOVERY PHASE.

(L,B) CO-ORDINATE SYSTEM

For a charged particle "bouncing" and "drifting" in the GEOMAGNETIC FIELD, both the MAGNETIC MOMENT (μ) and the LONGITUDINAL INVARIANT (I) are conserved. The invariance of μ requires that the particle must always mirror on a surface of constant field-strength B; the invariance of I requires that the particle must drift on a particular MAGNETIC SHELL (constant L). These two surfaces will intersect along a closed curve in each hemisphere; these curves, characterized by (L,B), are the loci of the particle's MIRROR POINTS. (L,B) CO-ORDINATES may thus be used to characterize the motions of charged particles in the earth's magnetic field.

See also MAGNETIC SHELL PARAMETER. (D.3.6,162; D.3.11)

LCT see LOCAL CIVIL TIME

LD_{50-30}

The DOSE of IONIZING RADIATION which causes effects, apparent within 30 days of exposure, leading to the death of 50% of the exposed population. (F.3.8,63)

L_e, L^e ("EXTERNAL" LUNAR DAILY VARIATION) see LUNAR DAILY VARIATION

LEPTON see PARTICLES

LET see LINEAR ENERGY TRANSFER

LF (LOW FREQUENCIES)

30-300 kc/s. (E.2.1,393)

L_i, L^i ("INTERNAL" LUNAR DAILY VARIATION) see LUNAR DAILY VARIATION

LIGHT CURVE

A plot of BRIGHTNESS against time for the portion of a SOLAR FLARE which attains maximum LUMINOSITY.

Many flares brighten non-uniformly (i.e. some parts reach peak brightness after others have begun to fade). Flares of this type may require several light curves.

Richardson has defined a classification of flare light curves as FAST, SLOW, FLASH, PERSISTENT, RECURRENT, and SUPERFLARE on the basis of resemblances to the light curves of NOVAE.

See also DEVELOPMENT CURVE and GROWTH CURVE. (B.3.14,99)

LIGHTNING

An electrical discharge in the earth's atmosphere. A lightning discharge may occur within a cloud, or between a cloud and the ground, and may have a wide variety of forms. (See AIR DISCHARGE, BALL LIGHTNING, BEAD LIGHTNING, RIBBON LIGHTNING.)

Electromagnetic impulses from lightning discharges are responsible for the generation of WHISTLERS and ATMOSPHERICS. (E.5.4,314; E.5.5,65)

LIGHT OF THE NIGHT SKY see NIGHTGLOW

LIMB

The boundary of the solar DISK, corresponding to the level at which the SOLAR ATMOSPHERE becomes transparent to visible light. More precisely, the limb marks the height in the solar atmosphere at which the OPTICAL THICKNESS of the solar gases, with respect to a tangential ray, is equal to unity.

The boundary between the PHOTOSPHERE and the CHROMOSPHERE is arbitrarily set to coincide with the limb, as observed at 5000 Å.

(B.1.1,1135; B.1.2,117)

LIMB-DARKENING

The observed decrease, toward the LIMB, of the brightness of the solar DISK. This decrease is more pronounced at shorter wavelengths; hence the sun's colour reddens toward the limb.

The limb-darkening is due to the fact that the line of sight at the limb intersects cooler PHOTOSPHERIC levels than that at the centre of the disk. (B.1.5,5)

LIMB FLARE

A SOLAR FLARE seen at the LIMB. Limb flares may generally be classified as mounds, cones, columns, loops, or irregular structures. Very few large flares have been seen in true limb projection. The majority thus observed would have been of IMPORTANCE 1^- or 1 on the DISK. (B.3.14,85)

LIMB SURGE see SURGE

LINEAR ENERGY TRANSFER (LET)

The energy an IONIZING PARTICLE loses in unit path length to the medium through which it is travelling. The energy-transfer is usually expressed in ergs/cm or KeV/micron.

In general, LET is proportional to $(\text{charge})^2/\text{velocity}$ of the particle in question. A particle may be considered "highly ionizing" if the LET exceeds 30 KeV/micron. (F.3.2; F.3.7,382; F.3.8,63)

LINE EMISSION

Emission of ELECTROMAGNETIC RADIATION concentrated in narrow frequency-bands.

See EMISSION LINE.

LINE PROFILE

A plot of intensity against wavelength for a spectral ABSORPTION or EMISSION LINE.

LINE WIDTH

The "width" of a solar-flare EMISSION LINE is defined as the separation in ÅNGSTROMS of the points at which the flare LINE PROFILE merges with the normal profile of the quiet DISK.

If the flare-profile is sensibly wider than the FRAUNHOFER LINE on which it is superimposed, the flare line-width is measured between the points at which flare BRIGHTNESS is 105% that of the quiet disk.

(B.3.14,119)

LINE-WIDTH CURVE

A plot of LINE WIDTH against time for a SOLAR-FLARE emission line. In general, Hα line width and central intensity increase in phase and reach maximum together; line width decreases faster than intensity after maximum.

Also known as DEVELOPMENT CURVE. (B.3.14,96)

LINE SHIFTER

A modification to the LYOT FILTER, whereby the first and last polaroids are provided with quarter-wave plates and rotating mounts. This arrangement permits the filter pass-band to be shifted by as much as twice the bandwidth to either side of its normal position. (B.3.14,37)

LMT see LOCAL MEAN TIME

LOCAL CIVIL TIME (LCT)

The MEAN SOLAR TIME at a given location on the surface of the earth, referred to the day beginning at midnight.

See also LOCAL MEAN TIME. (F.1.5,174)

LOCAL MEAN TIME (LMT)

The MEAN SOLAR TIME at a given location on the surface of the earth, referred to the day beginning at noon.

See also LOCAL CIVIL TIME; LOCAL TIME. (F.1.5,174)

LOCAL THERMODYNAMIC EQUILIBRIUM (LTE)

The thermodynamic state in which:

(a) the distribution of particle velocities is Maxwellian, at temperature T,

(b) the relative population of atomic levels are given by the Boltzmann ratio, at temperature T,

(c) the ionization equilibrium is in accordance with Saha's Law, at temperature T.

LOCAL TIME (LT)

Roughly speaking "local time" may be assumed synonymous with APPARENT SOLAR TIME. The anti-solar meridian of longitude - the one which intersects the earth-sun line on the night side of earth - is taken as zero, and longitude is measured eastward round the globe. LT is then given by $12/\pi$ times the longitude.

For more precise definitions of LT, see LOCAL CIVIL TIME, LOCAL MEAN TIME, MEAN SOLAR TIME; see also MAGNETIC LOCAL TIME.

LONGITUDINAL INVARIANT

The action integral

$$J = \oint m v_{\parallel} \, d\ell$$

for a particle "bouncing" between MIRROR POINTS on a magnetic line of force. (m is the particle's mass; $v_{\parallel}$ its velocity along the force-line; and the integral is evaluated along the force-line, between the mirror points.) This quantity is an ADIABATIC INVARIANT, under the condition that the magnetic and electric fields change very little in a time comparable with the "bounce" period.

When the overall particle velocity v is constant, the longitudinal invariant is written as

$$I = J/mv = \oint (\cos \alpha) \, d\ell = \oint \left(1 - \frac{B}{B_m}\right)^{\frac{1}{2}} d\ell \quad ,$$

where α is the PITCH ANGLE; and B_m is the MAGNETIC FIELD STRENGTH at the MIRROR POINT.

For particles MIRRORING in the GEOMAGNETIC FIELD, the "bounce" period is of the order of seconds. (D.3.13,512)

LONG-PERIOD VLF PULSATIONS see VLF EMISSIONS

LOOP see AURORA (FORMS)

LOOP PROMINENCE

A form of PROMINENCE labelled AS1 in the MENZEL-EVANS CLASSIFICATION. Loop prominences are evidence of unusually energetic activity, and are usually found in regions of considerable CORONAL and FLARE activity. Meterial streams down two main curved arms which meet in or near a SUNSPOT.

The loop height above the LIMB is of the order of 100,000 km. The coronal line CaXV (yellow, λ5694) is almost always observed in association with loop prominences. (B.3.14,28)

Lpc, LPc (LONG CONTINUOUS PULSATIONS)

The class of continuous MICROPULSATIONS with periods from 2-7 min, including the so-called GIANT MICROPULSATIONS (Pg). Lpc has now been supplanted by the classification Pc5.

Also known as Pc-III.

See CONTINUOUS PULSATIONS.

LT see LOCAL TIME

LTE see LOCAL THERMODYNAMIC EQUILIBRIUM

LUMINANCE see BRIGHTNESS

LUMINESCENCE

The re-emission of absorbed energy, in the form of visible or near-visible radiation. The initial excitation may be by light, electron or ion-bombardment, mechanical strain, chemical reaction, or heating. (F.4.9,524)

LUMINESCENCE ATMOSPHÉRIQUE French term for AIRGLOW

LUMINOSITY

The apparent monochromatic BRIGHTNESS of a given source.

LUMINOSITY CLASS see SPECTRAL CLASS

LUMINOUS FLUX

The visible-light energy crossing a surface per unit time.

The luminous flux incident on a surface per unit area is known as the ILLUMINANCE.

LUMINOUS INTENSITY

Light energy radiated by a given source in a given direction, per unit solid angle and unit time.

The MONOCHROMATIC INTENSITY of the source at wavelength λ is defined by restricting consideration to energy radiated at wavelengths between λ and $\lambda + d\lambda$.

LUNAR DAILY VARIATION (L)

A regular GEOMAGNETIC FIELD variation connected with the 25-hour lunar day, and the current system responsible for this variation. The monthly mean values of L for each hour, plotted as a function of time in the lunar day, give a simple semi-diurnal curve.

At most places L is very small, being about 1/10 the size of the SOLAR DAILY VARIATION, S. Reliable values may be determined only by using data covering a period of many years.

The amplitude of L is greatest during daylight, when the IONOSPHERIC conductivity is high. Like S, L varies with the season and with GEOMAGNETIC ACTIVITY.

L is attributed to the small contribution of lunar tidal forces to DYNAMO CURRENTS in the IONOSPHERE. The variation may be split into

$$L = L_e + L_i \ (\text{or } L = L^e + L^i) \quad ,$$

where "e" and "i" refer to "external" (above the earth's surface) and "internal" (within the earth) current-systems respectively.

(B.3.14,231; D.2.2,67; D.2.6; D.2.8,490; E.1.3,374)

LUNAR ECLIPSE see ECLIPSE

LUXEMBURG EFFECT see IONOSPHERIC CROSS-MODULATION

LYMAN LIMIT see LYMAN SERIES

LYMAN SERIES

The series in the hydrogen-atom spectrum resulting from transitions to or from the first ($n = 1$), or K-shell, electron states. The lines converge to the LYMAN LIMIT at 911 Å.

LYOT FILTER

A MONOCHROMATOR developed independently by LYOT and ÖHMAN and used widely in studies of SOLAR ACTIVITY. The device consists of a series of birefringent plates, whose thicknesses increase in a geometrical progression, spaced by sheets of polaroid set at 45° to the optic axes. The transmission profile consists of a series of narrow "spikes", each as wide as a single band of the channel-spectrum of the thickest plate. The separation of the "spikes" is that of the successive peaks in the channel-spectrum of the thinnest plate. Filters of this type are small and compact, and permit convenient mounting arrangements. They are widely used in FLARE-PATROL cameras.

Also known as a BIREFRINGENT FILTER. (B.3.14,36)

LYOT HELIOGRAPH

An instrument designed to produce a monochromatic image of the SUN on a photographic plate, without having to "dissect" and reconstruct the image as in the SPECTROHELIOGRAPH. A LYOT FILTER is used to provide the required MONOCHROMATIC PURITY. (F.1.6)

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m_λ see MAGNITUDE

M

The MAIN GEOMAGNETIC FIELD, due to sources within the earth. See GEOMAGNETIC FIELD.

MAGCALME (MAGNETIC CALM)

A telegraphic abbreviation used by AGIWARN to denote a period of low GEOMAGNETIC ACTIVITY. (C.4.5)

MAGNETIC BAY

A smooth excursion of the H and Z components of the GEOMAGNETIC FIELD, generally most pronounced near the AURORAL ZONES. Large bays are observed simultaneously all over the world.

The relative magnitudes and amplitudes of X, Y and Z vary strongly with latitude during a bay. Amplitudes may be as great as several hundred GAMMAS; durations are of the order of 1-2 hours.

Bays are called "positive" or "negative" according to whether H increases or decreases. Positive bays, which are more frequent, occur mainly at night; negative bays occur mostly during the afternoon.

Bays may be interpreted in terms of DYNAMO ACTION, or in terms of the effect of atmospheric winds on ionization produced by incoming 50 KeV SOLAR COSMIC RAYS.

The name "bay" is used because the MAGNETOGRAPHIC records of these variations resemble indentations in a sea-coast. (B.3.14,232; E.1.3,402)

MAGNETIC BOTTLE

A magnetic field configuration in which field lines beginning in a localized region on the SUN (e.g. a SUNSPOT) stretch out into space in a reasonably well-ordered manner, and return to a different location on the sun. Such a configuration could be set up, for example, by PLASMA (ejected from a chromospheric disturbance) convecting solar fields into interplanetary space to distances of 1 A.U. or more. Field configurations of this sort are also known as MAGNETIC LOOPS or TONGUES.

The term "magnetic bottle" is also used for certain laboratory field configurations used to contain thermonuclear plasmas. (C.2.11,361)

MAGNETIC BREMSSTRAHLUNG see SYNCHROTRON RADIATION (F.3.10,100)

MAGNETIC CO-LATITUDE (θ) see MAGNETIC CO-ORDINATES (D.2.3,v.1,22)

MAGNETIC CO-ORDINATES

Along each line of force in the GEOMAGNETIC FIELD the value of MAGNETIC FIELD STRENGTH varies, reaching a minimum near the equator. When all the lines of force are considered together, these equatorial minima generate a surface known as the MAGNETIC EQUATOR. This surface is time-dependent and far from planar; at large altitudes it may split into several sheets.

As the geomagnetic INCLINATION, or DIP, is zero on the magnetic equator, the intersection of the magnetic equator with the earth's surface is known as the DIP EQUATOR. At points away from the magnetic equator the value of the dip (I) may be used to define the MAGNETIC LATITUDE, or DIP LATITUDE, Φ':

$$\tan \Phi' = \tfrac{1}{2} \tan I \quad .$$

The magnetic latitude should not be confused with the GEOMAGNETIC LATITUDE, Φ, defined by

$$\tan \Phi = \tfrac{1}{2} \tan I_{dipole} = \tfrac{1}{2} \left(\frac{Z}{H}\right)_{dipole}$$

(Z_{dipole} and H_{dipole} are the vertical and horizontal components of the best magnetic-dipole approximation to the geomagnetic field.) The MAGNETIC CO-LATITUDE or POLAR ANGLE, θ, is defined as the complement of Φ:

$$\theta = 90° - \Phi$$

The MAGNETIC DIP POLES are the points on the earth's surface at which $\Phi' = 90°$, while the MAGNETIC AXIS POLES are those at which $\Phi = 90°$. The dip poles are not antipodal, as their positions depend on local conditions; for the same reason the dip and axis poles do not coincide.

A system of MAGNETIC LONGITUDE may be defined by labelling each line of force of the geomagnetic field with the geographical longitude of the point at which the line of force intersects the magnetic equator. The lines of force of $\vec{H}$, the directed horizontal component of the geomagnetic field at the earth's surface, are sometimes referred to as MAGNETIC MERIDIANS.

See also (L,B) CO-ORDINATE SYSTEM; MAGNETIC SHELL PARAMETER.

(D.2.2,9,22; D.2.3,v.1,22; D.2.9)

<u>MAGNETIC CROCHET</u> see CROCHET

<u>MAGNETIC DECLINATION</u> (D, d°) see DECLINATION; GEOMAGNETIC FIELD

<u>MAGNETIC DIP LATITUDE</u> (Φ') see MAGNETIC CO-ORDINATES

<u>MAGNETIC ELEMENTS</u>

The components of the GEOMAGNETIC FIELD at the surface of the earth.

See GEOMAGNETIC ELEMENTS; D, F, H, I, V, W, X, Y, Z.

<u>MAGNETIC FIELD STRENGTH MAXIMUM; MAGNETIC FIELD STRENGTH CENTRE</u>

A region of enhanced magnetic field in the solar PHOTOSPHERE.

See SUNSPOT GROUP CLASSIFICATION.

<u>MAGNETIC FRONT</u>

A sharply localized increase in the strength of a magnetic field being convected outward from the SUN.

A magnetic front may occur, for example, where fast-moving PLASMA ejected from a chromospheric disturbance overtakes the slower "quiet" SOLAR WIND.

See also "SWEEPING-OUT" EFFECT.

MAGNETIC INDEX

A measure of variations in the GEOMAGNETIC FIELD during a specified time-interval. The most commonly used indices are:

1. RANGE INDICES, R_H, R_D, R_Z.
2. K-INDICES, K, K_p.
3. AMPLITUDES, A_k, a_k, A_p, a_p.
4. CHARACTER FIGURES, C, C_i, C_p.

The use of a p-subscript in a MAGNETIC INDEX denotes a planetary average.

(B.3.14,231)

MAGNETIC LATITUDE (Φ) see MAGNETIC CO-ORDINATES

MAGNETIC LOCAL TIME (MLT)

A GEOMAGNETIC TIME used in organizing data related to the GEOMAGNETIC FIELD (e.g. data on AURORAE and TRAPPED RADIATION).

A system of "longitude" is first defined about the GEOMAGNETIC AXIS. The anti-solar meridian - the one which intersects the sun-earth line on the night side of earth - is taken as zero, and longitude is measured "eastward" round the earth. MLT is then given by $(12/\pi)$ times the geomagnetic longitude.

(D.3.8,2498; D.4.17)

MAGNETIC LONGITUDE see MAGNETIC CO-ORDINATES

MAGNETIC LOOP see MAGNETIC BOTTLE

MAGNETIC MERIDIANS

The lines of force of $\vec{H}$, the directed horizontal component of the GEOMAGNETIC FIELD.

(D.2.2,2)

MAGNETIC MIRROR see MIRROR POINT

MAGNETIC MOMENT (μ)

The quantity $\mu = mv_\perp^2/2B$, for a particle of mass m and velocity $v_\perp$ perpendicular to a magnetic field $\vec{B}$. This quantity is an ADIABATIC INVARIANT, provided that:

(a) no electric fields are present,

(b) the magnetic field changes very little across a LARMOR ORBIT,

(c) the magnetic field changes very little in a time comparable with the particle's period of gyration (in the order of milliseconds for particles moving in the GEOMAGNETIC FIELD).

The magnetic moment is also referred to as the TRANSVERSE INVARIANT.

(D.3.13,509)

MAGNETIC POLES see MAGNETIC CO-ORDINATES

MAGNETIC PRESSURE

In MAGNETOHYDROSTATICS and MAGNETOHYDRODYNAMICS the quantity $B^2/8\pi$ appears as a "magnetic pressure", where B is the strength of the magnetic field. (F.2.3,45)

MAGNETIC PULSATIONS

Fluctuations in the GEOMAGNETIC FIELD, such as ATMOSPHERICS, MICRO-PULSATIONS, etc. This general category includes fluctuations with a wide range of periods. (D.2.8,508)

MAGNETIC REFLECTION see MIRROR POINT

MAGNETIC RIGIDITY

For a particle of momentum p and charge Ze (in e.s.u.) the MAGNETIC RIGIDITY is:

$$R_M = \frac{pc}{Z|e|}$$

(where c = velocity of light).

For a relativistic particle of rest mass m_o and energy E,

$$R_M = \frac{(E^2 + 2E\,m_o c^2)^{\frac{1}{2}}}{Z|e|}$$

R_M has dimensions of electrical potential.

$$R_M(\text{volts}) = 300\ R_M(\text{cgs}) \ .$$

(D.3.6)

MAGNETIC SHELL see ELECTRO-ORBITAL SURFACE

MAGNETIC SHELL PARAMETER (L)

A parameter introduced by McIlwain to characterize the "equatorial radii" of ELECTRO-ORBITAL SURFACES in the GEOMAGNETIC FIELD.

For a pure dipole field, with dipole moment M, a function F may be defined such that the surface $F\left(I^3 \frac{B}{M}\right) = R_o^3 \frac{B}{M}$; ($R_o$ = constant) is just the magnetic shell with equatorial radius R_o, in units of earth radii. (I = LONGITUDINAL INVARIANT for particle motion in the field; B = MAGNETIC FIELD STRENGTH.)

In the geomagnetic field, the exact (I,B) relationship is non-dipolar; however, the surfaces $F\left(I^3 \frac{B}{M}\right) = L^3 \frac{B}{M}$; (L = constant) are still close fits to the magnetic shells. McIlwain has shown that L varies less than 1% round an exact electro-orbital surface; hence L defines an effective "mean equatorial radius" (in units of earth radii) for a given magnetic shell.

For an equilibrium distribution of TRAPPED RADIATION in the geomagnetic field, the particle-flux MIRRORING at a field-strength B is the same everywhere on a surface of constant L. The flux may thus be described very simply in terms of (L,B) CO-ORDINATES.

Each point in (L,B) space may be transformed into dipole-like co-ordinates (R,λ) by the relations:

$$B = \frac{M}{R^3}\left\{4 - \frac{3R}{L}\right\}^{\frac{1}{2}}$$

$$R = L \cos^2\lambda \quad .$$

The "latitude" at which an L-surface intersects the earth is thus given by:

$$L \cos^2\Lambda = 1 \quad .$$

Λ is known as the INVARIANT LATITUDE, and is often more useful than the GEOMAGNETIC LATITUDE, Φ, which is derived from a less exact representation of the geomagnetic field.

See also MAGNETIC CO-ORDINATES. (D.3.11; D.3.12)

MAGNETIC STORM see GEOMAGNETIC STORM

MAGNETIC TONGUE see MAGNETIC BOTTLE

MAGNETIC VARIOMETER

An instrument designed to measure small variations in the components of the GEOMAGNETIC FIELD. The MAGNETIC ELEMENTS usually recorded are H, V and D; and the records obtained are known as MAGNETOGRAMS (sometimes also referred to as MAGNETOGRAPHS). (D.2.3,v.1,48)

MAGNETOACOUSTIC WAVE

A plane wave, which is at least partly longitudinal, propagating in a compressible PLASMA in the presence of a magnetic field.

Two types of magnetoacoustic waves occur. For "fast" waves, the magnetic and gas pressure perturbations are in phase; for "slow" waves, they are 180° out of phase.

Also known as MAGNETOSONIC WAVES. (F.2.6,81)

MAGNETOGASDYNAMICS see MAGNETOHYDRODYNAMICS

MAGNETOGRAM

The record obtained from a MAGNETIC VARIOMETER. (D.2.3,v.1,48)

MAGNETOGRAPH (Instrument)

A device used to measure magnetic fields on the SUN and other stellar bodies by observing the Zeeman splitting of spectral lines. As EMISSION LINES in the PHOTOSPHERIC spectrum are too broad to permit separation of the Zeeman components, splittings are determined by comparing the intensities in the line "wings". (B.3.14,172; F.1.4)

MAGNETOGRAPH (Record) see MAGNETIC VARIOMETER

MAGNETOHYDRODYNAMICS (MHD)

The study of the motion of an electrically conducting fluid in the presence of a magnetic field.

It is often useful to consider an ionized gas as a "continuous fluid" and apply the equations of MHD. In many cases, however, this approximation is too crude, and the treatment must be modified to include the effects of individual-particle motions. When these effects are taken into account, and the DEBYE LENGTH is small compared with other lengths of interest, the study of the gas's motion in the presence of a magnetic field is known as

MAGNETOPLASMADYNAMICS (MPD). If the Debye length is comparable with other lengths of interest, so that the gas may no longer be treated as a PLASMA, the study of the gas-particle motions is known as MAGNETOGASDYNAMICS, MAGNIONICS, or MAGNETOIONICS.

Magnetohydrodynamics is also referred to as HYDROMAGNETICS. (F.2.2,1)

<u>MAGNETOHYDRODYNAMIC SHOCK</u> see HYDROMAGNETIC SHOCK

<u>MAGNETOHYDROSTATICS</u>

The study of an electrically conducting fluid in mechanical equilibrium in the presence of a non-uniform magnetic field.

<u>MAGNETOIONICS</u> see MAGNETOHYDRODYNAMICS

<u>MAGNETOMETER</u>

An instrument designed to measure the absolute value of the GEOMAGNETIC FIELD, or of one of its components (e.g. H or V). (D.2.3,v.1,39)

<u>MAGNETOPAUSE</u>

The outer boundary of the MAGNETOSPHERE.

<u>MAGNETOPLASMADYNAMICS</u> (MPD) see MAGNETOHYDRODYNAMICS

<u>MAGNETOSONIC WAVE</u> see MAGNETOACOUSTIC WAVE

<u>MAGNETOSPHERE</u>

The region of a planet's upper atmosphere in which the effects of collisions and gravity on charged-particle motion are negligible, and the motion is controlled by the planet's magnetic field. The magnetosphere may be thought of as the portion of the EXOSPHERE where ions predominate. The outer boundary of the earth's magnetosphere (the MAGNETOPAUSE) lies at 8-15 earth radii on the sunward side. Both "open" and "closed" magnetospheric configurations are possible, depending on whether or not the magnetosphere is linked to interplanetary space by a finite magnetic flux. If the earth's magnetosphere is closed, the SOLAR WIND is excluded from a region around the earth known as the GEOMAGNETIC CAVITY.

The earth's magnetosphere is sometimes referred to as the OUTER IONOSPHERE or WHISTLER MEDIUM. Its thermal proton component is sometimes called the PROTOSPHERE (PROTONOSPHERE); its ionized helium component is known as the HELIOSPHERE. (D.1.3,505; D.1.4,538; D.3.9; D.3.13,506; E.1.4,245)

MAGNIONICS

The branch of science dealing with the motion of charged particles in electromagnetic fields.

See also MAGNETOHYDRODYNAMICS. (D.4.7,241)

MAGNITUDE

The monochromatic MAGNITUDE of a star is defined as:

$$m_\lambda = s \log_{10} e_\lambda + q$$

where e_λ is the monochromatic illumination of a receiver placed outside the earth's atmosphere, and s and q are factors defining the scale and zero of magnitude. The normal scale of magnitudes is defined by taking $s = -2.5$.

The ABSOLUTE MAGNITUDE is defined as the apparent magnitude the star in question would have at a distance of 10 PARSECS from the earth.

(F.1.10,125,333)

MAGSTORM

A telegraphic abbreviation used by AGIWARN to denote a GEOMAGNETIC STORM. (C.4.5)

MAIN GEOMAGNETIC FIELD see GEOMAGNETIC FIELD

MAIN PHASE

The main-activity part of a GEOMAGNETIC STORM, straddling the minimum in the horizontal component of the GEOMAGNETIC FIELD (H). The main phase begins when H first falls below normal, and ends when recovery from the minimum slows down.

See also DR. (D.4.8,468; D.4.12,461)

MASS ABSORPTION COEFFICIENT (κ_λ, κ_ν) see ABSORPTION COEFFICIENT

MAUNDER DIAGRAM see BUTTERFLY DIAGRAM

MAXIMUM PERMISSIBLE BODY BURDEN

The BODY BURDEN, q, is a measure of the number of radioactive disintegrations occurring in the body per second after irradiation with a given radio-nuclide. The maximum permissible body burden corresponds to the disintegration rate at which the DOSE EQUIVALENT delivered to the CRITICAL BODY ORGAN reaches its maximum permissible value.

q is normally expressed in MICROCURIES. (F.3.9,570; F.3.15)

MAXIMUM PERMISSIBLE CONCENTRATION (MPC)

The maximum concentration of a given radio-nuclide that is to be tolerated in air, water, and food. (F.3.9,569; F.3.15)

MAXIMUM PERMISSIBLE DOSE (MPD)

The MPD for an individual is that dose of IONIZING RADIATION, "accumulated over a long period of time or resulting from a single exposure, which in the light of present knowledge carries a negligible probability of severe somatic or genetic effects; furthermore, it is such a dose that any effects that ensue more frequently are limited to those of a minor nature that would not be considered unacceptable by the exposed individual and by competent medical authorities ... (The MPD can) be expected to produce effects that could be detectable only by statistical methods applied to large groups". (F.3.5)

MAXIMUM PERMISSIBLE EXPOSURE (MPE)

An exposure to IONIZING RADIATION which should not be exceeded, except in emergencies.

In 1960, the U.S. Federal Radiation Council (FRC) introduced the term RADIATION PROTECTION GUIDE (RPG) in place of MPE (and MPD), in order to avoid giving the impression that there is a "single permissible or acceptable level of exposure without regard to the reason for permitting the exposure". (F.3.9,566; F.3.14)

M-BURST

An impulsive, short-lived, intense enhancement of the SOLAR RADIO EMISSION at centimeter wavelengths preceding a TYPE IV-A RADIO BURST. M-bursts are usually accompanied by TYPE III RADIO BURSTS at meter and decimeter wavelengths.

Also known as a MICROWAVE EARLY BURST. (B.3.14,194,205; F.3.10,118)

M-DISTURBANCE see M-REGION

MEAN ASYMPTOTIC DIRECTION OF VIEWING

The mean ASYMPTOTIC DIRECTION OF ARRIVAL of the SOLAR COSMIC RAY fluxes detected by a given NEUTRON MONITOR.

See also ASYMPTOTIC CONE OF ACCEPTANCE. (C.3.8,492)

MEAN DAILY INEQUALITY see S

MEAN SOLAR TIME

The HOUR-ANGLE of the "mean sun" plus 12 hours. (The mean sun is assumed to move uniformly round the CELESTIAL EQUATOR in the same time that the true sun takes to complete a revolution along the ECLIPTIC.)

The mean solar day is divided into 24 hours. An hour thus defined is slightly longer than an hour of SIDEREAL TIME. (F.1.5,173)

MENZEL-EVANS CLASSIFICATION

A semi-pictorial scheme for classifying PROMINENCES according to direction of motion, relation to SUNSPOTS, and appearance. Symbolically, each type is given a 3-letter label, one letter being chosen from each of the following classes:

A = descent from ABOVE, in the CORONA
B = ascent from BELOW, in the CHROMOSPHERE

S = a SPOT PROMINENCE
N = a NON-SPOT PROMINENCE

a, b, c, d, ... = a pictorial label.

The pictorial designations (e.g. TREE, HEDGEROW, etc.) do not generally represent actual 3-dimensional structures. They usually refer to sectional projections of the ribbon-like structure of the QUIESCENT PROMINENCES.

(B.1.2,224; B.1.9; B.3.14,26)

MESONS see PARTICLES

MESOPAUSE

The temperature minimum in the earth's atmosphere at 80-85 km altitude, marking the upper limit of the MESOSPHERE and the lower limit of the THERMOSPHERE. (E.1.1; E.1.2,3)

MESOPEAK see MESOSPHERE

MESOSPHERE

The region of the earth's atmosphere between the STRATOPAUSE (the upper limit of the STRATOSPHERE) and the MESOPAUSE (the lower limit of the THERMOSPHERE, at about 80 km altitude).

Two definitions of the STRATOPAUSE are in use at present:- that of Chapman, who limits the STRATOSPHERE to the isothermal region between 10 and 20-30 km; and that of Nicolet, who considers the STRATOSPHERE to extend up to the temperature maximum at around 50 km. Nicolet's "stratopause" temperature maximum is called the MESOPEAK by Chapman. Chapman's "mesosphere" is thus a region in which the temperature first increases, then decreases with height. Nicolet's "mesosphere" includes only the temperature decrease.

(E.1.2,3)

METASPHERE

That portion of the EXOSPHERE in which a significant number of neutral atoms are still to be found. The rather indefinite boundary between the metasphere and the fully-ionized PROTOSPHERE has been called the METAPAUSE.

(E.1.2,14; E.1.5,21; E.1.6,206)

METEOR

A particle of stone or iron entering the earth's atmosphere from interplanetary space and detectable by virtue of its ionized, luminous trail, produced by collisions between evaporated meteor atoms and air molecules.

The term METEOROID is often used to designate the particles responsible for meteoric phenomena. These particles are classified according to size as MICROMETEORITES ($<1\mu - 100\mu$); METEORS ($100\mu - 10$ cm); FIREBALLS and BOLIDES (10 cm - 300 cm). Meteoroids move in closed orbits within the solar system - often in groups of "clouds" responsible for METEOR SHOWERS - and are thought to be of COMETARY and ASTEROIDAL origin.

Meteors incident on the atmosphere in groups are referred to as SHOWER METEORS; those arriving independently are known as SPORADIC METEORS.

(E.5.1,513; F.1.12,519)

METEORITE

The remains of a METEOROID that is not completely evaporated in its passage through the atmosphere to the earth's surface. Meteorites may be entirely ASTEROIDAL in origin. They are subdivided into groups, according to composition - SIDERITES (iron), SIDEROLITES (stony iron), AEROLITES (stone). Some authorities would include a fourth group: TEKTITES (glassy).

It is not generally accepted, however, that tektites are true meteorites. See TEKTITES. (F.1.5,99; F.1.12,559)

METEORITIC DUST

A distribution of fine particles in interplanetary space, comprising MICROMETEORITES and fragmentation products from larger METEOROIDS. (F.1.12,530)

METEOROID see METEOR

METEOR SHOWER see METEOR

MHD see MAGNETOHYDRODYNAMICS

MICROBURSTS

Intense, impulsive increases of X-RAY intensity, observed at balloon altitudes in the AURORAL ZONES. Microbursts have durations of the order of 250 msec, and are due to localized electron-precipitation into the atmosphere. (D.3.2; D.3.4)

MICROCURIE (μc)

A unit of radioactive source strength = 1×10^{-6} CURIE.

MICROMETEORITE

A METEORITE so small that it is not markedly altered when it strikes the earth's atmosphere. Micrometeorites fall roughly into the size range <1μ -100μ, and are too small to be detected by radio or optical methods. Micrometeorites are the smallest constituents of the METEORITIC DUST. (F.1.12,530)

MICRON (μ)

A unit of length = 1×10^{-6} meter.

MICROPULSATIONS

Regular oscillations of the GEOMAGNETIC FIELD, with shorter periods and smaller amplitudes than DISTURBANCE VARIATIONS.

The IAGA has recently proposed the following classification:

1. CONTINUOUS PULSATIONS:

Pc1	periods	0.2 - 5 sec	(formerly PP)
Pc2	"	5 - 10 sec	
Pc3	"	10 - 45 sec	(formerly Pc-1 or Pc)
Pc4	"	45 - 150 sec	(formerly Pc-II or Pc°)
Pc5	"	150 - 600 sec	(formerly Pc-III, Pg, or LPc)

2. IRREGULAR PULSATIONS:

Pi1	periods	1 - 40 sec	(formerly SIP)
Pi2	"	40 - 150 sec	(formerly Pt)

The scheme of classification formerly used was:

1. PEARL-TYPE PULSATIONS (PP)
2. CONTINUOUS PULSATIONS (Pc, including Pc-1 and Pc-II)
3. GIANT PULSATIONS (Pg, Lpc, LPc, or Pc-III)
4. PULSATION TRAINS (Pt)
5. RAPID IRREGULAR PULSATIONS (SIP).

(B.2.1; D.5.6; D.5.12; E.1.3,405)

MICROWAVE BURST

A transient enhancement of the SOLAR RADIO EMISSION at centimeter wavelengths (1.5- 30 cm). These bursts are often associated with SOLAR FLARES.

TYPE A (SIMPLE BURST; IMPULSIVE BURST) - A burst lasting 1-5 min, with a sharp rise to maximum and a slower decline; possibly due to SYNCHROTRON RADIATION.

TYPE B (POST-BURST INCREASE) - A rise in intensity following a TYPE A burst, gradually decreasing over a period of several minutes to several hours; probably of thermal origin.

TYPE C (GRADUAL BURST) - A burst lasting about 10 min, with a slow increase to maximum and an equally slow decrease; possibly of thermal origin. (B.3.14,204)

MICROWAVE EARLY BURST see M-BURST

MINAURORAL BELT

The band of MAGNETIC LATITUDE from -45° to +45°, in which the AURORA is rarely observed. (D.4.7,232)

MIRRORING see MIRROR POINT

MIRROR POINT

A point in a non-uniform magnetic field at which the GUIDING CENTER motion of a charged particle along a line of force must be reversed if the particle's MAGNETIC MOMENT is to remain constant.

If no electric fields are present, the constancy of μ requires the constancy of $(\sin^2\alpha)/B$, where α is the PITCH ANGLE, and B is the MAGNETIC FIELD STRENGTH. MAGNETIC REFLECTION (or MIRRORING) will occur when $\alpha = 90^\circ$ - i.e. when B has risen to the value

$$B_m = B_o/\sin^2\alpha_o$$

(where "o" refers to some other point on the particle's trajectory). In the GEOMAGNETIC FIELD, a particle may "bounce" back and forth along a field-line, between the points in each hemisphere at which $B = B_m$.

(D.3.5,161; D.3.13,509)

MLT see MAGNETIC LOCAL TIME

MM (MULTIPOLAR MAGNETIC) see MULTIPOLAR MAGNETIC REGION

MÖGEL-DELLINGER EFFECT see SHORT WAVE FADE-OUT (E.3.4; E.3.6)

MONOCHROMATIC INTENSITY see LUMINOUS INTENSITY

MONOCHROMATIC PURITY

The ratio of the central wavelength transmitted by a MONOCHROMATOR, to the width of its pass-band.

Also known as FILTER PURITY. (F.1.8,617)

MONOCHROMATOR

An instrument, such as the LYOT FILTER, the SOLC FILTER, or the SPECTROHELIOGRAPH, designed to isolate a narrow region of the electromagnetic spectrum.

See also MONOCHROMATIC PURITY. (B.3.14,35)

MOON DOGS see HALO

MORPHOLOGY

The morphology of a magnetic field is its spatial distribution as a function of time. (D.4.7,467)

MOTTLES

Fine-structure features of the CHROMOSPHERE and of FACULAE. FINE CHROMOSPHERIC MOTTLES are sometimes called CHROMOSPHERIC GRANULES. K_2 observations of the low CHROMOSPHERE ($<$1000 km) reveal bright COARSE MOTTLES, with diameters of 8000 km. In quiet regions, these mottles are 10,000-20,000 km apart, forming a NETWORK. In ACTIVE REGIONS, they occur in denser concentration, forming PLAGES. Above 1000 km, the NETWORK is subdivided into FINE MOTTLES seen best in K_3. These have diameters 700-1000 km; separations 1000-6000 km; lifetimes 6-14 hours; and may also occur independently.

Above 3000 km, Hα observations reveal dark mottling, again of two types: COARSE (diameter 8000 km; life 1 day) and FINE (diameter 1700-4000 km; life 5 min). Bright Hα mottles, similar to FIBRILLES, occur as elements of PLAGES.

FACULAR MOTTLES, seen in white light, are 500 km-wide groupings of FACULAR GRANULES. These mottles group together into a chain-network which forms the FACULAE. (B.1.2,126; B.3.14,18)

MOUND

A form of PROMINENCE labelled ANm in the MENZEL-EVANS CLASSIFICATION.

MOUSTACHES

Transitory, localized enhancements of emission in the WINGS of active-region FRAUNHOFER LINES.

Moustaches extend up to 10-15 Å on either side of the stronger lines (e.g. H and K-LINES; BALMER LINES). However, the enhanced emission often stops short of the center of the line. In most cases moustaches are highly asymmetric, the blue wing of the line being broader and brighter than the red.

Moustaches originate in small GRAINS in the lower CHROMOSPHERE, and are relatively short-lived ($\sim$10 min). Their LIGHT CURVES are similar to those of SOLAR FLARES, although no definite correlation between the two phenomena exists. Moustaches are nearly always accompanied by GRAINS OF CONTINUOUS EMISSION (EMISSION STRIPS).

When observed with an off-band MONOCHROMATOR, moustaches appear as small, bright, starlike objects (see PETITS POINTS).

Also known as BOMBS; SOLAR HYDROGEN BOMBS. (B.1.2,206; B.3.14,145)

MPC, MPD, MPE

See MAXIMUM PERMISSIBLE CONCENTRATION, DOSE, and EXPOSURE. (MPD is also used as an abbreviation for MAGNETOPLASMADYNAMICS.)

M-REGION

A long-lived centre of enhanced corpuscular emission in the SOLAR ATMOSPHERE. M-region activity may endure for several solar rotations.

The quasi-stationary streams of particles from M-regions are responsible for weak and moderate GEOMAGNETIC STORMS having a 27-day recurrence period. These storms are known as M-DISTURBANCES or M-STORMS; they are not correlated with SOLAR FLARES, and do not have SUDDEN COMMENCEMENTS.

(B.1.2,359; B.3.14,236)

M-STORM see M-REGION

MULTIPHASE PERIODIC EMISSIONS

The superposition of several sets of periodic VLF EMISSIONS. When the number of sets exceeds half a dozen or so, the result is classified as a type of CHORUS. (D.6.6,325)

MULTIPOLAR MAGNETIC REGION

A region of the solar PHOTOSPHERE containing several strong MAGNETIC FIELD STRENGTH MAXIMA. MM regions occur at the same latitudes as BIPOLAR MAGNETIC REGIONS. (B.1.2,181)

MULTIPOLAR SUNSPOT GROUP see SUNSPOT GROUP CLASSIFICATION

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n see RELATIVE DAMAGE FACTOR

NADIR

The point on the CELESTIAL SPHERE directly opposite an observer's ZENITH. (F.1.5,256)

NASA (NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, Washington, D.C., U.S.A.)

NATURAL BREADTH see RADIATION DAMPING

NCRP (NATIONAL COMMITTEE ON RADIOLOGICAL PROTECTION)

A body set up in 1929 under the auspices of the United States National Bureau of Standards. The Committee carries out at the national level work similar to that done by the ICRP at the international level. (F.3.9,566)

NEGATIVE BAY

An impulsive decrease in the intensity of the horizontal component (H) of the GEOMAGNETIC FIELD. Negative bays are probably caused by the AURORAL ELECTROJET. (D.4.2,526)

NERA (NEDERHORST DEN BERG - RADIO)

IGY World Data Centre C - SOLAR ACTIVITY, St. Paulusstraat, Leidschendam, Netherlands. (A.2.17)

NETWORK

The CHROMOSPHERIC mesh of COARSE MOTTLES. The characteristic length, or "mesh-width" is 25,000 - 50,000 km. (B.1.2,126)

NEUTRAL LINE see NEUTRAL POINT

NEUTRAL PLANE see NEUTRAL POINT

NEUTRAL POINT

A point in a magnetic field at which the field strength is zero. In two-dimensional situations, neutral points may be of two types: O-TYPE and X-TYPE, according to whether the lines of force near the neutral point are elliptical or hyperbolic.

The terms NEUTRAL LINE and NEUTRAL PLANE are also used to denote regions of zero magnetic field. (F.2.3,40)

NEUTRON MONITOR

A secondary-neutron detector used for the ground-based monitoring of COSMIC RADIATION.

See SIMPSON PILE.

NIGHTGLOW

The extremely feeble non-AURORAL radiation emitted by the earth's upper atmosphere at night. In the older literature, nightglow is sometimes referred to as the NONPOLAR AURORA, the PERMANENT AURORA, the EARTHLIGHT, and the LIGHT OF THE NIGHT SKY. (The last term is now used in a more general sense to include STARLIGHT, GALACTIC LIGHT, and ZODIACAL LIGHT in addition to the nightglow.)

See AIRGLOW. (D.4.6,345; E.4.3)

NIGHT PULSATIONS see IRREGULAR PULSATIONS (D.5.8)

NIMBUS

A dark "halo" sometimes observed to form around large SOLAR FLARES. Within a few minutes of flare maximum, the Hα disk-brightness diminishes by up to 5% over a region 3×10^5 km across. The nimbus persists for 1-2 hours, and is most clearly visible about 30 minutes after flare maximum.

The nimbus is thought to be due to extraction of the magnetic energy of the region around the flare - probably by a plasma efflux which carries the field out to several solar radii. (B.3.5,167; B.3.14,85)

NIZMIR

Institute of Terrestrial Magnetism and Radiowave Propagation (near Moscow).

Also known as IZMIRAN. (A.2.17)

NOCTILUCENT CLOUDS

Bright clouds seen in the earth's atmosphere at night. These clouds, which occur at the altitude of the MESOPAUSE, lie high enough in the atmosphere to be illuminated by sunlight when the sun is well below the horizon; they therefore stand out brightly against the night sky.

Noctilucent clouds generally resemble cirrus or cirrostratus clouds, and are tenuous enough for the stars to shine through them undimmed. They are observed most frequently in high latitudes during the summer months. (E.5.7)

NOISE

In general, any signal which varies randomly with time.

See COSMIC NOISE; RADIO NOISE; SOLAR NOISE.

NOISE BURSTS see RAPID IRREGULAR PULSATIONS (SIP) (D.5.12,504; D.5.15)

NOISE STORM

A transient, nonthermal enhancement of the SOLAR RADIO EMISSION at frequencies below 250 Mc/s, consisting of CONTINUUM RADIATION and series of TYPE I RADIO BURSTS. NOISE STORMS account for over 90% of the burst activity observed at metre wavelengths. They are generally associated with large SUNSPOTS. (B.3.14,184)

NONPOLAR AURORA see NIGHTGLOW (D.4.6,348)

NON-SPOT PROMINENCE

In the MENZEL-EVANS CLASSIFICATION, a PROMINENCE whose occurrence is not linked with SUNSPOT activity. Non-spot prominences generally survive longer than SPOT PROMINENCES, and do not change shape as rapidly. They may be broadly identified with the QUIESCENT PROMINENCES and the SPICULES.

(B.1.2,225; B.3.14,27)

NORTHERN LIGHTS see AURORA

NOSE WHISTLER

A WHISTLER including both descending and ascending tones, diverging from the NOSE FREQUENCY. The name is derived from the shape of the frequency vs.-time curve.

Nose whistlers are explained by ionospheric dispersion which gives rise to a double-valued curve of frequency vs. group velocity for the VLF signals concerned. (D.6.5,84)

NOVA

A star whose BRIGHTNESS increases abruptly by several MAGNITUDES, then decays gradually to its original value.

On the basis of their LIGHT CURVES, novae may be classed as:-

FAST (rapid rise to maximum brightness, after initial sharp increase);
SLOW (gradual rise to maximum brightness, after initial sharp increase);
DWARF or FLASH (small enhancement; brief duration);
RECURRENT (repeated nova-type "outbursts");
PERSISTENT (some permanent nova characteristics - e.g. P Cygni);
SUPERNOVA (very large enhancement of brightness).

Richardson has proposed a similar classification of SOLAR FLARES, on the basis of resemblances between their light curves and those of novae.

(B.3.12)

NUCLEAR EMULSION

A photographic emulsion used to detect nuclear charged particles and other IONIZING RADIATIONS, and to record their ionization-tracks.

Emulsions have been developed with grain sizes and sensitivities which permit the recording of charged particles of any energy. Densities (around 3.8 g/cm^2) are such that energetic particles are efficiently stopped; and decays may be detected over a wide range of lifetimes. (F.4.13,115)

NUCLEAR STAR

A nuclear interaction between a high-energy particle and a "target" nucleus, resulting in partial disruption of the nucleus and the emission of one or more SECONDARY particles. The tracks of the IONIZING PARTICLES involved in the event form a characteristic "star-like" pattern, and are called PRONGS.

The secondaries produced in a STAR may be neutrons, protons, pions, deuterons, tritons, or α-particles. The residual nucleus, known as a SPALLATION PRODUCT, recoils with an energy of a few MeV. The high RBE's associated with stars are due to secondary α-particles and slow protons, and to the nuclear recoil.

In the irradiation of soft tissue by PRIMARY COSMIC RAYS the most effective producers of stars are protons and α-particles; but at modest atmospheric depths, greater than 10 grams/cm^2, the majority of stars that occur are caused by neutrons of energy 20-200 MeV. Neutrons of these energies would also be responsible for most of the stars occurring inside the body of an astronaut outside the earth's atmosphere.

(F.3.8,67; F.3.10,86)

NUCLEON A proton or a neutron.

NUCLEONIC CASCADE see CASCADE

OAO (ORBITING ASTRONOMICAL OBSERVATORY)

A series of 3600 lb satellites designed to observe astronomical phenomena above the atmosphere. The UV spectrum from 1200 to 4000 Å will be investigated. Three satellites are planned. (C.1.12,53; C.1.14)

OCCULTATION

The hiding of one object in the sky by another.

The occultation of a satellite by its planet is to be distinguished from an ECLIPSE, which occurs whenever the satellite enters the shadow of the primary.

Although a SOLAR ECLIPSE is a true occultation, it is not usually referred to as such. (F.1.5,257)

OECD (ORGANIZATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT)

An organization set up in October 1961 to replace OEEC. It comprises the eighteen member countries of the OEEC with the addition of Canada and the United States. (A.2.18,57)

OEEC (ORGANIZATION FOR EUROPEAN ECONOMIC CO-OPERATION)

An organization set up in 1948 to administer the Marshall Aid plan, and foster economic co-operation to enable Europe to recover from World War II. OEEC was replaced in October 1961 by OECD. (A.2.14,544)

OER see OXYGEN ENHANCEMENT RATIO

OERSTED

The unit of magnetic field intensity in the c.g.s. (e.m.u.) system. A field of one oersted exerts a force of one dyne on a unit magnetic pole. (The unit magnetic pole is defined so that a unit pole exerts a force of one dyne on another unit pole one centimetre away.)
(D.2.5,1; D.2.3,v.1,22)

OGO (ORBITING GEOPHYSICAL OBSERVATORY)

A series of 1000 lb satellites carrying instruments for geophysical measurements. Each can carry 20 or more experiments. Plans for the series include eccentric-orbit and polar-orbit geophysical observatories (EGO and POGO).

OGO-1 (1964-54A) was launched in September 1964.

OGO-2 was launched in October 1965, but became inactive after 10 days because of a power failure. (C.1.8; C.1.9,21; C.1.11; C.1.12,53)

OPACITY (κ)

A mean value of the MASS-ABSORPTION COEFFICIENT (κ_ν) of a gas, taken over all values of the frequency (ν).

For low densities (ρ), and temperatures (T) in the range 2-8 × 10^6 °K, the opacity is well represented by KRAMERS' LAW OF OPACITY,

$$\kappa = \kappa_o \rho T^{-3.5} .$$

Outside this range, the opacity is often written as

$$\kappa = \frac{\kappa_o}{\tau} \rho T^{-3.5} ,$$

where the correction term, or GUILLOTINE FACTOR, τ is a function of ρ and T.

In the interior of the SUN, the opacity is in the range 1-10, decreasing toward the centre. (B.1.14,41,46)

OPTICAL DEPTH (τ_λ)

For an atmospheric layer at depth h below a given zero-level, the OPTICAL DEPTH at wavelength λ is:

$$\tau_\lambda \equiv \int_o^h k_\lambda \, dh$$

where k_λ is the ABSORPTION COEFFICIENT at wavelength λ. The intensity of radiation emitted at optical depth τ_λ is reduced by a factor $\exp(-\tau_\lambda)$ by the time it reaches the zero-level.

In solar physics, optical depths are measured in the line of sight. (B.1.10,102; B.3.14,3)

OPTICAL THICKNESS

If τ_2 and τ_1 are the OPTICAL DEPTHS (at a given frequency) of the two sides of an atmospheric layer, then the OPTICAL THICKNESS of the layer is $|\tau_2 - \tau_1|$.

ORDINARY RAY

One of the two modes of propagation of electromagnetic waves in a magnetic plasma. For propagation along the magnetic field, it is the mode whose electric vector rotates in the opposite sense to that in which the electrons gyrate (circularly polarized transverse waves). For propagation perpendicular to the magnetic field, it is the mode whose electric vector oscillates parallel to the steady magnetic field. The ORDINARY RAY propagation is thus not as strongly affected by the magnetic field as is that of the EXTRAORDINARY RAY.

OSCILLATION BURSTS see RAPID IRREGULAR PULSATIONS (SIP) (D.5.5; D.5.12,504)

OSO (ORBITING SOLAR OBSERVATORY)

A series of satellites designed to monitor solar radiations.

OSO-1 (1962 ζ) was launched in March 1962.

OSO-2 (1965-7A) was launched in February 1965.

OSO-3 was launched in August 1965, but failed to achieve its orbit.

Six more OSO's are planned in this series. Plans for a series of ADVANCED OSO's have been dropped, but may be revived later.

(A.2.6,4; C.1.4,17; C.1.9,21; C.1.12,53; C.1.13)

O-TYPE NEUTRAL POINT see NEUTRAL POINT

OUTBURST

The occurrence of several high-intensity solar radio BURSTS in a short time sequence. (B.3.14,204)

OUTER IONOSPHERE

Another name for MAGNETOSPHERE; see also IONOSPHERE. (D.1.4,538)

OUTER RADIATION ZONE see VAN ALLEN RADIATION BELTS

OXYGEN ENHANCEMENT RATIO (OER)

The factor by which a dose of IONIZING RADIATION absorbed in fully oxygenated body-cells must be multiplied to give the dose needed to produce the same effect in the absence of free oxygen.

For lightly-ionizing radiations, with RBE$\sim$1, the OER may be as high as 3. Its value drops steadily to 1, for very heavily-ionizing particles.

(F.3.3,1053)

PAIR FORMATION see PAIR PRODUCTION

PAIR PRODUCTION

The creation of a position-electron pair by the annihilation of a photon of energy greater than 1.02 MeV.

Also known as PAIR FORMATION.

PARALLAX see SOLAR and STELLAR PARALLAX

PARSEC

The distance from the sun at which a star would have a PARALLAX of one second of arc. (F.1.10,332)

PARTICLES

Constituents of matter, on a nuclear scale. Several classification schemes have been proposed; one such identifies four groups of particles (in roughly descending order of mass):

BARYONS - This group includes NUCLEONS (protons, anti-protons, neutrons, and anti-neutrons) and HYPERONS (heavy "strange" particles). These particles are all fermions (i.e. they obey Fermi-Dirac statistics).

MESONS - This group includes K-mesons (kaons), π-mesons (pions), etc. These particles are bosons (i.e. they obey Bose-Einstein statistics).

LEPTONS - This group contains muons (μ-mesons), electrons, and neutrinos. Leptons, like baryons, are fermions.

PHOTONS, GRAVITONS - These particles are massless bosons.

(In the above list, particles and anti-particles are grouped together.) The baryons and mesons, which all have "strong" interactions, are known collectively as HADRONS.

Some authors refer to the particles listed above as FUNDAMENTAL (or ELEMENTARY) PARTICLES. (F.4.16)

PASCHEN LIMIT see PASCHEN SERIES

PASCHEN SERIES

The series in the hydrogen-atom spectrum resulting from transitions to or from the third (n = 3), or M-shell electron states. The lines converge to the PASCHEN LIMIT at λ8200 Å.

PATCHES see AURORA (FORMS)

PATROL see FLARE PATROL

P_b (MAGNETIC BAY PULSATIONS)

MICROPULSATIONS occurring during a MAGNETIC BAY. Pulsations of this sort may generally be expressed as

$$P_b = Pi1 + Pi2 + Pc1$$

in terms of the basic classification of micropulsations. (D.5.6)

Pc see CONTINUOUS PULSATIONS

Pc° see CONTINUOUS PULSATIONS; MICROPULSATIONS

Pc1, Pc2, Pc3, Pc4, Pc5

Regular and mainly continuous MICROPULSATIONS, according to the new IAGA classification scheme.

See CONTINUOUS PULSATIONS.

Pc-1, Pc-II, Pc-III

A classification of continuous MICROPULSATIONS which has been supplanted by the new IAGA scheme.

Pc-1 (or Pc) = regular, continuous pulsations with periods from 10-40 sec; now included in the class Pc3.

Pc-II (or Pc°) = continuous pulsations with periods from 60-100 sec; now included in the class Pc4.

Pc-III (or Lpc) = continuous pulsations with periods from 2-7 min; now included in the class Pc5.

See CONTINUOUS PULSATIONS. (D.5.12,488)

PCA see POLAR CAP ABSORPTION

PCA EVENT see POLAR CAP ABSORPTION

PCD see POLAR CAP DISTURBANCE

PEARLS (PP); PEARL-TYPE PULSATIONS

See CONTINUOUS PULSATIONS; MICROPULSATIONS. (D.5.11)

PENETRATING COMPONENT see COSMIC RADIATION

PENETRATING SHOWER see SHOWER

PENETRATION FREQUENCY see CRITICAL FREQUENCY

PENUMBRA

The outer region of a SUNSPOT, surrounding the darker UMBRA. The intensity of the penumbra is about 75% that of the undisturbed PHOTOSPHERE. The penumbra always shows a bright filamentary structure of greatly elongated GRANULES. These granules are directed in a roughly radial fashion, and have a life of about 30 minutes. (B.1.2,151)

PERMANENT AURORA see NIGHTGLOW (D.4.6,348)

PERMANENT CORONAL CONDENSATION see CORONAL CONDENSATION

PERSISTENT FLARE

A small SOLAR FLARE with an abnormally long DECAY TIME and a DURATION of 2 hours or more. Flares of this type are called "persistent" by analogy with stars of the P Cygni type, which show permanent NOVA characteristics. (B.3.12; B.3.14,66)

PERSISTENT NOVA see NOVA

PETITS POINTS

A term used by Lyot to describe the small, bright, starlike objects observed on the solar DISK when it is viewed through a MONOCHROMATOR shifted to one side of the Hα LINE.

Petits points are the same phenomena as the MOUSTACHES revealed by spectrographic observations.

Also known as BOMBS. (B.3.14,147)

PFOTZER MAXIMUM

The level in the earth's atmosphere at which the total COSMIC RAY intensity (PRIMARY + SECONDARY) has its maximum value, for a given latitude.

Because of excitation, ionization, and BREMSSTRAHLUNG losses, the primary cosmic-ray intensity falls off with increasing depth in the atmosphere. Above the Pfotzer maximum, this depletion is outweighed by the production of secondaries. Below this altitude, however, the primary-beam energy has decreased so much that the secondary-production rate is less than the rate of attrition. (C.5.6,137)

Pg (GIANT MICROPULSATIONS)

See CONTINUOUS PULSATIONS; MICROPULSATIONS

PHANTOM

A configuration of tissue-equivalent material designed to have roughly the same DEPTH-DOSE DISTRIBUTION as the human body when exposed to IONIZING RADIATION. The depth-dose distribution is measured by means of DOSIMETERS incorporated in the phantom's structure.

PHASE HEIGHT see PHASE PATH

PHASE PATH (P)

If a given wave front takes time t to travel along a specified path in a given medium, the corresponding PHASE PATH (or PHASE PATH LENGTH) P is defined as:

$$P = ct$$

(i.e. P is the distance that a wave propagating at the speed of light in vacuum would travel in time t).

The concept of phase path is widely used in work on the IONOSPHERIC propagation of radio waves. The travel time of a vertically-incident wave front reflected by the ionosphere may be used to calculate the PHASE HEIGHT, h_p:

$$h_p = \tfrac{1}{2}P \ .$$

The phase path is related to the GROUP PATH P' by the equation:

$$P' = P + f \frac{\partial P}{\partial f}$$

where f = frequency.

Also referred to as OPTICAL PATH LENGTH. (E.2.7,214)

PHASE VELOCITY another name for WAVE VELOCITY

PHOSPHOR

A crystalline solid which displays LUMINESCENCE.

PHOTOELECTRIC ABSORPTION see PHOTOELECTRIC EFFECT

PHOTOELECTRIC EFFECT

The process whereby an atom absorbs a photon and emits an orbital electron, the photon providing enough energy to excite the electron into the ionization continuum.

This atomic absorption of electro-magnetic energy is known as PHOTOELECTRIC ABSORPTION. (F.4.1,83,275; F.4.6,204)

PHOTOHELIOGRAM A photograph of the SUN.

PHOTOMETRIC BRIGHTNESS see BRIGHTNESS

PHOTOSPHERE

The innermost layer of the SOLAR ATMOSPHERE, lying below the CHROMOSPHERE. The PHOTOSPHERE is a region of high OPACITY, 200 to 400 km deep, responsible for the CONTINUOUS SPECTRUM of solar radiation, and the superimposed FRAUNHOFER LINES. (B.1.2,80; B.1.5)

PHOTOSPHERIC FACULA see FACULA

Pi see IRREGULAR PULSATIONS

Pi1, Pi2

MICROPULSATIONS which are irregular in form. These pulsations are closely connected with GEOMAGNETIC DISTURBANCES, and are correlated with upper atmospheric phenomena.

Pi1 (formerly known as RAPID IRREGULAR PULSATIONS) have periods in the range 1-40 sec.

Pi2 (formerly denoted by Pt) have periods 40-150 sec.

Some workers use the notation Pi for Pi1, and Pt for Pi2.

See IRREGULAR PULSATIONS. (D.5.6)

PIDB (PERTURBATION IONOSPHÉRIQUE À DÉBUT BRUSQUE)

French name for SUDDEN IONOSPHERIC DISTURBANCE (SID).

PINCH EFFECT

Confinement of a current-carrying PLASMA within a filament of finite cross-section by the action of the plasma's self-magnetic field. (F.2.5,41)

PITCH ANGLE

The angle between the velocity vector of a charged particle and the direction of the magnetic field in which the particle moves. (D.3.5,161)

PLAGE

A dense concentration of bright MOTTLES and FIBRILLES in an ACTIVE REGION of the CHROMOSPHERE, observed in monochromatic light. PLAGES appear in association with FACULAE, but are longer-lived. (B.3.14,17)

PLASMA

An ionized gas in which the DEBYE LENGTH is small compared with other distances of interest. The number densities of electrons and ions tend to remain almost equal at each point in space, so that the plasma is electrically neutral (or nearly so) throughout. (F.2.5,16; F.2.6)

PLASMA FREQUENCY see PLASMA OSCILLATION

PLASMA OSCILLATION

A term introduced by Langmuir to denote characteristic oscillations of very high frequency which a PLASMA can support even in circumstances where normal sound is strongly damped.

Because of the large charge-to-mass ratio of electrons, any local charge imbalance will produce an electric field strong enough to accelerate electrons into (or out of) the region, and thus restore neutrality. Because of their inertia, the electrons oscillate about the region, but at a very high frequency, so that quasi-neutrality is preserved in the mean.

The characteristic frequency of free plasma oscillations, known as the PLASMA FREQUENCY, is given by

$$\omega_p^2 = 4\pi n e^2/m \quad ,$$

where n is the electron density, and e and m are the electronic charge and mass. (F.2.6,1)

PLASMA WAVES

Oscillatory solutions of the Maxwell equations for the electromagnetic field in a PLASMA. (F.2.1; F.2.5,47)

POCIBO (POLAR CIRCLING BALLOON OBSERVATORY)

A project in which instruments for monitoring COSMIC RAYS, radiation, atmospheric motions, etc. will be carried to heights >30 km by balloons flown near the poles. The balloons are to be operated during conditions of continuous daylight or darkness, and each will remain aloft for several days. (E.5.6,17)

POGO (POLAR ORBITING GEOPHYSICAL OBSERVATORY) see OGO (A.2.7,3; D.2.4,315)

POLAR ANGLE (θ)

The MAGNETIC CO-LATITUDE, $\theta = 90° - \Phi$, where Φ is the GEOMAGNETIC LATITUDE.

See MAGNETIC CO-ORDINATES.

POLAR BLACKOUT

A strong enhancement of ionization in the lower IONOSPHERE at high MAGNETIC LATITUDES. Polar blackouts fall into two main categories: AURORAL ZONE BLACKOUTS and POLAR CAP BLACKOUTS (POLAR CAP ABSORPTION, PCA).

The "blackout" effect is apparent on IONOGRAMS as an increase of CRITICAL FREQUENCY, and on RIOMETER records as an enhancement of COSMIC NOISE ABSORPTION. (E.2.9,338)

POLAR BRUSH see BRUSH

POLAR CAP ABSORPTION (PCA)

A large increase in the IONOSPHERIC absorption of COSMIC NOISE at high MAGNETIC LATITUDES. PCA's are due to increases in the D-REGION electron density, caused by SOLAR COSMIC RAYS with energies 5-300 MeV. The arrival of solar particles of this type is called a PCA EVENT.

A PCA event due to a SOLAR FLARE with a single associated GEOMAGNETIC STORM is known as a SINGLE PCA EVENT:

(1) F-TYPE: fast onset, with maximum well before storm onset.

(2) F*-TYPE: fast onset, with maximum at the time of storm onset.

(3) S-TYPE: event delayed more than 10 hours after flare; slow onset, with gradual rise to maximum.

A series of PCA's, associated with two or more flares and/or storms and having a complex time-dependence, is known as a COMPLEX PCA EVENT. RIOMETERS are widely used in the detection of PCA's.

Also referred to as POLAR CAP BLACKOUT. (B.3.14,242; C.2.6,469)

POLAR CAP BLACKOUT see POLAR CAP ABSORPTION; POLAR BLACKOUT (E.2.9,339)

POLAR CAP DISTURBANCE (PCD)

A disturbance in the signal intensity and phase of low-frequency radio waves propagating at high MAGNETIC LATITUDES during a SOLAR PROTON EVENT which causes POLAR CAP ABSORPTION at higher frequencies. (E.3.2)

POLAR CAP GLOW

A weak glow over the polar cap, caused by the arrival of protons with energies greater than 100 MeV.

POLAR ELEMENTARY STORM see POLAR SUBSTORM

POLAR FACULA see FACULA

POLAR-GLOW AURORA

A brightening or "glow" with no discrete structure seen in the night sky during a PCA EVENT. At the peak of a great event this glow is intense enough to partially obscure the Milky Way.

The intensities of a polar-glow aurora and its associated POLAR CAP ABSORPTION have the same time-dependence and geographical extent. The brightest features in the aurora's visible spectrum are the first negative bands of N_2, excited by solar protons and secondary electrons. (E.3.1,502)

POLARITY LAW

The two members of a BIPOLAR SUNSPOT GROUP or a BIPOLAR MAGNETIC REGION have opposite polarity. In addition, all preceding members in the northern hemisphere have the same polarity, opposite to that of preceding members in the southern hemisphere. The distribution of polarity changes sign with each new SOLAR CYCLE. (B.1.2,116)

POLAR PROMINENCE see PROMINENCE

POLAR SUBSTORM

A burst of intensity in the DP field during a GEOMAGNETIC STORM. Polar substorms are associated with active AURORAL displays, with large increases in COSMIC NOISE ABSORPTION along the AURORAL ZONES, and with large fluxes of electrons entering the AURORAL IONOSPHERE.

Also known as a POLAR ELEMENTARY STORM. (D.4.3,364; D.4.7,237)

PORE

A dark area in the PHOTOSPHERE, a few thousand kilometers in diameter. Pores often occur in groups.

Most pores last only a few hours. Some, however, persist and develop into SUNSPOTS or SUNSPOT GROUPS. (B.3.14,13)

POSITIVE-ION OSCILLATIONS see ELECTROACOUSTIC WAVE

POST-BURST INCREASE see MICROWAVE BURST, Type B

PP (PEARL-TYPE PULSATIONS) see CONTINUOUS PULSATIONS; MICROPULSATIONS

PRESSURE BROADENING another name for COLLISION DAMPING

PRIMARY COSMIC RAYS see COSMIC RADIATION

PRIORITY REGULAR WORLD DAY (PRWD) see REGULAR WORLD DAY

PROFILE see LINE PROFILE

PROMINENCE

A temperature and density anomaly in the CORONA which can be seen by its BALMER emission at the LIMB as a bright structure extending 30,000 to 40,000 km above the CHROMOSPHERE. (Rare specimens may reach 100,000 km.)

Seen in projection against the DISK, prominences appear as regions of absorption, or dark FILAMENTS.

Crudely, prominences are projections from the "cool" chromosphere into the hot corona. They are essentially stable, slowly-changing structures, although some occasionally undergo dramatic changes in form.

ACTIVE PROMINENCES (SPOT PROMINENCES) are generally associated with SUNSPOTS. QUIESCENT PROMINENCES (NON-SPOT PROMINENCES) are not associated with CENTRES OF ACTIVITY, and are generally more stable and longer-lived than active prominences. Prominences have a wide variety of forms (see MENZEL-EVANS CLASSIFICATION).

In each hemisphere, prominences occur in two main zones. The major zone drifts from 30° to 17° solar latitude during a SUNSPOT CYCLE; the zone of POLAR PROMINENCES drifts from 40-50° at SOLAR MINIMUM to 65°-90° at SOLAR MAXIMUM.

The spectra of prominences consist mainly of the BALMER LINES, the lines of neutral helium, and the H and K-LINES of calcium.

(B.1.2,329; B.3.14,28,105)

PROMINENCE ACTIVATION

The onset of internal motions within a previously quiet PROMINENCE or FILAMENT, with velocities up to 30 km/sec, and a strengthening and enlargement of localized parts. On average, activation lasts only a few hours.

On becoming activated, a filament may disappear suddenly from MONOCHROMATOR images of the DISK. These SUDDEN DISAPPEARANCES (DISPARITIONS BRUSQUES) are of two general types: DISSOLUTION (the apparent fading of prominence material) and ERUPTION (dynamic expansion, followed by dispersal and fading). In 2 out of 3 cases the filament reappears within a few hours to a few days, often with nearly the same shape. (B.3.14,111)

PRONGS see NUCLEAR STAR

PROPORTIONAL COUNTER see GEIGER-MÜLLER COUNTER

PROTOSPHERE (PROTONOSPHERE)

The thermal proton component of the MAGNETOSPHERE, or OUTER IONOSPHERE. The protosphere extends from about 2000 km altitude at its base, out to 8-30 earth radii; the density at its base ranges from 10^3 to 10^4 protons/cm^3. The energetic particles trapped in the VAN ALLEN BELTS are not considered part of the protosphere.

(E.1.1,14; E.1.5,21; E.1.6,206; E.1.7,167,195)

PRWD (PRIORITY REGULAR WORLD DAY) see REGULAR WORLD DAY

PSEUDO BREAKUP

The partial disruption of an AURORAL display during a weak AURORAL SUBSTORM. In "pseudo breakup", poleward motion of an ARC occurs (lasting only a few minutes), without other arcs being seriously affected. (D.4.2,503)

P_{ssc} (SUDDEN COMMENCEMENT PULSATIONS)

MICROPULSATIONS occurring during the SUDDEN COMMENCEMENT of a GEOMAGNETIC STORM. P_{ssc} may generally be expressed as:-

$$P_{ssc} = Pc2 + Pi1 + Pc1$$

in terms of the IAGA classification. (D.5.6)

Pt (PULSATION TRAINS) see IRREGULAR PULSATIONS: MICROPULSATIONS

PUFF

A form of PROMINENCE labelled BSp in the MENZEL-EVANS CLASSIFICATION. A PUFF is a diffuse expansion of part of a DISK FLARE just before a SURGE is ejected. Puffs usually last for a few minutes, and sometimes proceed at an explosive rate.

Also known as a FLARE PUFF. (B.3.14,107)

PULSATIONS see MAGNETIC PULSATIONS; X-RAY PULSATIONS

PYRHELIOMETER

A device for measuring the total radiation flux received from the SUN at a given point in space (e.g. the surface of the Earth). (F.1.2)

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q (BODY BURDEN) see MAXIMUM PERMISSIBLE BODY BURDEN

$q, Q, \bar{q}$

q is an index equal to the product of the DURATION and the IMPORTANCE of a given SOLAR FLARE.

The index Q is defined as $(D/T^*)(\Sigma q)$. D is the length in hours of the interval considered; T^* is the effective number of hours during the interval for which a FLARE PATROL was in operation; (Σq) is the sum of the q-indices of all the flares observed during the patrol.

$\bar{q}$, the "mean" value of q for a given interval, is defined as Q/N, where N is the number of flares observed. (B.3.14,75)

QUALITY FACTOR → see below

Q-CENTRE

An ACTIVE CENTRE on the sun with which no BURSTS of SOLAR RADIO EMISSION are associated.

See also R-CENTRE (B.4.2,210)

QF see QUALITY FACTOR

QUALITY FACTOR (QF)

A factor used in radiation-protection work in place of the RELATIVE BIOLOGICAL EFFECTIVENESS (RBE) of IONIZING RADIATION.

Several QF's may be assigned in a given situation: e.g. the "radiation" QF, determined by the LINEAR ENERGY TRANSFER of the radiation concerned; the "tissue" QF, or RELATIVE DAMAGE FACTOR, n; etc. The overall QF is given by:

$$QF_{TOTAL} = QF_{LET} \times n \times QF_3 \times QF_4 \times \ldots$$

(Note: The QF_{LET} is given by an RBE determined without reference to such criteria as the type of tissue irradiated.) (F.3.9,568)

QUARTERLY WORLD DAY (QWD) see REGULAR WORLD DAY

QUIESCENT PROMINENCE

A PROMINENCE which is not associated with a CENTRE OF ACTIVITY.

See PROMINENCE; NON-SPOT PROMINENCE.

QUIET DAYS (q)

The 5 days in each month with the lowest INTERNATIONAL MAGNETIC CHARACTER FIGURES, C_i.

See C, S.

QUIET SUN

The SUN, at a time of minimal SOLAR ACTIVITY. In more general terms, the "quiet sun" is the source of the background continuum radiation on which the disturbances associated with solar activity are superimposed.

QWD (QUARTERLY WORLD DAY) see REGULAR WORLD DAY

R

The component of the GEOMAGNETIC FIELD due to the RING CURRENTS in the VAN ALLEN BELTS.

See RING CURRENT.

R.A. (RIGHT ASCENSION) see HOUR-CIRCLE

RAD

The international unit of ABSORBED DOSE, corresponding to the absorption of 100 ergs by a gram of the absorbing medium. In radiation protection work, the RAD is normally defined with reference to energy absorption in soft tissue (or water).

The biological effect of a given RAD-dose will vary according to the nature of the tissue irradiated, the DOSE RATE, the ACCUMULATED DOSE, and the LINEAR ENERGY TRANSFER of the radiation. These variations are taken into account in the definition of another unit of dosage, the REM.

(F.3.8,62; F.3.9,567)

RADIATION DAMPING

The "natural broadening" of spectral lines.

Classically, the NATURAL BREADTH of an oscillator line is due to the damping effect of emitted radiation acting on the oscillator. In quantum theory the natural breadth of a line is roughly defined by the uncertainty relation:

$$(\Delta E)(\Delta t) \sim \hbar$$

where (Δt) is the lifetime of an excited state, and $(\Delta E)/\hbar$ is the breadth of the corresponding emitted line. (F.4.6,181)

RADIATION PROTECTION GUIDE (RPG)

"The radiation DOSE (EQUIVALENT) which should not be exceeded without careful consideration of the reasons for doing so; every effort should be made to encourage the maintenance of radiation doses as far below this guide as practicable."

For radiation workers, the RPG is 5 REM/year; for non-radiation workers it is 0.5 rem/year. (F.3.10; F.3.14)

RADIO BURST

See BURST; TYPE I, II, III, IV, V RADIO BURSTS; M-BURST; U-BURST.

RADIO METEOR

A METEOR detected by means of radio echoes from its ionized trail in the earth's upper atmosphere. (E.5.1,513; F.1.12,536)

RADIOMETER

A device used to observe radio waves of cosmic origin. Radiometers of several different types are used in the study of radio emission from the sun. (B.3.14,179)

RADIO NOISE

In general, any radio signal which varies randomly with time.

Fluctuations in an observed signal may be classified as "external noise" arising during signal generation and propagation, and INTERNAL NOISE (RECEIVER NOISE) introduced during signal amplification.

See COSMIC NOISE; SOLAR NOISE.

RADIO WAVES

ELECTROMAGNETIC RADIATION at wavelengths longer than about 4×10^{-2} cm.

RAIN

A form of PROMINENCE labelled ASa in the MENZEL-EVANS CLASSIFICATION.

RANGES (R_H, R_D, R_Z)

Indices denoting the mean daily extent of variation of the H, D and Z components of the GEOMAGNETIC FIELD at a given place. (B.3.14,231)

RAPID IRREGULAR OSCILLATIONS see RAPID IRREGULAR PULSATIONS (SIP) (D.5.12,504; D.5.14)

RAPID IRREGULAR PULSATIONS (SIP)

Irregular MICROPULSATIONS denoted by Pi1 in the IAGA classification (periods 1-40 sec). SIP periods rarely exceed 20 sec; in fact, SIP's were formerly taken to include only the 1-15 sec range. However, the upper limit has been raised to 40 sec to eliminate "gaps" in the Pi classification.

SIP's mainly occur early in the morning and late at night. Their amplitudes are greatest in the AURORAL ZONES, and decrease sharply with latitude; their durations decrease with overall SOLAR ACTIVITY, and increase with K_p. SIP's are connected with auroral intensity variations, X-RAY bursts, and COSMIC NOISE ABSORPTION; they are probably caused by pulsating currents along lines of force in the E-LAYER, set up by equatorial-plane interaction of the GEOMAGNETIC FIELD with streams of solar particles.

SIP's have also been referred to as NOISE BURSTS; OSCILLATION BURSTS; RAPID IRREGULAR OSCILLATIONS; and Spt.

See also IRREGULAR PULSATIONS. (D.5.12,504)

RAY (1)

A narrow coronal STREAMER.

The term "ray" (or JET) has also been used to denote a maximum in the daily plot of a CORONAL EMISSION LINE'S intensity against solar latitude. This usage arose because of the appearance of intensity maxima on polar diagrams, and because at "ray" latitudes the emission lines are visible to greater distances out from the LIMB than they are elsewhere.

(B.1.2,280; B.1.16,293,296)

RAY (2) see AURORA (FORMS)

RAYED ARC see AURORA (FORMS)

RAYED BAND see AURORA (FORMS)

RBE see RELATIVE BIOLOGICAL EFFECTIVENESS

RBE DOSE

A measure of IONIZING RADIATION dosage which takes into account the RELATIVE BIOLOGICAL EFFECTIVENESS (RBE) of the radiation concerned.

$$\text{RBE DOSE in REM} = \text{total ABSORBED DOSE in RADS} \times \text{RBE} .$$

The term "RBE dose" is still used in radiobiology, but has been replaced by DOSE EQUIVALENT in radiation protection work. (F.3.6; F.3.9,568)

R-CENTRE

An ACTIVE REGION on the sun with which BURSTS of SOLAR RADIO EMISSION are associated.

See also Q-CENTRE. (B.4.2,210)

R_D (DECLINATION RANGE) see RANGES

RECEIVER NOISE see RADIO NOISE

RECOVERY PHASE

The final, slow-recovery phase of a GEOMAGNETIC STORM.

Also known as LAST PHASE.

RECURRENT FLARE REGION

An ACTIVE REGION on the SUN in which 10 or more distinct SOLAR FLARES are observed during a single passage of the region across the DISK. (B.3.12)

RECURRENT NOVA see NOVA

REGIONAL WARNING CENTERS

Telegraphic addresses: AGIWARN WASHINGTON (USA); DEMPA TOKYO (JAPAN); NIZMIR MOSCOW (USSR); IONOSPHAERE DARMSTADT (GFR); CNETAGI MEUDO (FRANCE); AGI NEDERHORSTDENBERG (NETHERLANDS).

See IUWDS.

REGULAR GEOMAGNETIC FIELD see GEOMAGNETIC FIELD

REGULAR GEOPHYSICAL DAY (RGD)

For the purpose of co-ordinating international geophysical research, every Wednesday in the year is designated as an "RGD", on which routine weekly observations are to be made.

See also REGULAR WORLD DAY (RWD). (A.2.8)

REGULAR WORLD DAY (RWD)

For the purpose of co-ordinating international geophysical research, a Tuesday, Wednesday and Thursday near the middle of each month are designated as "RWD's", and are set aside for programmes of co-operative research.

An RWD which is also an RGD (REGULAR GEOPHYSICAL DAY) is known as a PRWD (PRIORITY REGULAR WORLD DAY).

The PRWD's falling in each WGI (WORLD GEOPHYSICAL INTERVAL) are known as QWD's (QUARTERLY WORLD DAYS). (A.2.8; A.2.12,11)

RELATIVE BIOLOGICAL EFFECTIVENESS (RBE)

The factor by which an ABSORBED DOSE of a given IONIZING RADIATION must be multiplied to give the X-RAY dose needed to produce the same biological effect.

Lightly-ionizing radiations, such as X-RAYS and GAMMA RAYS (LET $\lesssim 5$ KeV μ^{-1}), and very heavily-ionizing particles, such as fission fragments (LET >> 200 KeV μ^{-1}) have RBE's of 1. Types of radiation between these two extremes have higher RBE's; the maximum RBE values occur for LET's around 120 KeV μ^{-1}.

Although the concept of RBE is still used in radiobiology, it has proved inadequate in radiation protection work, and QUALITY FACTORS (QF) have been introduced instead. Each factor modifying the biological effect of a given radiation (e.g. the LET, the nature of the tissue irradiated, etc.) is assigned a separate QF, and the total QF is given by:

$$QF_{TOTAL} = QF_1 \times QF_2 \times \dots$$

Also known as RELATIVE BIOLOGICAL EFFICIENCY.

(F.3.3,1053; F.3.8,63; F.3.9,567)

RELATIVE DAMAGE FACTOR (n)

The tissue QUALITY FACTOR used to express the relative susceptibility of different types of body tissue to damage by different types of IONIZING RADIATION.

For non-bony tissue, and for X-RAYS, GAMMA RAYS, and radium-series nuclides in bone, n = 1. For "bone-seeking" radio-nuclides in bone, n = 5. ("Bone-seeking" nuclides, such as Sr^{90} and Pu^{239}, produce greater biological damage in bone than Ra^{226}, for the same RBE DOSE.) (F.3.9,568)

REM (RÖNTGEN EQUIVALENT MAN)

The unit of DOSE EQUIVALENT (or RBE DOSE).

The dose of IONIZING RADIATION in REM is equal to the ABSORBED DOSE in RADS multiplied by the total QUALITY FACTOR (or the RELATIVE BIOLOGICAL EFFECTIVENESS) for the radiation concerned. (F.3.8,63; F.3.9,568)

REP (RÖNTGEN EQUIVALENT PHYSICAL)

The ABSORBED DOSE of IONIZING RADIATION corresponding to an energy deposition of 93 ergs per gram in soft tissue (or water). REP units have now been superseded by RAD units (see RAD).

The REP may also be defined as the dose absorbed by soft tissue exposed to 1 RÖNTGEN of X or GAMMA RADIATION. (F.3.8,63)

RESONANCE BROADENING

A "spreading" of spectral LINE PROFILES, caused by the presence of molecules of the same type as the emitter. SELF BROADENING of this sort is due to the resonance exchange of energy between two like oscillators. (F.4.2,231)

RESONANT FREQUENCY

The frequency at which a vibrating system must be driven by an external force to give the oscillations of the system their largest possible amplitude.

In the absence of significant dissipation, resonances occur at the natural frequencies of the vibrating system, and the average rate of energy transfer from the driving force to the system is peaked at these frequencies.

For plane-wave propagation in simple PLASMAS, resonances may occur at the PLASMA FREQUENCY, and at the ion and electron CYCLOTRON FREQUENCIES (or GYRO-FREQUENCIES). At these frequencies the plane-wave index of refraction becomes infinite, the phase velocity vanishes, and the wave is strongly absorbed. (F.2.1,7; F.4.8; F.4.10)

RETROSPECTIVE WORLD INTERVAL (RWI)

An interval selected for intensive data reduction and analysis, after preliminary studies have revealed features of great geophysical interest. RWI's are being chosen in cases of outstanding IONOSPHERIC and GEOMAGNETIC STORMS; for periods of very quiet solar and geophysical activity; for certain geomagnetic MICROPULSATIONS; for significant changes in COSMIC RAY flux; and for periods of abnormal ionospheric absorption. (A.2.1,551)

RETURNING ALBEDO

Low-energy, electrically charged ALBEDO PARTICLES deflected by the GEOMAGNETIC FIELD in such a way that they return to the top of the atmosphere.

REVERSING LAYER

A name used for the lower portion of the CHROMOSPHERE in the older literature.

The idea of a "reversing layer" was first proposed to account for the dark FRAUNHOFER LINES in the solar spectrum. Later the presence of this "layer" was invoked to explain the FLASH SPECTRUM. The name was dropped when it was found that these phenomena cannot be explained in terms of a single, geometrically-defined layer. It is necessary to refer to a given range of OPTICAL DEPTH for each line in turn. (B.1.3,6; B,1.16,208)

RGD see REGULAR GEOPHYSICAL DAY

R_H (HORIZONTAL-COMPONENT RANGE) see RANGES

RIGHT ASCENSION (R.A.) see HOUR-CIRCLE

RIGIDITY see MAGNETIC RIGIDITY

RING CURRENT

An electric current circling the earth, due to the normal westward drift-motion of ions and eastward drift-motion of electrons trapped in the VAN ALLEN RADIATION BELTS.

The ring current gives rise to the "R" portion of the GEOMAGNETIC FIELD. See also DR. (D.4.3,363; D.4.16)

RIOMETER (RELATIVE IONOSPHERIC OPACITY METER)

A continuum radiation monitor for decameter wavelengths, used to record the ground-level power of COSMIC RADIO NOISE. Any decrease in this power represents an increase of "ionospheric opacity" (a measure of radio-wave absorption in the IONOSPHERE).

In a standard riometer, the receiver is switched rapidly between an antenna and a noise diode; a servosystem adjusts the diode current to keep diode-noise and antenna-noise equal. The diode is operated so that its noise power (= cosmic noise power) is proportional to the diode current, which is recorded.

Riometers are widely used to detect SUDDEN COSMIC NOISE ABSORPTIONS (SCNA) and POLAR CAP ABSORPTIONS (PCA).

See also INDIRECT FLARE DETECTOR. (B.3.14,225; B.2.7,273)

<u>RISE RATIO</u> see RISE TIME (1)

<u>RISE TIME (1)</u>

The interval between the times of onset and maximum for a SOLAR FLARE. Most flares have rise times of 5-10 minutes. Usually the rise time based on flare brightness (see LIGHT CURVE) is essentially the same as that based on flare area (see GROWTH CURVE).

The ratio of rise time to the total duration of a flare is known as the flare's RISE RATIO. (B.3.14,102)

<u>RISE TIME (2)</u>

The time during which the flux of energetic solar particles arriving at earth after a SOLAR FLARE rises to maximum intensity. The rise time is reckoned from the arrival of the first particles, usually 10-30 minutes after the start of the optical flare.

See also DECAY TIME; TRANSIT TIME. (C.3.8,493)

<u>RISE TIME (3)</u>

The time during which SOLAR ACTIVITY rises from minimum to maximum in the SOLAR CYCLE.

<u>ROCKET</u> Alternative name for SURGE or FLARE PROMINENCE.

<u>RÖNTGEN</u>

A quantity of X or GAMMA RADIATION for which the ASSOCIATED CORPUSCULAR EMISSION in 0.001293 grams of air produces ions carrying 1 e.s.u. of charge of either sign. (The density of dry air at 0°C and 1 atmosphere is 0.001293 gram/cm^3.)

As equal masses of air and tissue absorb X and gamma radiation with about the same effectiveness, one RONTGEN of irradiation will always produce approximately the same amount of radiation damage. By recent measurements, one RONTGEN corresponds to an energy deposition of 87.6 erg/gram. Older references give slightly different values. (F.3.7,106)

<u>RÖNTGEN EQUIVALENT MAN</u> see REM

<u>RÖNTGEN EQUIVALENT PHYSICAL</u> see REP

RPG see RADIATION PROTECTION GUIDE

RWD see REGULAR WORLD DAY

RWI see RETROSPECTIVE WORLD INTERVAL

R_Z (VERTICAL-COMPONENT RANGE) see RANGES

S see SOLAR DAILY VARIATION

S_q (MEAN SOLAR DAILY VARIATION) see SOLAR DAILY VARIATION

SC, Sc see SUDDEN COMMENCEMENT

SC*

An impulsive decrease in intensity of the horizontal component (H) of the GEOMAGNETIC FIELD, sometimes observed just before a SUDDEN COMMENCEMENT (SC). An SC* lasts for about a minute.

See SUDDEN COMMENCEMENT. (B.3.14,233)

SCAR (SCIENTIFIC COMMITTEE ON ANTARCTIC RESEARCH)

A committee within ICSU, set up in 1958 to continue the joint scientific exploration of the Antarctic started during the IGY.

(A.2.14,316; A.2.18,234; A.2.19,44)

SCINTILLATION COUNTER

A device which detects charged particles and photons by means of the LUMINESCENCE they excite in a crystalline solid (PHOSPHOR). Photons emitted by the phosphor strike a "photo-surface", where they give rise to secondary electrons by the PHOTOELECTRIC EFFECT. These electrons are "multiplied" by a cascade process, and the resulting pulse is measured.

(F.4.13,301)

SCNA see SUDDEN COSMIC NOISE ABSORPTION

SCOR (SCIENTIFIC COMMITTEE ON OCEANIC RESEARCH)

A committee within ICSU. (A.2.14,316)

SCRIV (SUB-COMMISSION FOR COSMIC RAY INTENSITY VARIATIONS)

A sub-commission of the IUPAP. (A.2.7,6)

S_d (MEAN "DISTURBED" SOLAR DAILY VARIATION) see SOLAR DAILY VARIATION

S_D, SD; SD_a, SD_d; SD_e, SD_i, SD^e, SD^i (SOLAR DISTURBANCE DAILY VARIATION)

See GEOMAGNETIC DISTURBANCE: SOLAR DAILY VARIATION.

S_e, S^e ("EXTERNAL" SOLAR DAILY VARIATION) see SOLAR DAILY VARIATION)

SEA see SUDDEN ENHANCEMENT OF ATMOSPHERICS

SECONDARY, SECONDARY RAY see COSMIC RADIATION

SECULAR VARIATIONS

Variations of the GEOMAGNETIC FIELD which continue in the same sense over long periods of time (decades or centuries). These variations, which do not usually progress at a constant rate, are thought to be due to HYDROMAGNETIC processes in the earth's core.

Lines of equal annual secular change in a given MAGNETIC ELEMENT are known as ISOPORS; these lines are plotted on ISOPORIC MAPS. (D.2.2,14)

SEEING

The definition achieved in astronomical observations. To a great extent seeing depends on local conditions in the earth's atmosphere.

(B.2.3,324; F.1.10,112)

SELF ABSORPTION

The absorption of radiation emitted in one part of a medium by atoms in another part of the same medium. Self absorption may occur, for example, in a layer of cool gas overlying a hot emission region. (B.3.14,20)

SELF BROADENING see RESONANCE BROADENING

SELF-REVERSAL

A central absorption "trough" superimposed on the PROFILE of an EMISSION LINE.

Self-reversal is observed in the H and K-LINES of PLAGES, and in Hα FLARE PROFILES. In these cases, reversal is probably due to variations of physical conditions (e.g. source-function intensity, excitation, etc.) with depth in the SOLAR ATMOSPHERE, and not simply to SELF ABSORPTION.

Also known as CENTRAL REVERSAL. (B.3.14,127)

SEMI-DIURNAL VARIATIONS

Regular variations, with a period of half a solar or lunar day. Semi-diurnal variations are observed in local values of the GEOMAGNETIC FIELD (see L), and in the intensity of COSMIC RAYS arriving at each point on earth. (C.2.10; D.2.2)

SES see SUDDEN ENHANCEMENT OF SIGNAL

SFA see SUDDEN FIELD ANOMALY; SUDDEN FIELD-STRENGTH ANOMALY

SFD see SUDDEN FREQUENCY DEVIATION

SFE see SOLAR FLARE EFFECT, CROCHET

SFERICS

An abbreviated form of the term "ATMOSPHERICS".

SFERICS is also the name used for the technique of locating thunderstorms by means of ATMOSPHERICS. The directions of arrival of atmospherics from a given storm are observed at several stations, and the storm's position is found by triangulation. (E.5.2,156)

Sg see GRADUALLY COMMENCING STORM

SGC (SPECIAL COMMITTEE FOR INTERNATIONAL GEOPHYSICAL CO-OPERATION)

A committee set up in May 1959 by ICSU to act as an interim successor to CSAGI in dealing with the closing stages of the IGY-IGC period. Its duties included the publication of IGY data, and the organization of co-operation in its use. The SGC was replaced by the CIG. (A.2.14,316)

SHEP (SOLAR HIGH-ENERGY PARTICLE) see SOLAR COSMIC RADIATION

SHOCK

A discontinuity in pressure, density, and particle velocity, propagating through a compressible fluid. In HYDROMAGNETIC SHOCKS, propagating through PLASMAS, the "pressure" includes the MAGNETIC PRESSURE.

In real fluids the shock "discontinuity" is replaced by a narrow transition region, or SHOCK FRONT, between the rear and forward values of pressure and density. (C.2.9,93; F.2.3,90; F.2.6,86; F.4.10,286)

SHOCK FRONT see SHOCK

SHORT-WAVE FADEOUT (SWF)

The MÖGEL-DELLINGER EFFECT - a typically abrupt decrease of radio-signal strength observed at frequencies above a few Mc/s over long transmission paths in the sunlit hemisphere.

An SWF is due to the increase of ionization in the D and lower E-REGIONS which accompanies a SUDDEN IONOSPHERIC DISTURBANCE. Signals normally reflected from the E and F-LAYERS are strongly absorbed in passing through the region of enhanced ionization.

SWF's are classified as follows:-

(1) S-SWF: sudden drop-out and gradual recovery.

(2) SLOW S-SWF: drop-out taking 5-15 minutes, with gradual recovery.

(3) G-SWF: gradual disturbance; irregular drop-out and/or recovery. (B.1,2,351; B.3.14,243; E.2.7,108; E.3.5,2)

SHOWER

The chain of events initiated by a PRIMARY COSMIC RAY particle interacting with air nuclei in the earth's upper atmosphere, or in a detector.

The development of a shower is dominated by its "core" of nuclear-active particles. Outside this core the shower consists mainly of secondary electrons and photons ("shower electromagnetic component").

The energy and initial direction of an incoming primary particle determine the lateral distribution, number spectrum and energy spectrum of the resulting shower at all atmospheric depths. Those showers which reach sea level as a conspicuous phenomenon are known as EXTENSIVE AIR SHOWERS (EAS).

Also known as AIR SHOWERS; PENETRATING SHOWERS. (C.5.7,194)

SHOWER METEOR see METEOR

S_i, S^i ("INTERNAL" SOLAR DAILY VARIATION) see SOLAR DAILY VARIATION

SI see SUDDEN IMPULSE

SIA (SUDDEN IONOSPHERIC ABSORPTION) see SUDDEN IONOSPHERIC DISTURBANCE

SID see SUDDEN IONOSPHERIC DISTURBANCE

SIDEREAL

A term used in referring to the constellations or the "fixed stars". For example, SIDEREAL TIME is a measure of the earth's diurnal rotation with respect to the fixed stars.

SIDEREAL TIME

The HOUR-ANGLE of the VERNAL EQUINOX. See also SIDEREAL. (F.1.5,258)

SIDERITE

An "iron" METEORITE, composed almost completely of iron-nickel alloy, with occasional inclusions of stony material. (E.5.3,2; F.1.12,560)

SIDEROLITE

A "stony iron" METEORITE, composed of an iron-nickel matrix with many stony inclusions. Siderolites are relatively rare (2.5% of total). (E.5.3,2; F.1.12,560)

SIMPSON PILE

A secondary-neutron detector widely used in ground-based monitoring of SOLAR COSMIC RADIATION. Low-energy secondary neutrons, produced in lead, are slowed by inelastic collisions in a massive paraffin buffer, and detected by a BORON TRIFLUORIDE COUNTER. (B.3.14,215)

SIMULTANEOUS FLARES

Unrelated SOLAR FLARES which brighten at nearly the same time, by accident. Simultaneous flares should not be confused with SYMPATHETIC FLARES. (B.3.14,92)

SINGLE PCA EVENT see POLAR CAP ABSORPTION

SIP see MICROPULSATIONS; RAPID IRREGULAR PULSATIONS

SLOT see VAN ALLEN RADIATION BELTS

SLOW-DRIFT BURST see BURST; TYPE II RADIO BURST

SLOW FLARE

A SOLAR FLARE whose RISE TIME is greater than 40% of its total DURATION. The LIGHT CURVES of "slow flares" resemble those of SLOW NOVAE; hence the name. (B.3.12)

SLOWLY VARYING COMPONENT

Continuous slow fluctuations in the SOLAR RADIO EMISSION at wavelengths from 3 to 100 cm, lasting for weeks or months. The slowly varying component is probably of thermal origin, and is closely associated with PLAGES.

(B.3.14,181,209; B.4.4,146-194)

SLOW NOVA see NOVA

SLOW S-SWF see SHORT WAVE FADE-OUT

SMRP (STRATOSPHERIC METEOROLOGY RESEARCH PROJECT)

An agency of the U.S. Weather Bureau which served as the IQSY STRATWARM agency for issuing regional and world-wide "stratospheric warming alerts" during 1964-65. (A.2.6,5)

SOFLARE (SOLAR FLARE) A telegraphic abbreviation used by AGIWARN. (C.4.5)

SOFT COMPONENT see COSMIC RADIATION

SOLACTIVITY (SOLAR ACTIVITY)

A telegraphic abbreviation used by AGIWARN. (C.4.5)

SOLAR ACTIVITY

Transient perturbations of the SOLAR ATMOSPHERE. SUNSPOTS, FACULAE, PLAGES, PROMINENCES, and SOLAR FLARES are all forms of solar activity.

See also ACTIVE CENTRE; ACTIVE REGION. (B.2.3,322; B.3.14,11)

SOLAR ATMOSPHERE

The layers of the SUN whose OPTICAL DEPTH is small enough to permit light to escape from them. The atmosphere contains three physically distinct regions - the PHOTOSPHERE, the CHROMOSPHERE and the CORONA. (B.1.2)

SOLAR CONSTANT

The total radiant energy received vertically from the sun, per square centimetre per minute, at a position just outside the earth's atmosphere when the earth is at its average distance from the sun. Radiation at all wavelengths, from all parts of the solar disk is included. The quantity thus determined is generally assumed to be practically constant, but is probably variable.

Recent determinations of the solar constant give the value $2.00 \text{ cal cm}^{-2} \text{ min}^{-1} = 1.39 \times 10^{6} \text{ erg cm}^{-2} \text{ sec}^{-1}$, with a possible uncertainty of 2-3%. (B.1.5,2; B.1.12,172; B.2.1,3)

SOLAR COSMIC RADIATION

Intermittent high and moderate-energy CORPUSCULAR RADIATION emitted by the sun, usually in conjunction with SOLAR FLARES. Relativistic particle events are rare; non-relativistic particles, with energies less than 0.5 BeV, are observed more frequently.

See COSMIC RADIATION. (B.1.2,215; B.2.3,451; B.3.14,218ff)

SOLAR COSMIC RAY EVENT

An outburst of SOLAR ACTIVITY (usually a SOLAR FLARE) which is accompanied by the emission of SOLAR COSMIC RAYS. (B.3.14,213ff)

SOLAR COSMIC RAYS see SOLAR COSMIC RADIATION; COSMIC RADIATION

SOLAR CYCLE

A quasi-periodic variation of SOLAR ACTIVITY, closely related to the SUNSPOT CYCLE. Systematic differences between "odd" and "even" sunspot cycles indicate that the fundamental solar cycle includes two sunspot cycles, and thus has an average duration of about 22 years.

(B.1.2,322; B.3.14,30)

SOLAR DAILY VARIATION (S)

Variations of the GEOMAGNETIC FIELD which depend on local solar time; and the current-systems responsible for these variations.

For each hour of the day a mean variation may be determined for each MAGNETIC ELEMENT at a given place over a given period. These hourly means are averaged over the day and the result is subtracted from each hourly mean. The 24-value sequence thus obtained is called a MEAN DAILY INEQUALITY, and represents that part of the variation which depends on local solar time.

In each month mean daily inequalities are determined for all days (S_a), for 5 QUIET DAYS (S_q), and for 5 DISTURBED DAYS (S_d). The solar daily variation for days on which no disturbance occurs at all is denoted by Sq. In general $Sq \neq S_q$, although the difference is small at low MAGNETIC LATITUDES. As the symbol Sq has only recently been introduced, many authors still use S_q to denote the true quiet-day variation. The form of the Sq field changes with the season and varies irregularly from day to day. A CROCHET appears as an augmentation of the Sq currents and field, and is denoted by Sqa.

The DISTURBANCE DAILY VARIATION, SD or S_D, represents the contribution of the disturbance field D to the solar daily variation. SD-values are defined for all days: $SD_a = S_a - Sq$; and for disturbed days: $SD_d = S_d - Sq$. These values may be considered as averages of the DS (or Ds) component of the D field (see GEOMAGNETIC DISTURBANCE).

The S field may also be divided into "external" and "internal" components:

$$S = S_e + S_i = (Sq_e + SD_e) + (Sq_i + SD_i) \ .$$

Here "external" (e) refers to current-systems above the earth's surface, and "internal" (i) refers to EARTH CURRENTS induced by changes in the e-currents. (The same notation may be used with S_a, S_d and S_q; also the subscripts may be replaced by superscripts - e.g. S^e, S^i.)

S is attributed to the contribution of solar tidal forces to DYNAMO CURRENTS in the earth's IONOSPHERE.

(B.3.14,230; D.2.3,vol.1,194,215; D.4.8,384,465,466)

<u>SOLAR ECLIPSE</u> see ECLIPSE

<u>SOLAR FLARE</u>

A sudden, short-lived brightening of a localized region in the solar CHROMOSPHERE.

Flares nearly always occur in a CENTRE OF ACTIVITY and are usually only visible in MONOCHROMATIC radiation (e.g. Hα-LINE, K-LINE). They are classified according to AREA and BRIGHTNESS (see FLARE CLASSIFICATION; IMPORTANCE).

On average, flare LIGHT CURVES show a steep rise (EXPLOSIVE PHASE; FLASH PHASE) to maximum brightness, followed by a slow decline. Flare brightness and area (see GROWTH CURVE) develop in much the same way. For most flares peak intensity and maximum area occur at roughly the same time.

A wide variety of SOLAR RADIO EMISSIONS are associated with solar flares. (See BURSTS.)

Flares emit corpuscular and X-RAY radiations that can be detected either directly or by their effects on the GEOMAGNETIC FIELD and the earth's IONOSPHERE. Flare particles fall into three broad categories:

(1) High-energy SOLAR COSMIC RAYS (proton energies >0.5 BeV), responsible for the GROUND LEVEL EFFECT. Particle emissions of this type are rare.

(2) Moderate-energy solar cosmic rays (proton energies ≤0.5 BeV), responsible for POLAR CAP ABSORPTIONS.

(3) Low-energy solar corpuscular emissions, responsible for many GEOMAGNETIC STORMS.

The X-ray emission associated with a flare occurs in two phases:

(1) "First phase" - Bursts of high-energy (>20 KeV) X-rays, coincident with impulsive MICROWAVE BURSTS at centimeter wavelengths. Peak intensity is reached before flare maximum, and emission ends as the optical flare starts to fade. These X-rays are thought to be responsible for SUDDEN FREQUENCY DEVIATIONS.

(2) "Second phase" - Bursts of low-energy (<20 KeV) X-rays, reaching peak intensity at the same time as, or later than, the optical flare. These X-rays are responsible for SUDDEN IONOSPHERIC DISTURBANCES.

(B.1.2,191; B.2.3,376; B.3.14; B.4.4,581)

SOLAR FLARE EFFECT (SFE) Another name for CROCHET. (B.2.1,54)

SOLAR GUSTS see SOLAR WIND

SOLAR HIGH-ENERGY PARTICLE (SHEP) A SOLAR COSMIC RAY particle. (B.3.4)

SOLAR HYDROGEN BOMBS

The name originally proposed by ELLERMAN (1917) for the phenomena now known as MOUSTACHES. (B.3.14,145)

SOLAR NOISE

Bursts of non-thermal RADIO NOISE superimposed on the SOLAR RADIO EMISSION.

See NOISE STORM.

SOLAR PARALLAX

The angle subtended at the centre of the sun by the earth's equatorial radius when the earth-sun distance is 1 ASTRONOMICAL UNIT.

(F.1.7,340; F.1.10,333)

SOLAR PROTON EVENT (SPE)

Another name for PCA EVENT.

See POLAR CAP ABSORPTION.

SOLAR RADIO EMISSION

Radio emissions from the SUN fall into three main categories:

(1) The background CONTINUUM RADIATION caused by thermal emission in the CHROMOSPHERE and CORONA.

(2) The SLOWLY VARYING COMPONENT associated with SUNSPOTS and PLAGES - probably also thermal in origin.

(3) The transient enhancements associated with ACTIVE REGIONS (e.g. NOISE STORMS and radio BURSTS) - non-thermal in origin.

(B.3.14,178; B.4.3; B.4.4; B.4.7; B.4.9)

SOLAR VORTEX Another name for WHIRL. (B.3.14,23)

SOLAR WHISTLE

A low-frequency fluctuation of the GEOMAGNETIC FIELD (0.1-100 cycles/sec) whose period increases or decreases with time. When speeded up by a factor of 1000 to bring the frequencies into the audio range, solar whistles closely resemble WHISTLERS.

Solar whistles were originally thought to represent waves propagating in the whistler mode between the sun and earth. Tepley (D.5.9) and Dessler contend, however, that such signals, travelling as MAGNETOACOUSTIC WAVES, would suffer an impedance mismatch at the MAGNETOPAUSE, and would therefore fail to cause significant fluctuations at the surface of the earth. Tepley suggests that the term HYDROMAGNETIC EMISSION be used instead of "solar whistle", on the grounds that the observed signals are probably generated by corpuscular radiation near the top of the IONOSPHERE.

Also known as INTERVAL OF PULSATIONS DIMINISHING IN PERIOD (IPDP).
(D.5.3; D.5.4,123; D.5.9)

SOLAR WIND

Because of the high temperatures in the outer CORONA, the thermal energy of particles in this region is greater than the gravitational "binding" energy, and the coronal gas is free to expand. The resulting continual outward streaming of coronal PLASMA is known as the SOLAR WIND.

In the expanding plasma the local velocity increases steadily outward as the local density falls; the flow becomes supersonic at a radial distance of a few solar radii. At the earth's orbit the quiet-day CORONAL EXPANSION is characterized by velocities of 250-400 km/sec, proton and electron densities of $7\text{-}20/\mathrm{cm}^3$, and a net flux of about $0.6 \times 10^9/\mathrm{cm}^2$ sec.

SOLAR ACTIVITY leads to increases in both the strength and the irregularity of the solar wind. Such increases are sometimes referred to as SOLAR GUSTS.
(C.2.9,15,51)

SOLAR ZENITH ANGLE

The angle formed at the centre of the earth between a line to the SUN and a line to the observer's ZENITH.

SOLCALM (SOLAR CALM)

A telegraphic abbreviation used by AGIWARN to denote a period of low SOLAR ACTIVITY.

SOLC FILTER

A MONOCHROMATOR consisting of many identical retardation plates arranged in a configuration designed by SOLC. The transmission characteristics of this filter are similar to those of a LYOT FILTER of the same total length. The SOLC FILTER has real advantages for studying PROMINENCES against the sky, but is not as good as the LYOT FILTER for Hα observations on the DISK.
(B.3.14,38)

SOLSTICE

One of the two places where the sun assumes its greatest DECLINATION. These points are half-way between the EQUINOXES. The SUMMER SOLSTICE is the point on the ECLIPTIC where the sun is at maximum northern declination; the WINTER SOLSTICE is the point of maximum southern declination. The word "solstice" is also applied to the time when the sun is at a solstice point.
(F.1.5,258)

SONAGRAM

The record produced by a SONAGRAPH (sound spectrograph). The trace intensity provides a measure of the power density; the co-ordinates of the record are frequency and time.

SONAGRAPH

A type of sound spectrograph which consists of a spectrum analyzer of the frequency-scanning type operating in the audio range.

SPA see SUDDEN PHASE ANOMALY

SPALLATION PRODUCT see NUCLEAR STAR

SPARMO (SOLAR PARTICLES AND RADIATION MONITORING ORGANIZATION)

SPE (SOLAR PROTON EVENT)

Another name for PCA EVENT.
See POLAR CAP ABSORPTION.

SPECIAL WORLD INTERVAL (SWI)

An interval for which AGIWARN, in consultation with REGIONAL WARNING CENTRES, has broadcast a GEOALERT to announce that major solar-geophysical disturbances are likely to occur. (A.2.2,2; A.2.5,14; A.2.12)

SPECIFIC IONIZATION

The number of ion pairs produced per unit length of track by a beam of IONIZING RADIATION passing through matter. The specific ionization is proportional to the LINEAR ENERGY TRANSFER (LET) of the radiation at each point along the track.

SPECTRAL BRIGHTNESS see BRIGHTNESS

SPECTRAL CLASS

A subdivision of the Harvard spectral sequence of stellar spectra. Each star is assigned to a spectral class according to the characteristics of its spectrum. The classes are:

```
      Q                         R - N    (Nebular series R)
      |                        /
P - W - O - B - A - F - G - K - M        (Main series)
                             \
                              S          (Nebular series S)
(Early types)        (Late types)
```

99% of all stars fall into classes B - M of the main series.

In accurate work a star's position within its class is given in "decimal" form. For example "B3" denotes a star whose spectrum is 0.3 of the way from B-type to A-type. Unfortunately there is no generally accepted method of interpolation. Several detailed schemes have been proposed, and these give results which agree only to within about ±1 subdivision (e.g. the sun is classed by different workers as G0, G1 and G2).

Stars are also assigned to LUMINOSITY CLASSES, as follows:

I = supergiants, including c-stars. Also labelled "c" (e.g. B0I or cB0).

II = bright giants (e.g. B5II).

III = giants. Also labelled "g". (e.g. G0III or gG0)

IV = sub-giants (e.g. G5IV).

V = main-sequence dwarfs. Also labelled "d" (e.g. G0V or dG0).

\- sub-dwarfs, labelled "sd" (e.g. sd K5).

\- white dwarfs, labelled "w" (e.g. wA4). (F.1.1,175; F.1.3,9)

<u>SPECTRO-ENREGISTREUR DES VITESSES</u> see SPECTROHELIOGRAPH (B.3.14,41)

<u>SPECTROHELIOGRAPH</u>

A high-resolution, high-purity MONOCHROMATOR invented by JANSSEN for use in specialized studies of SOLAR ACTIVITY. An image of the sun is formed on the slit of a spectrograph; a second slit, in the focal plane of the spectrograph, transmits only the light of the desired wavelengths. As the slits are moved in unison across the solar image, a monochromatic picture of the sun (SPECTROHELIOGRAM) is built up on a photographic plate.

In the SPECTROHELIOSCOPE, due to HALE, the photographic plate is replaced by the eye of the observer.

In the SPECTRO-ENREGISTREUR DES VITESSES (DESLANDRES) and the STONE SPECTROHELIOGRAPH, the exit slit is enlarged to transmit a 5-15 Å spectral region centred on the Hα LINE. Photographs obtained from these instruments are used to measure line-of-sight velocities in the field of view.

(B.3.14,38; F.1.8,617)

SPECTROHELIOSCOPE

A SPECTROHELIOGRAPH designed for visual observations. (B.3.14,38)

SPHERICS see ATMOSPHERICS

SPICULE

A form of PROMINENCE, labelled BNs in the MENZEL-EVANS CLASSIFICATION. Spicules are fine, bristling jets of matter ejected upward into the CORONA from the top of the CHROMOSPHERE. Individual spicules have lifetimes of the order of 3-5 minutes, during which time they elongate at a mean velocity of 25-30 km/sec to heights often in excess of 12000 km above the base of the chromosphere. The diameters of spicules are typically less than 1 sec of arc, and the spicules are distributed randomly over the sun.

Also referred to as a JET. (B.1.2,108,135; B.1.16,212)

SPORADIC CORONAL CONDENSATION see CORONAL CONDENSATION

SPORADIC E (E_s)

A phenomenon occurring in the E-REGION of the IONOSPHERE, characterized by an irregular variation of one of the region's CRITICAL FREQUENCIES with local time.

E_s varies markedly with latitude. Near the equator it is a daytime phenomenon, while in the AURORAL REGIONS it occurs most frequently at night. In middle latitudes the behaviour of E_s is very irregular, and E_s-ionization is generally less than that at high and low latitudes.

E_s-ionization has been ascribed to a wide variety of causes. Correlations have been noted with:

(a) particle bombardment of the ionosphere
(b) meteor showers
(c) thunderstorms.

E_s-ionization may also be connected with:

(d) turbulence in the E-region
(e) TRAVELLING IONOSPHERIC DISTURBANCES
(f) ionospheric currents and associated tidal forces
(g) other methods of "rearranging" pre-existing ionization.

Some authors ascribe E_s to the appearance of "layers" of enhanced ionization near 100 km altitude, but this interpretation is not generally accepted.

(E.1.7,183; E.2.6,301,308; E.2.8,286; E.2.12,295; E.2.15,15)

SPORADIC METEOR see METEOR

SPÖRER'S LAW

The law of SUNSPOT ZONES:

Nearly all SUNSPOTS occur in two "zones" parallel to the sun's equator and within ±45° solar latitude; each of these zones has a width of 15-20°. During a SUNSPOT CYCLE the mean latitudes of the sunspot zones decrease continuously from around ±35° to around ±8°. The zones rarely extend to the equator. (B.1.2,326; B.2.3,335)

SPOT PROMINENCE

In the MENZEL-EVANS CLASSIFICATION, a form of PROMINENCE observed in association with SUNSPOT activity, and designated by the label S. Spot prominences are in general more transitory than NON-SPOT PROMINENCES. (B.1.2,225)

SPRAY

An ejection of luminous material from a SOLAR FLARE along a confined path at a velocity at or above the velocity of escape. (670 km/s.) The initially continuous ejected mass degenerates into numerous clumps, and only a small proportion descends again into the CHROMOSPHERE. SPRAYS are thus closely related to, but distinct from, SURGES.

Also known as a FLARE SPRAY. (B.3.14,109)

SPREAD-F

Diffuse F-LAYER echoes observed on conventional IONOGRAMS.

In equatorial latitudes spread-F is most commonly observed at night and is negatively correlated with GEOMAGNETIC ACTIVITY. At high latitudes spread-F occurs throughout the day and is positively correlated with magnetic activity. There is a clear minimum in the occurrence of spread-F near 30° MAGNETIC LATITUDE.

Spread-F is thought to be due to scattering or ducting of signals by field-aligned irregularities of ionization in the F-region. (E.1.7,190; E.2.6,303)

Spt see RAPID IRREGULAR PULSATIONS (SIP) (D.5.7; D.5.12,504)

S_q (MEAN "QUIET" SOLAR DAILY VARIATION) see SOLAR DAILY VARIATION

Sq (SOLAR QUIET-DAY VARIATION) see SOLAR DAILY VARIATION

Sqa (SOLAR QUIET AUGMENTED VARIATION) see CROCHET; SOLAR DAILY VARIATION

Sq_e, Sq_i; Sq^e, Sq^i (SOLAR QUIET-DAY VARIATION - EXTERNAL and INTERNAL)

See SOLAR DAILY VARIATION.

SSC see SUDDEN STORM COMMENCEMENT

SST (SUPERSONIC TRANSPORT) see SUPERSONIC TRANSPORT AIRCRAFT

S-SWF see SHORT WAVE FADE-OUT

STA see SUPERSONIC TRANSPORT AIRCRAFT

STAR see NUCLEAR STAR

STARK BROADENING

A form of COLLISION DAMPING in which plasma LINE PROFILES are broadened by the STARK EFFECT.

The motions of charged particles in a PLASMA give rise to local electric fields which vary in space and time. Line-splittings and frequency-shifts caused by the Stark effect thus vary from atom to atom and from moment to moment, and a smooth distribution of emission or absorption is produced around each line in the plasma's spectrum. (B.3.14,6; F.4.2,118,192)

STARK EFFECT

The splitting of atomic energy levels which takes place in the presence of an external electric field. (F.4.8,662)

STARLIGHT

Radiation received directly from stellar sources. (Starlight is one of the components of the LIGHT OF THE NIGHT SKY.)

STELLAR PARALLAX

The angle subtended by an earth-sun separation of 1 ASTRONOMICAL UNIT at the centre of the star in question. (F.1.10,332)

STONE SPECTROHELIOGRAPH see SPECTROHELIOGRAPH

STORAGE

Observations of SOLAR COSMIC RAY fluxes indicate that energetic particles propagate in two different ways from the SUN to the earth:

(1) "Direct" propagation, corresponding o GUIDING CENTRE motion along a magnetic field line from an ACTIVE REGION on the sun. Propagation of this type gives rise to a directional flux at the earth.

(2) "Delayed" propagation, with longer TRANSIT TIMES than direct propagation. Propagation of this type gives rise to a roughly isotropic flux at the earth. In some cases the particle intensity rises fairly slowly to a maximum; in others the flux increases abruptly.

For both "direct" and "delayed" propagation the post-maximum decline in particle intensity is very slow.

The phenomena responsible for delaying the arrival of solar cosmic rays are referred to as STORAGE mechanisms. The principal mechanisms proposed to explain events with long RISE TIMES are:

(1) The particles are temporarily TRAPPED in magnetic fields near the sun, then "leak" gradually out of the storage region by drift and/or diffusion, and propagate along magnetic field lines to the earth. The leakage process accounts for both the slow rise and the slow decline in particle intensity.

(2) The particles reach the earth by drift and/or diffusion through interplanetary magnetic fields without being initially trapped. The delayed arrival and finite rise time are consequences of the diffusion process; the slow decline is caused by the inability of the particles to pass freely outward through a region of disordered magnetic fields beyond the earth's orbit.

Delayed events in which the particle intensity rises abruptly are thought to be due to a different type of storage mechanism:

(1) Trapping of the particles behind a MAGNETIC FRONT or "blast wave" moving outward from the sun.

(2) Trapping of the particles in a MAGNETIC BOTTLE which eventually sweeps past the earth. (C.2.9,208; C.3.8,497; C.3.9,128)

STØRMER TRAJECTORY (ORBIT)

The path followed by a charged particle moving in a dipole magnetic field. (D.3.5,143; D.3.6,148)

STØRMER TRAPPING REGION

The allowed STØRMER TRAJECTORIES for a charged particle moving in a dipole magnetic field may fall into two categories - bounded orbits and unbounded orbits. When bounded orbits exist, they fill a region in the field known as the STØRMER TRAPPING REGION. A particle moving along one of these orbits and subject only to the force exerted by the field can never leave the trapping region.

The intersection of the outer boundary of a trapping region with the equatorial plane of the dipole is a circle of radius

$$r = \frac{1}{\sqrt{M(R_M)_{max}}} .$$

Here M is the dipole moment and $(R_M)_{max}$ is the highest MAGNETIC RIGIDITY a particle may have and still remain trapped in the region. r is thus equal to the STØRMER UNIT associated with M and $(R_M)_{max}$. (D.3.6,150)

STØRMER UNIT

For a particle of MAGNETIC RIGIDITY R_M moving in the magnetic field of a dipole of moment M, the STØRMER UNIT is

$$b = (MR_M)^{-\frac{1}{2}} = \left(\frac{MZ\,|e|}{pc}\right)^{\frac{1}{2}} .$$

Here (Ze) is the charge on the particle in e.s.u., p is the particle's momentum, and c is the velocity of light. The Størmer unit b thus has the dimension of length. (D.3.5,145; D.3.6,150)

STORM BURST see BURST; TYPE 1 RADIO BURST

STORM TIME (T)

Time elapsed during a GEOMAGNETIC STORM, reckoned from the storm's SUDDEN COMMENCEMENT. (D.2.3,vol.1,272; D.4.8,467)

STORM TIME VARIATION (Dst, D_{st})

The mean variation of a GEOMAGNETIC ELEMENT at a given place as a function of STORM TIME during a GEOMAGNETIC STORM. Variations are averaged over a large number of storms with local times of onset spread evenly over the day to cancel out DIURNAL VARIATIONS.

The current systems and magnetic fields associated with storm time variations are denoted by Dst. The daily mean value of the Dst field is sometimes denoted by D_m.

The subscripts or superscripts "e" and "i" are used to denote the components of Dst due to external (above the earth's surface) and internal (within the earth) current systems, respectively - thus giving Dst_e and Dst_i or Dst^e and Dst^i.

See also GEOMAGNETIC DISTURBANCE (D). (D.4.8,467; D.4.12,455ff)

STRATALERT

A telegraphic abbreviation used by REGIONAL WARNING CENTRES in announcing minor changes in stratospheric temperature and circulation. (A.2.6,5)

STRATOPAUSE

The boundary between the STRATOSPHERE and the MESOSPHERE.

Chapman's original definition of the stratosphere (E.1.1; E.1.2,3) placed the stratopause at an altitude of about 20 km. However, the IUGG and the WMO have since adopted Nicolet's definition (E.1.4,245; E.1.5,19), which places the stratopause at the temperature maximum at 50 ±5 km.

STRATOSPHERE

In the scheme of atmospheric nomenclature proposed by Chapman in 1950 (E.1.1; E.1.2,3) the term "stratosphere" referred to the isothermal atmospheric region around the temperature minimum at 13 km altitude. This region was considered to extend from the "tropopause" at 10 km to the "stratopause" at around 20 km.

The IUGG and the WMO have since adopted several modifications to Chapman's terminology suggested by Nicolet (E.1.4,245; E.1.5,19). The stratosphere is now taken to be the region of increasing temperature between the minimum at 13 ±5 km (the TROPOPAUSE) and the maximum at 50 ±5 km (the STRATOPAUSE). In Chapman's scheme the maximum at 50 km was called the MESOPEAK.

STRATWARM (STRATOSPHERIC WARMING)

A telegraphic abbreviation used by AGIWARN to denote major changes in stratospheric temperature and circulation. (A.2.6,5; C.4.5)

STREAM ANGLE (ψ)

The angle which a magnetic field line, carried out from the SUN by the SOLAR WIND, makes with the radius vector from the sun at any point. The term does not refer to the particle streamlines, which are radial.

The stream angle is often referred to as the GARDEN-HOSE ANGLE, and is given by:

$$\psi = \tan^{-1}(B_\phi/B_r) = \tan^{-1}\frac{\Omega r}{V}$$

where Ω is the sun's angular velocity of rotation, V is the solar wind velocity, and r is the radial distance from the sun. B_r and B_ϕ are the radial and azimuthal field components at the point in question.

(C.2.11,360)

STREAMER

Any long extension of the solar CORONA - broad or narrow, with or without fine structure. FANS and RAYS are particular types of streamer.

(B.1.2,280; B.1.16,295ff)

STRIATION see CHROMOSPHERIC STRIATION; FIBRILLES

S-TYPE EVENT see POLAR CAP ABSORPTION

SUBAURORAL BELTS

The regions between 60° and 45° North or South MAGNETIC LATITUDE, bordering the AURORAL REGIONS. (D.4.7,232)

SUBFLARE

A SOLAR FLARE of IMPORTANCE 1- (old classification) or S (new classification). The corrected AREA of a subflare is thus <100 millionths of the DISK. (B.3.14,67)

SUDDEN COMMENCEMENT (SC, Sc)

An abrupt increase in intensity of the horizontal component (H) of the GEOMAGNETIC FIELD observed almost simultaneously at all places with MAGNETIC LATITUDE <60°. The time of onset rarely differs by more than a minute from place to place; amplitudes, however, may vary with latitude and local time.

SC's are often followed by GEOMAGNETIC STORMS (SUDDEN STORM COMMENCEMENT - SSC), but a significant proportion have little or no subsequent disturbance. SSC's are usually associated with SUNSPOTS and/or SOLAR FLARES.

An SC may sometimes be preceded by a reverse impulse (SC*), lasting about a minute.

See also DCF. (B.2.1,61; B.3.14,233; E.1.3,387; F.2.3,132)

SUDDEN COSMIC NOISE ABSORPTION (SCNA)

A sudden decrease in the signal-strength of COSMIC RADIO NOISE. Noise absorptions of this type occur at the times of SUDDEN IONOSPHERIC DISTURBANCES (SID).

The solar radiations causing an SID give rise to enhanced ionization in the lower IONOSPHERE (cf. SHORT-WAVE FADE-OUT). The attenuation of COSMIC NOISE passing through this region is consequently increased, and an SCNA is observed.

Most SCNA receivers (see INDIRECT FLARE DETECTOR; RIOMETER) operate at around 18 Mc/s. (B.1.2,351; B.2.1,54; B.3.14,245; E.2.7,109; E.3.5,4)

SUDDEN DISAPPEARANCE

Disappearance of an activated FILAMENT from MONOCHROMATOR images of the solar DISK.

Also known as DISPARITION BRUSQUE.

See PROMINENCE ACTIVATION. (B.3.14,111)

SUDDEN ENHANCEMENT OF ATMOSPHERICS (SEA)

A sudden increase in the intensity of long-wave RADIO NOISE (frequencies $\lesssim$30 kc/s) observed at the surface of the earth. Noise enhancements of this type occur at the times of SUDDEN IONOSPHERIC DISTURBANCES.

SEA's are caused by the improvement in D-LAYER long-wave reflectivity which accompanies enhanced ionization. As a result of this improvement, ATMOSPHERICS generated by distant thunderstorms arrive with amplitudes greater than normal. Man-made VLF signals are also enhanced (see SUDDEN ENHANCEMENT OF SIGNAL). (B.1.2,351; B.3.14,246; E.3.5,4)

SUDDEN ENHANCEMENT OF SIGNAL (SES)

A sudden increase in the strength of VLF (<30 kc/s) signals from a distant radio transmitter. Signal enhancements of this type occur at the time of a SUDDEN IONOSPHERIC DISTURBANCE.

SES's may be attributed to the same cause as SUDDEN ENHANCEMENTS OF ATMOSPHERICS. (C.3.6,8; E.3.5,7)

SUDDEN FIELD ANOMALY, SUDDEN FIELD-STRENGTH ANOMALY (SFA)

An oscillatory change in the total-field record of the signal received from a radio transmitter within ground-wave range. Changes of this type occur at the times of SUDDEN IONOSPHERIC DISTURBANCES.

When an SID occurs, the sky-wave path length for a given transmission is altered. Consequently the amplitude and phase of the sky-wave will charge and the ground wave-sky wave interference pattern will be displaced, producing an SFA. The changes in sky-wave phase and amplitude can be deduced (in outline) from the form of the SFA. (B.1.2,353; E.2.17,155)

SUDDEN FREQUENCY DEVIATION (SFD)

An abrupt change in the frequency of an HF (3-30 Mc/s) signal received from a distant radio transmitter, usually lasting about 5 minutes.

SFD's are thought to be caused by increases of ionization in the F_1-REGION and upper E-REGION of the IONOSPHERE; these increases are associated with bursts of high-energy (>20 KeV) solar X-RAYS. The phase path of a wave travelling through the affected ionospheric regions varies with time as the ionization changes, and the wave frequency is shifted accordingly.

SFD's correlate with the "first phase" of SOLAR FLARE activity and thus precede the "second phase" phenomena associated with SUDDEN IONOSPHERIC DISTURBANCES. On average SCNA's lag SFD's by 5 minutes, SPA's lag SFD's by 6 minutes, and SEA's lag SFD's by 8.5 minutes. (E.3.3)

SUDDEN IMPULSE (SI)

An impulsive, world-wide increase or decrease in the H component of the GEOMAGNETIC FIELD. SI's are generally similar to SUDDEN COMMENCEMENTS (SC), but are not followed by noticeable MAIN PHASE or AURORAL activity. An SI may occur at any time during a GEOMAGNETIC STORM.

Positive SI's are apparently caused by enhancement of the solar PLASMA pressure on the MAGNETOSPHERE, and the consequent magnetospheric "contraction". Negative SI's seem to be due to magnetospheric "expansion".

(D.4.12,461; D.4.13)

SUDDEN IONOSPHERIC DISTURBANCE (SID)

A large, simultaneous increase of ionization in the D-REGION (and sometimes the lower E-REGION) over the entire daylit hemisphere of the earth.

SID's are caused by the greatly enhanced flux of 1-10 Å solar X-RAYS emitted during the "second phase" of SOLAR FLARES. Typically, an SID begins about 7 minutes after the start of its flare (before flare MAXIMUM), and lasts from a few minutes to a few hours. "First-phase" phenomena (see SUDDEN FREQUENCY DEVIATION) precede SID's by several minutes.

A large number of IONOSPHERIC effects are observed in conjunction with SID's. (See CROCHET; SUDDEN COSMIC NOISE ABSORPTION; SUDDEN ENHANCEMENT OF ATMOSPHERICS/SIGNAL; SUDDEN FIELD-STRENGTH ANOMALY; SUDDEN PHASE ANOMALY; SHORT-WAVE FADE-OUT.)

(B.1.2,350; B.3.14,242; E.1.7,171,213; E.2.7,108)

SUDDEN PHASE ANOMALY (SPA)

An abrupt shift in the phase of a radio signal received via IONOSPHERIC reflection. Phase-shifts of this type are observed at the times of SUDDEN IONOSPHERIC DISTURBANCES.

When the ionization of the D-REGION increases, the ionospheric reflection-height is correspondingly lowered. The resulting change in "sky-wave" path-length is responsible for SPA's.

SPA's may be detected in several ways:

(a) by comparing the phases of ground-wave and sky-wave signals from a single VLF transmitter,

(b) by noting changes in the amplitude of a combined ground and sky-wave signal (SUDDEN FIELD-STRENGTH ANOMALIES),

(c) by comparing the phase of a signal from a phase-stable transmitter with the phase of a stable local oscillator.

(B.3.14,245; E.2.17,156; E.3.5,4)

SUDDEN STORM COMMENCEMENT (SSC)

A SUDDEN COMMENCEMENT which is followed by a GEOMAGNETIC STORM.

SUN

The typical main-sequence dwarf star around which the earth revolves at a mean distance of one ASTRONOMICAL UNIT. The sun's SPECTRAL CLASS is variously quoted as G0, G1, G2, and even G3.

(B.1.14,36; F.1.1,130; F.1.3,9)

SUN DOGS see HALO

SUNSPOT

A relatively dark region in the solar PHOTOSPHERE, seen in integrated light.

A well-developed spot consists of a central UMBRA (LUMINOUS INTENSITY ~0.2-0.3 that of photosphere) surrounded by a brighter PENUMBRA (intensity ~0.75 that of photosphere). The intensity-transitions between umbra, penumbra and photosphere are steep, but are smoothed by scattered light and lack of resolving power. Medium and large spots sometimes show an irregular BRIGHT RING around the penumbra (2-3% brighter than the photosphere, if observations are made at the centre of the DISK); in exceptional cases a bright ring is seen at the inner border of the penumbra.

A sunspot generally has an irregular structure and considerable internal detail. In large spots (area $>5 \times 10^{-4}$ visible hemisphere) the mean umbral area is 0.16 that of the whole spot. Most spots occur as members of SUNSPOT GROUPS.

Sunspots are characterized by strong magnetic fields. These fields are mainly perpendicular to the solar surface, with field strengths ranging from several hundreds to several thousands of GAUSS.

(B.1.2,151; B.2.3,340; B.3.14,12)

SUNSPOT CYCLE

A systematic, quasi-periodic variation of SUNSPOT activity with an average period of about 11 years.

The smoothed SUNSPOT NUMBER (R) has its lowest value at the start of a cycle (SUNSPOT MINIMUM). During the cycle the smoothed R rises to a maximum value R_M (at SUNSPOT MAXIMUM), then falls to a minimum again. R_M may vary widely from cycle to cycle. The rate of rise to sunspot maximum is greatest when R_M is large. The fall from sunspot maximum to sunspot minimum is approximately exponential.

Successive cycles overlap at sunspot minimum and coexist for 2-3 years. The true length of an isolated cycle is thus about 13 years.

Odd and even cycles seem to follow slightly different patterns. It is therefore thought that the fundamental SOLAR CYCLE includes two sunspot cycles. (B.1.2,322; B.2.3,330; B.3.14,30)

SUNSPOT GROUP

A relatively compact association of SUNSPOTS.

Most spot groups have small areas and last less than 10 days. However large groups (which may contain dozens of individual spots) can endure for 100-150 days.

A group starts life as a PORE (or group of pores) a few thousand kilometers in diameter. Although most pores disappear within a few hours some grow fairly rapidly into spot groups, reaching maximum development within about a week. Soon afterwards, the area of the group begins to decrease; usually this decay proceeds at a much slower rate than the pre-maximum growth phase. The various stages of spot-group development are summarized in the ZURICH CLASSIFICATION, due to Waldmeier.

Spot groups are also classified according to the forms of their magnetic fields (see SUNSPOT GROUP CLASSIFICATION). The majority of groups are BIPOLAR and obey the POLARITY LAW. (B.1.2,166; B.2.3,340; B.3.14,13)

SUNSPOT GROUP CLASSIFICATION (MAGNETIC)

A scheme in which SUNSPOT GROUPS are characterized by the forms of their magnetic fields. Each group is labelled according to the number of MAGNETIC FIELD STRENGTH MAXIMA (CENTRES) it contains and the positions of these maxima with respect to the surrounding distribution of PLAGES.

Field strength maxima (FSM) are not necessarily in one-to-one correspondence with visible SUNSPOTS. Those FSM's which are not accompanied by spots are known as INVISIBLE SUNSPOTS.

In the classification the western section of an elongated distribution of plages is known as the "preceding part" (p), while the eastern section is referred to as the "following part" (f).

UNIPOLAR GROUPS (α-type): groups which contain only one FSM.

α - groups in which the preceding and following plages are distributed in a fairly symmetrical way around the field strength centre.

αp - groups in which the centre is located in the preceding part of the plage distribution.

αf - groups in which the centre is located in the following part of the plage distribution.

BIPOLAR GROUPS (β-type): groups which contain two FSM's of opposite polarity (see POLARITY LAW).

β - groups in which the areas of the preceding and following centres are roughly equal.

βp - groups in which the preceding centre is the main member.

βf - groups in which the following centre is the main member.

$\beta\gamma$ - groups with bipolar characteristics in which there is no clear borderline between the regions of opposite polarity.

MULTIPOLAR (COMPLEX) GROUPS (γ-type): groups which include several irregularly distributed regions of both polarities.

A letter "l" preceding (following) the classification symbols indicates that the group in question appeared (disappeared) at the eastern (western) LIMB on the day of observation.

A letter "d" preceding (following) the symbols indicates that the group originated (died) on the day of observation. (B.1.2,166; B.2.3,354)

SUNSPOT MAXIMUM, SUNSPOT MINIMUM see SUNSPOT CYCLE

SUNSPOT NUMBER (R)

An index of SUNSPOT activity defined by

$$R = K(10g + f)$$

where, for a single observation,

f = total number of individually countable spots

g = total number of SUNSPOT GROUPS

K = a standardizing factor determined separately for each telescope-observer combination.

Values of R fluctuate grossly from day to day, but smoothed values are found to vary systematically over a SUNSPOT CYCLE.

Also known as the WOLF NUMBER. (B.1.2,322; B.2.3,323; B.3.14,30)

SUNSPOT ZONES

The two "bands" of solar latitude (one on each side of the solar equator) in which SUNSPOT activity is concentrated.

The sunspot zones are 15°-20° wide and move toward the equator during the course of each SUNSPOT CYCLE. At SUNSPOT MINIMUM the old-cycle zones (mean latitudes ±8°) and the new-cycle zones (mean latitudes ±35°) coexist for 1-2 years. The zones only rarely extend to the equator.

The more active a cycle is, the greater the latitudes at which spots may occur. However, sunspot activity is rarely observed at latitudes >±45°.

The statement of the properties and behaviour of sunspot zones is referred to as "the law of zones" or SPÖRER'S LAW. (B.1.2,326; B.2.3,335)

SUPERALFVÉNIC

Faster than the local speed of ALFVÉN WAVES.

SUPERFLARE

A very large SOLAR FLARE of IMPORTANCE 3^+ (old classification) or 4 (new classification). The corrected AREA of a superflare is thus >1200 millionths of the DISK.

The LIGHT CURVES of superflares superficially resemble those of SUPERNOVAE.

See also GIANT FLARE. (B.3.12; C.4.3)

SUPERGRANULATION

A large-scale system of long-lived, relatively well-ordered horizontal motions on the solar DISK. In appearance this system closely resembles the flow pattern for cellular convection.

The supergranulation is similar to, but apparently physically independent of, the normal solar GRANULATION. (B.1.6; B.1.7,34; B.1.8)

SUPERNOVA

A star whose BRIGHTNESS increases explosively to an extremely high value, then decays gradually to a level that is presumed to be comparable to or less bright than the original value. During its explosive phase a supernova becomes nearly as bright as the entire galaxy in which it appears.

The LIGHT CURVES of supernovae bear roughly the same relationship to those of ordinary NOVAE as the curves for SUPERFLARES do to those for ordinary SOLAR FLARES. (F.1.5,133; F.1.10,409)

SUPERPOSED EPOCH ANALYSIS

A method of investigating the periodicity of a recurrent phenomenon without imposing any preconceived estimate of the period.

The data-vs-time plot is first examined for significant peaks (or troughs). The time-origin of the plot is then shifted to each of these peaks in turn, and the curves so obtained are averaged. Finally the plot of average value vs. time, known as a CHREE DIAGRAM, is examined for periodicity.

See also TIME-PATTERN ANALYSIS. (D.4.8,400)

SUPERSONIC TRANSPORT AIRCRAFT (SST, STA)

Passenger aircraft designed to fly at supersonic velocities.

SURFACE

One of the two basic forms of auroral display. See AURORA (FORMS).

SURGE

A form of PROMINENCE labelled BSs in the MENZEL-EVANS CLASSIFICATION.

A surge is a continuous stream of gas which moves outward into the CORONA from a SOLAR FLARE until it reaches a maximum extension of 20,000-170,000 km. The material then falls back into the CHROMOSPHERE along its original path. When observed at the LIMB a surge appears as a sharply-defined "finger" thrust out into the corona. Most often the surge trajectory is nearly radial, but large inclinations sometimes occur.

Surges usually start later than their accompanying flares (mean delay 4 minutes) and last for 2 min - 2.5 hr (mean duration 25 minutes). They have a tendency to be recurrent. Peak ejection velocities are usually in the range 100-200 km/s.

Surges are the most common type of solar flare ejection.

Also known as a FLARE SURGE. (B.1.2,211; B.2.3,385; B.3.14,105)

SUSPENDED CLOUD

A form of PROMINENCE labelled ANf in the MENZEL-EVANS CLASSIFICATION.

SWEEPERS

Radio-frequency "ATMOSPHERIC" signals of rapidly changing frequency, chiefly in the 23 to 26.5 Mc/s region. These signals often occur in trains, with constant intervals between individual sweepers. (E.2.3; E.2.13)

SWEEP-FREQUENCY RECEIVER

A narrow-band tunable radio receiver used in the radio-spectrum analysis of solar BURSTS. Several instruments of this type, each covering a different frequency octave, are connected to a broad-band antenna. Each receiver is swept over its frequency range 1-3 times a second, and the receiver outputs are continuously recorded on film. (B.3.14,180)

SWEEPING-OUT EFFECT

A MAGNETIC FRONT propagating outward from the SUN encounters charged COSMIC RAY particles and "pushes" them along by means of MAGNETIC REFLECTION. Particles convected away from the sun in this manner are said to be "swept out" by the front.

The "sweeping out" effect is modified by "leakage" of high-RIGIDITY particles through the front, by particle drift into the region behind the front (because of large-scale magnetic field gradients), by particle diffusion through the front (because of scattering by small irregularities in the magnetic field lines), etc. (C.2.9,161ff)

SWF see SHORT WAVE FADE-OUT

SWI see SPECIAL WORLD INTERVAL

SYMPATHETIC FLARES

SOLAR FLARES which brighten in rapid succession, apparently as a result of physical interaction between ACTIVE REGIONS.

Not to be confused with SIMULTANEOUS FLARES. (B.3.14,192)

SYNCHROTRON RADIATION

The ELECTROMAGNETIC RADIATION emitted by high-energy charged particles gyrating in a magnetic field.

At relativistic speeds the energy radiated by a single gyrating particle is strongly beamed along the particle's direction of motion. A distant observer in the orbital plane thus receives energy in a short, sharp pulse once a cycle, when the particle is moving toward him. The spectrum of this regular pulse train consists of a series of harmonics of the relativistic GYROFREQUENCY. The higher the particle energy, the greater the number and the closer the spacing of harmonics. In the radiation received from an assembly of highly relativistic particles, individual harmonics are broadened by a number of effects, and the macroscopic spectrum is smeared into a continuum. Roughly speaking, most of the energy is concentrated around a "critical frequency" much higher than the gyro-frequency.

Also known as MAGNETIC BREMSSTRAHLUNG.

See also GYRO-RADIATION. (B.4.4,44; B.4.9,351)

T see STORM TIME

TAPER see THIN-DOWN

TEKTITES

Small, glassy objects (frequently button- or tear-shaped) found in several limited regions on the earth's surface. The recognized true tektites are: australites (southern Australia), bediasites (Texas), billitonites (Java Sea area), indochinites (Thailand and Vietnam), Ivory Coast tektites, javaites (Java), moldavites (Czechoslovakia), and phillipinites (Phillipine Islands).

The origin of tektites is a matter of controversy. Some authorities contend that tektites have been formed from terrestrial materials (e.g. by fusion during the impact of a giant METEORITE). Others argue that tektites are of extra-terrestrial origin, and should themselves be classed as meteorites. (E.5.3,201; F.1.12,559)

TELLURIC CURRENTS see EARTH CURRENTS

TELLURIC LINES see FRAUNHOFER LINES

THERMAL BROADENING

DOPPLER BROADENING of spectral lines due to thermal motions of the emitting atoms (e.g. in a PLASMA). Thermal broadening is inversely proportional to the square root of the molecular weight of the atoms considered, while TURBULENCE BROADENING is not. (B.3.14,5)

THERMAL EMISSION

The emission of ELECTROMAGNETIC RADIATION by hot bodies, as a result of the thermal energy available to excite atomic transitions.

THERMODYNAMIC EQUILIBRIUM

The state which exists when a system and its surroundings satisfy all the conditions for MECHANICAL, CHEMICAL and THERMAL EQUILIBRIUM.

(a) MECHANICAL EQUILIBRIUM - there is no unbalanced force in the interior of the system, or between the system and its surroundings.

(b) CHEMICAL EQUILIBRIUM - the system has no tendency to undergo a spontaneous change of internal structure, such as a chemical reaction, or a transfer of matter from one part of the system to another, such as diffusion or solution.

(c) THERMAL EQUILIBRIUM - all parts of the system are at the same temperature, and this temperature is the same as that of the surroundings.

States of thermodynamic equilibrium can be described in terms of macroscopic co-ordinates that do not involve the time. (F.4.17,24)

THERMOPAUSE

The boundary between the THERMOSPHERE, in which temperature rises with altitude, and the isothermal region which lies above it. The thermopause occurs at an altitude of 300-400 km. (E.1.4,245)

THERMOSPHERE

The atmospheric region lying between the MESOPAUSE (80-85 km) and the THERMOPAUSE (300-400 km). In this region the temperature increases with height. (E.1.2,3,6)

THIN-DOWN

The track of a highly-charged IONIZING PARTICLE which loses energy to the target medium by dislodging electrons, and eventually comes to rest in the medium without having been involved in nuclear reactions.

For a heavy PRIMARY COSMIC RAY particle in living tissue the track is arrow-shaped, typically 0.025 mm in diameter and 1.5 mm long. Several thousand cells are affected. Toward the end of the track the ABSORBED DOSE may be as high as 10,000 RADS.

Also known as a TAPER. (F.3.8,65,67)

THOMSON SCATTERING

The scattering of ELECTROMAGNETIC RADIATION by free electrons.

See also K-CORONA. (F.4.12,326)

THRESHOLD RIGIDITY

The minimum value of MAGNETIC RIGIDITY an extra-terrestrial particle must have in order to penetrate the earth's magnetic field and reach the earth's surface at a given GEOMAGNETIC LATITUDE.

Also known as GEOMAGNETIC CUT-OFF RIGIDITY.

THUNDERBOLT

A term commonly used to refer to a stroke of LIGHTNING, but sometimes restricted to the special case of BALL LIGHTNING.

TID see TRAVELLING IONOSPHERIC DISTURBANCE

TIME-PATTERN ANALYSIS

A method of investigating the periodicity of a recurrent phenomenon without imposing any preconceived estimate of the period.

A rectangle is subdivided into small squares. Each square is taken to represent a fixed time (with the sequence "reading" like a printed page), and is shaded in according to the amplitude for that time. Any true periodicity will show up as a vertical or diagonal "line" of similar shading on the "page".

See also SUPERPOSED EPOCH ANALYSIS. (D.4.8,400)

TOPSIDE

The upper "side" of the IONOSPHERE. Usually the term refers specifically to the upper portion of the F_2-REGION. (E.1.7,190)

TOPSIDE SOUNDER

A satellite-mounted device which acts as a "downward-looking" IONOSONDE, sweeping the frequency range from 1 to 20 Mc/s. The reflected signals provide information about the peak of the F_2-REGION, and the region between this peak and the satellite. (E.2.8,298)

TRANSIT ACCELERATION

The acceleration a charged particle experiences in passing through a time-dependent electromagnetic field. Examples of transit-acceleration mechanisms are:

(1) the BETATRON MECHANISM;

(2) energy transfer from oscillating field "bumps" to particles passing through them;

(3) acceleration by VLF electromagnetic waves moving along the magnetic field.

(F.2.4)

TRANSIT TIME

The time taken by a SOLAR HIGH-ENERGY PARTICLE to travel from the SUN to the earth.

In calculating a transit time it is usually assumed that the instant of particle release from the sun coincides with the time of maximum intensity in H (or centimetre-wave emission) for the flare concerned.

Some authors refer to the occurrence of a transit time greater than that predicted by direct-path calculations as a TRANSIT TIME ANOMALY.

(C.3.3; C.3.8; C.3.9)

TRANSIT TIME ANOMALY see TRANSIT TIME

TRANSVERSE INVARIANT see MAGNETIC MOMENT

TRAPPED RADIATION

A flux of energetic charged particles constrained to "bounce" and "drift" on the ELECTRO-ORBITAL SURFACES of an ordered magnetic field. TRAPPING may only occur if the energy density of the magnetic field is greater than the kinetic energy density of the particle flux. (D.3.13,506)

TRAPPING

The confinement of a charged particle within a limited region of space by a magnetic field. A trapped particle (e.g. one whose GUIDING CENTER moves back and forth between two "mirror" fields) is magnetically reflected back into the trapping region whenever it approaches one of the region's boundaries.

"Leakage" occurs when the PITCH ANGLE of a trapped particle is altered to such an extent that relection no longer takes place (e.g. because of the nature of the mirror fields, or because of scattering within the trapping region), and when the mirror fields themselves are changed (e.g. because of field-entrainment by moving PLASMAS). Large numbers of charged particles can only be trapped by a magnetic field when the magnetic energy density is greater than the kinetic energy density of the particles.

See also MIRROR POINT. (C.2.9,166; D.3.5,159; D.3.6,153; D.3.13,508)

TRAVELLING IONOSPHERIC DISTURBANCE (TID)

A large-scale irregularity of ion density propagating through the F-REGION of the IONOSPHERE.

TID's may travel horizontally for thousands of kilometers with little change of form or amplitude. They usually move toward the equator, on a North-South line, with speeds of propagation through the medium around 160 m/sec. The wave-front of a TID is "tilted" forward, and the frontal extent is large ($\gtrsim$1000 km).

TID's are thought to be caused by a wave-like phenomenon with a downward component of motion and periods in the range 15-50 min. Hines (E.2.6) suggests that "internal atmospheric gravity waves" are the type of wave involved. (E.2.4; E.2.5; E.2.6,310)

TREE

A form of PROMINENCE labelled ANc in the MENZEL-EVANS CLASSIFICATION.

TREE-TRUNK

A form of PROMINENCE labelled ANb in the MENZEL-EVANS CLASSIFICATION.

TROPOPAUSE

The boundary region between the TROPOSPHERE and the STRATOSPHERE, marking a minimum in the atmospheric temperature. Its height varies with latitude, from <10 km at the poles to >15 km at the equator. (E.1.5,17)

TROPOSPHERE

The lowest layer of the earth's atmosphere, stretching upward to the TROPOPAUSE at about 13 km altitude. In this region, the temperature decreases with height. (E.1.4,244; E.1.5,17)

TROPOSPHERIC DUST

Dust particles occurring in the lower regions of the Earth's atmosphere. See COSMIC DUST.

TURBOPAUSE

The boundary between the TURBOSPHERE and the DIFFUSOSPHERE, marking the level above which diffusive separation of atmospheric constituents is dominant over turbulent mixing.

The turbopause occurs at 100-120 km altitude. (E.1.1,122; E.1.7,201)

TURBOSPHERE

The region of the earth's atmosphere in which turbulent mixing of atmospheric constituents is dominant over diffusive separation.

The turbosphere is bounded above by the TURBOPAUSE, which lies at an altitude of 100-120 km. At this level the rate of diffusive separation, which increases exponentially with height above the MESOPAUSE, equals the rate of turbulent mixing, which decreases sharply near 100 km altitude. (E.1.7,201)

TURBULENCE

An irregular condition of flow, etc. which may be characterized only by average values of quantities of physical interest. On detailed inspection, these quantities show a random variation in both space and time. (F.2.3,86; F.4.8,215)

TURBULENCE BROADENING

DOPPLER BROADENING of spectral lines due to turbulent motions of the emitting atoms (e.g. in a PLASMA). (B.3.14,5)

TWEEKS

A series of impulsive ATMOSPHERICS received from a single LIGHTNING discharge at night. Each impulse corresponds to a different propagation path (i.e. a different number of IONOSPHERIC reflections); later members of the series have undergone more reflections than their predecessors have. As the series progresses, the interval between impulses approaches the reflection time for vertical incidence (of the order of 600 μsec). (D.6.8,315)

TWILIGHTGLOW The AIRGLOW observed at twilight. (E.4.3,251)

TYPE A, B, C, D OSCILLATIONS

A scheme for classifying MICROPULSATIONS proposed by Benioff (1961).

TYPE A - nearly sinusoidal oscillations with periods 0.3-2.5 sec (now classified as Pc1).

TYPE B - nearly sinusoidal oscillations with periods 3-8 sec (now classified as Pc1 or Pc2).

TYPE C - very nearly sinusoidal oscillations with periods 7-30 sec (now classified as Pc3).

TYPE D - transients consisting of single pulses, or of short wave trains with peak-to-peak times of 40-300 sec (usually <120 sec); these transients sometimes display microstructure with periods 2-2.5 sec (Type D is now classified as Pi2, while its microstructure is classified as Pi1).

See CONTINUOUS PULSATIONS; IRREGULAR PULSATIONS. (D.5.2)

TYPE I RADIO BURST (STORM BURST)

A brief enhancement of the SOLAR RADIO EMISSION during a solar NOISE STORM.

Type I bursts normally occur in groups of hundreds or thousands over a wide range of frequencies. Two main types are observed:

(a) broad-band emission lasting a few seconds.
(b) narrow-band emission with durations in the range <1 sec - 1 min.

Type I radiation is generally associated with large SUNSPOTS.

(B.1.2,315; B.3.14,184; B.4.4,443,483)

TYPE II RADIO BURST (SLOW-DRIFT BURST)

A brief (5-10 min), intense enhancement of the SOLAR RADIO EMISSION over a narrow frequency band which slowly drifts from high to low frequencies. (The drift rate is typically -0.3 Mc/s^2 at 100 Mc/s.)

Type II bursts are relatively rare. They are generally ascribed to disturbances moving outward through the CORONA from SOLAR FLARES, eruptive PROMINENCES, or SURGES. Many of these bursts exhibit harmonic structure.
(B.1.2,311; B.3.14,188; B.4.4,333)

TYPE III ABSORPTION Another name for POLAR CAP ABSORPTION. (B.2.1,59)

TYPE III RADIO BURST (FAST-DRIFT BURST)

A brief (<1 sec - 30 sec) enhancement of the SOLAR RADIO EMISSION over a frequency band which drifts rapidly from high to low frequencies.

Type III bursts are relatively frequent, and tend to occur in groups of ten or more. They are generally ascribed to disturbances moving outward through the CORONA at high velocities ($\sim 10^5$ km/sec).

There are several types of burst related to Type III - e.g. U-BURSTS, INVERTED U-BURSTS, and bursts in which the frequency drift is from low to high. (B.1.2,301; B.3.14,196; B.4.4,274)

TYPE IV RADIO BURST (CONTINUUM BURST)

A transient enhancement of the SOLAR RADIO EMISSION over a wide range of frequencies, often lasting several hours.

Type IV bursts normally follow SOLAR FLARES, and are often accompanied by TYPE II RADIO BURSTS. The stability of Type IV radiation generally distinguishes it from the CONTINUUM RADIATION of a NOISE STORM.

Several sub-types of Type IV radiation are observed:

TYPE IV-A: (bursts at centimetre wavelengths) These bursts are small (<5'), lie low in the CHROMOSPHERE near the flare, and remain almost stationary. Type IV-A bursts are more common than the other two sub-types, and may occur as an isolated phenomenon. They are probably due to SYNCHROTRON RADIATION by chromospheric electrons during the associated flare.

TYPE IV-B: (bursts at metre wavelengths) These bursts occur in the CORONA, and are large (≥10') and non-stationary. Type IV-B bursts are usually accompanied by Type IV-A. They may be due to synchrotron radiation from coronal electrons which are excited by the shock front of a gas cloud ejected by the flare.

TYPE IV-C: These are rare, long-lived (hours or days), intense bursts at metre and decimetre wavelengths following Type IV-B. Type IV-C bursts are small compared to Type IV-B bursts, originate lower in the corona, and are stationary. They are apparently observed only when the associated flare lies near the centre of the DISK. (B.1.2,320; B.3.14,192; B.4.4,383)

TYPE V RADIO BURST (CONTINUUM BURST)

A short-lived (0.5-5 min), intense enhancement of the SOLAR RADIO EMISSION over the low-frequency range (<150 Mc/s) following a TYPE III RADIO BURST.

Type V radiation, although rare, is very highly correlated with SOLAR FLARES. It is probably SYNCHROTRON RADIATION from high-velocity electrons moving outward from a flare. (B.1.2,320; B.3.14,202; B.4.4,312)

U, U_1

An index of geomagnetic disturbance. U is defined as the day-to-day change of the component of the GEOMAGNETIC FIELD in the direction of the MAGNETIC AXIS, averaged over various stations.

U_1 is the value of U reduced to a scale similar to that of SUNSPOT NUMBERS. (B.2.1,65)

U-BURST

A fast solar RADIO BURST which first decreases in frequency, then increases again. The turning point usually falls between 100-150 Mc/s, although higher values have been observed. Lifetimes and drift-rates are similar to those of TYPE III bursts.

INVERTED U-BURSTS, in which the frequency increases at first, then decreases, are also observed.

Bursts of these two types are generally ascribed to exciters guided along curved magnetic lines of force. (B.1.2,302; B.3.14,202; B.4.5)

UHF (ULTRA-HIGH FREQUENCIES) >300 Mc/s

ULF (ULTRA-LOW FREQUENCIES) <3 kc/s

ULTRAVIOLET LIGHT

ELECTROMAGNETIC RADIATION at wavelengths between 5×10^{-7} cm and 4×10^{-5} cm (50-4000 Å).

UM (UNIPOLAR MAGNETIC) see UNIPOLAR MAGNETIC REGION

UMBRA

The dark central region of a SUNSPOT, surrounded by the brighter PENUMBRA. The intensity of the umbra is 20-30% that of the undisturbed PHOTOSPHERE; and the effective umbral temperature is cooler than the photospheric temperature by about 1500°K. In the case of large spots, the umbral area is about 16% that of the entire spot. In many spots a part of the umbra is filled with small bright points, smaller than photospheric GRANULES. (B.1.2,151)

UNESCO (UNITED NATIONS EDUCATIONAL, SCIENTIFIC AND CULTURAL ORGANIZATION) (A.2.14,666; A.2.19,20)

UNIPOLAR MAGNETIC REGION (UM REGION)

A region of the solar PHOTOSPHERE containing an isolated MAGNETIC FIELD STRENGTH MAXIMUM, of moderate or small intensity (0.1-3 gauss). UM regions are relatively rare, and occur in the same latitudes as BIPOLAR MAGNETIC REGIONS. They cover a large area (0.1-0.2 of the disk), and have poorly-defined boundaries. (B.1.2,181)

UNIPOLAR SUNSPOT GROUP see SUNSPOT GROUP CLASSIFICATION

UNIVERSAL TIME (UT)

The LOCAL CIVIL TIME on the meridian of Greenwich (GREENWICH CIVIL TIME). For purposes of standardization, most astronomical observations are referred to universal time. (F.1.5,174)

UNSCEAR (UNITED NATIONS SCIENTIFIC COMMITTEE ON THE EFFECTS OF ATOMIC RADIATION)

URSIGRAM

An urgent message circulated by IUWDS to solar and geophysical observatories, to warn them of significant changes in solar/geophysical activity. (A.2.8; C.4.5)

<u>URSI</u> (UNION RADIO SCIENTIFIQUE INTERNATIONALE, or the INTERNATIONAL SCIENTIFIC RADIO UNION)

The International Commission on Scientific Wireless Telegraphy, formed in 1913 and re-organized as an international scientific union in 1920, adopted the name URSI in 1928. The purpose of URSI is to promote scientific research into radio communications at the international level; to encourage discussion; and to facilitate agreement on common methods of measurement and the standardization of scientific measuring instruments. (A.2.14,428)

<u>USGS</u> (UNITED STATES GEOLOGICAL SURVEY)

<u>UT</u> see UNIVERSAL TIME

<u>UV</u> see ULTRAVIOLET LIGHT

<u>V</u>

The magnitude of the vertical component of the GEOMAGNETIC FIELD (Z). See GEOMAGNETIC ELEMENTS.

$\underline{v_A}$ (ALFVÉN SPEED) see ALFVÉN WAVES

<u>VAN ALLEN RADIATION</u>

A flux of energetic charged particles of natural origin (almost exclusively electrons and protons) TRAPPED in the GEOMAGNETIC FIELD. The Van Allen radiation does not include ARTIFICIAL RADIATION (such as that due to high-altitude nuclear explosions), although these particles also can be geomagnetically trapped. (D.3.6; D.3.13,505; D.3.17)

<u>VAN ALLEN RADIATION BELTS</u>

Regions of the GEOMAGNETIC FIELD in which TRAPPING of energetic charged particles may occur. Early observations suggested the existence of an INNER RADIATION ZONE ($L < 2$) and an OUTER RADIATION ZONE ($L > 2$), separated by a region of low trapped intensity called the SLOT. However, recent work has shown that there is only one trapping zone, extending outward to the limit of the MAGNETOSPHERE. The intensities, energy spectra, and relative proportions of the electrons and protons forming the TRAPPED RADIATION vary with L throughout this zone.

See also L. (D.3.13,521)

VAN DER WAALS FORCES

Weak, long-range, attractive forces between ions, atoms, or molecules, arising from the mutual polarization of electronic configurations.

(F.4.1,309; F.4.11,132; F.4.14,265)

VARIOMETER see MAGNETIC VARIOMETER

VERDET CONSTANT see FARADAY EFFECT

VERNAL EQUINOX see EQUINOX

VHF (VERY HIGH FREQUENCY) 30-300 Mc/s (A.1.21,555)

VIRTUAL HEIGHT (h') see GROUP PATH

VISIBLE LIGHT

ELECTROMAGNETIC RADIATION at wavelengths between 4×10^{-5} cm and 7.2×10^{-5} cm (4000-7200 Å).

VISUAL BRIGHTNESS see BRIGHTNESS

VLF (VERY LOW FREQUENCIES) 3-30 kc/s (E.2.1,393)

VLF EMISSIONS

Very low frequency RADIO NOISE signals, believed to arise from the excitation of WHISTLER-MODE waves by streams of charged particles travelling along GEOMAGNETIC FIELD lines in the MAGNETOSPHERE.

VLF emissions include steady noise, or HISS, and a variety of discrete forms of a generally musical character, such as DAWN CHORUS. Periodic emissions are also observed; these are sometimes related to WHISTLERS. LONG-PERIOD VLF PULSATIONS appear as repeated rising tones superimposed on the normally steady 2-4 kc/s hiss, with periods from 20 sec to 3 min or more. These pulsations are observed over a wide range of latitudes, and occur in trains lasting an hour or so, on average. A single event may include several of these trains.

(D.6.1; D.6.3; D.6.4; D.6.6; D.6.7; E.2.7,366)

VLF PULSATIONS see VLF EMISSIONS

VOLUME ABSORPTION COEFFICIENT (k_λ) see ABSORPTION COEFFICIENT

W

The westward component of the GEOMAGNETIC FIELD (W = -Y).
See GEOMAGNETIC ELEMENTS.

WALDMEIER C-REGION see C-REGION (B.1.17; B.2.6; B.3.14,305)

WAVE INTERACTION see IONOSPHERIC CROSS-MODULATION

WAVE VELOCITY

The velocity at which a condition of constant phase in a wave-motion (e.g. a wave-crest) progresses through a given medium.

Also known as PHASE VELOCITY.

WDC see WORLD DATA CENTRE

WGI see WORLD GEOPHYSICAL INTERVAL

WHIRLS

The characteristic cyclonic configurations of the FIBRILLE structure in the CHROMOSPHERE. These vortical structures are independent of magnetic-field polarity, and probably represent stream lines of hydrodynamical vortices.

Also known as SOLAR VORTICES. (B.3.14,23,26)

WHISTLER

A form of RADIO NOISE in the audio portion of the radio spectrum, characterized by a "whistling" tone which may last for several seconds. During a "whistle" the signal frequency may glide from as high as 30 kc/s to as low as 30 c/s.

Whistlers occur when the VLF components of a LIGHTNING-stroke pulse penetrate the IONOSPHERE and propagate along the lines of the GEOMAGNETIC FIELD. During propagation, the high frequencies usually outstrip the low, and the signal lengthens into a descending "whistle". (Rising whistles may also occur.)

On arrival at the opposite geomagnetic hemisphere (transit time $\sim\frac{1}{2}$ sec) the signal may be reflected back to its original hemisphere, again being guided along the geomagnetic lines of force. This mode of propagation is known as the WHISTLER MODE.

See also SOLAR WHISTLE.

(D.6.2; D.6.5; D.6.6,319; D.6.8; E.2.7,361; E.5.2,136)

WHISTLER MEDIUM Another name for MAGNETOSPHERE. (D.1.4,538)

WHITE-LIGHT FLARE

A SOLAR FLARE visible in integrated light, or associated with an enhancement of the solar CONTINUOUS EMISSION. In general an enhancement of this sort occurs during the FLASH PHASE of the flare, and lasts for less than 15 minutes. (B.3.14,162)

WINGS

The portions of an EMISSION (or ABSORPTION) LINE PROFILE, on either side of the line-centre, in which the intensity falls off (or rises) to merge with the background.

WINTER ANOMALY EVENT

A moderate increase in D-REGION electron densities, observed in the winter months at middle latitudes. Such increases last for several days. Their cause is unknown. (E.1.7,171)

WMI see WORLD METEOROLOGICAL INTERVAL

WMO (WORLD METEOROLOGICAL ORGANIZATION)

An agency set up under the auspices of the United Nations to advance the science of meteorology and to improve weather forecasting techniques.

(A.2.7,14; A.2.14,713; A.2.18,163; A.2.19,13)

WMS (WORLD MAGNETIC SURVEY)

A survey being carried out under the direction of the IUGG with the aim of completely mapping the earth's magnetic field. The WMS is a deferred IGY project. (A.2.19,45; D.2.4; D.2.5)

WOLF NUMBER, R see SUNSPOT NUMBER

WORLD DATA CENTRE (WDC)

A centre for the collection, organization, and dissemination of observational data obtained during the IGY-IGC. A number of these centres are now functioning as permanent data centres.

WDC's were established for each of the following fields: meteorology; GEOMAGNETISM; AURORA; AIRGLOW; IONOSPHERE; SOLAR ACTIVITY; COSMIC RADIATION; longitude and latitude; glaciology; oceanography; rockets and satellites; seismology; gravimetry; nuclear radiation.

(A.2.12; A.2.17)

WORLD GEOPHYSICAL INTERVAL (WGI)

For the purpose of co-ordinating international geophysical research, two weeks in each season are designated as "WGI's", and are set aside for programmes of co-operative research.

See also REGULAR WORLD DAY (RWD). (A.2.8)

WORLD METEOROLOGICAL INTERVAL (WMI)

Ten consecutive days in each quarter, including the EQUINOX or SOLSTICE day and three REGULAR WORLD DAYS, set aside for programmes of co-operative meteorological research. (A.2.2,2; A.2.12,11)

WORLD METEOROLOGICAL ORGANIZATION see WMO

WORLD WARNING AGENCY (AGIWARN) see IUWDS

X

The northward component of the GEOMAGNETIC FIELD.

See GEOMAGNETIC ELEMENTS.

X-RAY PULSATIONS

Fluctuations in X-RAY intensity observed at balloon altitudes in the AURORAL ZONES. The time-separation of peaks may range from a fraction of a second to several hundred seconds; separations in the 5-10 sec range are most common. Pulsations may be either fairly regular or irregular in form; irregular pulsations are more common.

Pulsations are caused by pulsating electron precipitation into the auroral atmosphere. Such precipitations may be due to local instabilities in the MAGNETOSPHERIC plasma. (D.3.3; D.3.4)

X-RAYS

Short-wave ELECTROMAGNETIC RADIATION, with wavelengths in the range 6×10^{-10} cm to 5×10^{-7} cm (0.06 – 50 Å). The X-ray region of the spectrum is bounded toward longer wavelengths by ULTRAVIOLET LIGHT, and toward shorter wavelengths by GAMMA RAYS.

X-TYPE NEUTRAL POINT see NEUTRAL POINT

Y

The eastward component of the GEOMAGNETIC FIELD.
See GEOMAGNETIC ELEMENTS.

Z

The vertical component of the GEOMAGNETIC FIELD, reckoned positive downward.
See GEOMAGNETIC ELEMENTS.

ZEEMAN EFFECT

The splitting of atomic energy levels and the associated spectral lines which occurs when the atoms are subjected to a magnetic field.
(B.3.14,13; F.4.8,663)

ZENITH

The point of the CELESTIAL SPHERE directly overhead at a given place on earth. The angular distance between an astronomical body and the zenith is known as the ZENITH DISTANCE of that body.

The point on the celestial sphere directly opposite the zenith is known as the NADIR.

See also SOLAR ZENITH ANGLE. (F.1.5,259)

ZENITH DISTANCE see ZENITH

ZODIACAL BAND see ZODIACAL LIGHT

ZODIACAL CLOUD see INTERPLANETARY DUST

ZODIACAL LIGHT

An extended band of light visible in the region of the ECLIPTIC just after sunset and just before sunrise. Its brightness may be as great as 100 times that of integrated STARLIGHT.

The width and brightness of the ZODIACAL BAND fall off with increasing ELONGATION, but increase again as the anti-solar direction is approached. This increase is known as GEGENSCHEIN.

The zodiacal light is generally ascribed to the scattering of sunlight by electrons and INTERPLANETARY DUST. It is considered to be essentially an extension of the F-CORONA.

(F.1.11,524)

ZURICH CLASSIFICATION

A scheme drawn up by Waldmeier to summarize the stages that may occur in the development of a SUNSPOT GROUP. The scheme recognizes nine "classes":

A. Small single spot, or very small group with no BIPOLAR structure; spots have no PENUMBRAE. — 1st DAY

B. Bipolar group of spots without penumbrae.

C. Bipolar group in which at least one major spot has a penumbra. — 2nd DAY

D. Bipolar group in which both major spots have penumbrae; length of group $<10^\circ$.

E. Large bipolar group with complicated structure. Both major spots have penumbrae. Many small spots. Length of group $\gtrsim 10^\circ$. — 5th-10th DAY

F. Very large bipolar or COMPLEX group; length of group $>15^\circ$.

G. Large bipolar group without small spots; length of group $\gtrsim 10^\circ$. — 10th-15th DAY

H. UNIPOLAR SPOT with penumbra; structure may be complicated. Diameter $>2.5^\circ$.

J. Round unipolar spot with penumbra; diameter $<2.5^\circ$.

The most common development sequences for short-lived groups are A, A-B-A, and A-B-C-B-A. Typical sequences for long-lived groups are A-B-C-D-C-H-J-A and A-B-C-D-E-F-G-H-J-A.

(B.1.2,167; B.2.3,340)

5 IMPORTANT PHYSICAL CONSTANTS AND CONVERSION FACTORS

c	Speed of light in vacuum	$= 2.9979 \times 10^{10}$ cm/s
AU	Astronomical unit (mean earth-sun distance)	$= 1.4960 \times 10^{13}$ cm
		$= 499.01$ light-seconds
ly	Light year	$= 9.4605 \times 10^{17}$ cm
		$= 6.324 \times 10^{4}$ AU
pc	Parsec	$= 3.086 \times 10^{18}$ cm
		$= 2.06265 \times 10^{5}$ AU
		$= 3.262$ ly
R_E	Earth's equatorial radius	$= 6.378 \times 10^{8}$ cm
$R_\bullet$	Solar radius	$= 6.960 \times 10^{10}$ cm
	Angular diameter of the sun at 1 AU	$= 1919.3$ seconds of arc
		$= 9.305 \times 10^{-3}$ radian
	Mean equatorial horizontal solar parallax	$= 8.794$ seconds of arc
		$= 4.263 \times 10^{-5}$ radian
	Mean velocity of earth in its orbit	$= 29.77$ km/s
	Velocity of sun relative to near stars	$= 19.4$ km/s
	Angular rotation velocity of sun (at equator)	$= 2.90 \times 10^{-6}$ radian/s
G	Gravitational constant	$= 6.67 \times 10^{-8}$ dyne cm^2/g^2
k	Boltzmann constant	$= 1.3084 \times 10^{-16}$ erg/deg
		$= 8.617 \times 10^{-5}$ eV/deg
σ	Stefan-Boltzmann constant	$= 5.669 \times 10^{-5}$ erg cm^{-2}deg^{-4}sec^{-1}
h	Planck's constant	$= 6.625 \times 10^{-27}$ erg sec
$\hbar$	$(2\pi)^{-1}$ × Planck's constant	$= 1.0544 \times 10^{-27}$ erg sec
e	Electronic charge	$= 4.803 \times 10^{-10}$ esu
		$= 1.602 \times 10^{-20}$ emu
		$= 1.602 \times 10^{-19}$ coulomb
m	Electron rest mass	$= 9.108 \times 10^{-28}$ g

mc^2	Rest mass energy of electron	$= 8.185 \times 10^{-7}$ erg
		$= 0.51098$ MeV
e/m	Specific charge on electron	$= 5.273 \times 10^{17}$ esu/g
		$= 1.7589 \times 10^{7}$ emu/g
m_p	Proton rest mass	$= 1.67239 \times 10^{-24}$ g
m_p/m	Ratio of proton and electron rest masses	$= 1836.1$
m_pc^2	Rest mass energy of proton	$= 1.503 \times 10^{-3}$ erg
		$= 938.211$ MeV
m_n	Neutron rest mass	$= 1.6747 \times 10^{-24}$ g
m_nc^2	Rest mass energy of neutron	$= 1.505 \times 10^{-3}$ erg
		$= 939.51$ MeV
E_o	Energy of one electron volt (eV)	$= 1.602 \times 10^{-12}$ erg
E_o/k	Temperature associated with one electron volt	$= 11{,}606°K$
λ_o	Wavelength associated with one electron volt	$= 12{,}396$ Å
ν_o	Frequency associated with one electron volt	$= 2.4184 \times 10^{14}\ s^{-1}$
	Energy of 1 gram mass	$= 5.61 \times 10^{26}$ MeV
	Energy of 1 A.M.U.	$= 931.15$ MeV
R_o	Gas constant per mole (physical scale)	$= 8.317 \times 10^{7}$ erg deg^{-1} $mole^{-1}$
N, N_o	Avogadro's constant (physical scale-atoms in 16g of O^{16})	$= 6.025 \times 10^{23}$ $(g\ mole)^{-1}$
V_o	Standard volume of a perfect gas (physical scale)	$= 2.242 \times 10^{4}$ cm^3 atm $mole^{-1}$
L_o	Loschmidt's constant (physical scale - molecules in 1 cm^3 of perfect gas at s.t.p.)	$= 2.687 \times 10^{19}$ cm^{-3}
J	Joule equivalent (15° calorie)	$= 4.186$ joule/cal

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