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- object glass.** See OBJECTIVE.
- objective, *n.*** The lens or combination of lenses which receives light rays from an object, and refracts them to form an image in the focal plane of the eyepiece of an optical instrument, such as a telescope. Also called OBJECT GLASS.
- oblate spheroid.** An ellipsoid of revolution, the shorter axis of which is the axis of revolution. An ellipsoid of revolution, the longer axis of which is the axis of revolution, is called a PROLATE SPHEROID. The earth is approximately an oblate spheroid.
- oblique, *adj.*** Neither perpendicular nor parallel; slanting.
- oblique angle.** Any angle not a multiple of 90°.
- oblique ascension.** The arc of the celestial equator, or the angle at the celestial pole, between the hour circle of the vernal equinox and the hour circle through the intersection of the celestial equator and the eastern horizon at the instant a point on the oblique sphere rises, measured eastward from the hour circle of the vernal equinox through 24h. The expression is not used in modern navigation.
- oblique chart.** A chart on an oblique map projection.
- oblique coordinates.** Magnitudes defining a point relative to two intersecting non-perpendicular lines, called AXES. The magnitudes indicate the distance from each axis, measured along a parallel to the other axis. The horizontal distance is called the abscissa and the other distance the ordinate. This is a form of CARTESIAN COORDINATES.
- oblique cylindrical orthomorphic chart.** See OBLIQUE MERCATOR CHART.
- oblique cylindrical orthomorphic map projection.** See OBLIQUE MERCATOR MAP PROJECTION oblique equator. A great circle the plane of which is perpendicular to the axis of an oblique projection. An oblique equator serves as the origin for measurement of oblique latitude. On an oblique Mercator map projection, the oblique equator is the tangent great circle. See also FICTITIOUS EQUATOR.
- oblique graticule.** A fictitious graticule based upon an oblique map projection.
- oblique latitude.** Angular distance from an oblique equator. See also FICTITIOUS LATITUDE.
- oblique longitude.** Angular distance between a prime oblique meridian and any given oblique meridian. See also FICTITIOUS LONGITUDE.
- oblique map projection.** A map projection with an axis inclined at an oblique angle to the plane of the equator.
- oblique Mercator chart.** A chart on the oblique Mercator map projection. Also called OBLIQUE CYLINDRICAL ORTHOMORPHIC CHART. See also MERCATOR CHART.
- oblique Mercator map projection.** A conformal cylindrical map projection in which points on the surface of a sphere or spheroid, such as the earth, are developed by Mercator principles on a cylinder tangent along an oblique great circle. Also called OBLIQUE CYLINDRICAL ORTHOMORPHIC MAP PROJECTION. See also MERCATOR MAP PROJECTION.
- oblique meridian.** A great circle perpendicular to an oblique equator. The reference oblique meridian is called prime oblique meridian. See also FICTITIOUS MERIDIAN.
- oblique parallel.** A circle or line parallel to an oblique equator, connecting all points of equal oblique latitude. See also FICTITIOUS PARALLEL.
- oblique pole.** One of the two points 90° from an oblique equator.
- oblique rhumb line.** 1. A line making the same oblique angle with all fictitious meridians of an oblique Mercator map projection. Oblique parallels and meridians may be considered special cases of the oblique rhumb line. 2. Any rhumb line, real or fictitious, making an oblique angle with its meridians. In this sense the expression is used to distinguish such rhumb lines from parallels and meridians, real or fictitious, which may be included in the expression rhumb line. See also FICTITIOUS RHUMB LINE.
- oblique sphere.** The celestial sphere as it appears to an observer between the equator and the pole, where celestial bodies appear to rise obliquely to the horizon.
- obliquity factor.** A factor in an expression for a constituent tide or tidal current involving the angle of the inclination of the moon's orbit to the plane of the earth's equator.
- obliquity of the ecliptic.** The acute angle between the plane of the ecliptic and the plane of the celestial equator, about 23° 27'.
- obscuration, *n.*** The designation for the sky cover when the sky is completely hidden by obscuring phenomena in contact with, or extending to the surface.
- obscuring phenomenon.** Any atmospheric phenomenon, not including clouds, which restricts the vertical or slant visibility.
- observed altitude.** Corrected sextant altitude; angular distance of the center of a celestial body above the celestial horizon of an observer measured along a vertical circle, through 90°. Occasionally called TRUE ALTITUDE. See also ALTITUDE INTERCEPT, APPARENT ALTITUDE, SEXTANT ALTITUDE.
- observed gravity anomaly.** See GRAVITY ANOMALY.
- observed latitude.** See LATITUDE LINE.
- observed longitude.** See LONGITUDE LINE.
- obstruction, *n.*** Anything that hinders or prevents movement, particularly anything that endangers or prevents passage of a vessel or aircraft. The term is usually used to refer to an isolated danger to navigation, such as a submerged rock or reef in the case of marine navigation, and a tower, tall building, mountain peak, etc., in the case of air navigation.
- obstruction buoy.** A buoy used to indicate a dangerous obstruction. See ISOLATED DANGER BUOY.
- obstruction light.** A light indicating a radio tower or other obstruction to aircraft.
- obstruction mark.** A navigation mark used to indicate a dangerous obstruction. See ISOLATED DANGER MARK.
- obtuse angle.** An angle greater than 90° and less than 180°.
- occasional light.** A light put into service only on demand.
- occluded front.** A composite of two fronts, formed when a cold front overtakes a warm front or stationary front. This is common in the late stages of wave-cyclone development, but is not limited to occurrence within a wave-cyclone. There are three basic types of occluded front, determined by the relative coldness of the air behind the original cold front to the air ahead of the warm (or stationary) front. A cold occlusion results when the coldest air is behind the cold front. The cold front undercuts the warm front and, at the earth's surface, cold air replaces less-cold air. When the coldest air lies ahead of the warm front, a warm occlusion is formed in which case the original cold front is forced aloft at the warm-front surface. At the earth's surface, cold air is replaced by less-cold air. A third and frequent type, a neutral occlusion, results when there is no appreciable temperature difference between the cold air masses of the cold and warm fronts. In this case frontal characteristics at the earth's surface consist mainly of a pressure trough, a wind-shift line, and a band of cloudiness and precipitation. Commonly called OCCLUSION. Also called FRONTAL OCCLUSION.
- occlusion, *n.*** 1. See OCCLUDED FRONT. 2. The process of formation of an occluded front. Also called FRONTAL OCCLUSION.
- occultation, *n.*** 1. The concealment of a celestial body by another which crosses the line of view. Thus, the moon occults a star when it passes between the observer and the star. 2. The interval of darkness in the period of the light. See also FLASH.
- occulting light.** A light totally eclipsed at regular intervals, with the duration of light always longer than the intervals of darkness called OCCULTATIONS. The term is commonly used for a SINGLE OCCULTING LIGHT, an occulting light exhibiting only single occultations which are repeated at regular intervals.
- occupied bandwidth.** As defined by the International Telecommunication Union (ITU) the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission. In some cases, for example multichannel frequency-division systems, the percentage of 0.5 percent may lead to cer-

- tain difficulties in the practical application of the definitions of occupied and necessary bandwidth; in such cases a different percentage may prove useful.
- ocean**, *n.* 1. The major area of salt water covering the greater part of the earth. 2. One of the major divisions of the expanse of salt water covering the earth.
- ocean current**. A movement of ocean water characterized by regularity, either of a cyclic nature, or as a continuous stream flowing along a definable path. Three general classes may be distinguished, by cause: (a) currents associated with horizontal pressure gradients, comprising the various types of gradient current; (b) wind-driven currents, which are those directly produced by the stress exerted by the wind upon the ocean surface; (c) currents produced by long-wave motions. The latter are principally tidal currents, but may also include currents associated with internal waves, tsunamis and seiches. The major ocean currents are of continuous, stream-flow character, and are of first-order importance in the maintenance of the earth's thermodynamic balance.
- oceanic**, *adj.* Of or pertaining to the ocean.
- oceanographic**, *adj.* Of or pertaining to oceanography, or knowledge of the oceans.
- oceanographic survey**. The study or examination of conditions in the ocean or any part of it, with reference to zoology, chemistry, geology, or other scientific discipline. See also HYDROGRAPHIC SURVEY.
- oceanography**, *n.* The study of the sea, embracing and integrating all knowledge pertaining to the sea's physical boundaries, the chemistry and physics of sea water, and marine biology. Strictly, oceanography is the description of the marine environment, whereas OCEANOLOGY is the study of the oceans.
- oceanology**, *n.* The study of the ocean. See also OCEANOGRAPHY.
- Ocean Passages for the World***. A British publication relating to the planning and conduct of ocean passages. Published by the Hydrographer of the Navy, *Ocean Passages for the World* addresses those areas which lie mainly outside the areas covered in detail by Admiralty Sailing Directions. It is kept up-to-date by periodical supplements. The publication should not be used without reference to the latest supplement and those *Notices to Mariners* published to correct Sailing Directions.
- ocean waters**. For application to the provisions of the Marine Protection, Research, and Sanctuaries Act of 1972, those waters of the open sea lying seaward of the base line from which the territorial sea is measured.
- octagon**, *n.* A closed plane figure having 8 sides.
- octahedral cluster**. An arrangement of eight corner reflectors with common faces designed to give substantially uniform response in all directions. The octahedral cluster is formed by mounting three rectangular plates mutually at right angles with the geometric centers of the plates coincident. See also PENTAGONAL CLUSTER.
- octant**, *n.* A double-reflecting instrument for measuring angles, used primarily for measuring altitude of celestial bodies. It has a range of 90°, with the graduated arc subtending 45°, or 1/8 of a circle, hence the term octant; a precursor of the sextant, whose arc subtends 60° or 1/6 of a circle.
- octant altitude**. See SEXTANT ALTITUDE.
- Odyssey protractor**. A device used in conjunction with a plotting sheet having equally spaced concentric circles (range circles) drawn about two or more stations of a radio determination system being operated in the ranging mode.
- oe**, *n.* A whirlwind off the Faeroe Islands.
- oersted**, *n.* The centimeter-gram-second electromagnetic system unit of magnetic field strength. It corresponds to 1000/4π ampere per meter.
- off-center PPI display**. A plan position indicator display in which the center about which the sweep rotates is offset from the center of the radarscope.
- offing**, *n.* The part of the visible sea a considerable distance from the shore, or that part just beyond the limits of the area in which a pilot is needed.
- offshore**, *adj. & adv.* Away from the shore.
- offshore**, *n.* The comparatively flat zone of variable width which extends from the outer margin of the rather steeply sloping shore face to the edge of the shelf.
- offshore light stations**. Manned light stations built on exposed marine sites to replace lightships.
- offshore navigation**. Navigation at a distance from a coast, in contrast with COASTWISE NAVIGATION in the vicinity of a coast.
- offshore water**. Water adjacent to land in which the physical properties are slightly influenced by continental conditions.
- offshore wind**. Wind blowing from the land toward the sea. An OFFSHORE WIND blows in the opposite direction. See also LAND BREEZE.
- off soundings**. Navigating beyond the 100-fathom curve. In earlier times, said of a vessel in water deeper than could be sounded with the sounding lead.
- off station**. Not in charted position.
- ogival buoy**. A buoy with a pointed-arch shaped vertical cross-section. Used in the cardinal system.
- ohm**, *n.* A derived unit of electrical resistance in the International System of Units; it is the electrical resistance between two points of a conductor when a constant potential difference of 1 volt, applied to these points, produces in the conductor a current of 1 ampere, the conductor not being the seat of an electromotive force.
- old ice**. Sea ice which has survived at least one summer's melt. Most topographic features are smoother than on first-year ice. Old ice may be subdivided into SECOND-YEAR ICE and MULTI YEAR ICE.
- Omega Navigation System**. A worldwide, continuous, radionavigation system of medium accuracy which provides hyperbolic lines of position through phase comparisons of VLF (10-14kHz) continuous wave signals transmitted on a common frequency on a time-shared basis. The full system is comprised of eight transmitting stations.
- Omega plotting chart**. See under PLOTTING CHART.
- Omega Table**. See PUB. 224.
- omni-**. A prefix meaning all.
- omni-azimuthal antenna**. See OMNIDIRECTIONAL ANTENNA.
- omnidirectional antenna**. An antenna whose radiating or receiving properties at any instant are the same on all bearings. Also called OMNIAZIMUTHAL ANTENNA. See also DIRECTIONAL ANTENNA.
- omnidirectional light**. A light which presents the same characteristic over the whole horizon of interest to marine navigation. Also called ALL-ROUND LIGHT.
- omnidirectional radiobeacon**. A radiobeacon transmitting a signal in all directions. A circular radiobeacon is an omnidirectional beacon which transmits in all horizontal directions simultaneously. A rotating radiobeacon is an omnidirectional beacon with one or more beams that rotate. A DIRECTIONAL RADIOBEACON is a beacon which beams its signals in one or several prescribed directions.
- onshore wind**. Wind blowing from the sea towards the land. An OFFSHORE WIND blows in the opposite direction. See also SEA BREEZE.
- on soundings**. Navigating within the 100-fathom curve. In earlier times, said of a vessel in water sufficiently shallow for sounding by sounding lead.
- on the beam**. Bearing approximately 090° relative (on the starboard beam) or 270° relative (on the port beam). The expression is often used loosely for BROAD ON THE BEAM, or bearing exactly 090° or 270° relative. Also called ABEAM.
- on the bow**. Bearing approximately 045° relative (on the starboard bow) or 315° relative (on the port bow). The expression is often used loosely for BROAD ON THE BOW, or bearing exactly 045° or 315° relative.
- on the quarter**. Bearing approximately 135° relative (on the starboard quarter) or 225° relative (on the port quarter). The expression is often used loosely for BROAD ON THE QUARTER, or bearing exactly 135° or 225° relative.
- ooze**, *n.* A soft, slimy, organic sediment covering part of the ocean bottom, composed principally of shells or other hard parts of minute organisms.
- open**, *v., i.* To move or appear to move apart, such as when range lights appear to separate as the vessel moves off the channel centerline. The opposite is CLOSE.
- open basin**. See TIDAL BASIN.
- open berth**. An anchorage berth in an open roadstead.
- open coast**. A coast that is not sheltered from the sea.
- open harbor**. An unsheltered harbor exposed to the sea.
- opening**, *n.* A break in a coastline or a passage between shoals, etc. See also GAT.

- open pack ice.** Pack ice in which the concentration is 4/10 to 6/10, with many leads and polynyas, and the floes generally not in contact with one another.
- open roadstead.** A roadstead with relatively little protection from the sea.
- open sea.** 1. The part of the ocean not enclosed by headlands, within narrow straits, etc. 2. The part of the ocean outside the territorial jurisdiction of any country. The opposite is CLOSED SEA. See also HIGH SEAS.
- open water.** A large area of freely navigable water in which sea ice is present in concentration less than 1/10. When there is no sea ice present, the area should be described as ICE FREE, even though icebergs may be present.
- operating area chart.** A base chart with overprints of various operating areas necessary to control fleet exercise activities. Submarine Transit Lanes, Surface and Sub-surface Operating Areas, Air Space Warning Areas, Controlled Air Spaces, and other restricted areas are portrayed.
- operating system.** The portion of a computer's software devoted to running programs and providing for operator interface.
- opposition, n.** The situation of two celestial bodies having either celestial longitudes or sidereal hour angles differing by 180°. The term is usually used only in relation to the position of a superior planet or the moon with reference to the sun. The situation of two celestial bodies having either the same celestial longitude or the same sidereal hour angle is called conjunction.
- optic, adj.** Of or pertaining to vision.
- optical, adj.** Of or pertaining to optics or to vision.
- optical double star.** Two stars in nearly the same line of sight but differing greatly in distance from the observer, as distinguished from a PHYSICAL DOUBLE STAR (two stars in nearly the same line of sight and at approximately the same distance from the observer).
- optical glass.** Glass of which the composition and molding are carefully controlled in order to insure uniform refractive index and high transmission factor.
- optical path.** The path followed by a ray of light through an optical system.
- optical system.** A series of lenses, apertures, prisms, mirrors, etc., so arranged as to perform a definite optical function.
- optics, n.** The science dealing with light, lenses, etc.
- Optimum Track Ship Routing.** See under SHIP WEATHER ROUTING.
- orbit, n.** 1. The path of a body or particle under the influence of a gravitational or other force. See also CENTRAL FORCE ORBIT, INERTIAL ORBIT, INTERMEDIATE ORBIT, NOMINAL ORBIT, NORMAL ORBIT, OSCULATING ORBIT, PERTURBED ORBIT, POLAR ORBIT, STATIONARY ORBIT.
- orbital altitude.** The mean altitude of the orbit of a satellite above the surface of the parent body.
- orbital elements.** Parameters that specify the position and motion of a body in orbit. The elliptical orbit of a satellite attracted by an exactly central gravitational force is specified by a set of six parameters as follows: Two parameters, the semimajor axis and eccentricity of the ellipse, establish the size and shape of the elliptical orbit. A third parameter, time of perifocal passage, enables determination of the location of the satellite in its orbit at any instant. The three remaining parameters establish the orientation of the orbit in space. These are the inclination of the orbital plane to a reference plane, the right ascension of the ascending node of the satellite, and the argument of pericenter. See also ORBITAL PARAMETERS OF ARTIFICIAL SATELLITE, MEAN ELEMENTS, OSCULATING ELEMENTS.
- orbital inclination.** See as INCLINATION, definition 2.
- orbital mode.** A method for determining the position of an unknown station position when the unknown position cannot be viewed simultaneously with known positions. The arc of the satellite orbit is extrapolated from the ephemeris of the satellite determined by the known stations which permits the determination of the position of the unknown station dependent completely on the satellite's orbital parameters.
- orbital motion.** Continuous motion in a closed path about and as a direct result of a source of gravitational attraction.
- orbital parameters of artificial earth satellite.** The precessing elliptical orbit of an artificial earth satellite is unambiguously specified by the following set of parameters: semimajor axis, eccentricity, time of perigee, inclination of the orbital plane to the plane of the reference plane (celestial equator), the right ascension of the ascending node of the satellite at time of perigee, the argument of perigee at time of perigee, right ascension of Greenwich at time of perigee, mean motion (rate of change of mean anomaly), rate of change of argument of perigee, and rate of change of right ascension of the ascending node at time of perigee. With the inclination expressed as the sine and cosine of the orbital inclination, the parameters number 11. See also ORBITAL ELEMENTS.
- orbital path.** One of the tracks on a primary body's surface traced by the subpoint of a satellite that orbits about it several times in a direction other than normal to the primary body's axis of rotation. Each track is displaced in a direction opposite and by an amount equal to the degrees of rotation between each satellite orbit and of the nodical precession of the plane of the orbit. Also called SUBTRACK. See also WESTWARD MOTION.
- orbital period.** If the orbit is unchanging and ideal, the interval between successive passages of a satellite through the same point in its orbit. If the orbit is not ideal, the point must be specified. When the perigee is specified it is called radial or anomalistic period. When the ascending node is specified, it is called nodical period. When the same geocentric right ascension is specified, it is called sidereal period. Also called PERIOD OF SATELLITE.
- orbital plane.** The plane of the ellipse defined by a central force orbit.
- orbital velocity.** The velocity of an earth satellite or other orbiting body at any given point in its orbit.
- ordinary, adj.** With respect to tides, the use of this non technical term has, for the most part, been determined to be synonymous with mean. The use of the term ordinary in tidal terms is discouraged.
- ordinate, n.** The vertical coordinate of a set of rectangular coordinates. Also used in a similar sense in connection with oblique coordinates.
- orient, v., t.** 1. To line up or adjust with respect to a reference. 2. To obtain a mental grasp of the existing situation.
- orientability of a sound signal.** The property of a sound signal by virtue of which a listener can estimate the direction of the location of the signal.
- orographic rain.** Rain resulting when moist air is forced upward by a mountain range.
- orthodrome, n.** See GREAT CIRCLE.
- orthodromic curve.** See GREAT CIRCLE.
- orthogonal, adj.** Right angled, rectangular.
- orthographic map projection.** See ORTHOGRAPHIC MAP PROJECTION.
- orthographic, adj.** Of or pertaining to right angles or perpendicular lines.
- orthographic chart.** A chart on the orthographic map projection.
- orthographic map projection.** A perspective azimuthal projection in which the projecting lines, emanating from a point at infinity, are perpendicular to a tangent plane. The projection is used chiefly in navigational astronomy for inter converting coordinates of the celestial equator and horizon systems. Also called ORTHOGONAL PROJECTION.
- orthomorphic, adj.** Preserving the correct shape. See also CONFORMAL MAP PROJECTION.
- orthomorphic chart.** A chart on which very small shapes are correctly represented. See also CONFORMAL MAP PROJECTION.

- orthomorphic map projection.** A projection in which very small shapes are correctly represented. See also CONFORMAL MAP PROJECTION.
- oscar satellite.** A general term for one of the operational satellites of the Navy Navigation Satellite System, except for satellite 30110 called TRANSAT, placed in orbit prior to 1981. The improved satellites placed in orbit beginning in 1981 are called NOVA.
- oscillation, n.** 1. Fluctuation or vibration to each side of a mean value or position. 2. Half an oscillatory cycle, consisting of fluctuation or vibration in one direction; half a vibration.
- oscillator, n.** A sound signal emitter comprising a resonant diaphragm maintained in vibrating motion by electromagnetic action.
- oscillatory wave.** A wave in which only the form advances, the individual particles of the medium moving in closed orbits, as ocean waves in deep water; in contrast with a WAVE OF TRANSLATION, in which the individual particles are shifted in the direction of wave travel, as ocean waves in shoal water.
- oscilloscope, n.** An instrument for producing a visual representation of oscillations or changes in an electric current. The face of the cathode-ray tube used for this representation is called a SCOPE or SCREEN.
- osculating elements.** A set of parameters that specifies the instantaneous position and velocity of a celestial body, or artificial satellite in a perturbed orbit. Osculating elements describe the unperturbed (two-body) orbit (osculating orbit) that the body would follow if perturbations were to cease instantaneously.
- osculating orbit.** The ellipse that a satellite would follow after a specific time "t" (the epoch of osculation) if all forces other than central force ceased to act from "t" on. An osculating orbit is tangent to the real, perturbed, orbit and has the same velocity at the point of tangency. See also OSCULATING ELEMENTS.
- outage, n.** The failure of an aid to navigation to function exactly as described in the light list.
- outer harbor.** See under INNER HARBOR.
- outfall, n.** The discharge end of a narrow street sewer, drain, etc.
- outfall buoy.** A buoy marking the position where a sewer or other drain discharges.
- outline chart.** A chart with only a generally presentation of the landmass with little or no culture or relief. See also PLOT CHART.
- output axis.** The axis of precession of a gyroscope. See also INPUT AXIS, PRECESSION.
- outside fix.** A term describing the fix position determined by the method of bisectors when the lines of position result from observations of objects or celestial bodies lying within a 180° arc of the horizon. See also METHOD OF BISECTORS.
- outward bound.** Heading for the open sea. The opposite is INWARD BOUND. See also HOMEWARD BOUND.
- overcast, adj.** Pertaining to a sky cover of 95% or more.
- overcast, n.** A cloud cover.
- overfalls, n. pl.** Breaking waves caused by the meeting of currents or by waves moving against the current. See also RIPS.
- overhead cable effect.** A radar phenomenon which may occur in the vicinity of an overhead power cable. The echo from the cable appears on the plan position indicator as a single echo, the echo being returned from that part of cable where the radar beam is at right angles to the cable. If this phenomenon is not recognized, the echo can be wrongly identified as the echo from a ship on a steady bearing. Evasive action results in the echo remaining on a constant bearing and moving to the same side of the channel as the ship altering course. This phenomenon is particularly apparent for the power cable spanning the Straits of Messina.
- overhead compass.** See INVERTED COMPASS.
- overhead constraints.** The elevation angle limitations between which usable navigation data may be obtained from a satellite in the doppler mode.
- overlay, n.** A printing or drawing on a transparent or translucent medium at the same scale as a map, chart, etc., to show details not appearing on the original.
- overprint, n.** New material printed on a map or chart to show data of importance or special value in addition to that originally printed.
- overtide, n.** A harmonic tidal or tidal current constituent with a speed that is an exact multiple of the speed of one of the fundamental constituents derived from the development of the tide-producing force. The presence of overtides is usually attributed to shallow water conditions.
- Oyashio, n.** A cold ocean current flowing from the Bering Sea southwestward along the coast of Kamchatka, past the Kuril Islands to meet the Kuroshio off the coast of Honshu. The Oyashio turns and continues eastward, eventually joining the Aleutian Current.