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SPECIAL PUBLICATION

GLOSSARY
OF
OCEANOGRAPHIC TERMS

1966



U.S. NAVAL OCEANOGRAPHIC OFFICE

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*Glossary of
Oceanographic Terms*

2d Edition
1966

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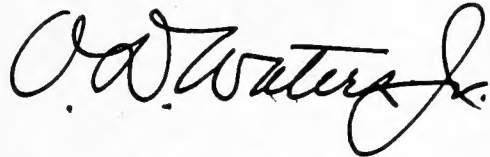


U.S. NAVAL OCEANOGRAPHIC OFFICE
Washington, D.C. 20390

Foreword

The increasing application of oceanography to naval operations, planning, and research is resulting in the dissemination to the Fleet of many types of publications by this Office. The intent of this glossary is to provide the users of our publications with current basic definitions of the technical terms used therein as an aid to the understanding, interpretation, and application of the environmental data presented. Hopefully, others in the oceanographic community will find this glossary helpful.

To improve future editions of this publication, users are urged to submit comments, suggestions, and pertinent material.

A handwritten signature in black ink, reading "O. D. Waters, Jr." in a cursive style.

*O. D. WATERS, JR.
Rear Admiral, U.S. Navy
Commander*

PREFACE

This glossary attempts to provide the U.S. Fleet; Naval shore facilities, laboratories, planning staffs, and instructional components; other governmental agencies concerned with the marine environment; foreign hydrographic/oceanographic activities; merchant marine; ocean engineering industry; and the oceanographic community in general with definitions of technical terms used in oceanography and allied marine sciences.

As the field of oceanography encompasses practically all of the scientific disciplines, the compilers of this glossary recognized from the outset that, within the prescribed framework of time, manpower, and funds, this publication could not possibly include the entire complex lexicon which has evolved from the marine sciences over the past few decades. For the most part, the terms and definitions cited here represent current and, in some places, past usage in the marine aspects of physics, chemistry, biology, geology, geophysics, geography, mathematics, and meteorology, particularly in the manner that these terms are used in the U.S. Naval Oceanographic Office research, operations, and publications.

The selection of terms for inclusion, together with their definitions, was left to the discretion of the several subject specialists employed at this Office who contributed the bulk of this volume. Generally, terms and their definitions were selected from existing sources or publications dealing with specific aspects of oceanography, as well as the few available related glossaries. Some terms in borderline subject areas were included arbitrarily, and the tendency here was probably toward overinclusion. In ad-

dition to compilation, review, consolidation, and design of format by the editing committee, another substantive review of the entire manuscript was performed by the various components of this Office, among whom draft copies were circulated.

In order that this glossary may serve the user with minimum effort of his part, the terms are arranged alphabetically and followed immediately by a definition or a reference to the preferred synonym. In some entries the user is referred to a related term whose definition contains an explanation of the term in question. Synonyms, symbols, and scientific names are italicized. An asterisk indicates a copyrighted name. Nearly all terms are singular nouns; verbs and adjectives have been kept to a minimum. Also, mathematical equations have been kept to a minimum and, where possible, stated in sentence form. Where a term has more than one definition, each definition is numbered, the first definition representing the term's applicability to oceanography or its use in this Office; otherwise, the sequence is arbitrary. As a further aid to the user, some words (in boldface type) within a definition indicate an internal cross reference whereby the user can go to a term defined elsewhere in this glossary. Every effort was made to keep the definitions as uncomplicated as possible, since this glossary is not intended to be "encyclopedic." Illustrations have been used sparingly and confined to the simplest forms of representation.

Although the references used in preparing this glossary represent only a small portion of the extensive literature devoted to the marine sciences, the List of Sources can serve the user by: 1)

giving the authoritative source of a definition and 2) giving sources from which a review of a specific subject can be made. Where the definition given reflects substantially that given in the source, a number in parentheses corresponding to that item in the List of Sources follows the definition. If a term has multiple definitions, the location of the source number underneath the entry on the left indicates that this source supports all definitions; otherwise, each definition has its own reference number, if applicable. Definitions containing no source number represent the opinion of the contributing specialist

or a major modification of an existing definition.

As a further guide to the user, appendixes are included which contain information of possible interest, although not necessarily within the basic scope of a glossary. Appendix A contains abbreviations and acronyms related to oceanography-oriented Navy projects, operations, and equipment and scientific usage in general. Appendix B contains abbreviations, titles, and locations of institutions, agencies, activities, and groups currently engaged either directly in oceanography or in work in closely allied marine sciences.

A

abioseston—*See* **tripton**.

ablation—1. The combined processes (such as sublimation, melting, evaporation) which remove snow or ice from the surface of a glacier, snowfield, etc.; in this sense, the opposite of **alimentation**. Particularly in glaciology, the term may be applied to reduction of the entire snow-ice mass, and may also include losses by wind action and by **calving**.

Air temperature is the dominant factor in controlling ablation; precipitation amounts exercise only secondary control. During the ablation season, an ablation rate of about two millimeters per hour is typical of most glaciers.

2. The amount of snow or ice removed by the above processes; in this sense, the opposite of **accumulation**.

(5)

abnormal—Opposed to normal in whatever sense the latter term is used. When normal signifies typical, abnormal means unusual, lying outside the range of common occurrence. When normal signifies an **arithmetic mean** or **median** value, abnormal implies a deviation, however slight, from the mean or median. (5)

abrasion—The wearing away or rounding of surfaces by friction; for example, the action of glaciers, wind, and waterborne sand on rocks or rock fragments.

abrasion platform—A surface of marine denudation formed by wave erosion which is still in its original position at or near the **wave base**, with the marine forces still operating on it.

absolute index of refraction—*See* **index of refraction** (sense 1).

absolute refractive index—*See* **index of refraction** (sense 1).

absolute temperature scale—(abbreviated A). *See* **Kelvin temperature scale**.

absorptance—The ratio of the **radiant flux** lost from a beam by means of **absorption** to the incident flux. (8)

absorption—1. The process in which incident radiant energy is retained by a substance. A further process always results from absorption, that is, the irreversible conversion of the absorbed radiation into some other form of energy within and according to the nature of the absorbing medium. The absorbing medium itself may emit radiation, but only after an energy conversion has occurred.

A substance which absorbs energy may also be a medium of **reflection**, **refraction**, **diffraction**, or **scattering**; these processes, however, involve no energy retention or transformation and are to be clearly differentiated from absorption. *See* **attenuation**.

2. In general, the taking up or assimilation of one substance by another, where the two substances chemically or physically combine.

(5)

absorption coefficient—1. A measure of the amount of normally incident radiant energy absorbed through a unit distance or by a mass of absorbing medium. (5)

2. For dissolved gases: Maximum volume of gas that can be dissolved in a unit volume of water. The absorption coefficient of gases generally decreases with increasing temperature and salinity.

absorption factor—*See* **absorptivity**.

absorption loss—That part of the **transmission loss** which is due to dissipation or the conversion of sound energy into some other form of energy, usually heat. This conversion may take place within the medium itself or upon a reflection at one of its boundaries. (3)

absorptivity—(also called *absorption factor*). A measure of the amount of radiant energy absorbed by a given substance of definite dimensions; defined as the ratio of the amount of radiant energy absorbed to the total amount incident upon that substance. (5)

abyss—A particularly deep part of the ocean, or any part below 300 fathoms. (68)

abyssal—(or *abyssobenthic*). Pertaining to the great depths of the ocean, generally below 2,000 fathoms (3,700 meters). (*See* figure for **classification of marine environments**.)

abyssal benthic—According to some authorities corresponding to the approximate lower half of the **bathyal** and all of the **abyssal** and **hadal**. *See* **classification of marine environments**.

Pertaining to a deep sea zone extending below 400 to 600 fathoms (800 to 1,100 meters) and comprising all of the deep sea **benthic** system below the **archibenthic** zone.

abyssal gap—This term is not recommended by ACUF. *See* **gap**.

abyssal hill—This term is not recommended by ACUF. *See* **knoll**.

abyssal plain—This term is not recommended by ACUF. *See* **plain**.

abyssobenthic—See **abyssal**.

abyssopelagic—Pertaining to that portion of the ocean which lies below depths of 2,000 fathoms (3,700 meters). (See figure for **classification of marine environments**.)

acceleration—The rate of change with time of speed and/or velocity; strictly, the rate of change with time of the velocity of a particle. (5)

In the **egs system** of physical measurements, it is expressed in terms of centimeters per second per second. See **gal**. (37)

acceleration of gravity—The acceleration of a freely falling body due to the gravitational attraction of the earth. Its true value varies with latitude, altitude, and the nature of the underlying rocks.

accelerometer—A device which measures the forces of **acceleration** acting on a body within the instrument. Among many uses it can be used to measure wave effect on a ship at sea.

accepted depth—(sometimes called *observed depth*). The best possible determination of the true depth of each **Nansen bottle** at the time of reversal. (67)

accretion—1. Natural accretion is the gradual build-up of land over a long period of time solely by the action of the forces of nature, on a **beach** by deposition of water or airborne material. Artificial accretion is a similar build-up of land by reason of an act of man, such as the accretion formed by a groin, breakwater, or beach fill deposited by mechanical means. (61) See **aggradation**.

2. The process by which inorganic masses grow larger, by the addition of fresh particles to the outside. (2)

accretionary limestone—A limestone which has formed *in situ* by slow accumulation of organic remains such as **coral** or shells. (2) See **biostrome**, **bioherm**, **organic reef**.

accumulation—In glaciology, the quantity of snow or other solid form of water added to a glacier or snowfield by **alimentation**; the opposite of **ablation**. (5)

accuracy—The degree of conformity with a standard. Accuracy relates to the quality of a result, and is distinguished from precision which relates to the quality of the operation by which the result is obtained. (37)

acicular ice—(also called *fibrous ice*, *satın ice*). Fresh water ice consisting of numerous long crystals and hollow tubes having variable form, layered arrangement, and a content of air bubbles. This ice often forms at the bottom of an ice layer near its contact with water. (59)

acid rock—**Igneous rock** containing a high proportion of silica, contrasted with **basic rock** in a two-division classification of rocks. (2)

acclinic line—(or *dip equator*, *magnetic equator*). The line through those points on the earth's surface at which the magnetic **inclination** is zero.

The acclinic line is a particular case of an **isoclinic line**.

In South America the acclinic line lies at about 15°S; while from central Africa to about Vietnam it coincides approximately with the parallel of 10°N. (5)

acorn barnacle—(or *rock barnacle*). A **barnacle** (Blaniidae) whose shell is attached or cemented directly to a firm surface.

acoustic, acoustical—These two qualifying adjectives can be confused and, in fact, are often misused. The qualifying adjective **acoustic** is used when the term which it modifies designates something which has the properties, dimensions, or physical characteristics, associated with sound waves. The adjective **acoustical**, on the other hand, is used when the term being qualified does not innately contain some property, dimension, or physical characteristic which is intimately associated with sound. Thus, we speak of an acoustic impedance, but we speak of the Acoustical Society of America. (3)

acoustic bearing—See **sonic bearing**.

acoustic dispersion—1. The **scattering** or **spreading of sound** with frequency.

2. The separation of a complex **sound wave** into its various frequency components, usually caused by a variation with frequency of the wave velocity of the medium. The rate of change of the velocity with frequency is used as a measure of the dispersion. (6)

acoustic impedance—For a given surface area of an acoustic medium perpendicular, at every point, to the direction of propagation of sinusoidal acoustic waves of given frequency, and having equal acoustic pressures and equal volume velocities per unit area at every point of the surface at any instant, the acoustic impedance is the quotient obtained by dividing (1) the **phasor** corresponding to the acoustic pressure by (2) the phasor corresponding to the volume velocity. (28)

acoustic intensity—The limit approached by the quotient obtained by dividing the power of the acoustic energy being transmitted at a given time through a given area by the magnitude of this area as the magnitude of this area approaches zero.

$$I = \frac{P^2}{\rho c}$$

where intensity, *I*, in root mean square pressure, *P*, of a plane wave, *ρ* is the density, and *c* the sound velocity. Units are energy per square centimeter per second. (28)

acoustic pressure—The difference at a point between the instantaneous **sound pressure** and the **hydrostatic pressure**.

acoustics—The science of sound, including its production, transmission, and effects.

- acoustic scattering**—The irregular **reflection**, **refraction**, or **diffraction** of a sound in many directions. (3)
- acoustic screen**—A blanket of air bubbles that effectively entraps backscattered sound energy.
- acoustic signature**—The graphic noise output characteristic of and identified with a specific noise source, for example, the noise output of a particular class of submarine.
- acoustic sounding**—*See* **echo sounding**.
- acoustic wave**—*See* **sound wave**.
- acre-foot**—The volume of water required to cover one acre to a depth of one foot, hence 43,560 cubic feet; a convenient unit for measuring irrigation water, runoff volume, and reservoir capacity. (5)
- actinometry**—The science of measurement of **radiant energy**, particularly that of the sun, in its thermal, chemical (actinic), and luminous aspects. (5)
- actinotrocha**—The planktonic larva of the bottom dwelling worm *Phoronis*.
- activated water**—A transient chemically reactive state created in water by absorbed ionizing radiations. The passage of **ionizing radiation** through water produces, temporarily, ions, atoms, radicals, or molecules in a chemically reactive state. The combined effect of all such entities is said to be due to activated water. Their identity has not been established with certainty, although evidence exists of the presence of free hydroxyl radicals and hydrogen atoms. (41, 70)
- activation**—The process of inducing **radioactivity** through neutron bombardment or by other types of irradiation. (41)
- activation analysis**—A method of elemental analysis, especially for small traces of material, based on the detection of characteristic **radio-nuclides** following a nuclear bombardment. (41)
- active glacier**—A **glacier** which has an **accumulation** area, in contrast to a **stagnant glacier**. An active glacier need not have an advancing front. (59)
- active material**—Fissionable material, such as plutonium, uranium enriched in the isotope 233 or 235, and any other material capable of releasing substantial quantities of atomic energy. In the military field of atomic energy, the term refers to the nuclear components of nuclear weapons exclusive of the natural uranium parts; or, in the field of nuclear power, it refers to the nuclear fuel in atomic reactors. (63)
- active sonar**—The method or equipment by which information concerning a distant object is obtained through evaluation of the sound signal reflected from the object to the generating equipment. *See* **passive sonar**.
- activity**—1. The number of atoms decaying per unit of time. The unit of activity is the **curie**, 3.7×10^{10} disintegrations per second. (41)
2. A measure of the intensity of emission from a radioactive substance in terms of observable effects, often expressed in counts per unit of time. (41)
3. A term frequently used to designate a particular radioactive **nuclide**. (41)
4. A term frequently used to designate a particular radiation component, for example, the gamma activity of a source. (41)
5. A term commonly used for **radioactivity**. (41)
6. In practice, activity is often expressed in terms of observable effects, such as counts per minute or **roentgens** per hour at one meter. (41)
7. Chemical activity of dissolution of salts.
- adfreezing**—The process by which one object becomes adhered to another by the binding action of ice. (5)
- adiabatic phenomena**—Those phenomena which occur without a gain or loss of heat.
- adiabatic process**—A thermodynamic change of state of a system in which there is no transfer of heat or mass across the boundaries of the system. In an adiabatic process, compression always results in warming, expansion in cooling. (5)
- adiabatic temperature changes**—The compression of a fluid without gain or loss of heat to the surroundings is work performed on the system and produces a rise or fall of temperature. Such a rise or fall of temperature occurs with changing depth.
- adjacent seas**—*See* **marginal seas**.
- adrift**—Floating without moorings or anchor: drifting at the mercy of the sea and weather. *See* **stopped**.
- adsorption**—The adhesion of a thin film of liquid or gas to a solid substance. The solid does not chemically combine with the adsorbed substance. (5)
- advance (of a shoreline)**—1. A continuing seaward movement of the **shoreline**.
2. A net seaward movement of the shoreline over a specified time. (61)
- advection**—1. In oceanography, advection refers to the horizontal or vertical flow of sea water as a current.
2. The process of transport of an atmospheric property solely by the mass motion (velocity field) of the atmosphere. In meteorology, advection describes the predominantly horizontal, large-scale motions of the atmosphere.
- advection fog**—1. A type of **fog** caused by the **advection** of moist air over a cold surface, and the consequent cooling of that air to below its dew point.
A very common advection fog is that caused by moist air in transport over a cold body of water (**sea fog**).
2. Sometimes applied to **steam fog**. (5)
- aeolian sands**—*See* **eolian sands**.

aerobe—(also called *aerobiont*). An organism which can live and grow only in the presence of oxygen. An organism which employs aerobic respiration.

aerobiont—*See* **aerobe**.

A-frame—A steel frame used for outboard suspension of oceanographic gear in shipboard survey work, so named because of its A-shape.

afternoon effect—The solar heating of the surface water, which causes a shallow negative temperature gradient. The net result is downward refraction of sound rays and reduction in near-surface ranges.

aftershock—An earthquake which follows a larger earthquake and originates at or near the focus of the larger earthquake. (2)

age—1. *See* **age of phase inequality**.

2. The stage of development of **sea ice**. The term usually refers to the length of time since its formation and to its thickness.

age dating—The calculation of the absolute age of a material by such means as the fossil record or by radioactive determination of the number of atoms of a stable radiogenic end product relative to the number of atoms of its radioactive parent.

age of diurnal inequality—(or *age of diurnal tide*). The time interval between the maximum semimonthly north or south declination of the moon and the maximum effect of the declination upon the range of tide or speed of the tidal current. (50)

age of diurnal tide—*See* **age of diurnal inequality**.

age of moon—The time elapsed since the preceding new moon. (50)

age of parallax inequality—The time interval between the **perigee** of the moon and the maximum effect of the parallax (distance of the moon) upon the range of tide or speed of tidal current. (50)

age of phase inequality—(or *age, age of tide*). The time interval between the new or full moon and the maximum effect of these phases upon the range of tide or speed of tidal current. (50)

age of tide—*See* **age of phase inequality**.

age of water—The time elapsed since a water mass was last at the surface and in contact with the atmosphere. The water's age gives an indication of the rate of overturn of ocean water, an important factor in the use of the oceans for dumping radioactive wastes and determining the rate of replenishment of nutrients.

The most commonly used method for determining the age of water involves the decay rate of carbon¹⁴ whose **half-life** is 5,600 years. This method gives the following approximate ages to an accuracy of ± 100 years: North Atlantic Central Water, 600 years; North Atlantic Bottom Water, 900 years; North Atlantic Deep Water, 700 years; Antarctic Intermediate

and Bottom Water (South Atlantic), less than 350 years.

Another method for determining the age of water makes use of the depletion rate of dissolved oxygen. This method assumes that the water was saturated with oxygen while at the surface and that its oxygen was consumed at a fixed rate by chemical combination with detritus.

(45)

agger—*See* **double tide**.

agglomerate—*see* **breccia**.

aggradation—The process of building up a surface by continuous or intermittent deposition.

aggregate sample—*See* **compound sample**.

agonic line—The line through all points on the earth's surface at which the magnetic **declination** is zero; that is, the locus of all points at which magnetic north and true north coincide. This line is a particular case of an **isogonic line**. The position of this line exhibits variations in time. (5)

agua enferma—*See* **aguaje**.

aguaje—(also called *salgaso, agua enferma*). An annual condition noted in the coastal water of Peru which results in **discolored water** (usually red or yellow) and various degrees of destruction of marine life. Aguaje usually occurs from April through June and is a local term used along certain portions of the Peruvian coast. The immediate cause of this condition is the increase in water temperature when warmer oceanic currents are carried inshore. Marine organisms unaccustomed to warm water die and decompose. Coincidentally large concentrations of **dinoflagellates** form discolored water patches. Dinoflagellates, in turn may destroy marine organisms, possibly due to toxins they contain. This is not the same as the massively catastrophic condition associated with **El Niño** which occurs approximately every seven years.

Agulhas Current—(sometimes called *Agulhas Stream*). A fast current flowing southward along the southeast coast of Africa.

Throughout the year, part of the **South Equatorial Current** turns south along the east coast of Africa and feeds the strong Agulhas Current. To the south of 30°S the Agulhas Current is a narrow, well-defined current that extends less than 100 kilometers from the coast; south of 35°S a major portion of the current turns counterclockwise and joins the prevailing eastward flow across the southern part of the Indian Ocean. However, a small portion of the Agulhas Current rounds the Cape of Good Hope into the Atlantic Ocean.

Agulhas Stream—*See* **Agulhas Current**.

aid to navigation—1. A device external to a boat or ship designed to assist in determination of position, a safe course, or to warn of dangers. Examples are: lighthouses, lights, buoys, day-beacons, radio beacons, and electronic devices. (51)

2. The expression "aid to navigation" should not be confused with "navigational aid," a broad expression covering any instrument, device, chart, method, etc. intended to assist in the navigation of a craft. (68)

air bladder—(also called *swim bladder*, *gas bladder*). A membranous sac of atmospheric gases lying in the body cavity between the vertebral column and the alimentary tract of certain fishes. It serves a hydrostatic function in most fishes that possess it; in some it participates in sound production.

airborne expendable bathythermograph—A buoyant canister which is ejected into the water from an aircraft to provide measurements of water temperature with depth. The temperature information is transmitted to the aircraft. The instrument is designed to measure the temperature from the surface to 1,000 feet with an accuracy of ± 5 percent in depth and a temperature accuracy of $\pm 0.5^\circ\text{F}$ within the range of 28° to 90°F .

airborne oceanography—The use of airborne platforms such as aircraft and helicopters to study physical parameters of the ocean.

airborne radiation thermometer—An infrared-sensing device which measures the sea surface temperature from an aircraft.

airborne sea and swell recorder—A frequency modulated continuous wave radar system used to measure wave height from an aircraft.

air embolism—(also called *traumatic air embolism*). The blocking of an artery by an air bubble. A serious potential injury among divers or personnel escaping from submarines. It is caused by an expansion of air inside the lungs, which increases when the breath is held during ascent. Lung tissues rupture, air is forced into the capillaries of the lung, and the resulting air bubbles are carried to the heart and into the arterial system.

airglow—(also called *night-sky light*, *permanent aurora*). The quasi-steady radiant emission from the upper atmosphere over middle and low latitudes; as distinguished from the sporadic emission of **auroras** which occur over high latitudes. Airglow is not to be confused with **air-light**. (5)

airlight—In determinations of visual range, light from sun and sky which is scattered into the eyes of an observer by atmospheric suspensoids (and, to slight extent, by air molecules) lying in the observer's cone of vision. That is, airlight reaches the eye in the same manner that diffuse sky radiation reaches the earth's surface. Airlight is not to be confused with **airglow**. (5)

air mass—A widespread body of air, the properties of which can be identified as (a) having been established while that air was situated over a particular region of the earth's surface (**air-mass source region**), and (b) undergoing specific modifications while in transit away from

the source region. An air mass is often defined as a widespread body of air that is approximately homogeneous in its horizontal extent, particularly with reference to temperature and moisture distribution; in addition, the vertical temperature and moisture variations are approximately the same over its horizontal extent.

The stagnation or long-continued motion of air over a source region permits the vertical temperature and moisture distribution of the air to reach relative equilibrium with the underlying surface. (5)

air-mass source region—An extensive area of the earth's surface over which bodies of air frequently remain for a sufficient time to acquire characteristic temperature and moisture properties imparted by that surface. Air so modified becomes identifiable as a distinct **air mass**. (5)

aktological—Refers to nearshore shallow water areas, environment, sediments, or life. (2)

Alaska Current—A current that flows northward and westward along the coasts of Canada and Alaska to the Aleutian Islands.

It contains water from the **North Pacific Current**, and has the character of a warm current; it therefore exercises an influence on climatic conditions of the region similar, but on a smaller scale, to that which the **North Atlantic** and **Norway Currents** exercise on the climates of northwestern Europe.

albedo—The ratio of the amount of **electromagnetic radiation** reflected by a body to the amount incident upon it, commonly expressed as a percentage. The albedo is to be distinguished from the **reflectivity**, which refers to one specific wavelength (monochromatic radiation). (5)

In the oceans the albedo of the water's surface (direct solar radiation) ranges from about 6 to 11 percent between 40°N and 40°S ; the reflectivity for diffuse sky radiation is somewhat larger.

Alberta low—A low pressure area centered on the eastern slope of the Canadian Rockies in the province of Alberta, Canada.

Formerly, it was thought that such lows actually originated (more or less independently) over this location. It is now recognized that depressions moving inland from the Pacific are the actual parent systems. Alberta lows appear as these systems enhance, or are enhanced by, the dynamic trough that is atypical, almost semi-permanent, feature of this region. (5)

Aleutian Current—A current setting southwestward along the south coasts of the Aleutian Islands.

Aleutian low—The low pressure center located near the Aleutian Islands on mean charts of sea level pressure. It represents one of the main **centers of action** in the atmospheric circulation of the Northern Hemisphere.

- The Aleutian low is most intense in the winter months; in summer it is displaced toward the North Pole and is almost nonexistent. On a daily basis, the area of the Aleutian low is marked by alternating high and low pressure centers, moving generally to the eastward; it is not the scene of an intense stationary low. (5)
- Alexander's Acres**—An unusual, but easily recognizable type of deep scattering layer record (possibly caused by tent fish) in which the train of echoes forms a series of crescentic or mound-shaped traces. This type of layer record usually occurs at a depth of about 180 fathoms and has been recorded most consistently in the slope water off the northeastern United States by means of an echo sounder using 12-kc sound.
- alga(e)**—A thallophyte possessing chlorophyll; includes almost all seaweeds. *See red alga, blue-green alga, brown alga, green alga.*
- algal ball**—*See algal biscuits.*
- algal biscuits**—(also called *algal ball, marl ball*). Spherical and disk-shaped bodies up to 20 centimeters in diameter, composed of **algal limestone** and often dolomitic. (2)
- algal limestone**—A limestone composed largely of the remains of calcium-secreting **algae**. (2)
- algal reef**—A reef composed largely of algal remains.
- algal ridge**—The elevated margin of a windward reef built by actively growing **calcareous algae**. (2)
- algal rim**—A low rim built by actively growing **calcareous algae** on the lagoonal side of a leeward reef, or on the windward side of a reef patch in a lagoon. (2)
- alignment**—(also spelled *alinement*). In a near-shore wave study, a line drawn on a chart parallel to the general direction of a section of coast. The waves calculated to strike the mid-point of the alignment are assumed to be characteristic of those reaching the shallow water of the entire section.
- alignment chart**—*See nomogram.*
- alimentation**—Generally, the process of providing nourishment or sustenance; thus in glaciology, the combined processes which serve to increase the mass of a glacier or snowfield; the opposite of **ablation**. The deposition of snow is the major form of glacial alimentation, but other forms of precipitation along with **sublimation**, refreezing of melt water, etc. also contribute.
- The additional mass produced by alimentation is termed **accumulation**. (5)
- alinement**—*See alignment.*
- alkalinity**—In sea water, the excess of hydroxyl ions over hydrogen ions, generally expressed as milliequivalents per liter. (5)
- allochem**—Marine sediment formed by chemical or biochemical precipitation; includes intracasts, oolites, fossils, and pellets. (2)
- allogenic**—The term applied to rock or sediment constituents which originated at a different place and at a previous time to the rock of which they now constitute a part. Examples are **pebbles in a conglomerate**.
- alluvium**—The detrital deposits eroded, transported, and deposited by streams; an important constituent of shelf deposits.
- alpha particle**—1. A positively charged particle emitted from a nucleus and composed of two protons and two neutrons. It is identical in all measured properties with the nucleus of a helium atom.
2. By extension, the nucleus of a helium atom, especially when it is in rapid motion, as when artificially accelerated.
- (41)
- alpha ray**—A synonym for **alpha particle**. (70)
- alternating current**—*See reversing current, tidal current.*
- altitude**—1. The vertical distance between a point and a datum surface, such as **mean sea level**.
2. The vertical angle between the plane of the horizon and the line to the observed point, as a star.
3. *See elevation.*
- (2)
- ambient**—The environment surrounding a body but undisturbed or unaffected by it.
- ambient noise**—The noise produced in the sea by marine animals, ship and industrial activity, terrestrial movements, precipitation, and other underwater or surface activity outside the measuring platform and detection equipment itself.
- ambient temperature**—The temperature of the medium surrounding an object.
- American Mediterranean**—A name for the Caribbean Sea and the Gulf of Mexico region.
- ammonia nitrogen**—An intermediate product of the **nitrogen cycle** of the sea which is present where organic matter decomposes in quantity.
- amphidromic point**—A no-tide or nodal point on a chart of **cotidal lines** from which the cotidal lines radiate. (*See figure for cotidal chart.*)
- amphidromic region**—An area surrounding an **amphidromic point** in which the cotidal lines radiate from the no-tide point and progress through all hours of the **tide cycle**. (*See figure for cotidal chart.*)
- amphidromic system**—*See amphidromic region.*
- amphipod**—One of an order (Amphipoda) of elongate and usually laterally compressed **crustaceans**. The species live in a variety of habitats from the parasitic state to the deep pelagic. Some species are semipermanent members of fouling communities.
- amphitrite**—A large inflatable ship. Sixty-five feet long, weighing 6 tons, it draws only 14 inches when fully loaded. It has been used as a tender in sea-diving operations.

amplitude—1. The magnitude of the displacement of a wave from a mean value. For a **simple harmonic wave**, it is the maximum displacement from the mean. For more complex wave motion, amplitude is usually taken as one-half the mean distance (or difference) between maximums and minimums.

An ocean surface wave has an amplitude equal to the vertical distance from **still water level** to **wave crest**, that is, one-half the **wave height**. (5)

2. In engineering usage, loosely, the wave height from crest to trough. (61)

3. The semirange of a constituent tide. (50)

anadromous—A form of life cycle among fishes in which maturity is attained in the ocean, and the adults ascend streams and rivers to spawn in fresh water. Salmon and shad are two examples.

anaerobe—(also called *anaerobiont*). Organisms for whose life processes a complete or (in some forms) nearly complete absence of oxygen is essential. Facultative anaerobes can utilize free oxygen; obligate anaerobes are poisoned by it.

anaerobic—Conditions in which oxygen is excluded, and as a result normal life that depends on the presence of oxygen is not possible. Some bacteria can, however, live in these conditions. (32)

anaerobic sediment—A highly organic sediment rich in H_2S formed in the absence of free oxygen. Characteristic of some **fiords** and marine basins where little or no circulation or mixing of the **bottom water** occurs.

anaerobiont—*See anaerobe*.

anchorage—1. An area where a ship anchors or may anchor, either because of suitability or designation.

2. Explosives anchorage—an area set part for anchored ships discharging or receiving explosives.

3. Exposed anchorage—an anchorage that is unprotected from such dangers as weather, sea, or ice.

4. Prohibited anchorage—a section of a harbor kept free of anchored ships.

5. Temporary anchorage—a place where ships can anchor only under favorable conditions and where ships must have power ready to get under way.

anchorage stone—*See anchor stone*.

anchor ice—(also called *bottom ice*, *depth ice*, *ground ice*, *lapped ice*, *underwater ice*). Ice found attached or anchored to the bottom irrespective of its nature of formation. (74)

anchor stone—(or *anchorage stone*). A **pebble** or **boulder** to which marine plants have attached themselves. (2)

andesite line—The postulated geographic and petrographic boundary between the andesite-dacite-rhyolite rock association of the margin of the Pacific Ocean and the olivine basalt-

trachyte rock association of the Pacific Ocean basin and its included islands. (2)

anemometer—The general name for instruments designed to measure the speed (or force) of the wind. (5)

anemone—*See sea anemone*.

aneroid—1. Literally, “not wet,” containing no liquid; applied to a kind of barometer which contains no liquid, an aneroid barometer.

2. *See aneroid barometer*.

(5)

aneroid barometer—(rarely called *holosteric barometer*). An instrument for measuring atmospheric pressure. It is constructed on the following principles: an aneroid capsule (a thin corrugated hollow disk) is partially evacuated of gas, and is restrained from collapsing by an external or internal spring. The deflection of the spring will be nearly proportional to the difference between the internal and external pressures. Magnification of the spring deflection is obtained both by connecting capsules in series and by mechanical linkages.

The aneroid barometer is temperature compensated at a given pressure level by adjustment of the residual gas in the aneroid or by a bimetallic link arrangement. The instrument is subject to uncertainties due to variations in the elastic properties of the spring and capsules, and due to wear in the mechanical linkages. (5)

angel—A radar echo caused by a physical phenomenon not discernible to the eye.

Studies indicate that a fair portion of angels are caused by strong temperature and/or moisture gradients such as might be found near the boundaries of bubbles of especially warm or moist air. They frequently occur in shallow layers at or near temperature inversions within the lowest few thousand feet of the atmosphere. (5)

angle of bank—*See angle of roll*.

angle of deviation—The angle through which a ray is bent by **refraction**. (68)

angle of incidence—The angle at which a ray of energy, or an object, impinges upon a surface, measured between the direction of propagation of the energy (or object) and a perpendicular to the surface at the point of impingement, or incidence. *See angle of reflection*, **angle of refraction**. (5)

angle of reflection—The angle at which a reflected ray of energy leaves a reflecting surface, measured between the direction of the outgoing ray and a perpendicular to the surface at the point of reflection. (5)

angle of refraction—The angle at which a refracted ray of energy leaves the interface at which the **refraction** occurred, measured between the direction of the refracted ray and a perpendicular to the interface at the point of refraction. (5)

angle of roll—(also called *angle of bank*, *roll angle*). The angle between the lateral axis of a craft and the horizontal. It is considered positive if the port side is higher than the starboard side, but may be designated starboard or port depending upon which side is lower. (68)

angle of yaw—(also called *yaw angle*). 1. The horizontal angular displacement of the longitudinal axis of a ship from its neutral position, during a yaw. It is designated right or left according to the direction of displacement of the bow.

2. The angle between a line in the direction of the relative wind and a plane through the longitudinal and vertical axes of an aircraft. It is considered positive if the nose is displaced to the right.

(68)

angstrom—(abbreviated Å, formerly Å). A unit of length used in the measurement of the wavelength of light, X-rays, and other **electromagnetic radiation** and in the measurement of molecular and atomic diameters. One angstrom equals 10^{-8} centimeter or 10^{-4} micron. (5)

Ångström compensation pyrheliometer—An absolute instrument developed by K. Ångström for the measurement of direct solar radiation. The radiation receiver station consists of two identical manganic strips whose temperatures are measured by attached thermocouples. One of the strips is shaded, while the other is exposed to sunlight. An electrical heating current is passed through the shaded strip so as to raise its temperature to that of the exposed strip. The electric power required to accomplish this is a measure of the solar radiation. (5)

Ångström pyrgeometer—An instrument developed by K. Ångström for measuring the effective terrestrial radiation. It consists of four manganic strips, of which two are blackened and two are polished. The blackened strips are allowed to radiate to the atmosphere while the polished strips are shielded. The electrical power required to equalize the temperature of the four strips is taken as a measure of the outgoing radiation. (5)

angular momentum—The moment of the linear momentum of a particle about a point. If m is the mass of the particle, V the velocity, and r the position vector from the given point O to the particle, the angular momentum M about O is given by,

$$M = r \cdot mV$$

The angular momentum of a particle about an axis is defined as that component, along the axis, of the angular momentum of the particle about any point on the axis.

The angular momentum of a continuous medium is given by the integral of the product $r \cdot V$ over the mass of the medium.

In meteorology, it is conventional to deal with the angular momentum per unit volume, which is given by the product $r \cdot \rho V$, where ρ is the density. (5)

angular spreading—The lateral extension of ocean waves as they move out of the **generating area** as **swell**. (5)

angular-spreading factor—In ocean wave forecasting, the ratio of the actual wave energy present at a point to that which would have been present in the absence of **angular spreading**. (5)

angular velocity—A representation of the rate of rotation of a particle about the axis of rotation, with magnitude equal to the time rate of angular displacement of any point of the body.

The angular velocity of the earth (in the absolute coordinate system) is directed along the earth's axis toward the pole star and is equal in magnitude to 7.2921×10^{-5} radian per second.

(5)

anion—A negatively charged ion.

anisotropic—Not **isotropic**; that is, exhibiting different properties when tested along axes in different directions.

annelid—(or *segmented worm*). One of a phylum (Annelida or Annulata) of segmented worms, with the majority of marine forms possessing a distinct head. Members of the group are either free swimming, burrowing, or tube building or may combine two of these modes of living. Several tube-building species are notable **fouling organisms**.

anniversary winds—A general term for **local winds** or larger-scale wind systems (such as the monsoon, etesians, etc.) that recur annually.

(5)

annual inequality—The seasonal or yearly variation in the water level or in the tidal current speed; more or less periodic, due chiefly to meteorological causes. (50)

anomalous tide cycle—The average period of about $27\frac{1}{2}$ days, measured from **perigee** to perigee, during which the moon completes one revolution around the earth.

anomalous—Not encompassed by rules governing the majority of cases; distinguished from **abnormal** by implying a difference of kind rather than a difference merely of degree. (5)

anomalous field—See **residual magnetic field**.

anomalous propagation—The propagation of energy (such as sound) when it arrives at a destination via a path significantly different from the normally expected path. (5)

anomaly—1. In oceanography, the difference between conditions actually observed at a **serial station** and those that would have existed had the water all been of a given arbitrary temperature and salinity. (5)

2. A deviation from a norm. (37)

3. In geophysics, the difference between the theoretical or computed and actual value. (2)

- anomaly of dynamic height**—*See* **dynamic height anomaly**.
- anomaly of geopotential difference**—*See* **dynamic height anomaly**.
- anomaly of specific volume**—*See* **specific volume anomaly**.
- anoxemia**—*See* **anoxia**.
- anoxia**—(also called *anoxemia*). The absence of oxygen; an abnormal condition produced by breathing air which is deficient in oxygen. (5)
- anstau**—The process resulting in the piling up of water, such as occurs in **convergence**. (14)
- antagonism**—A relationship between species in which at least one species is harmed. *See* **antibiosis, parasitism**.
- antarctic air**—A type of air whose characteristics are developed in an antarctic region. Antarctic air appears to be colder at the surface in all seasons, and at all levels in autumn and winter, than **arctic air**. (5)
- antarctic anticyclone**—(or *antarctic high*). The glacial anticyclone which has been said to overlie the continent of Antarctica; analogous to the Greenland anticyclone. (5)
- Antarctic Bottom Water**—*See* **water mass**.
- Antarctic Circumpolar Current**—*See* **West Wind Drift**.
- Antarctic Convergence**—(or *Antarctic Convergence line, Antarctic Convergence zone*). The Southern Hemisphere **polar convergence**. It is the best defined convergence line in the oceans, being recognized by a relatively rapid northward increase in the surface temperature. It can be traced around the world in the broad belt of open water between Antarctica to the south and Africa, Australia, and South America to the north. *See* **convergence**.
- Antarctic Convergence line**—*See* **Antarctic Convergence**.
- Antarctic Convergence zone**—*See* **Antarctic Convergence**.
- antarctic high**—*See* **antarctic anticyclone**.
- Antarctic Intermediate Water**—*See* **water mass**.
- Antarctic Ocean**—The name commonly applied to those portions of the Atlantic, Pacific, and Indian Oceans which reach the Antartic Continent on the south and are bounded on the north by the **Subtropical Convergence**. This feature is not a recognized ocean body.
- antecedent platform theory**—A theory of coral atoll and **barrier reef** formation which postulates a submarine platform 50 meters or more below sea level from which barrier reefs and **atolls** grow upward to the water surface without changes in sea level. (2)
- anthozoan**—One of a class (Anthozoa) of **coelenterates** in which the medusoid stage is absent and the **polyp** (hydroid) stage is better developed than in the other coelenterates. The **sea anemones, sea pens, and corals** are some members of this group.
- antibiosis**—The relationship between species in which certain substances produced or excreted by organisms are generally harmful to others. The mass kills of fishes and other organisms due to outbreaks of **red tide** are examples of antibiosis.
- anticline**—A fold or arch of rock in which the strata dip in opposite directions away from the plane of the axis. *See* **syncline**.
- anticyclone**—An atmospheric **anticyclonic** circulation, a closed circulation. With respect to the relative direction of its rotation, it is the opposite of a **cyclone**.
- Because anticyclonic circulation and relative high atmospheric pressure usually coexist, the terms anticyclone and **high** are used interchangeably in common practice. (5)
- anticyclonic**—Having a sense of rotation about the local vertical opposite to that of the earth's rotation; that is, clockwise in the Northern Hemisphere, counterclockwise in the Southern Hemisphere, undefined at the Equator. It is the opposite of **cyclonic**. (5)
- antifouling coating**—*See* **antifouling paint**.
- antifouling paint**—(or *antifouling coating*). A substance applied to a surface to prevent the attachment of **fouling organisms** when submerged. The principle applied is the gradual release of compounds toxic to fouling organisms; effectiveness of the coating depends upon the toxicity of the compound and the rate and duration of release. Toxic compounds commonly used are cuprous oxide and mercuric oxide.
- Antilles Current**—A current formed by part of the **North Equatorial Current** that flows along the northern side of the Greater Antilles. The Antilles Current joins the **Florida Current** north of Grand Bahama Island to form the **Gulf Stream**.
- antinode**—*See* **loop**.
- Antisubmarine Warfare**—(abbreviated ASW). Operations conducted against submarines, their supporting forces and operating bases. (63)
- Antisubmarine Warfare Environmental Prediction System**—(abbreviated ASWEPS). An integrated system of men and machines to predict and display oceanographic parameters in support of antisubmarine warfare operations.
- antitrades**—(formerly, also called *countertrades*). A deep layer of westerly winds in the troposphere above the surface **trade winds** of the tropics. They comprise the equatorward side of the mid-latitude westerlies, but are found at upper levels rather than at the surface.
- The antitrades are best developed in the winter hemisphere, and also above the eastern extremities of the **subtropical highs**. (5)
- aperiodic motion**—Any nonperiodic motion.
- aphelion**—The point in the earth's orbit farthest from the sun. (50)

- aphotic zone**—That portion of the ocean waters where light is insufficient for plants to carry on **photosynthesis**. *See euphotic zone.* (*See figure for classification of marine environments.*)
- apogean range**—(abbreviated An). The average of all monthly tide ranges occurring at the time of **apogee**.
- apogean tidal current**—A tidal current of decreased speed occurring at the time of **apogean tide**.
- apogean tide**—Tides of decreased range occurring monthly near the time of the moon's **apogee**.
- apogee**—That point on the orbit of the moon (or any other earth satellite) farthest from the earth; opposed to **perigee**. (5)
- apparent contrast**—The change in **contrast** that depends upon the distance to an object, the amount of light absorption, and the inclination of line of sight to the vertical; expressed as percentage.
- apparent freezing point**—*See freezing point.*
- apparent luminance**—With respect to the visual range of a dark, distant object: **luminance**, created by **airlight**, of that portion of the visual field subtended by the object; that is, the light scattered into the eye by particles, including air molecules, lying along the optic path from eye to object. (5)
- apparent velocity**—The velocity with which a fixed phase of a seismic wave, usually its front or beginning, passes an observer. (35)
- appendicularian**—One of a class (Larvacea) of small, transparent, planktonic **tunicates** in which the body is covered by a large **tunic** and is composed of a trunk and a long tail. Some species are luminescent.
- approach**—The area or space of indefinite extent in immediate contact with an objective; particularly, that part of the sea adjacent to a **shoreline**. (68)
- approximate absolute temperature scale**—(abbreviated AA). A temperature scale with the ice point at 273 degrees and boiling point of water at 373 degrees. (5)
- apron**—A sloping underwater extension of an **iceberg**, or an outspread deposit of ice or rock material in front of a **glacier**. (68) *See ram.*
- apsis**—Either of the two orbital points nearest or farthest from the center of attraction, the **perihelion** and **aphelion** in the case of an orbit about the sun, and the **perigee** and **apogee** in the case of an orbit about the earth. The line connecting these two points is called line of apsides. (68)
- aquaculture**—Fish, shellfish, and algae farming; development of new sea foods, and methods of rearing larvae of clams and oysters. Today largely practiced in Japan and Southeast Asia. (35)
- aquafact**—An isolated boulder which has been worn smooth on its seaward face by wave **abrasion**.
- Aqua-Lung***—Self-contained underwater breathing apparatus (SCUBA) of the demand or open circuit type; specifically, the Cousteau-Gagnan apparatus. The trademark for SCUBA equipment manufactured by a U.S. concern.
- aqueous desert**—A marine bottom environment in which there is little or no macroscopic invertebrate shelled life, usually a bottom of shifting sands. (2)
- aragonite**—A mineral, orthorhombic $CaCO_3$, a major constituent of shallow muds on the Bahama Banks and elsewhere.
- arch**—*See rise.*
- arched iceberg**—An **iceberg** with a large opening at the water line, extending through the iceberg, forming an arch. (68)
- archibathyal**—*See archibenthic.*
- archibenthal**—*See archibenthic.*
- archibenthic**—(also called *archibenthal*, *archibathyal*).
1. According to some authorities a subdivision of the **benthic division**. According to other authorities it corresponds roughly to the upper half of the **bathyal**.
 2. Pertaining to a zone extending from a depth of about 650 feet (200 meters) (continental shelf edge) to between 2,625 and 3,600 feet (800 and 1,100 meters). *See classification of marine environments.*
- Archimedean buoyant force**—*See buoyancy* (sense 2).
- Archimedes's principle**—The statement that a new upward or buoyant force, equal in magnitude to the weight of the displaced fluid, acts upon a body either partly or wholly submerged in a fluid at rest under the influence of gravity. This force is known as the Archimedean buoyant force (or **buoyancy**) and is independent of the shape of the submerged body and does not depend upon any special properties of the fluid. (5)
- archipelagic apron**—A gently sloping **sea floor** with a generally smooth surface on the sea floor, particularly found around groups of islands or **seamounts**. (62)
- archipelago**—A sea or part of a sea studded with islands or island groups; often synonymous with island group.
- arc shooting**—(or *fan shooting*). A method of **refraction**; seismic prospecting, in which the variation of travel time with the azimuth from a shot is used to infer geologic structure. (35)
- arctic air**—A type of air whose characteristics are developed mostly in winter over arctic surfaces of ice and snow. Arctic air is cold aloft and it extends to great heights, but the surface temperatures are often higher than those of **polar air**. For two or three months in summer arctic air masses are shallow and rapidly lose

their characteristics as they move southward.

(5)

arctic anticyclone—*See* **arctic high**.

Arctic Convergence—(or *Arctic Convergence zone, Arctic Convergence line*). The Northern Hemisphere **polar convergence**. Because of the configuration of the oceans in the northern latitudes, this convergence zone is poorly defined. *See* **convergence**.

Arctic Convergence line—*See* **Arctic Convergence**.

Arctic Convergence zone—*See* **Arctic Convergence**.

arctic high—(also called *arctic anticyclone, polar anticyclone, polar high*). A weak **high** that appears on mean charts of sea-level pressure over the Arctic Basin during late spring, summer, and early autumn. (5)

Arctic Intermediate Water—*See* **water mass**.

arctic pack—1. (sometimes called *many-year ice*).

Sea ice more than two years old. This nearly salt-free ice has a smoothly undulating surface due to the smoothing of **pressure ice** by weathering. It also has a thickness of more than 2.5 meters (8.2 feet), and often is colored in different tints of blue. (74)

2. *See* **polar ice** (sense 1). (59)

3. (sometimes called *polar ice*). The drifting **ice floes** of the Arctic Basin; specifically, the thick, heavily hummocked polar ice of the central Arctic Ocean. (59)

arctic sea smoke—Same as **steam fog**; but often specifically applied to steam fog rising from small areas of **open water** within **sea ice**. *See* **frost smoke, steam fog**. (5)

arctic smoke—*See* **steam fog, frost smoke**.

arcuate delta—A curved or bowed **delta** with the convex side toward the sea.

arenaceous—Applied to rocks or sediments derived from or containing sand.

arenite—(also spelled *arenyte*). *See* **sandstone**.

argillaceous—Applied to all rocks or sediment composed partly or completely of clay.

argillite—A rock derived either from siltstone, claystone, or shale.

argonaut—*See* **nautilus**.

Argus Island—An oceanographic research tower erected on Plantagenet Bank 22 miles southwest of Bermuda.

arithmetic mean—(also called *mean, average*).

The sum of a set of individual values of any quantity, divided by the number of values in the set.

arm—Any deep and comparatively narrow branch of the sea extending inland, as opposed to **gulfs** and **firths**.

array—A group of two or more devices such as **hydrophones** which feed into a common receiver. The purpose of thus grouping hydrophones is to increase coverage and sensitivity of the listening unit and also to determine the bearing of a target.

arrival—The chronologic appearance (such as first, second, third arrival) of different wave energies on a seismic or acoustic record.

arrow worm—(or *chaetognath, glass worm*). One of a phylum (Chaetognatha) of small, elongate, transparent, wormlike animals pelagic in all seas from the surface to great depths. They are abundant and may multiply rapidly into vast swarms. Some species of the group, especially of the genus *Sagitta*, have been identified as **indicator species**.

arthropod—One of a phylum (Arthropoda) of animals, most with a segmented external skeleton of **chitin** but some with plates of calcium carbonate, and with jointed appendages; for example, the crustaceans, spiders, and insects.

artificial radioactivity—1. A term used to denote the phenomenon of **radioactivity** produced by particle bombardment or electromagnetic irradiation.

2. The radioactivity of synthetic nuclides.

See **induced radioactivity**.

(41)

artificial sea water—Prepared solutions that duplicate sea water as exactly as possible. The following table shows three formulas for artificial sea water: (54)

FORMULAS FOR ARTIFICIAL SEA WATER (Cl=19.00‰)					
McCLENDON ET AL (1917)		BRUJEWICZ (SUBOW, 1931)		LYMAN AND FLEMING (1940)	
SALT	g/kg	SALT	g/kg	SALT	g/kg
NaCl	26.726	NaCl	26.518	NaCl	23.476
MgCl ₂	2.260	MgCl ₂	2.447	MgCl ₂	4.981
MgSO ₄	3.248	MgSO ₄	3.305	Na ₂ SO ₄	3.917
CaCl ₂	1.153	CaCl ₂	1.141	CaCl ₂	1.102
KCl	0.721	KCl	0.725	KCl	0.664
NaHCO ₃	0.198	NaHCO ₃	0.202	NaHCO ₃	0.192
NaBr	0.058	NaBr	0.083	KBr	0.096
H ₃ BO ₃	0.058			H ₃ BO ₃	0.026
Na ₂ SiO ₃	0.0024			SrCl ₂	0.024
Na ₂ Si ₄ O ₉	0.0015			NaF	0.003
H ₃ PO ₄	0.0002				
Al ₂ Cl ₆	0.013				
NH ₃	0.002				
LiNO ₃	0.0013				
TOTAL WATER TO	34.4406 1,000.0000	TOTAL WATER TO	34.421 1,000.000	TOTAL WATER TO	34.481 1,000.000

(SYVERUP, ET AL., 1949)

artificial upwelling—The concept of having a nuclear reactor (or other unnatural source) sitting on the bottom of the ocean in cold, low productivity parts of the sea to create warmth needed to generate turbulence and subsequent fertility to the area.

ascendant—The vector representing the rate of increase of a property. *See* **gradient**.

ascidian—(or *sea squirt*). One of a class (Ascidiacea) of attached or buried **tunicates** having a saclike body covered by a tough flexible **tunic**, called a **test**. They are widespread and notable **fouling organisms**.

asea—On the sea; at sea; seaward.

aseismic—Not subject to earthquakes, as an aseismic region. (35)

ash breeze—Absence of wind; calm. (68)

ash fall—(also called *ash shower*). 1. A rain of airborne **volcanic ash** falling from an eruption cloud, characteristic of volcanic eruptions.

2. A deposit of volcanic ash resulting from such a fall. (2)

ash shower—*See ash fall*.

aspect—The angle made by a target with the line joining it to the observation point is known as the aspect of the target. (28)

astacin carotenoid—An animal pigment found especially in the covering of adult planktonic **crustacea**. Measurement of this carotenoid in sea water samples gives some measure of microscopic animal matter.

asthenosphere—*See mantle*.

astronomical meteor—*See meteor*.

astronomical position—A point on the earth whose position has been determined by celestial observations. (66)

astronomical tidal constituent—*See constituent*.

astronomical tide—(or *astronomic tide*). Tide due to the attractions of the sun and moon, in contrast to a **meteorological tide**, which is caused mainly by wind and atmospheric pressure. *See equilibrium tide*.

astronomic tide—*See astronomical tide*.

ASWEPS aircraft—A specially instrumented flying laboratory which conducts thermal structure research in support of ASWEPS.

asymptotic radiance distribution—The radiance distribution which is the limit of the distribution in the **hydrosphere** as the depth increases infinitely. It is symmetrical around the vertical and independent of sun zenith distance. (8)

Atlantic Ocean—The Atlantic Ocean extends from Antarctica northward to the southern limits of the Greenland and Norwegian Seas. It is separated from the Pacific Ocean by the meridian of Cape Horn to the Antarctic Continent, and the boundary between the Atlantic and Indian Oceans is placed at the meridian of Cape Agulhas to the Antarctic Continent.

The Equator separates the Atlantic Ocean into the North and South Atlantic Oceans.

The limits of the Atlantic Ocean exclude the seas lying within it.

ATLANTIS—A long-range study to determine the feasibility of large ocean surveillance systems.

atmosphere—This term when used as a pressure term is defined as the pressure exerted per square centimeter by a column of mercury 760 millimeters high at a temperature of 0°C where the acceleration of gravity is 980.665 centimeters per second per second. One atmosphere of pressure equals 1.0133×10^6 dynes per square centimeter. The actual effect of atmospheric pressure is ignored when considering pressures within the ocean. Surface pressure is considered to be zero.

atmospheric pressure—(also called *barometric pressure*). The pressure exerted by the atmosphere as a consequence of gravitational force exerted upon the "column" of air lying directly above the point in question. (5)

atmospheric tide—*See tide*.

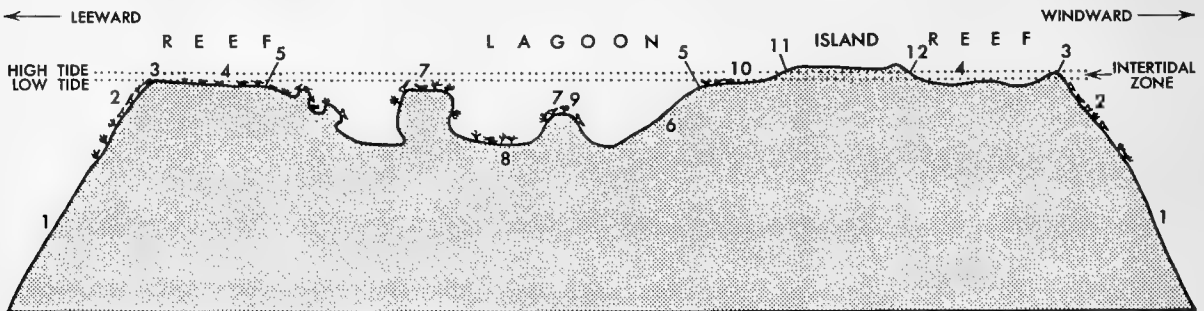
atoll—A ring-shaped **organic reef** that encloses a **lagoon** in which there is no preexisting land, and which is surrounded by the open sea. (56)

atoll lagoon—*See barrier lagoon*.

atollon—A large reef ring in the Maldivé Islands consisting of many smaller reef rings. The word **atoll** was derived from this name. (2)

atoll reef—A ring-shaped coral and limestone reef often carrying low sand islands, enclosing a body of water. (2)

atom—The smallest particle of an element which can enter into a chemical combination. All



CONSPICUOUS FEATURES OF AN ATOLL AND ITS PERIPHERAL REEF

1. Outer slope; 2. Reef front; 3. Seaward reef margin; 4. Reef flat; 5. Lagoon reef margin; 6. Lagoon slope; 7. Reef patch; 8. Lagoon floor; 9. Coral head; 10. Lagoon reef flat; 11. Lagoon beach; 12. Seaward beach.

(AFTER TRACY, ET. AL., 1955)

chemical compounds are formed of atoms, the difference between compounds being attributable to the nature, number, and arrangement of their constituent atoms. (27)

atomic energy—All forms of energy released in the course of nuclear fission or nuclear transformation (*P.L. 703, 83d Congress*). (63)

atomic weight—The relative weight of the atom on the basis of oxygen as 16. For a pure isotope, the atomic weight rounded off to the nearest integer gives the total number of nucleons (neutrons and protons) making up the atomic nucleus. If these weights are expressed in grams they are called **gram atomic weights**. (27)

Note: According to the *International Unified Scale of 1961*, the relative weight of the atom is based on Carbon as 12.

attenuance—The sum of **absorptance** and **scattering**. (8)

attenuation—1. In physics, any process in which the flux density, power, amplitude, intensity, illuminance, etc. of a "parallel beam" of energy decreases with increasing distance from the energy source. Attenuation is always due to the action of the transmitting medium itself. It should not be applied to the divergence of flux due to distance alone, as described by the inverse-square law. (5)

2. The reduction in sound or light intensity caused by the **absorption** and **scattering** of sound or light energy in air or water.

3. A lessening of the amplitude of a wave with distance from the origin. (66)

4. The decrease of submarine motion with increasing depth. Submarine motion resulting from surface waves attenuates rapidly with depth and practically disappears at a depth equal to a surface wavelength.

attenuation coefficient—A measure of the space rate of diminution, or **attenuation**, of any transmitted **electromagnetic radiation**. This quantity may be identified in a form of Bouguer's law (or Beer's law):

$$dI = -\alpha I dx;$$

or

$$I = I_0 e^{-\alpha x}$$

where I is the flux density at the selected point in space, I_0 is the flux density at the source, x is the distance from the source, and α is the attenuation coefficient.

In general, the attenuation coefficient is specified only when the attenuation is known to be due to both **absorption** and **scattering** or when it is impossible to determine which is the cause. More common is the use of either the **absorption coefficient** or the **scattering coefficient**.

Extinction coefficient is a synonymous term, but it is used mostly in reference to visible radiation. (5)

attenuation constant—(also called *attenuation factor*, *decay constant*). A measure of the space rate of **attenuation**, that is, the rate of flux-density (or power) reduction as energy (visual, electromagnetic, acoustic) propagates from its source. (5)

attenuation factor—*See* attenuation constant.

Atterberg grade scale—(or *Atterberg scale*). A decimal grade scale for particle size, with 2 millimeters as the reference point, and involving the fixed ratio 10. Subdivisions are the geometric means of the grade limits: 0.2, 0.6, 2.0, 6.3, 20.0. (2)

Atterberg limits—The indices (LL, PL) of the water content of a sediment at the boundary between the semiliquid and plastic state (liquid limit) and the plastic and the semisolid state (plastic limit). (31)

Atterberg scale—*See* Atterberg grade scale.

attitude—The position of a body as determined by the inclination of the axes to some frame of reference. If not otherwise specified this frame of reference is fixed to the earth. (63)

audio frequency—(also called *sonic frequency*). A frequency within the audible range, about 20 to 20,000 cycles per second. (68)

augmenting factor—A factor used in the **harmonic analysis** of tides or tidal currents. It is a correction factor for tabulating the hourly heights or speeds used in the summation for **constituents** other than S which do not occur on the exact constituent hours to which they are assigned, but at times may differ by as much as a half hour. (50)

aural null—A null detected by listening for a minimum signal or the complete absence of an audible signal. (68)

auricularia larva—The planktonic young of a **sea cucumber**.

aurora—The sporadic radiant emission from the upper atmosphere over middle and high latitudes.

In northern latitudes these displays are called **aurora borealis**, **aurora polaris**, or northern lights; and in southern latitudes they are called **aurora australis**. (5)

aurora australis—The **aurora** of southern latitudes. (5)

aurora borealis—(also called *aurora polaris*, *northern lights*). The **aurora** of northern latitudes. (5)

aurora polaris—*See* **aurora**, **aurora borealis**.

auroral zone—A zone of maximum auroral activity at about 23 degrees from the **geomagnetic pole**.

authalic projection—*See* **equal area projection**.

authigenic—A term applied to products of chemical and biochemical action which originated in sediments at the time of or after deposition, and before burial and consolidation, such as calcium carbonate or manganese oxide deposition. (2)

autochthonous—Of local origin; indigenous.

automatic tide gage—An instrument that automatically registers the rise and the fall of the tide. (50)

automatic weather station—A weather station at which the services of an observer are not required. Most automatic weather stations are equipped with telemeter apparatus for transmitting weather information at predetermined times, or by use of an interrogation system.

autophytic nutrition—*See* **autotrophic nutrition**.

autotrophic nutrition—That process by which an organism manufactures its own food from inorganic compounds. *See* **holophytic nutrition**, **chemotrophic nutrition**, **heterotrophic nutrition**, **mixotrophic nutrition**.

autumn ice—1. **Sea ice** in early stage of formation. It is comparatively brackish, and crystalline in appearance. Like **young ice**, it is not yet affected by lateral pressure. (5)

2. A Russian term defining a specific form of **one-year ice** (70 to 200 centimeters thick). At the end of the growth season in spring the thickest one-year ice is also called autumn ice since it formed earliest the previous autumn. Thus, it has been defined as 150 to 200 centimeters or more thick. Autumn ice usually does not completely disappear during the summer.

autumn maximum—A secondary flowering of **phytoplankton**. The flowering results from the regeneration of nutrients after the decomposition of organisms that have died during the summer and from vertical mixing after summer stratification.

auxiliary thermometer—A mercury-in-glass thermometer attached to the stem of a **reversing thermometer**. It is read at the same time as the reversing thermometer so that the correction to the reading of the latter, resulting from change

in temperature after reversal, can be computed. (5)

average—*See* **arithmetic mean**.

average current—*See* **mean current**.

average depth—The average water depths based on soundings reduced to **low water datum**.

average limit of ice—Average seaward extent of ice during a normal winter.

avulsion—Rapid erosion of shoreland by waves during a storm. (73)

awash—1. Tossed about or bathed by waves or tide. (61)

2. A rock exposed or one just bare at any stage of the tide between the datum of **mean high water** and the sounding.

axis of acoustic symmetry—For many **transducers** the three-dimensional directivity is such that it may be represented by the surface generated by rotating a two-dimensional directivity pattern about the axis corresponding to the reference bearing of the transducer. This axis may then be described as an axis of acoustic symmetry, or, more briefly, as the acoustic axis. (28)

axis of channel—The center line of a **channel**. (30)

azoic—Without life; however, most ocean areas described as azoic are known to contain at least a bacterial flora.

Azores high—The semipermanent **subtropical high** over the North Atlantic Ocean, so named especially when it is located over the eastern part of the ocean.

The same high, when displaced to the western part of the Atlantic, or when it develops a separate cell there, is known as the **Bermuda high**. On mean charts of sea-level pressure, this high is one of the principal **centers of action** in northern latitudes. (5)

B

back bay—A small bay into which streams drain and which is connected with the sea through passes between barrier islands. (2)

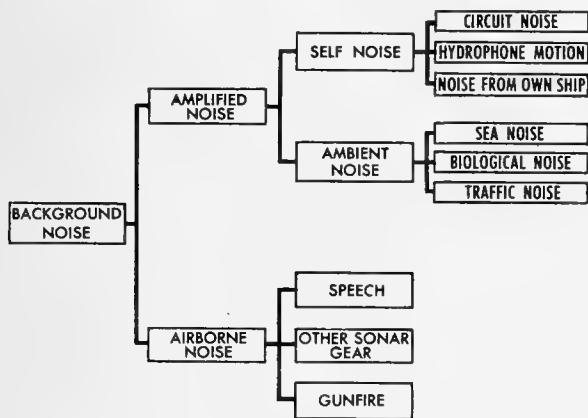
backbeach—*See backshore.*

backdeep—An oceanic depression on the concave side of an **island arc**. (2)

background—Ever-present effects in physical apparatus above which a phenomenon must manifest itself in order to be measured. Background can take various forms, depending on the nature of the measurement. In electrical measurements of radioactivity and nuclear phenomena, the term usually refers to those undesired counts or currents that arise from cosmic rays, local contaminating radioactivity, insulator leakage, amplifier noise, power-line fluctuations, etc. In nuclear work and photographic emulsions, the term refers to developable grains unrelated to the tracks under investigation. (41)

background count—The evidence or effect on a detector of **radiation**, other than that which it is desired to detect, caused by any agency. (63)

background noise—Noise made up of sound from a variety of sources, other than the desired signal, as indicated by the block diagram below:



CLASSIFICATION OF BACKGROUND NOISE

background radiation—1. Radiation arising from radioactive material other than the one directly under consideration.

2. In the ocean environment when measuring fission products or **radioactive tracers**, the background radiation (radioactivity) is that radiation (radioactivity) contributed by cosmic rays and the natural radioactive constituents of sea water.

(70)

backing—1. According to general internationally accepted usage, a change in wind direction in a counterclockwise sense (for example, south to southeast to east) in either hemisphere of the earth; the opposite of **veering**.

2. According to widespread usage among United States meteorologists, a change in wind direction in a counterclockwise sense in the Northern Hemisphere, clockwise in the Southern Hemisphere; the opposite of **veering**.

(5)

back radiation—*See counterradiation.*

back reef—The region behind a **reef**, between it and the land. Variously applied to **reef flat**, lagoonal deposits, or terrestrial deposits connecting the reef and the land. (2)

backrush—The seaward return of water following **uprush** of the waves. *See backwash.* (61) (*See figure for surf zone.*)

backscattering—The part of the reflected sound energy that returns to the **transducer**; equivalent to **reverberation**.

backscattering—The part of the reflected sound scattering cross section of an object is an area equal to 4π times the product of the square of a unit distance and the square of the **sound pressure** scattered by the object back in the direction from which the sound has come as observed at unit distance from the acoustic center of the object, divided by the square of the sound pressure of the plane wave incident on the object. The unit of the cross section is the square of the unit distance. (6)

backshore—That part of a **beach** which is usually dry, being reached only by the highest tides, and, by extension, a narrow strip of relatively flat coast bordering the sea. *See foreshore.* (68) (*See figure for shore profile.*)

back-slope—The gentler sloping side of a **ridge**; in contrast with **escarpment**, the steeper slope. (2)

backward scatterance—The ratio of the **radiant flux** scattered through angles 90 to 180 degrees from a beam, to the incident flux. (8)

backward scattering coefficient—The coefficient which relates to **backward scatterance**. Unit of measurement is m^{-1} . (8)

backwash—(also called *backrush*). Water or waves thrown back by an obstruction such as a ship, breakwater, cliff, etc. (61)

backwater—1. Water turned back by an obstruction, opposing current, etc. (68)

2. Water held back from the main flow, as that which overflows the land and collects in low places or that forming an inlet approximately parallel to the main body and connected thereto by a narrow outlet. (68)

3. An **arm** of the sea, usually lying parallel with the coast, behind a narrow strip of land. (30)

bacterial film—See **primary film**.

Baffin Bay pack—(or *middle pack*). The drifting **ice floes** west of Greenland between Davis Strait and the southern limit of **North Open Water**, which is roughly a line from Cape York to the entrance of Lancaster Sound. (59)

baffle area—An area of approximately 30 degrees to either side of the stern in which the chance of holding a sonar contact is nearly impossible.

Bahama Current—See **Antilles Current**.

balancing—A maneuver that enables a stationary submarine to float in a **density layer**.

balancing layer—A **density layer** of sufficient thickness, magnitude, intensity, and depth to allow a submarine to balance safely.

baleen—(or *whalebone*). The horny material growing down from the upper jaw of large plankton-feeding whales, which forms a strainer or filtering organ consisting of numerous plates with fringed edges.

baleen whale—(also called *mysticete*, *whalebone whale*). A member of the cetacean suborder Mysticeti, which comprises the right whales, gray whales, and rorquals.

ball—(also called *longshore bar*). A low sand ridge which extends generally parallel with the **shoreline** and is submerged at least by high tides. It is generally separated from the **beach** by an intervening trough. (2) (See figure for **shore profile**.)

ballast—Broken stone, gravel, or other heavy material which is used in a ship to improve its stability or control the draft. Frequently, jet-tisoned ballast is found in marine sediment samples. (9)

ball breaker—A device used in oceanographic operations such as coring for determining when the bottom is reached. It is a metal frame containing a glass ball with a weight suspended above it. When bottom contact is made the weight drops on the glass ball and causes it to implode. The sound wave generated by the implosion is received aboard ship by a listening device.

ball ice—Sea ice consisting of a large number of soft, spongy spheres 1 to 2 inches in diameter. This is a rare form of ice. (68)

ballycadder—(or *bellicatter*). An **ice foot**. (59)

band elimination filter—A wave filter which has a large insertion loss for one frequency band with the cutoff frequencies for this band neither zero nor infinite.

band level—A given spectrum level is usually associated with a specific frequency. To identify a transmission level measuring the power in a specified frequency band, or the acoustic intensity in a specified frequency band, it may be designated as a band level. (28)

band-pass filter—A wave filter which has a single transmission band extending from a lower cutoff frequency greater than zero to a finite upper cutoff frequency.

bandwidth—The number of units (cycles, kilocycles, etc.) of frequency required for transmission. (66)

bank—1. An elevation of the sea floor located on a **continental (or island) shelf** and over which the depth of water is relatively shallow but sufficient for safe surface navigation. It may support **shoals** or **bars** on its surface which are dangerous to navigation. (62)

2. In its secondary sense, a shallow area consisting of shifting forms of silt, sand, mud, gravel, etc., but in this case it is only used with a qualifying word such as "sand-bank," "gravel-bank," etc. (30)

Bankia—A genus of molluscan borers. See **ship-worm**.

bank-inset reefs—**Coral reefs** which are situated well within the unrimmed outer edges of continental and insular shelves. (2)

bank reef—A reef which lies within the outer margin of rimless **shoals** in contrast to **barrier** and **atoll reefs** which rise directly from deep water. (2)

bar—1. A submerged or emerged embankment of sand, gravel, or mud built on the sea floor in shallow water by waves and currents. A bar may also be composed of mollusk shells. When it is a ridge generally parallel to shore and submerged by high tides, it is a longshore bar. Off-shore bars or barrier bars or beaches are built principally by wave action on sand or gravel at a distance from shore and separated from it by a **lagoon**. When a bar extends partly or completely across the entrance to a bay it is called a **baymouth bar**. A crescentic bar commonly found off the entrance to a harbor is a **lunate bar**. (2)

2. A unit of pressure, defined as 1 bar equals 10⁶ dynes per square centimeter.

barber—1. A severe storm at sea during which spray and precipitation freeze onto the decks and rigging of boats.

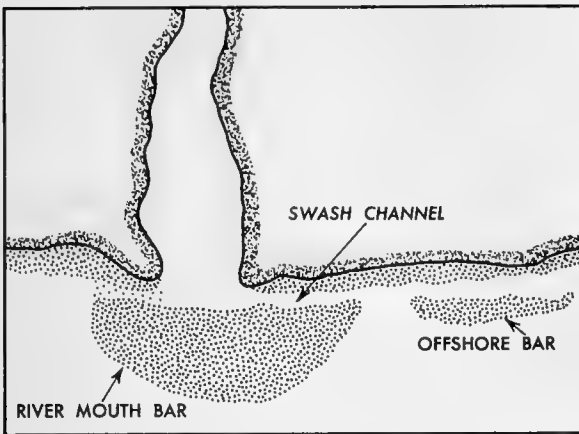
2. (also spelled *berber*). In the Gulf of St. Lawrence, a local form of **blizzard** in which the wind-borne ice particles almost cut the skin from the face.

3. See **frost smoke**.

(5)

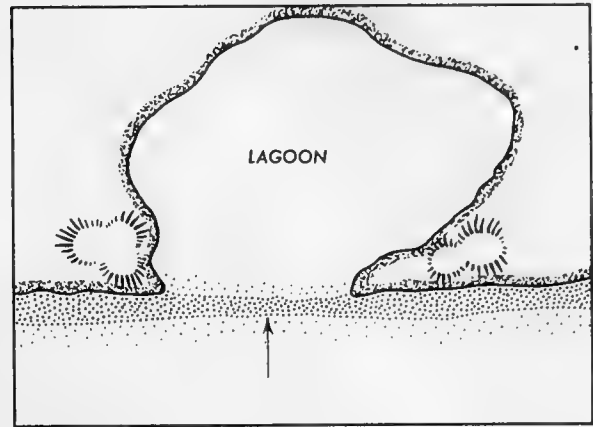
bare ice—Ice without snow cover. (74)

bar-finger sand—An elongated lenticular sand body underlying a distributary in a **bird-foot delta**. In the Mississippi delta it may be 15 to



BARS

(BEJ, TR-4, 1954)



BARRIER BEACH

(BEJ, TR-4, 1954)

20 miles long, 250 feet thick, and 5 miles wide. (2)

barnacle—One of an order (Cirripedia) of **crustaceans** which are enclosed in a calcareous shell and **sessile** during their adult life. They are of two general types, the **acorn barnacles** and the **stalked barnacles**. Barnacles are one of the most notable groups of **fouling organisms**.

baroclinity—The state of stratification in a fluid in which surfaces of constant pressure (isobaric) intersect surfaces of constant density (isosteric). The number, per unit area, of isobaric-isosteric solenoids intersecting a given surface is a measure of the baroclinity. (5)

barometer—An instrument for measuring **atmospheric pressure**. (35)

barometric pressure—*See atmospheric pressure*.

barotrauma—*See squeeze*.

barotropy—The state of a fluid in which surfaces of constant density (or temperature) are coincident with surfaces of constant pressure; it is the state of zero **baroclinity**. (5)

bar port—A harbor that can be entered only when the tide rises sufficiently to permit passage of ships over a **bar**. (73)

barred basin—*See silled basin*.

barrier—1. In polar terminology, an early term for **ice shelf**; first used by Sir James Clark Ross for the face of the antarctic ice shelf named for him, "Ross Barrier." (5)

2. Barrier is being replaced by **ice shelf** and **ice front** in publications and maps. (59)

barrier bar—*See bar*.

barrier basin—A basin produced by natural damming by glacial moraines, landslides, etc. (2)

barrier beach—(also called *offshore barrier*). A **bar** essentially parallel to the **shore**, the crest of which is above **high water**. (61)

barrier berg—*See tabular iceberg*.

barrier chain—A series of barrier islands, barrier spits, and barrier beaches which extends along a considerable length of coast. (2)

barrier ice—(or *shelf ice*). *See ice shelf*.

barrier iceberg—(or *barrier berg*). 1. *See tabular iceberg*.

2. A large tabular iceberg broken off an **ice shelf**. (59)

barrier lagoon—A bay roughly parallel to the coast and separated from the open ocean by barrier islands. Also the body of water encircled by coral islands and reefs, in which case it may be called an **atoll lagoon**. (*See figure for atoll*.)

barrier reef—A **coral reef** parallel to and separated from the coast by a **lagoon** that is too deep for coral growth. Generally, barrier reefs follow the coasts for long distances and are cut through at irregular intervals by **channels** or **passes**. (2)

barysphere—*See centrosphere*.

basalt—A basic **igneous (extrusive) rock** composed primarily of calcic plagioclase, pyroxene, and with or without olivine. Also an inner layer of worldwide extent underlying the oceans and the granitic continents. (2)

base line—1. A surveyed line established with more than usual care, to which surveys are referred for coordination and correlation. This established line becomes the base for the computation of the other two sides of a triangle (in triangulation). (37)

2. The line between the master and slave stations in **Loran** or other hyperbolic navigation systems.

basement—(also called *basement complex*, *basement rock*). An **igneous** or **metamorphic rock** complex underlying sedimentary or volcanic rocks.

basement complex—*See basement*.

basement rock—*See basement*.

base station—A geographic position whose absolute gravity value is known; also the point from which a survey begins.

In exploration, particularly magnetic or gravity surveys, a reference station where quantities under investigation have known values or may be under repeated or continuous measurement in order to establish additional stations in relation to it. (2)

base surge—A cloud which rolls out from the bottom of the column produced by a subsurface burst of a nuclear weapon. For underwater bursts the surge is, in effect, a cloud of liquid droplets which has the property of flowing almost as if it were homogeneous fluid. (63)

basic rock—In geology, a term for **igneous rocks** that are comparatively low in silica.

basin—A depression of the **sea floor** more or less equidimensional in form and of variable extent. (62)

bastard—A hard massive boulder or rock. Also adjective meaning of abnormal shape or of unusual composition or proportion. (48)

bathy—An indicator group in the coded bathythermograph message.

bathyal—Pertaining to ocean depths between 100 and 2,000 fathoms (180 and 3,700 meters); also to the ocean bottom between those depths, sometimes identical with the continental slope environment. (See figure for **classification of marine environment**.)

bathyconductograph (BC)—A device to measure the **electrical conductivity** of sea water at various depths from a moving ship.

bathymeter—An instrument primarily designed for measuring depth of water. Bathymetric surveys, previously done by **lead line**, are now performed by using an echo sounder and a precision depth recorder. (35)

bathymetric—Of or pertaining to **bathymetry**. (68)

bathymetric chart—A map delineating the form of the bottom of a body of water, usually by means of depth contours (**isobaths**). (5)

bathymetric low—See **low** (sense 2).

bathymetry—The science of measuring ocean depths in order to determine the sea floor **topography**.

bathypelagic—A depth zone of the ocean which lies between depths of 500 and 2,000 fathoms (900 and 3,700 meters). (See figure for **classification of marine environment**.)

bathypelagic fish—Any of a variety of oceanic fishes which, at least part of the time, inhabit a depth range between about 500 to 2,000 fathoms (900 to 3,700 meters). Many of these fishes characteristically undergo extensive diurnal vertical migrations and are thought to contribute to sound scattering layers in the sea.

Bathyscaphe—(also spelled Bathyscaph, Bathyscap). A free, manned vehicle for exploring the deep ocean.

Bathysphere—A spherical chamber in which persons are lowered for observation and study of ocean depths. (68)

bathythermogram—The record made by a **bathythermograph**, or a photographic print of this record and accompanying meteorological observations. Now rarely used. (68)

bathythermograph—(abbreviated BT). A device for obtaining a record of temperature against depth (strictly speaking, pressure) in the ocean, from a ship underway. For a thermal element it has a xylene filled copper coil, which actuates a stylus through a **Bourdon tube**. The pressure element is a copper aneroid capsule which moves a coated glass slide at right angle to the motion of the stylus. A double analog record is thus obtained as the BT is lowered and recovered. (5)

bathythermograph (BT) grid—A transparent glass slide, marked with calibration lines of temperature and depth, which, when superimposed against a **bathythermograph slide**, makes it possible to read off observed values of temperature and depth. Each instrument has its own grid. (5)

bathythermograph (BT) print—An enlarged photographic print of a **bathythermograph slide** superimposed against the appropriate **bathythermograph grid**, annotated with particulars of location and data. (5)

bathythermograph (BT) slide—A 1-inch by 1 $\frac{3}{4}$ -inch glass slide with a coated (now usually gold anodised, formerly smoked) surface on one side.

A stylus on the **bathythermograph** scratches a depth versus temperature trace on the coated surface.

bathythermograph (BT) viewer—A small magnifying device used in reading temperature and depth values from a **bathythermograph slide** overlaid by a **bathythermograph grid**.

bathythermograph (BT) winch—A small electric winch primarily used for lowering and raising a **bathythermograph**. This winch is a high-speed type holding about 2,500 feet of $\frac{3}{32}$ -inch diameter stainless steel wire.

bay—1. A recess in the shore or an inlet of a sea between two **capes** or **headlands**; not as large as a **gulf** but larger than a **cove**. (2)

2. An inward bend in the **ice edge** formed either by wind or current. (74)

bay deltas—Deltas formed at the mouths of streams which discharge into bays or estuaries. Their advance toward the bay mouths often extinguishes lagoons behind bay bars or completely fills open bays, thus simplifying the shoreline. When the delta forms at the head of the bay, it is a bay-head delta. (2)

bay-head delta—See **bay deltas**.

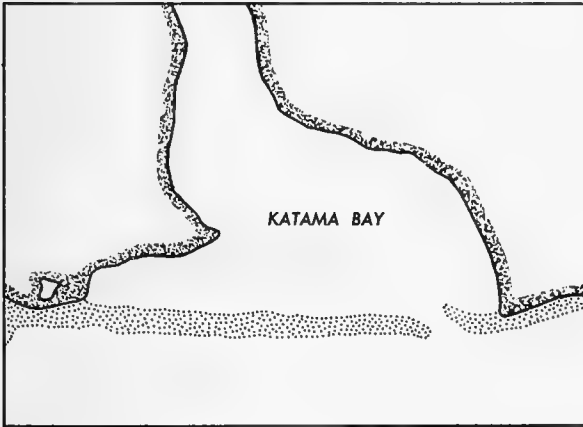
bay ice—1. **Level ice** of more than one winter's growth which has remained free of **hummocks** and is nourished by surface layers of snow. (74)

2. A Labrador term for **one-year ice** formed in bays or inlets. (59)

3. In the antarctic, sometimes applied to **heavy floes** recently broken away from an **ice shelf**. (5)

4. Young flat sea ice sufficiently thick to impede navigation. (59) Obsolete.

baymouth bar—A **bar** extending partially or entirely across the mouth of a **bay**. (61)



BAYMOUTH BAR

(REB, TR-4, 1954)

bayou—A small sluggish stream or estuarial creek, with a slow or imperceptible current, in coastal swamps or river deltas. *See* **slough**. (68)

beach—(or *seabeach*). 1. The zone of unconsolidated material that extends landward from the **low water line** to the place where there is marked change in material or physiographic form . . . or to the line of permanent vegetation (usually the effective limit of storm waves). A beach includes **foreshore** and **backshore**.

2. Sometimes, the material which is in more or less active transport, alongshore or on-and-off shore, rather than the zone. (*See* figure for **shore profile**.)

3. *See* **strand, shoreline, coastline, tideland**. (61)

beach berm—A nearly horizontal portion of the **beach** or **backshore** formed by the deposit of material by wave action. Some beaches have no **berms**, others have one or several. (61)

beachcomber—*See* **comber**.

beach cusp—(also called *cusp*). One of a series of low mounds of beach material separated by crescent A-shaped troughs spaced at more or less regular intervals along the **beach face**. (61)

beach erosion—The carrying away of beach materials by wave action, **tidal currents**, or **littoral currents**, or by wind. (61)

beach face—The section of the **beach** normally exposed to the action of the wave **uprush**. The

foreshore zone of a beach. (Not synonymous with **shoreface**.) (*See* figures for **surf zone** and **shore profile**.) (61)

beach profile—*See* **shore profile**.

beach ridge—An essentially continuous mound of beach material behind the beach that has been heaped up by wave or other action. Ridges may occur singly or as a series of approximately parallel deposits. In England they are called **fulls**. (61)

beachrock—(or *beach sandstone*). A friable to well-cemented rock consisting of calcareous skeletal debris and, in many places, mineral grains and rock fragments cemented by calcium carbonate. It is formed only in the **intertidal zone** and occurs in thin beds dipping seaward at angles of less than 15 degrees. *See* also **cay sandstone**. (2)

beach sandstone—*See* **beachrock**.

beach scarp—An almost vertical slope along the **beach** caused by erosion by wave action. It may vary in height from a few inches to several feet, depending on wave action and the nature and composition of the beach. (*See* figure for **shore profile**.) (61)

beach width—The horizontal dimension of the **beach** as measured normal to the **shoreline**. (61)

beam—A ray or collection of focused rays of radiated energy. (5)

(**beam**) **attenuance meter**—(or *beam transmittance meter*). A **radiance meter** which measures the beam transmittance, T , of a fixed path. The beam attenuation $C = 1 - T$. (8)

beam pattern—*See* **directional response pattern**.

beam sea—Waves moving in a direction approximately 90 degrees from the **heading**. Those moving in a direction approximately opposite to the heading are called **head sea**, those moving in the general direction of the heading are called **following sea**, and those moving in a direction approximately 45 degrees from the heading (striking the quarter) are called **quartering sea**. *See* **cross sea**. (68)

beam tide—In navigational usage, a **tidal current** setting in a direction approximately 90 degrees from the **heading** of a ship. One setting in a direction approximately 90 degrees from the course is called a **cross tide**. In common usage these two expressions are usually used synonymously. One setting in a direction approximately opposite to the heading is called a **head tide**. One setting in such a direction as to increase the speed of a ship is called a **fair tide**. (68)

beam transmittance—The **transmittance** for a beam the diameter of which is small compared to its length. (8)

beam transmittance meter—*See* (**beam**) **attenuance meter**.

beam trawl—A type of **trawl** which has a rigid front (or beam) fastened between two metal shoes the soles of which slide over the bottom. As the trawl passes over the bottom, fish and other marine life are captured within the attached net.

beam width—The beam width of a directional **transducer** of a given frequency in a given plane which includes the beam axis is the angle included between the two directions, one to the left and the other to the right of the axis, at which the angular deviation loss has a specified value.

beam wind—A nautical term for a **crosswind**, especially a wind blowing 90 degrees from a ship's heading.

bearing—The horizontal direction of one terrestrial point from another. It is usually measured from 000 degrees at the reference direction clockwise through 360 degrees. (66)

beat—The periodic variation that results from the superposition of two simple harmonic oscillations whose frequencies differ by a small amount. It involves a periodic increase and decrease of amplitude at the beat frequency which is equal to the difference in the frequencies of the two parent signals. Thus, if two pure tones having frequencies of 300 and 400 cycles per second are heard by a listener, he will also sense a frequency equal to the difference, 100 cycles per second. This is the beat frequency.

beating—A wave phenomenon which occurs when two or more waves of different frequencies become superimposed. The resultant wave has amplitude maximum ("beats") at the frequency equal to the difference of the frequencies of the initial waves. *See surf beat.* (5)

Beaufort force—(or *Beaufort number*). A number denoting the speed (or "strength") of the wind according to the **Beaufort wind scale**. (5)

Beaufort number—*See Beaufort force.*

Beaufort scale—*See Beaufort wind scale.*

Beaufort wind scale—A system of estimating and reporting wind speeds, devised in the early nineteenth century (1806) by Admiral Beaufort of the British Navy. It was originally based on the effects of various wind speeds on the amount of canvas that a full-rigged frigate of the period could carry, but has since been modified and modernized. In its present form for international meteorological use it equates (a) Beaufort force (or Beaufort number), (b) wind speed, (c) descriptive term, and (d) visible effects upon land objects or sea surface. (5)

bed—1. The smallest division of a layered rock series separated from material above or below by a more or less well defined change in character.

2. The ground upon which a body of water rests. The term is usually used with a modifier to indicate the type of water body, as sea bed. *See bottom.* (68)

bedded—*See bed.*

bedding cleavage—A cleavage or break that is parallel to the bedding. (68) *See bed.*

bedding joint—A joint that is parallel to the bedding. (68) *See bed.*

bedding plane—Division planes which separate the individual layers. (68) *See bed.*

bed load—*See load.*

bedrock—Any solid rock underlying soil or unconsolidated sediments.

bel—A unit of level when the base of the logarithm is 10. Use of the bel is restricted to levels of quantities proportional to power. *See decibel.* (69)

bell—*See umbrella.*

bellicatter—Variant spelling of ballycadder, meaning an **ice foot**. (59)

belt—(also called *ice belt, sea bar*). A long area of **sea ice** bounded by open water or land. Depending on their length, belts can vary from a few kilometers to more than 100 kilometers (54 n. miles) in width. (74)

bench—1. A level or gently sloping erosion plane inclined seaward.

2. A nearly horizontal area at about the level of maximum high water on the sea side of a dike. (61)

bench mark—A permanently fixed point of known elevation. A primary bench mark is one close to a **tide station** to which the **tide staff** and tidal datum originally are referenced.

bending—Upward or downward motion in a sheet of ice, caused by lateral pressure. This is the first stage in the formation of **pressure ice**, and is characteristic of thin and very plastic ice. *See rafting, tenting.* (68)

bends—*See decompression sickness.*

Benguela Current—A strong current flowing northward along the southwest coast of Africa; it is formed by the **West Wind Drift** and the **Agulhas Current**. The Benguela Current flows toward the Equator, gradually leaves the coast, and becomes the **South Equatorial Current**.

benthic—(also called *benthonic*). 1. That portion of the marine environment inhabited by marine organisms which live permanently in or on the bottom. (*See figure for classification of marine environments.*)

2. Pertaining to all submarine bottom terrain regardless of water depth.

benthic division—A primary division of the sea which includes all of the ocean floor. (*See figure for classification of marine environments.*)

benthonic—*See benthic, benthos.*

benthos—1. Bottom dwelling forms of marine life. Many authorities include certain fishes, such as stingrays and flounders, which spend much of

- their lives in close association with the bottom, in this category.
2. Also applied to the floor or deepest part of a sea or ocean. (2)
- bentonite**—A clay formed from the decomposition of **volcanic ash** and composed of the clay minerals montmorillonite and beidellite. (2)
- berber**—*See* **barber**.
- berg**—*See* **iceberg**.
- berg bit**—A medium-sized piece of ice, generally less than 5 meters (16.4 feet) high and about the size of a small cottage. A bergy bit mainly originates from **glacier ice** but occasionally from a massive piece of **sea ice** or **hummocked ice**. When it is known to be sea ice, the term **floeberg** may be used. (74)
- berg seltzer**—Sizzling sound comparable to that of Seltzer water which **icebergs** emit when they melt. It is caused by the release of air bubbles that were retained in the berg at high pressure.
- berm**—The nearly horizontal portion of a **beach** or **backshore** having an abrupt fall and formed by deposition of material by wave action, and marks the limit of ordinary high tides. (*See* figure for **shore profile**.)
- berm crest**—(also called *berm edge*). The seaward limit of a **berm**. (*See* figure for **shore profile**.) (61)
- berm edge**—*See* **berm crest**.
- Bermuda high**—The semipermanent **subtropical high** of the North Atlantic Ocean, so named especially when it is located in the western part of the ocean.
- This same high, when displaced toward the eastern part of the Atlantic, is known as the **Azores high**. On mean charts of sea-level pressure, this high is a principal **center of action**. (5)
- beset**—Surrounded so closely by **sea ice** that steering control is lost. The term does not imply pressure. If the ship is incapable of proceeding, it is **icebound**. If pressure is involved, the ship is said to be **nipped**. (68)
- best depth range**—The detection range of a submarine target which is at the best depth to escape detection by a ship with hull-mounted sonar.
- beta particle**—A negative electron or a positive electron (positron) emitted from a nucleus during beta decay. The symbols β , β^- , and β^+ are reserved for electrons of nuclear origin. (41)
- beta ray**—Synonym for **beta particle**.
- biennial ice**—**Sea ice** between one and two years old. *See* **young polar ice**.
- bifilar current indicator**—An apparatus used for obtaining only the direction of the current at different depths. (37)
- bifurcation**—A forking, or division into two branches; the point of forking; a branch.
- big clearing**—*See* **polynya**.
- bight**—1. A concavity in the **coastline** which forms a large open bay.
2. *See* **bay** (sense 2).
- big ice floe**—*See* **ice floe**.
- bilateral transducer**—(or *reversible transducer*). A **transducer** capable of transmission in either direction between its terminations. (69)
- bill**—A narrow **promontory** or **headland**. (68)
- Billion-electron-volts**—(abbreviated Bev). Equivalent to 10^9 **electron-volts**.
- billow**—Usually a great wave or surge of water; any wave. (73)
- binary scaler**—A **scaler** whose scaling factor is two per stage. (70)
- biocenose**—*See* **community**.
- biocenosis**—*See* **community**.
- bioclastic rock**—Rocks produced from material broken or arranged by animals or plants and consisting of fragmental organic remains.
- biogenic deposit**—A deposit resulting from the physiological activities of organisms. (2)
- bioherm**—A reef or mound built principally by sedimentary organisms such as **corals**, **mollusks**, etc. *See* also **accretionary limestone**, **biostrome**, **reef**. (2)
- biolithite**—Inclusive term for organic limestone. (2)
- biological half-life**—The time required for the body to eliminate one-half of an administered dose of any substance by regular processes of elimination. This time is approximately the same for both stable and radioactive **isotopes** of a particular element. (70)
- biological oceanography**—The study of the ocean's plant and animal life in relation to the marine environment, including the effects of habitat, sedimentation, physical and chemical changes in the environment, and other factors on the spatial and temporal distribution of marine organisms, as well as the action of organisms on the environment.
- bioluminescence**—(also called *phosphorescence*, *luminescence*). The production of light without sensible heat by living organisms as a result of a chemical reaction either within certain cells or organs or extracellularly in some form of secretion. **Luminescence** usually is induced by external stimuli, especially mechanical, such as wave action or shock waves. It is produced by a variety of marine organisms in displays of three general types, namely, **sheet type**, **spark type**, and **glowing-ball type**. *See* **luciferin**, **luciferase**.
- bioluminescent display**—Production of biological light of sufficient intensity to make the water or disturbances of the water conspicuously illuminated. Displays may be weak and noted only as a pale green luminosity of wave crests, or they may be extremely intense and capable of lighting large areas of ocean. Momentary **luminescence** created by a few jellyfish when disturbed is not considered a display.
- biomass**—(also called *standing crop*, *standing stock*, *live-weight*). The amount of living mat-

ter per unit of water surface or volume expressed in weight units.

biosphere—That transition zone between earth and atmosphere within which most forms of terrestrial life are commonly found; the outer portion of the **geosphere** and inner or lower portion of the **atmosphere**.

biostromal limestone—*See coquina*.

biostrome—Bedded structures such as shell beds consisting of and built mainly by sedentary organisms; not a moundlike or lenslike form. *See also accretionary limestone, bioherm, reef.* (2)

biota—The **fauna** and **flora** of a given region. (58)

biotic factors—Factors of a biological nature, such as availability of food, competition between species, predator-prey relationships, etc., which, besides the purely physical and chemical factors, also affect the distribution and abundance of a given species of plant or animal. (25)

biotic succession—The natural replacement of one or more groups of marine organisms growing in a specific habitat by other groups, the preceding groups in some way preparing or favorably modifying the habitat for the succeeding groups.

bipinnaria larva—The usually planktonic young of a sea star.

Birch discontinuity—Seismic discontinuity within the earth's **mantle** at a depth of about 900 kilometers (about 558 statute miles), possibly caused by a chemical or phase change, or both. (2)

bird-foot delta—A **delta** formed by the outgrowth of pairs of natural **levees** making the digitate or bird-foot form.



BIRD-FOOT DELTA

(AFTER LOBECK, A.K., "GEOMORPHOLOGY AN INTRODUCTION TO THE STUDY OF LANDSCAPING NEW YORK: MCGRAW-HILL 1939, p.230)

bittern—The liquid remaining after sea water has been concentrated by evaporation until salt has crystallized. (5)

bivalve—(or *pelecypod, lamellibranch*). One of a class (*Pelecypoda* or *lamellibranch*) of **mollusks** generally **sessile** or burrowing into soft sediment, rock, wood, or other materials. Individuals possess a hinged shell and a hatchet-shaped foot, which in some is used in digging. The clams, oysters, and mussels belong to this class; many of the latter two mollusks are notable **fouling organisms**; several are **marine borers**.

black and white iceberg—An **iceberg** having a dark, opaque portion containing sand and stones, and separated from the white portion by a definite line of demarcation. (68)

black body radiation—The **electromagnetic radiation** emitted by an ideal black body; it is the theoretical maximum amount of radiant energy of all wavelengths which can be emitted by a body at a given temperature. (5)

black bottle—(also called *dark bottle*). A container used in measuring respiratory activity of primary producers. The container is covered or coated to exclude light and thereby prevent photosynthetic activity. *See light bottle.*

black fish—*See pilot whale.*

black ice—Thin, new ice on fresh or salt water, appearing dark in color because of its transparency. (59)

black mud—(also called *hydrogen sulfide mud*). A dark fine-grained sediment formed in poorly aerated **bays, lagoons, and fiords**. This sediment contains large quantities of decaying organic matter and iron sulfides and generally exudes hydrogen sulfide gas.

blade—The expanded or elongate leaflike part of the larger algae, especially **kelp**. *See lamina.*

blanket deposit—A sedimentary deposit of uniform thickness which covers a wide region.

blast wave—A sharply defined wave of increased pressure rapidly propagated through a surrounding medium from a center of detonation or similar disturbance. (63)

blind lead—(also called *cul-de-sac, pocket*). A **lead** with only one outlet. (68)

blind rollers—Long, high **swells** which have increased in height, almost to the breaking point, as they pass over **shoals** or run in shoaling water. (61)

blink—*See ice blink, snow blink.*

blizzard—A severe weather condition characterized by low temperatures and by strong winds bearing a great amount of snow (mostly fine, dry snow picked up from the ground). The U.S. Weather Bureau specifies for blizzard, a wind of 28 knots or higher, low temperatures, and sufficient snow in the air to reduce visibility to less than 500 feet. (5)

bit—1. A small piece of sea ice; a single fragment of **brash ice**.

2. A binary unit of information. (5)

block—1. A **sea ice** fragment more than 6 feet but less than 30 feet in diameter. *See* **ice cake**. (59)

Note: The WMO is attempting to phase out this term.

2. An angular rock fragment variously defined as being larger than 4 millimeters, larger than 32 millimeters, or larger than 256 millimeters. (2)

blocky iceberg—An **iceberg** with steep, precipitous sides, and with an essentially horizontal upper surface. (68)

bloom—*See* **plankton bloom**.

blowing spray—Spray lifted from the sea surface by the wind and blown about in such quantities that the horizontal visibility is restricted. (5)

blown sands—*See* **eolian sands**.

blue-green alga—One of a division or phylum (Cyanophyta) (the Myxophyceae of another scheme) of single-celled or simply filamentous plants in which the blue color is imparted by a water-soluble accessory pigment, *c*-phycoerythrin. In the planktonic form, *Skujaella* (*Trichodesmium*) *erythraea*, for whose color the Red Sea was named, a red pigment dominates the others. Attached forms have a characteristic scummy or velvety growth on boat bottoms, rocks, and other underwater surfaces. Large masses of planktonic forms cause "sliming" of the water.

blue ice—The oldest and hardest form of **glacier ice**. It is distinguished by a slightly bluish or greenish color. (65)

blue mud—A combination of terrigenous and deep sea sediments having a bluish gray color due to the presence of organic matter and finely divided iron sulfides. Calcium carbonate is present in variable amounts up to 35 percent.

bluff—A **headland** or cliff with a bold almost perpendicular front.

boat channel—A shallow, narrow channel on a **reef flat** which separates a **fringing reef** from the shore. It is parallel to shore and generally only a few feet deep.

body waves—Either transverse or longitudinal seismic waves transmitted in the interior of an elastic solid or fluid, and not related to a boundary surface. (35)

boiling point—The temperature at which the equilibrium vapor pressure between a liquid and its vapor is equal to the external pressure on the liquid.

The boiling point of pure water at standard atmospheric pressure is equal to 100°C (212°F) and is a **fiducial point** for thermometer calibration. (5)

bold coast—A prominent landmass that rises steeply from the sea. (61)

bolometer—An instrument for measuring thermal radiation. (68)

bora—A fall wind whose source is so cold that when the air reaches the lowlands or coast the dynamic warming is insufficient to raise the air

temperature to the normal level for the region; hence it appears as a cold wind.

The term was originally and still is applied to the cold northeast wind on the Dalmatian coast of Yugoslavia in winter when cold air from Russia crosses the mountains and descends to the relatively warm coast of the Atlantic. It is very stormy and squally, the squalls sometimes reaching 100 miles per hour or more. (5)

borderland—A not so commonly used term for the declivity which marks the inner or landward margin of the **continental borderland**; the ACUF did not find sufficient evidence of this type of feature to warrant inclusion in their recommended terms and definitions.

borderland slope—The declivity which marks the inner or landward margin of the **continental borderland**. (2)

bore—1. *See* **hydraulic jump**.

2. (also called *eager*, *mascaret*, or *tidal bore*).

A high breaking wave of water, advancing rapidly up an **estuary**. Bores can occur at the mouths of shallow rivers if the tide range at the mouth is large. They can also be generated in a river when **tsunamis** enter shallow coastal water and propagate up the river. (5)

3. A submarine sand ridge in very shallow water. It may build up to intertidal level. (2)

4. *See* **borehole**.

borehole—(or *boring*, *bore*). A hole drilled into the earth to obtain samples of and measure the physical properties of the rock and sediments penetrated.

borer—*See* **marine borer**.

boring—1. Forcing a ship under power through ice, by breaking a **lead**.

2. *See* **borehole**.

(68)

bottle paper—*See* **drift bottle**.

bottle post—*See* **drift bottle**.

bottom—Any ground covered by water. **Bed** refers more specifically to the whole submerged basin, and floor is the essentially horizontal surface of the ground beneath the water.

bottom bounce—A technique by which acoustic energy is reflected off the ocean bottom one or more times before reaching the target.

bottom flow—(or *underflow*). A current denser than any part of the surrounding fluid and which flows along the sea bottom.

bottom friction—The force resulting from the interaction between the ocean bottom and water particle motion over it. In the case of currents, it is a retarding force acting in a direction opposite to the current flow. It is proportional to the roughness of the bottom, water density, velocity of the current, and water depth. The effect of bottom friction is also of importance in forecasting waves in **shallow water**. As the waves travel over shallow water they lose considerable energy because of the stress of moving

water against the bottom of the ocean, causing the waves to decrease in height.

bottom ice—*See* anchor ice.

bottom load—*See* load.

bottom materials—*See* bottom sediments.

bottom pressure—The pressure at a point on the bottom of a body of water due to the weight of the column of water above it.

bottom pressure fluctuation—The change in pressure at a point on the bottom of a body of water as a surface wave passes over it.

bottom reflection—The return of transmitted sound from the bottom of the ocean. The characteristics of reflected sound depend on the nature of the bottom and on the wavelength of the sound.

bottom resistivity—The resistance, in ohms, between opposite faces of a unit cube of sediment. It is governed more by the electrolyte concentration of the liquid filling the interstices than by the intrusive conductivity of the sediment grains itself.

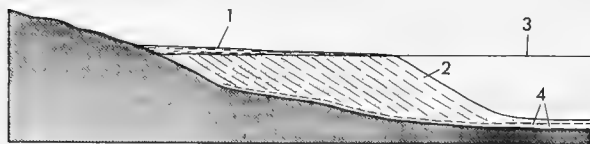
bottom reverberation—*See* reverberation.

bottom sample—A portion of the material forming the bottom, brought up for inspection. (68)

bottom sampler—Any instrument used to obtain a bottom sample. *See* grab.

bottom sediments—(also called *bottom materials*). In general all sedimentary material regardless of origin found on or in the submarine bottom, including ballast or other material dumped into the sea by man. More specifically it is limited to unconsolidated mineral and organic material forming the sea bottom, not including coral reefs or bedrock.

bottom-set beds—The layers of fine alluvial sediments carried out and deposited on the bottom of the sea in front of a delta. (2)



BOTTOM-SET BEDS

1. Top-set beds; 2. Fore-set beds; 3. Water surface; 4. Bottom-set beds

(AFTER: LEET, L. DON & AUDSON, SHELDON PHYSICAL GEOLOGY NEW YORK PRENTICE-HALL, INC 1954 p 139)

bottom temperature—Temperature observed at the bottom of the sea.

bottom water—The water mass at the deepest part of the water column. It is the densest water that is permitted to occupy that position by the regional topography. *See* water mass.

Bouguer anomaly—A difference between an observed value of gravity and a theoretical value at the point of observation, which has been corrected for the effect of topography only, the to-

pography being considered as resting on a plane of indefinite extent. (37)

Bouguer correction—A correction made in observed gravity values for the altitude (elevation) above sea level of the station and the rock between the station and sea level.

boulder—(or *boulder*). A rounded rock with a diameter of 256 millimeters or larger. *See* phi grade scale.

boulder barricade—A coast bordered with lines of innumerable large boulders visible between low water and half tide.

boulder clay—Unstratified or little stratified and unsorted deposit of silty and clayey materials in which are embedded particles of sand to boulder size. (2)

boulderet—*See* cobble.

boulder gravel—Deposit of uncemented boulders. (2)

boundary layer—A term referring broadly to the layer of fluid in the immediate vicinity of a bounding surface. It is the layer in which frictional forces are not negligible.

boundary surface—*See* interface.

Bourdon tube—Part of the temperature sensing element in a bathythermograph. It consists of a hollow brass coil connected to a xylene filled tube, with one end fixed and the other free to move with temperature expansion and contraction.

boulder—*See* boulder.

box gage—(or *float gage*). A tide gage that is operated by a float in a long, vertical stationary box to which the tide is admitted through an opening in the bottom. (50)

brachial—Pertaining to armlike structures, such as to the rays of starfishes.

brachiolaria—A more advanced stage of the bipinnaria larva of a sea star.

brachiopod—(or *lamp shell*). One of a phylum (Brachiopoda) of sessile, marine, mollusklike animals in which the body, whose construction differs considerably from that of the mollusks, is enclosed in calcareous or horny bivalve shell. Most species live in shallow water. Many fossil species are known.

brackish water—Water in which salinity values range from approximately 0.50 to 17.00 parts per thousand. (35)

branch fiord—A bifurcation of a narrow deep arm of the sea.

branchial—Pertaining to gills.

branching bay—*See* estuary.

brash ice—A fragment of sea ice or river ice less than 2 meters (6.6 feet) in diameter. (74)

brave west winds—A nautical term for the strong and rather persistent westerly winds over the oceans in temperate latitudes.

They occur between 40° and 65°N in the Northern Hemisphere and 35° to 65°S in the Southern Hemisphere, where they are more regular and are strongest between 40° and 50°S

(roaring forties). They are associated with the strong pressure gradient on the equatorial side of the frequent depressions passing eastward in subpolar temperate latitudes; hence they fluctuate mainly between southwest and northwest. (5)

Brazil Current—The warm ocean current that flows southward along the Brazilian coast below Natal.

Its origin is in the westward flowing **South Equatorial Current**, part of which turns south and flows along the South American coast as the Brazil Current. At about 35° S it meets the cold north-setting **Falkland Current** and the two turn to set eastward across the South Atlantic Ocean.

breaker—A wave breaking on the shore, over a reef, etc. Breakers may be roughly classified into three kinds, although the categories may overlap:

Spilling breakers break gradually over a considerable distance;

Plunging breakers tend to curl over and break with a crash; and

Surging breakers peak up, but then instead of spilling or plunging they surge up on the **beach face**.

In the figure on the following page, the sketches consist of a series of profiles of the wave form as it appears before, during, and after breaking. The numbers opposite the profile lines indicate the relative times of occurrence. (61)

breaker depth—(also called *breaking depth*).

The still water depth at the point where a wave breaks. (See figure for **surf zone**.) (61)

breaker zone—Generally used for **surf zone**.

breaking depth—See **breaker depth**.

breakup—In general, the spring melting of snow, ice, and frozen ground. Specifically, the destruction of the ice cover on rivers and seas during the spring thaw; or applied to the time when the solid sheet of ice breaks into pieces that move with the current.

Breakup connotes the end of winter to a resident of the north. (59)

breakwater—A structure protecting a shore area, harbor, anchorage, or basin from waves. (61)

breccia—(or *agglomerate*). A fragmental rock whose components are angular and therefore, as distinguished from **conglomerates**, are not waterworn. There are friction or fault-breccias, talus-breccias, and eruptive or **volcanic breccias**. (2)

bridge—A light formation of snow or ice joining two heavier formations. See **ramp**. (65)

brightness—See **luminance**.

brine—Sea water containing a higher concentration of dissolved salt than that of the ordinary ocean.

Brine is produced by the evaporation or freezing of sea water, for, in the latter case, the sea ice

formed is much less saline than the initial liquid, leaving the adjacent unfrozen water with increased salinity. The liquid remaining after sea water has been concentrated by evaporation until salt has crystallized is called **bittern**. (5)

brine slush—A mixture of ice crystals and salt water, which retards or prevents complete freezing, often found between young sea ice and a cover of newly fallen snow. (59)

brit—(sometimes spelled *britt*). 1. The young of the common herring; any of certain small herring.

2. The **plankton** upon which the right whales feed.

3. Any of the silversides.

British thermal unit—(abbreviated B.T.U., Btu). A unit of energy defined as the heat required to raise the temperature of one pound of water one degree Fahrenheit; it is equal to 252.1 calories or 1,055 Joules. (5)

brittle star—One of a class (Ophiuroidea) of **echinoderms** having five, sometimes six, rarely seven or eight, elongate, slender, cylindrical arms radiating from a flat central disc; they range from shallow water to great depths.

broad ice field—A Russian term for an ice field of more than 10 kilometers (5.4 n. miles) in width. It corresponds to the current WMO definition of vast **ice floe**.

broken beít—The transition zone between **open water** and **consolidated ice**. (68)

broken ice—(also called *loose ice*, *loose pack ice*, *open ice*, *open pack ice*, *slack ice*). Ice that covers from 5-tenths to 8-tenths of the sea surface. See **open pack ice**. (68)

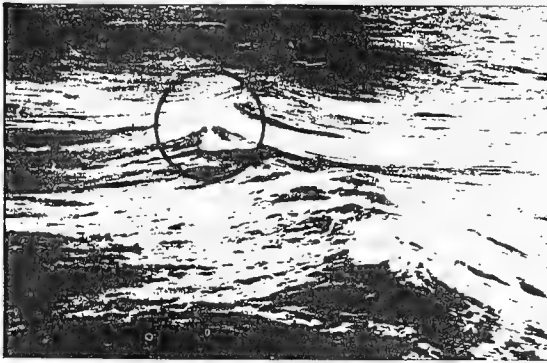
Note: This term is being superceded by the term open pack ice by WMO.

broken water—Water having a surface covered with **ripples** or **eddies**, and usually surrounded by calm water. (68)

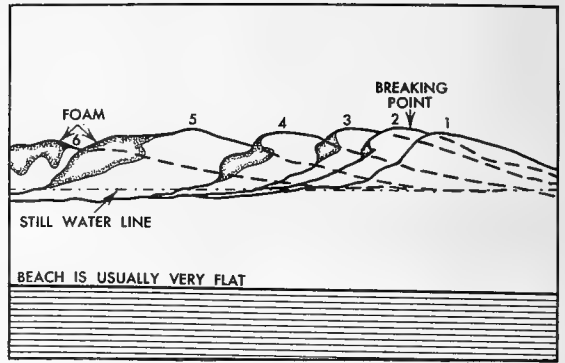
brown alga—One of a division or phylum (Phaeophyta) (the Phyophyceae of another scheme) of greenish yellow to deep brown, filamentous to massively complex plants, in which the color is imparted by the predominance of **carotenes** and **xanthophylls** over the **chlorophylls**. This group includes the **rockweeds**, gulfweeds, and the large **kelp**. Brown algae are most abundant in the cooler waters of the world.

bryozoan—(or *polyzoan*, *moss animal*, *sea mat*). One of a phylum (Bryozoa or Polyzoa) of minute, mostly colonial, aquatic animals with body walls often hardened by calcium carbonate and growing attached to aquatic plants, rocks, and other firm surfaces. Colonies may be encrusting, creeping, or erect and branching. Encrusting colonies may be white, yellowish, or brick red and consist of many tiny, beautifully formed shells. Members of this phylum are widespread and notable **fouling organisms**.

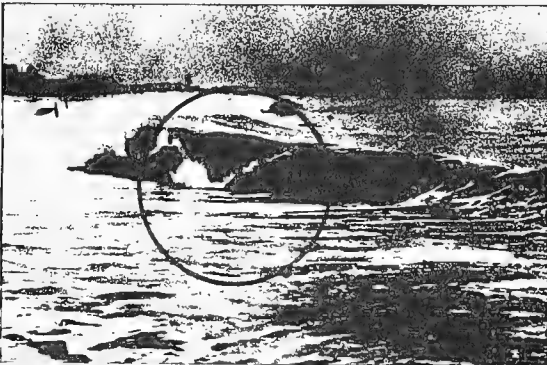
BT slug—See **airborne expendable bathythermograph**.



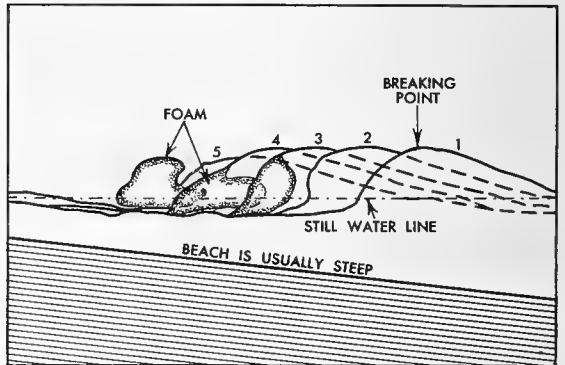
SPILLING BREAKERS



GENERAL CHARACTER OF SPILLING BREAKERS



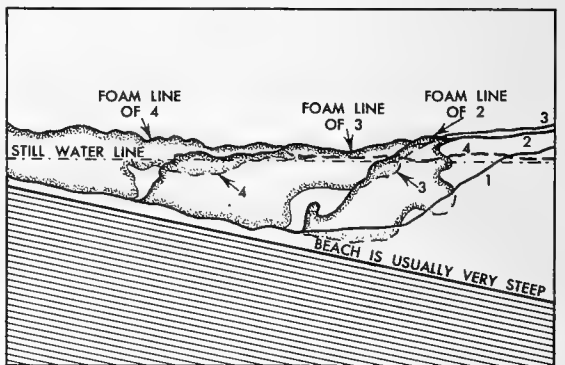
PLUNGING BREAKERS



GENERAL CHARACTER OF PLUNGING BREAKERS



SURGING BREAKERS



GENERAL CHARACTER OF SURGING BREAKERS

TYPES OF BREAKERS

(AFTER WEGEL, 1953)

bubble pulse—A pulsation attributable to the bubble produced by a seismic charge fired in water. The bubble pulsates several times with a period proportional to the cube root of the weight of the charge; each oscillation produces an identical unwanted seismic effect. (4)

bucket temperature—The surface temperature of the sea as measured by a **bucket thermometer**.

bucket thermometer—A thermometer used to measure the temperature of a bucket of water drawn from the surface of the ocean.

Bug Battery—A bacteria-filled fuel cell in which certain biological organisms act as supercatalysts in promoting electrochemical reactions. The Navy has sent radio signals more than 15 miles powered by this device. This new concept

developed from the discovery that electrodes thrust in ocean mud could pick up electrical energy from microorganisms under the bottom slime.

built platform—A bank of sediment which flanks the **marine-cut terrace** or wave cut platform on its seaward margin. The sediment is derived from marine erosion and from rivers. (2)

bulk modulus—*See* **coefficient of compressibility**.

bull kelp—1. One of a genus (*Nereocystis*) of large **brown algae**, which consist of a massive **holdfast**, a long tough **stipe** terminated by an elongate bulbous **pneumatocyst**, from which four lamina-bearing branches radiate. This genus occurs only on the Pacific coast of North America from southern California northward into Alaska and may reach lengths of 100 feet or more.

2. One of a genus (*Durvillea*) of large brown algae with broad, massive, leathery laminae, which grows on rocks in the intertidal zone in the cold waters of South America and New Zealand.

bummock—From the point of view of the submariner, a downward projection from the underside of the **ice canopy**; the submerged counterpart of a **hummock**. (7)

buoy—A float; especially a floating object moored to the bottom, to mark a channel, anchor, shoal rock, etc. Some common types are:

A nun or nut buoy is conical in shape;

A can buoy is squat, and cylindrical or nearly cylindrical above water and conical below water;

A spar buoy is a vertical, slender spar anchored at one end;

A bell buoy is one having a bell operated

mechanically or by the action of waves, usually marking shoals or rocks;

A whistling buoy is similarly operated (by wave action), marking shoals or channel entrances;

A dan buoy carries a pole with a flag or light on it.

(61)

buoyancy—1. That property of an object that enables it to float on the surface of a liquid, or ascend through and remain freely suspended in a compressible fluid such as the atmosphere. Quantitatively, it may be expressed as the ratio of the specific weight of the fluid to the specific weight of the object; or, in another manner, by the weight of the fluid displaced minus the weight of the object.

2. (or *buoyant force*; also called *Archimedean buoyant force*). The upward force exerted upon a parcel of fluid (or an object within the fluid) in a gravitational field by virtue of the density difference between the parcel (or object) and that of the surrounding fluid.

(5)

buoyant force—*See* **buoyancy** (sense 2).

burning of the sea—*See* **sea fire**.

buys Ballot's law—A law describing the relationship of the horizontal wind direction in the atmosphere to the pressure distribution; if one stands with his back to the wind, the pressure to the left is lower than to the right in the Northern Hemisphere. In the Southern Hemisphere, the relation is reversed.

This law was formulated in 1857 by the Dutch meteorologist Buys Ballot and is a qualitative statement of the geostrophic wind equation.

(5)

byssal thread—A part of a **byssus**.

byssus—A hairy attachment structure secreted by certain pelecypods.

C

- caballing**—The mixing of two water masses of identical *in situ* densities but different *in situ* temperatures and salinities, such that the resulting mixture is denser than its components.
- cable**—1. A chain of metal links or a strong hemp or wire rope used to anchor ships or buoys; an underwater or overhead ropelike wire carrying an electric current.
 2. A unit of distance equal to 720 feet in the U.S. Navy.
 3. A unit of distance equal to 608 feet in the British Navy or exactly one-tenth of a British Nautical Mile. (68)
- cable-laid rope**—(also known as *water-laid rope*). Three or four plain-laid, three-stranded ropes twisted together in the opposite direction to the twists in each rope. It is used for ropes much exposed to water.
- cadder**—A short form of ballycadder, meaning an ice foot. (59)
- caisson disease**—*See* decompression sickness.
- cake**—*See* ice cake.
- cake ice**—An ice pack composed of fragments of flat sea ice. (59)
- cake urchin**—*See* sea urchin.
- calcareenite**—A limestone or dolomite rock composed of 50 percent or more coral sand or shell sand whose particle size ranges from $\frac{1}{16}$ to 2 millimeters. Sometimes designates calcareous sand.
- calcareous**—Consisting of or containing calcium or calcium carbonate; impregnated with calcium carbonate. (13)
- calcareous algae**—Marine plants which form a hard external covering of calcium compounds. Calcareous algae are found in all oceans and frequently form reefs.
- calcareous grits**—Sandy beds, intermixed with calcareous matter. (48)
- calcareous sponge**—A sponge in which the internal skeletal elements (**spicules**) are composed of calcium carbonate.
- calclutite**—A very fine-grained limestone or calcareous sediment, often containing some clay matter. The mean grain diameter is less than 0.0625 millimeter.
- calcirudite**—A limestone conglomerate or sediment composed of fragments of coral, shell, or limestone, cemented by or mixed with calcite and calcareous sand or mud. (2)
- calcisiltite**—Limestone or limy sediment composed of silt-sized calcareous fragments.
- calcite**—Calcium carbonate, $CaCO_3$, crystallized in hexagonal-rhombohedral form; one of the principal constituents of limestone.
- calclithite**—Limestone containing 50 percent or more of fragments of older limestone eroded from the land. (2)
- calc-sapropel**—Sediments containing principally sapropel but also the remains of calcareous algae. (2)
- caldera**—A large basin-shaped volcanic depression, the diameter of which is many times greater than that of the included volcanic vent or vents. Calderas are classified into three major types: explosion, collapse, and erosion. Numerous islands are drowned remnants of calderas. (2) (*See* figure for **compound volcano**.)
- caldrion**—This term is not recommended by ACUF. *See* basin.
- calf**—A piece of floating ice which has broken away from a larger piece of sea ice or land ice. Specifically, a piece of ice which rises to the surface after breaking away from the submerged portion of its parent formation. (59)
- calibration**—Comparison between two instruments or devices, one of which is a standard of known accuracy, to detect and to correlate or adjust any variation in the accuracy of the instrument being compared. (22)
- calibration correction**—The value to be added to or subtracted from the reading of an instrument to obtain the correct reading. (68)
- calibration error**—(also called *scale error*). That error in an instrument due to imperfection of calibration or maladjustment of its parts. (68)
- calibration table**—A list of calibration corrections or calibrated values. A card having such a table on it is called a calibration card. (68)
- California Current**—The ocean current that flows southward along the west coast of the United States to northern Baja California. It is formed by parts of the **North Pacific Current** and the **Subarctic Current** and is a wide current that moves sluggishly toward the southeast. Off Central America, the California Current turns toward the west and becomes the **North Equatorial Current**.
- Callao Painter**—(or *El Pintor*). Mariners' reference to the catastrophic destruction of marine life which causes the blackening of paint on

- ships within the harbor of Callao, Peru. Hydrogen sulfide released during the decomposition of the organisms is responsible for the phenomenon. The immediate cause of this phenomenon is the increase in water temperature when warmer oceanic currents turn inshore; organisms normally accustomed to colder water temperatures die because of this abrupt temperature change.
- calm**—1. The state or condition of the water surface when there are no **wind waves** or **swell**. (73)
2. The apparent absence of motion of the surface water; the water is generally considered calm if the current speed is less than 0.1 knot. *See slack water.*
- calm belt**—A belt of latitude in which the winds are generally light and variable. The principal calm belts are the **horse latitudes** (the calms of Cancer and Capricorn) and the **doldrums**. (5)
- calorie**—(abbreviated cal). A unit of heat originally defined as the amount of heat required to raise the temperature of one gram of water through one degree centigrade (the gram-calorie or small calorie), but this proved to be insufficiently precise. The 15-degree gram-calorie (cal₁₅) is the amount of heat required to raise the temperature of one gram of water from 14.5°C to 15.5°C, and is equal to 4.1855 Joules. The kilogram-calorie or large calorie (Kcal, kg-cal, or Cal) is 1,000 times as large as a calorie. The International Table calorie (ITcal) equals 1.00032 cal₁₅. (5)
- calve**—To break off or discharge pieces of ice from a larger ice mass, as from a **tidal glacier**. (59)
- calved ice**—(also called *calf*). A piece of ice floating in a body of water after **calving** from a mass of land ice or an **iceberg**.
The term **calf** sometimes is used specifically for a piece that has broken loose from a submerged portion of an iceberg and risen to the sea surface. (5)
- calving**—The breaking off of a mass of ice from its parent **glacier**, **iceberg**, or **ice shelf**. (5)
- camber**—A small **basin**, usually with a narrow entrance, generally situated inside a harbor. (30)
- canal**—1. An artificial watercourse cut through land.
2. A long narrow **arm** of the sea extending inland, between islands, or between islands and the mainland. (2)
- Canaries Current**—*See Canary Current.*
- Canary Current**—The prevailing southward flow along the northwest coast of Africa; it helps to form the **North Equatorial Current**.
- candled ice**—*See candle ice.*
- candle ice**—(or *candled ice*, *penknife ice*, *needle ice*, *frost columns of ice*). A form of **rotten ice**; disintegrating sea ice (or lake ice) consisting of ice prisms or cylinders oriented perpendicular to the original ice surface; these "ice fingers" may be equal in length to the thickness of the original ice before its disintegration. (5)
- candle-power**—*See luminous intensity.*
- canyon**—A relatively narrow, deep depression with steep slopes, the bottom of which grades continuously downward. (62)
- canyon delta**—A variation and more specific definition of a type of fan which is described as a sloping cone-shaped accumulation of sediments at the mouth of a canyon having a single deep **seachannel** and high natural **levees** on its upper portion and multiple shallow distributary seachannels on its lower portion; not recommended by ACUF. *See fan.*
- cape**—A body of land jutting from a continent or large island which prominently marks a change in or interrupts the coastal trend.
- Cape Horn Current**—That part of the **West Wind Drift** flowing eastward in the immediate vicinity of Cape Horn, and then curving northeastward to continue as the **Falkland Current**. (68)
- capillary forces**—*See surface tension.*
- capillary ripple**—Same as **capillary wave**.
- capillary wave**—(also called *ripple*, *capillary ripple*). A wave whose velocity of propagation is controlled primarily by the **surface tension** of the liquid in which the wave is travelling. Water waves of length less than one inch are considered to be capillary waves. (61)
- carapace**—A chitinous or bony shield covering the whole or part of the back of certain animals, such as many **crustaceans** and the turtles. (26)
- carbon dioxide**—A heavy, colorless gas of chemical formula CO_2 . It is the fourth most abundant constituent of dry air, now present to the extent of 0.033 percent by volume.
Over 99 percent of the terrestrial CO_2 is found in the oceans, but its solubility is strongly temperature-dependent, so changes in sea surface temperatures can lead to marked local changes in CO_2 content. (5)
- Carbon¹⁴ method**—A method of radioactive dating which utilizes the ratio of radiocarbon (Carbon¹⁴) to Carbon¹² to determine the age of samples containing formerly living matter.
- Carbon¹⁴ technique**—A method of measuring **primary production** by using the radioactive isotope C^{14} as a **tracer**. The tracer, in the form $C^{14}O_2$, is assimilated by marine **phytoplankton** under appropriate test conditions. The amount of this tracer that has been incorporated into the organic matter of the phytoplankton is measured to determine the gross primary production.
- Caribbean Current**—A current flowing westward through the Caribbean Sea. It is formed principally by the major part of the **North Equatorial Current** setting through the Lesser

- Antilles; it is quite strong as it passes through Yucatan Channel and then turns clockwise to form the **Florida Current**.
- carotene**—A plant pigment. *See nonastacin carotenoid*.
- carrageen**—*See Irish moss*.
- carrageenin**—(or *carragheenin*). An extract of **Irish moss** or carrageen, with gel properties, used in puddings and as a stabilizer in various food products.
- carragheenin**—*See carrageenin*.
- cartography**—The art and science of making charts or maps. (66)
- cascade**—The mass of spray thrown outward from around the base of a **waterspout**. (5)
- cascajo**—Reef-derived material consisting of coral debris and other sediment occurring in old deposits. (2)
- castings**—*See fecal pellet*.
- catadromous**—A form of life cycle among fishes in which maturity is attained in fresh waters, and the adults migrate into the ocean to spawn. The common eel is an example.
- catazone**—The deepest zone of rock metamorphism where very high pressures and temperatures both prevail. (2)
- catenary**—The curve assumed by a flexible cord in equilibrium when suspended from both ends. The wire on which instruments are lowered into the sea forms half a catenary in the presence of currents.
- cathode ray tube**—A vacuum tube consisting essentially of an electron gun producing a concentrated electron beam (or cathode ray) which impinges on a phosphorescent coating on the back of a viewing face (or screen). The excitation of the phosphor produces light, the intensity of which is controlled by regulating the flow of electrons. Deflection of the beam is achieved either electromagnetically by currents in coils around the tube, or electrostatically by voltages on internal deflection plates. (5)
- cat ice**—*See shell ice*.
- cation**—A positively charged **ion**.
- cat's paw**—A puff of wind; a light breeze affecting a small area, as one that causes patches of ripples on the surface of a water area. (68)
- catter**—A short form of bellicatter, meaning an ice foot. *See ice foot*. (59)
- caustic**—1. In refraction of waves, the name given to the curve to which adjacent **orthogonals** of waves, refracted by a bottom whose contour lines are curved, are tangent. The occurrence of a caustic always marks a region of crossed orthogonals and high wave convergence. (61) (*See figure for wave refraction*.)
2. The envelope of a sequence of underwater sound rays which defines the boundary of the sound field.
- cavitation**—The turbulent formation, generally mechanically induced, including growth and collapse of bubbles in a fluid, and occurring when the static pressure at any point in fluid flow is less than fluid vapor pressure.
- cavitation noise**—The noise produced in a liquid by the collapse of bubbles that have been created by **cavitation**. (3)
- cay**—(also called *key* or *kay*). A low flat island or mound of sand built up on a **reef flat** slightly above high tide which may contain a large admixture of coral or shell fragments. (2)
- cay sandstone**—A friable to firm sandstone cemented by calcium carbonate and formed from coral sand near the base of **coral reefs** and extending to above high tide. *See also beach-rock*. (2)
- celerity**—*See wave celerity*.
- cellular convection**—An organized, convective, fluid motion characterized by the presence of distant convection cells or convective units, usually with upward motion (away from the heat source) in the central portions of the cell, and sinking or downward flow in the cell's outer regions. (5)
- Celsius temperature scale**—(abbreviated C). Same as *centigrade temperature scale*, by recent convention. *The Ninth General Conference on Weights and Measures (1948)* replaced the designation "degree centigrade" by "degree Celsius." (5)
- cementation**—The process of precipitation of a binding material such as quartz, calcite, or dolomite around grains or minerals in rocks. (2)
- center of action**—Any one of the semipermanent **highs** and **lows** that appear on mean charts of sea-level pressure. As originally used by L. Teisserenc de Bort in 1881, this term was applied to maximums and minimums of pressure on daily charts.
- The main centers of action in the Northern Hemisphere are the **Icelandic low**, the **Aleutian low**, the **Azores high** and/or **Bermuda high**, the **Pacific high**, the **Siberian high** (in winter), and the Asiatic low (in summer). Other less intense or less consistent "mean" systems may be considered. Fluctuations in the nature of these centers are intimately associated with relatively widespread and long-term weather changes. (5)
- center of gravity**—A point at which the mass of the entire body may be regarded as being concentrated.
- centigrade temperature scale**—*See Celsius temperature scale*.
- Central Water**—*See water mass*.
- centrifugal force**—The force with which a body moving under constraint along a curved path, reacts to the constraint. Centrifugal force acts in a direction away from the center of curvature of the path of the moving body. As a force caused by the rotation of the earth on its axis, centrifugal force is opposed to **gravitation**, and combines with it to form **gravity**. (37)
- centrifuge plankton**—*See nannoplankton*.

- centrosphere**—(also called *barysphere*, *core*). The central core of the earth, composed of dense material, and making up most of its mass. (2) (See figure for **earth structure**.)
- cephalopod**—One of a class (Cephalopoda) of **benthic** or free-swimming **mollusks** possessing a large head, large eyes, and a circle of arms or tentacles around the mouth; the shell is external, internal, or absent, and an ink sac usually is present. See **squid**, **octopus**, **nautilus**.
- cetacean**—A marine mammal of the order Cetacea, which includes the whales, dolphins, and porpoises.
- cgs system**—The system of physical measurements in which the fundamental units of length, mass, and time are the centimeter, gram, and second, respectively. (37)
- chaetognath**—See **arrow worm**.
- chain bag dredge**—See **chain mesh dredge**.
- chain mesh dredge**—(also called *chain bag dredge*). A **bottom sampler** constructed of a rectangular steel collar attached to a chain mail purse lined with screens or netting. It is used on the continental shelf to collect coarse-grained sediments and bottom dwelling organisms.
- chain reaction**—Any chemical or nuclear process in which some of the products of the process or energy released by the process are instrumental in the continuation or magnification of the process. (70)
- chalk**—A very soft white to light gray limestone composed of the **tests** of floating microorganisms and some shells of bottom dwelling animals in a matrix of finely crystalline **calcite**. Chalk is classed as rock on bottom sediment charts. (2)
- Challenger Expedition**—The expedition mounted by the British in *H.M.S. Challenger*, 1873–1876, which made the first extensive oceanographic research cruise.
- change of tide**—(or *turn of the tide*). A reversal of the direction of motion (rising or falling) of a **tide**. Sometimes applied to a reversal in the set of a **tidal current**.
- channel**—1. A natural or artificial waterway which either periodically or continuously contains moving water, or which forms a connecting link between two bodies of water. (61)
2. The part of a body of water deep enough to be used for navigation through an area otherwise too shallow for navigation. (61)
3. A large **strait**, as the English Channel. (61)
4. The deepest portion of a stream, bay, or strait through which the main volume or current of water flows. (61)
5. A **lead in pack ice**. (59)
6. An energy band of predetermined size used in the discrimination and storage of electronic pulses like those from a **gamma ray spectrometer** probe. See **pulse height analyzer**.
- channel wave**—Any elastic wave propagated in a sound channel because of a low velocity layer in the solid earth, the ocean, or the atmosphere. (35)
- chapeirao**—A Brazilian term for isolated coral structures, which often rise to a height of 40 to 50 feet like towers, sometimes spreading out in a mushroomlike top. (2)
- characteristic wave height**—See **significant wave height**.
- character of the bottom**—(also called *nature of the bottom*). The type of material of which the bottom is composed and its physical characteristics such as hard, sticky, and rough.
- chart**—A special-purpose map generally designed for purposes of navigation. The term is sometimes used to describe other special-purpose maps. (37)
- chart datum**—(or *datum*, *datum plane*, *hydrographic datum plane of reference*, *reference pline*, *tidal datum*). The permanently established surface from which soundings or tide heights are referenced (usually **low water**). The surface is called a tidal datum when referred to a certain phase of the tide. In order to provide a factor of safety, some level lower than **mean sea level** is generally selected, such as **mean low water** or **mean lower low water**. (See figure for **tide range**.)
- charted depth**—The vertical distance from the tidal datum to the bottom. (68)
- Charybdis**—See **Galofaro**.
- chemical oceanography**—The study of the chemical composition of the dissolved solids and gases, material in suspension, and acidity of ocean waters and their variability both geographically and temporally in relationship to the adjoining domains, namely, the atmosphere and the ocean bottom.
- chemiluminescence**—The production of light during a chemical reaction at low temperatures. **Bioluminescence** is a chemiluminescent reaction.
- chemistry of sea water**—See **constituents of sea water**.
- chemoautotrophic nutrition**—See **chemotrophic nutrition**.
- chemotrophic nutrition**—(or *chemoautotrophic nutrition*). That process by which an organism manufactures its food by using the energy derived from oxidizing organic matter. See **autotrophic nutrition**.
- Chile Current**—See **Peru Current**.
- chip log**—A line marked at intervals (commonly 50 feet), and payed out over the stern of a moving ship. By timing the intervals at which the markers appear as the line is pulled out by a drag (the “chip”), the ship’s speed can be determined. The wavelength of ocean waves can be estimated by noting the position of wave crests relative to the markers. (5)

- chi-square test**—A statistical significance test based on frequency of occurrence; it is applicable both to qualitative attributes and quantitative variables. Among its many uses, the most common are tests of hypothesized probabilities or probability distributions (goodness of fit), statistical dependence or independence (association), and common population homogeneity). (5)
- chitin**—A nitrogenous carbohydrate derivative forming the skeletal substance in **arthropods**. (26)
- chiton**—One of a class (Amphineura) of flattened **mollusks** protected either by calcareous **spicules** or plates.
- chlorine equivalent**—Original definition of **chlorinity**. It represents the total amount of chlorine, bromine, and iodine in grams per kilogram of sea water, with the assumption that the bromine and iodine have been replaced by chlorine. Chlorine equivalent is dependent on changes in **atomic weights**, whereas chlorinity is independent of such changes. (54)
- chlorinity**—(symbol Cl). A measure of the chloride content, by mass, of sea water (grams per kilogram of sea water, or per mille). Originally chlorinity was defined as the weight of chlorine in grams per kilogram of sea water after the bromides and the iodides had been replaced by chlorides. To make the definition independent of **atomic weight**, chlorinity is now defined as 0.3285233 times the weight of silver equivalent to all the halides.
Because of the Law of Constancy of Relative Proportions the amount of chlorinity in a sea water sample is generally used to establish the sample's **salinity**. By using **normal water** as a comparison standard, Knudsen burettes and pipettes for the analysis, and **Knudsen's Tables** to compute the results, determinations as accurate as those of a time-consuming gravimetric analysis can be made with a rapid titration of the sea water against silver nitrate solution, employing potassium chromate or other suitable indicator for the end-point.
- chlorophyll**—A group of green pigments, identified as *a*, *b*, and *c*, which occur chiefly in bodies called **chloroplasts** and are active in **photosynthesis**. The concentration of each of these pigments has been employed as a means of estimating the rate of photosynthesis (**primary production**) or as an index of the standing crop of plant forms.
- chloroplast**—The green pigmented body or bodies within the cells of **green algae**. (13)
- chlorosity**—The chlorine content of one liter of sea water. It is equal to the **chlorinity** of the sample times its **density** at 20°C. (5)
- chlorosity factor**—The ratio between the various substances in sea water and the **chlorosity**. It is obtained by dividing the concentration of the substance in milligram-atoms per liter by the chlorosity. (54)
- chop**—(or *wind chop*). The short-crested waves that may spring up quickly in a fairly moderate breeze and break easily at the crest. (61)
- chopping sea**—*See choppy sea*.
- choppy sea**—(also called *chopping sea*, *cockling sea*). Short, rough waves tumbling with a short and quick motion. (73)
- chordate**—One of a phylum (Chordata) of animals which possess a notochord (a middorsal cylindrical rod), a series of paired gill slits, both of which features are present only in the embryo of air-breathing members, and a dorsal central nervous system. Representative chordates are the **tunicates**, fishes, and mammals.
- chuck**—A narrow **passage** or **strait** swept by tidal currents, also applied to the **tidal current** itself. (2)
- ciguatera**—An intoxication in humans resulting from the ingestion of various tropical reef and inshore fishes and possibly certain invertebrates. The most common symptoms are tingling and numbness of the lips, tongue, hands, and feet, confusion of sensations of heat and cold, nausea, diarrhea, joint and muscular pain, burning urination, inability to coordinate voluntary muscular movements, and difficult breathing. The fatality rate is about 7 percent. The fishes involved usually are large carnivorous forms such as barracudas, snappers, groupers, and jacks. Many other common food fishes have been implicated in sporadic outbreaks of this type of poisoning, as well as certain marine snails and sea urchins.
- cilia**—Hairlike processes of cells, which beat rhythmically and cause locomotion of the cells or produce currents in water.
- cinders**—*See scoria, lapilli*.
- cinerite**—Sedimentary material consisting of volcanic cinders. (2)
- circle of longitude**—*See parallel of latitude*.
- circulation**—1. The flow or motion of a fluid in or through a given area or volume.
2. A general term describing water current flow within a large area; usually a closed circular pattern such as in the North Atlantic, Mediterranean, etc.
- cirripede**—*See barnacle*.
- cirrus**—1. One of the appendages of **barnacles**; one of the filamentous respiratory and tactile appendages of **annelids**. (26).
2. Also, a principal cloud type.
- cladoceran**—*See water flea*.
- clam**—A member of any one of several families of generally edible **bivalves**, the majority of which burrow into mud or sand bottoms.

clamshell snapper—A bottom sampling device used to collect a small amount (less than 1 pint) of material from the ocean floor. It has metal jaws that snap shut when the device touches the bottom.

clapotis—The French equivalent for a type of **standing wave**. In American usage it is usually associated with the standing wave phenomenon caused by the reflection of a **wave train** from a breakwater, bulkhead, or steep beach. (73)

Clarke-Bumpus quantitative plankton sampler—A plankton collecting device equipped with a **flowmeter** to determine the volume of water passed through it in a given time interval.

class—See **classification of organisms**.

classification of marine environments—The components of this classification commonly are used with or without the terms division, region, province, or zone. (40)

classification of organisms—The grouping of plants and animals according to natural relationships; the groups range progressively from those based upon broad and general relationships to those based upon narrow and specific relationships. One of the large marine sharks (the white shark) is classified below; the groups are listed in increasing order of specificity.

Kingdom: Animal
 Subkingdom: Metazoa
 Phylum: Chordata
 Subphylum: Gnathostomata
 Class: Chondrichthyes
 Subclass: Elasmobranchii

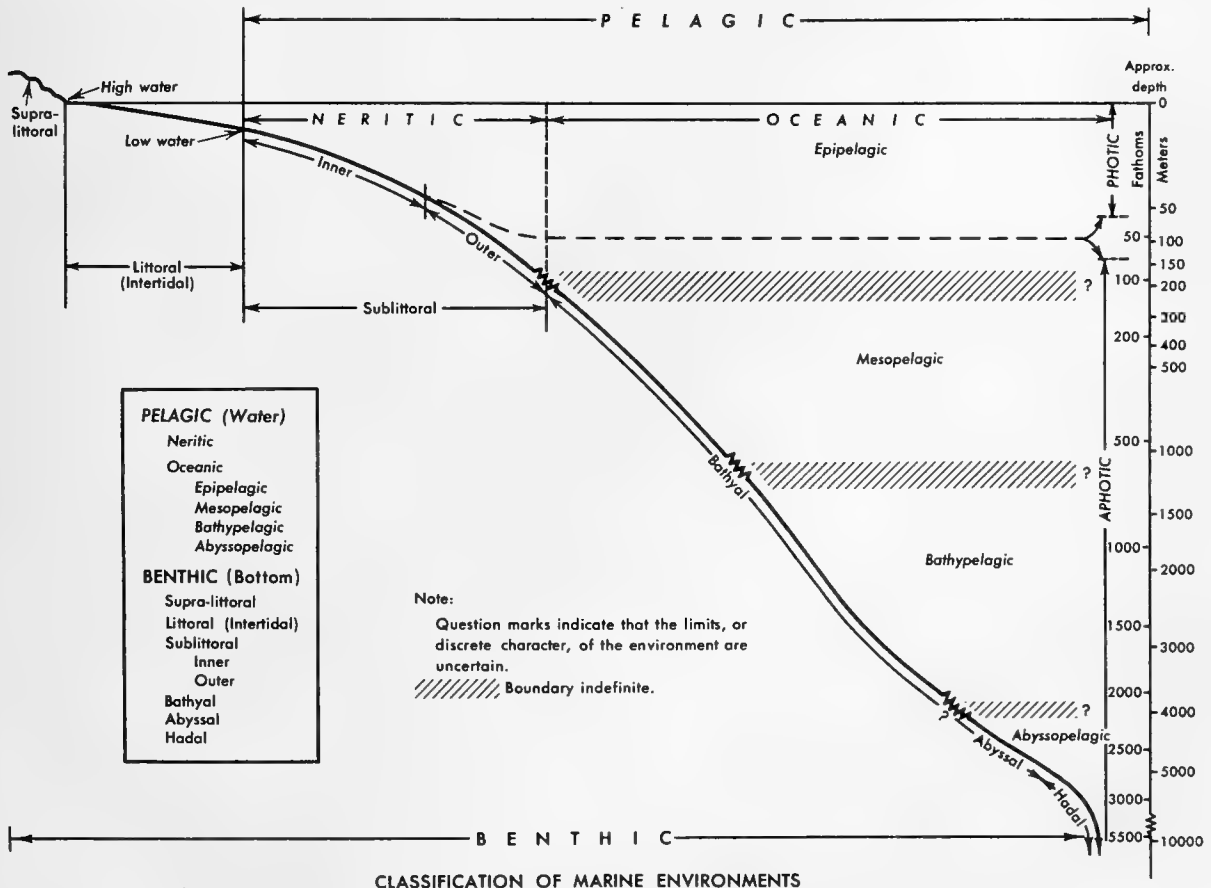
Order: Selachii
 Suborder: Galeoidea
 Family: Lamnidae
 Subfamily: Lamnini
 Genus: *Carcharodon*
 Species: *carcharias*

class interval—A range of values of a variable; an interval used in dividing the scale of the variable for the purpose of tabulating the frequency distribution of a sample. (5)

clastic—A rock composed principally of **detritus** transported mechanically into its place of final deposition. Sandstones and shales are the commonest clastics. Limestones are not clastic rocks unless formed of particles derived from pre-existing limestone. (2)

clastic rock—See **clastic**.

clay—As a size term, refers to sediment particles ranging from 0.0039 to 0.00024 millimeter, in which case it includes rock flour, calcareous muds, aragonite, etc. Mineralogically, clay is a hydrous aluminum silicate material with plastic properties and a crystal structure. Common clay minerals are **kaolinite**, **montmorillonite**, and **illite**. See **phi grade scale**.



- clay gall**—Small pellets of **clay** which are generally embedded in a sandy matrix.
- clearing**—*See* **polynya**.
- cleavage**—The splitting of bedded rocks along definite parallel closely spaced planes which may be highly inclined to the **bedding planes**.
- cliff**—*See* **bluff**.
- climate**—The prevalent or characteristic meteorological conditions of a place or region, in contrast with weather which is the state of the **atmosphere** at any time.
- clino**—The sloping part of the floor of the sea which extends from the **wave base** to the deeper parts of the sea. The deposit formed in the clino environment is called a **clinoform**. The rock unit of the clinoform is the **clinothem**. (2)
- clinoform**—*See* **clino**.
- clinothem**—*See* **clino**.
- clo**—A unit of thermal insulation, usually applied to clothing or bed covers. It is defined as the amount of insulation necessary to maintain comfort and a mean skin temperature of 92°F for a person who is producing heat at the standard metabolic rate (50 kilogram-calories per square meter of body surface per hour; one met) in an indoor environment characterized by a temperature of 70°F, relative humidity of less than 50 percent, and air motion of 20 feet per minute. (5)
- closed bay**—A **bay** indirectly connected with the sea through a narrow pass. (2)
- close drift ice**—*See* **close pack ice**.
- closed sea**—1. That part of the ocean enclosed by **headlands**, within narrow **straits**, etc.
2. That part of the ocean within the territorial jurisdiction of a country. (68)
- close ice**—(also called *close pack*, *packed ice*). Ice that covers from 8-tenths to 10-tenths of the sea surface. (68) *See* **close pack ice** (preferred WMO term).
- close pack**—*See* **close ice**.
- close pack ice**—(or *close drift ice*). **Sea ice** consisting of **ice floes** that are generally in contact. Their concentration ranges between 7-tenths and 9-tenths (6-eighths to 7-eighths). (74)
- Cl-ratio**—The amount of any **ion** or substance per unit weight of **chlorinity**. It is obtained by dividing the concentration of the various ions in grams per kilogram by the chlorinity. (54)
- cnoidal wave**—A type of wave profile in shallow water (depth of water is less than $\frac{1}{8}$ to $\frac{1}{10}$ the wavelength). The formula is expressed in terms of the Jacobian elliptic function *cn u*; hence the term “cnoidal.” (72)
- coast**—The general region of indefinite width that extends from the sea inland to the first major change in terrain features. (2)
- coastal area**—The land and sea area bordering the **shoreline**. (61)
- coastal current**—A relatively uniform **drift** usually flowing parallel to the shore in the deeper water adjacent to the **surf zone**. The current may be related to tides, winds, or distribution of mass.
Sometimes called a nearshore current or **offshore current**. (73)
- coastal ice**—*See* **fast ice**.
- coastal plain**—A plain which borders the sea coast, and extends from the sea to the nearest elevated land.
- coastal plain estuary**—*See* **estuary**.
- coastal pressure ridge**—The ridge formed when floating sea ice is thrust against **fast ice**. (59)
- coast ice**—(or *coastal ice*). *See* **fast ice**.
- coastline**—The configuration made by the meeting of land and the sea. (68).
- Coast Pilot**—A book of **sailing directions** for the United States or possessions, published by the U.S. Coast and Geodetic Survey. (5)
- cobble**—(also called *boulderet*, *cobblestone*). A rock fragment between 64 and 256 millimeters in diameter, larger than a **pebble** and smaller than a **boulder**, and rounded or otherwise abraded. (2) *See* **phi grade scale**.
- cobblestone**—*See* **cobble**.
- coccolith**—Very tiny calcareous plates, generally oval and perforated, borne on the surface of some planktonic marine algae (**coccolithophores**).
- coccolithophore**—One of a family (Coccolithophoridae) of microscopic, often abundant planktonic algae, the cells of which are surrounded by an envelope on which numerous small calcareous discs or rings (coccoliths) are embedded. Large concentrations give the water a milky appearance; this condition is called “white water” by the herring fishermen of northern Europe.
- cockling sea**—*See* **choppy sea**.
- cocurrent line**—A line on a chart passing through places having the same tidal current hour. (50)
- coefficient of absorption**—*See* **absorption coefficient**.
- coefficient of compressibility**—(or *compressibility*). The relative decrease of the volume of a system with increasing pressure in an isothermal process. This coefficient is

$$-\frac{1}{V}\left(\frac{\partial V}{\partial p}\right)_T,$$

where V is the volume, p the pressure, and T the temperature. The reciprocal of this quantity is the bulk modulus. (5)

coefficient of expansion—*See* **coefficient of thermal expansion**.

coefficient of heat conduction—*See* **thermal conductivity**.

coefficient of thermal conduction—*See* **thermal conductivity**.

coefficient of thermal expansion—(or *coefficient of expansion*). The relative increase of the volume of a system (or substance) with increasing temperature in an isobaric process. In symbols this coefficient is

$$-\frac{1}{V}\left(\frac{\partial V}{\partial T}\right)_p,$$

where V is the volume, T the temperature, and p the pressure. (5)

coelenterate—One of a phylum (Coelenterata or Cnidaria) of two-staged (**sessile** and free-floating) organisms. The sessile stage basically is cylindrical and is called a **polyp**; the free-swimming stage is disc or bell shaped and is called a medusa or **jellyfish**. Many coelenterates, particularly the **hydrozoans** and **corals**, are colonial, consisting of many polyps united in complex or massive structures. All contain stinging cells or **nematocysts**, many exhibit **bioluminescence**, and some reportedly scatter sound. See **hydrozoan**, **scyphozoan**, **anthozoan**.

col—In meteorology, the point of intersection of a trough and a ridge in the pressure pattern of a weather map. It is the point of relatively lowest pressure between two **highs** and the point of relatively highest pressure between two **lows**. (5)

cold light—Light emitted by any body whose temperature is below that of incandescence.

cold pool—A body of cold water entirely surrounded by warm water.

cold wall—The steep water-temperature gradient between the **Gulf Stream** and (a) the slope water inshore of the Gulf Stream or (b) the **Labrador Current**. It is considered part of the **Arctic Convergence** by most oceanographers. (5)

collar ice—See **ice foot**.

collector—In underwater optics a device required to fulfill the definition of the quantity being measured, for instance, a Gershun tube in radiance measurements or a **cosine collector** in irradiance measurements. (8)

colligative property—One of four characteristic properties of solutions, namely the interdependent changes in vapor pressure, freezing point, boiling point, and osmotic pressure, with a change in amount of dissolved matter. If, under a given set of conditions, the value for any one property is known, the others may be computed. In general, with an increase in dissolved matter (for example, salt in sea water) freezing point and vapor pressure decrease, and boiling point and osmotic pressure increase. (5)

colloid—As a size term refers to particles smaller than 0.00024 millimeter, smaller than clay size.

colonial coral—Coral in which the individuals are attached together as units, and do not exist as separate animals. (2)

colored filter—See **selective filter**.

comber—(also called *roller*, *beachcomber*). 1. A deepwater wave whose crest is pushed forward by a strong wind and which is much larger than a **whitecap**. (61)

2. A long-period spilling **breaker**. If there are many lines of breakers simultaneously on a shore, they form a **surf**.

comb jelly—See **ctenophore**.

commensalism—A symbiotic relationship between two species in which one species is benefited and the other is not harmed. The relationship between the shark and the remora or "suckerfish" is an example of commensalism. See **mutualism**, **inquilinism**, **symbiosis**.

common establishment—See **establishment of the port**.

community—(also called *biocenose*, *biocenosis*). An integrated, mutually adjusted assemblage of plants and animals inhabiting a natural area. The assemblage may or may not be self-sufficient and is considered to be in a state of dynamic equilibrium. Although the community concept is clear, specific communities and their limits, particularly in the ocean, are often difficult to recognize. The community usually is characterized as having a more or less definite species composition and may be defined on the basis of the habitat it occupies or on the basis of the species present.

compact ice—See **conglomerated ice**.

compaction—The decrease in volume or thickness of a sediment under load through closer crowding of constituent particles and accompanied by decrease in porosity, increase in density, and squeezing out of **interstitial water**. (2)

compensation depth—The depth at which **photosynthesis** equals plant respiration during a 24-hour period.

compensation point—See **compensation depth**.

component—See **constituent**.

composite chart—A chart based on data for extended periods, usually 5 to 10 days, treated as being synoptic.

composite sample—See **compound sample**.

compound pancake ice—Ice pancakes which have frozen together. (68)

compound ripples—See **ripple marks**.

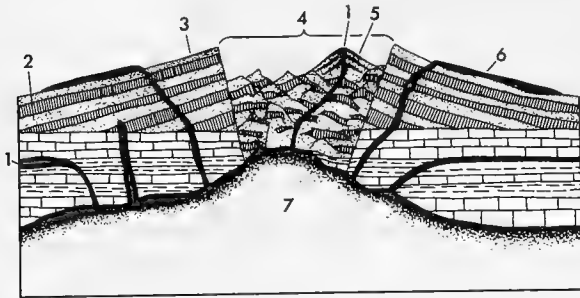
compound sample—(or *aggregate sample*, *composite sample*). A mixture of a number of spot samples to form an aggregate single sample.

compound shoreline—That **shoreline** whose essential features combine elements of at least two of the other shoreline classifications, that is, emergence, submergence, or neutral shoreline.

compound specific activity—Total radioactivity of a given **isotope** per gram of a compound. (70)

compound tide—A tide constituent with a speed equal to the sum or difference of the speeds of two or more basic constituents. Compound tides

usually occur in shallow water regions. *See shallow water constituent.* (50)
compound volcano—A volcano that consists of a complex of two or more cones, or a volcano that has an associated volcanic dome, either in its crater or on its flanks. (2)



COMPOUND VOLCANO

1. Vent; 2. Lava flow accumulations; 3. Primary cone; 4. Caldera; 5. Secondary cone; 6. Lava flow; 7. Magma reservoir

(AFTER: LEET, L. DON & JUDSON, SHELDON. PHYSICAL GEOLOGY. NEW YORK, PRENTICE-HALL, INC. 1954. p. 369.)

compressed-air illness—*See decompression sickness.*

compressibility—*See coefficient of compressibility.*

compressibility factor—*See compression factor.*

compressional wave—A wave in an elastic medium which causes an element of the medium to change its volume without undergoing rotation. (69)

compression factor—(or *diving rules, compressibility factor*). A coefficient expressing, in pounds per hundred feet, the combined effect on submarine buoyancy of the compressions of sea water and of the ship with increasing depth. It is always negative in value.

Compton absorption—The absorption of an X-ray or gamma ray photon in the Compton effect. The energy of the electromagnetic radiation is not completely absorbed since another photon of lower energy is simultaneously created. (41)

Compton effect—An attenuation process observed for X- or gamma radiation in which an incident photon interacts with an orbital electron of an atom to produce a recoil electron and a scattered photon of energy less than the incident photon. (70)

Compton scattering—*See scattering* (sense 3).

concentration—In sea ice reporting, the ratio of the areal extent of ice present to the total areal extent of ice and water. Concentration is usually reported in tenths, and is meaningful in definitions of open water, very open pack ice, open pack ice, close pack ice, very close pack ice.

concentration factor—An expression of the relative amount of an element in an organism as compared to its relative amount in sea water. Concentration factors as high as two million or higher have been reported for some elements in some organisms.

concretion—(or *concretionary*). Nodular or irregular concentrations of material through deposition from solution, usually about a central nucleus. Examples are clay and manganese nodules. *See nodules.*

concretionary—*See concretion.*

concussion crack—(also called *shock crack*). A fracture in sea ice produced by the impact of one ice cake upon another. (59)

condensation—The physical process by which a vapor becomes a liquid or solid; the opposite of evaporation. When water vapor condenses, heat is released, and the surrounding temperature is raised.

condensed deposit—Sedimentary material that accumulated very slowly; it is thin but not interrupted. (2)

conduction—The transfer of energy within and through a conductor by means of internal particle or molecular activity, and without any net external motion. Conduction is to be distinguished from convection (of heat) and radiation (of all electromagnetic energy). (5)

conductivity—*See electrical conductivity, thermal conductivity, thermometric conductivity.*

cone shell—A tropical marine snail of the family Conidae possessing a venom-injecting apparatus used to subdue its prey. Several Indo-Pacific species have been implicated in human fatalities; most species belong to the genus *Conus*.

conformal projection—A map which preserves angles; that is, a map such that if two curves intersect at a given angle, the images of the two curves on the map also intersect at the same angles.

On such a map, at each point, the scale is the same in every direction. Shapes of small regions are preserved, but areas are only approximately preserved (the property of area conservation is peculiar to the equal-area map).

The most commonly used conformal map is probably the Lambert conformal conic projection, with standard latitudes at 30° and 60°N. On the standard latitudes, the scale is exact; between them, it is decreased by not more than about 1 percent; outside them, distortion increases rapidly. The Mercator and stereographic projections are also conformal maps. (5)

confused sea—A rough sea where the direction and period of the sea and/or swell is indeterminate, caused by various overriding wave trains.

conglomerate—(or *puddingstone*). Rock consisting of gravel, pebbles, and sand cemented together.

conglomerated ice—(or *compact ice*). All types of floating ice compacted into one mass; term refers to the contents of an ice mass, not the concentration. (65)

conic projection—A map projection in which the surface of a sphere is conceived as projected, in the geometrical sense, on a tangent or secant cone, which is then developed on the plane.

conjunction—The situation of two celestial bodies with the same celestial longitude (the angular distance measured east of the vernal equinox along the ecliptic); for example, conjunction occurs when the moon and the sun are directly in line with the earth and the moon is between the earth and the sun. (66) (*See figure for tide cycle.*)

Conrad discontinuity—Seismic discontinuity in the earth's crust where velocity increases from 6.1 to 6.4–6.7 kilometers per second; occurs at various depths and is supposed to mark contact of "granitic" and "basaltic" layers. (2)

consecutive mean—(also called *moving average, running mean, overlapping mean*). A smoothed representation of a time series derived by replacing each observed value with a mean value computed over a selected interval. For example, if the observations are of daily maximum temperature and the selected interval is five days, then the value assigned to February 5th is the mean of the daily maximum from February 3rd through February 7th, etc.

Consecutive means are used in **smoothing** to eliminate unwanted periodicities or minimize irregular variations. (5)

conservative property—A property whose values do not change in the course of a particular series of events. Properties can be judged conservative only when the events (processes) are specified; also, properties that are conservative for a whole system may or may not be conservative for its parts, and conversely. (5) For example, those properties of the ocean, such as **salinity**, the concentrations of which are not affected by the presence or activity of living organisms but which are affected by **diffusion** and **advection**.

Conshelf Two—Short form for Continental Shelf Station Number Two. Conshelf Two was a manned undersea research station consisting of four prefabricated steel structures, under the supervision of Capt. Jacques-Yves Cousteau, located 36 feet beneath the surface of the Red Sea on a coral ledge which is part of Sha'ob Rūmi (Roman Reef) about 25 miles northeast of Port Sudan. This underwater research station was the second of two successful attempts. (12)

Consolan—An electronic navigational system providing a number of rotating equisignal zones that permit determination of bearings from a transmitting station.

consolidated ice—(also called *consolidated pack*). An area of the sea covered by ice of various origins compacted by wind and currents into a firm mass. In sea ice reporting, consolidated ice is a term used to describe an area completely devoid of **open water** with a concentration of 10-tenths. It usually includes some of the heavier forms of ice. *See very close pack ice* (preferred WMO term).

consolidated pack—*See consolidated ice.*

consolidated sediments—Sediments which have been converted into rocks by compaction, deposition of cement in pore spaces, and/or by physical and chemical changes in the constituents.

consolidation—The reduction in volume of sediment and increase in density in response to increased load through decrease in pore space, void ratio, and water content. (2)

constancy—*See persistence.*

constancy of the current—(or *persistency*). The ratio of the magnitude of the resultant velocity to the mean velocity of the current. Constancy is dimensionless and may be expressed as a percentage; it equals 100 percent if all observations indicate the current setting exactly in the same direction at the same speed; it decreases in value with increasing variability of current direction and speed; it equals zero if there is an equal number of observations from all directions and all observations have the same speed.

constituent—(also called *harmonic constituent, astronomical tidal constituent, component, tidal constituent, partial tide*). One of the harmonic elements in a mathematical expression for the **tide-producing force** and in corresponding formulas for the tide or tidal current. Each constituent represents a periodic change or variation in the relative positions of the earth, moon, and sun. (50) *See harmonic constant.*

constituent day—The duration of the earth's daily rotation relative to a fictitious star which represents one of the periodic **tide-producing forces**; it approximates the length of the lunar or solar day and corresponds to the period of a **diurnal constituent** of twice the period of a **semidiurnal constituent**. The term is not applicable to the **long-period constituents**. (50)

constituent hour—One twenty-fourth part of a **constituent day**. (50)

constituents of sea water—(or *chemistry of sea water*). Sea water obeying the Law of Con-

stancy of Relative Proportions contains the following constituents:

A. Major constituents	
Chlorine-----	18.980 g/kg (%)
Sodium-----	10.561
Magnesium-----	1.272
Sulfur-----	0.884
Calcium-----	0.40
Potassium-----	0.380
Bromine-----	0.065
Carbon-----	0.028
Strontium-----	0.013
Boron-----	0.005
B. Minor constituents	
Silicon-----	4×10^{-6} to 2×10^{-8}
Fluorine-----	1.4×10^{-6}
Nitrogen-----	7×10^{-7} to 6×10^{-9}
Aluminum-----	5×10^{-7}
Rubidium-----	2×10^{-7}
Lithium-----	1×10^{-7}
Phosphorus-----	1×10^{-7} to 1×10^{-9}
Barium-----	5×10^{-8}
Iodine-----	5×10^{-8}
Arsenic-----	2×10^{-8} to 2×10^{-9}
Manganese-----	1×10^{-8} to 1×10^{-9}
Copper-----	1×10^{-8}
Zinc-----	5×10^{-9}
Lead-----	4×10^{-9}
Selenium-----	4×10^{-9}
Cesium-----	2×10^{-9}
Uranium-----	1.5×10^{-9}
Molybdenum-----	5×10^{-10}
Thorium-----	5×10^{-10}
Cerium-----	4×10^{-10}
Silver-----	3×10^{-10}
Vanadium-----	3×10^{-10}
Lanthanum-----	3×10^{-10}
Yttrium-----	3×10^{-10}
Nickel-----	1×10^{-10}
Scandium-----	4×10^{-11}
Mercury-----	3×10^{-11}
Gold-----	6×10^{-12}
Radium-----	3×10^{-16} to 2×10^{-17}
Cadmium-----	Trace
Cobalt-----	Trace
Tin-----	Trace

continent—A large landmass rising abruptly from the deep ocean floor, including marginal regions that are shallowly submerged. Continents constitute about one-third of the earth's surface. (2)

continental air—A type of air whose characteristics are developed over a large land area and which, therefore, has the basic continental characteristic of relatively low moisture content. (5)

continental apron—*See* **continental rise**.

continental borderland—(or *borderland*). A region adjacent to a **continent**, normally occupied by or bordering a **continental shelf**, that is highly irregular with depths well in excess of those typical of a continental shelf. (62)

continental drift—The concept that the continents can drift on the surface of the earth because of the weakness of the suboceanic crust, such as ice can drift through water. (2)

continental glacier—(also called *continental ice*). A continuous sheet of land ice which covers a very large area and moves outward in many di-

rections. This type of ice mass is so thick as to mask the land surface contours, in contrast to the smaller and thinner highland ice. The continental glacier of Greenland often is called inland ice, that of Antarctica, the **ice cap**.

Perhaps this term is best used to describe the great ice masses which characterized the ice ages. (5)

continental ice—*See* **continental glacier**.

continental margin—A zone separating the emergent continents from the deep sea bottom; generally consists of the **continental shelf**, **slope**, and **rise**. (2)

continental plateau—A large elevated mass of the **lithosphere** coinciding approximately with a **continent** and including its **continental shelf**. (48)

continental platform—*See* **continental shelf**.

continental rise—A gentle slope with a generally smooth surface, rising toward the foot of the **continental slope**. (62)

continental shelf—(also called *continental platform*). A zone adjacent to a continent or around an island, and extending from the **low water line** to the depth at which there is usually a marked increase of slope to greater depth. (62)

continental slope—1. A declivity seaward from a **shelf edge** into greater depth. (62)

2. *See* **bathyal**.

continental terrace—This term is no longer recommended by the ACUF for a zone around the continents, extending from **low water line** to the base of the continental slope. It includes both **continental shelf** and **continental slope**.

continuity—The property of a field, such that neighboring values of a **parameter** differ only by an arbitrarily small amount if they are close enough in space and/or time. (5)

continuity equation—*See* **equation of continuity**.

contour—A line on a chart representing points of equal value with relation to a **datum**. It is called an **isobath** when connecting points of equal depth below sea level. *See* **isopleth**.

contour interval—The difference in value between two adjacent **contours**.

contra solem—*See* **cum sole**.

contrast—In optics, the ratio of the target **reflectance** (TR) minus the background reflectance (BR) to the background reflectance, that is,

$$\frac{TR - BR}{BR};$$

expressed as percentage.

convection—In general, mass motions within a fluid resulting in transport and mixing of the properties of that fluid. Convection, along with **conduction** and **radiation**, is a principal means of energy transfer.

Distinction is made between: free convection (or gravitational convection), motion caused

only by density differences within the fluid, and forced convection, motion induced by mechanical forces such as deflection by a large-scale surface irregularity, turbulent flow caused by friction at the boundary of a fluid, or motion caused by any applied external force. *See* **thermohaline convection**. (5)

convection cell—*See* **cellular convection**.

convective overturn—In oceanography, same as **overturn**. (5)

convergence—(or *front*). 1. Situation whereby waters of different origins come together at a point or, more commonly, along a line known as a convergence line. Along such a line the denser water from one side sinks under the lighter water from the other side. The recognized convergence lines in the oceans are the polar, subtropical, tropical, and equatorial convergence lines. Regions of convergence are also referred to as convergence zones. (25)

2. In refraction phenomena, the decreasing of the distance between **orthogonals** in the direction of wave travel. Denotes an area of increasing wave height and energy concentration. (61)

convergence zone—1. *See* **convergence** (sense 1).

2. The region in the deep ocean where sound rays, refracted from the depths, arrive at the surface in successive intervals of 30 to 35 nautical miles. The repeated occurrence of these zones to several hundred miles from the sound source depends on the **refraction** of sound rays at depth and the **reflection** of these rays at the surface.

convergence zone paths—The velocity structure of permanent deep **sound channels** which produces focusing regions at distant intervals from a shallow source.

convoy routing—Methods of providing optimal routes for one or more escorted ships under given environmental conditions. Routing may be made to provide minimum time routes, minimum wave routes, minimum submarine detection routes, etc.

Copenhagen water—*See* **normal water**.

copepod—One of a subclass (Copepoda) of minute shrimplike **crustaceans**, most species of which range between about 0.5 and 10.0 millimeters in length. Many species are bioluminescent, and concentrations can produce bright sparkling light. Copepods occur in the surface layers of temperate and subpolar waters in large concentrations.

coprolites—*See* **fecal pellet**.

coquina—(or *coquinoïd limestone, biostromal limestone*). A coarse-grained porous friable variety of limestone made up chiefly of shell, shell fragments, and coral. (2)

coquinoïd limestone—*See* **coquina**.

coral—1. The hard calcareous skeleton of various **anthozoans** and a few **hydrozoans** (the mil-

lepores), or the stony solidified mass of a number of such skeletons. In warm waters colonial coral forms extensive **reefs** of limestone. In cool or cold water coral usually appears in the form of isolated solitary individuals. Occasionally, large reefs formed in cold waters by **calcareous algae** (*Lithothamnion*) have been referred to as a coral. (9)

2. The entire animal; a compound **polyp** which produces the skeleton.

coralgal—The carbonate sediment derived from **corals** and **algae**.

coral head—A massive mushroom or pillar-shaped coral growth. *See* **reef patch**. (*See* figure for **atoll**.)

coral knoll—*See* **reef patch**.

coralline—Pertaining to, composed of, or having the structure of **corals**; as coralline limestone. (2)

coralline alga—One of a family (Corallinaceae) of **red algae** having either a bushy or encrusting form and deposits of calcium carbonate either on the branches or as a crust on the substrate. Certain genera of the encrusting forms, *Lithothamnion* and *Porolithon*, develop massive encrustations on **coral reefs**.

coral patch—*See* **encrusting bryozoans**.

coral pillar—*See* **reef patch**.

coral reef—A ridge or mass of limestone built up of detrital material deposited around a framework of the skeletal remains of **mollusks**, **colonial coral**, and massive **calcareous algae**. Coral may constitute less than half of the reef material. (55) (*See* also figure for **atoll**.)

corange line—A line passing through places of equal **tide range**. (50)

cordillera—An entire mountain system, including all the subordinate ranges, interior plateaus and basins. (62)

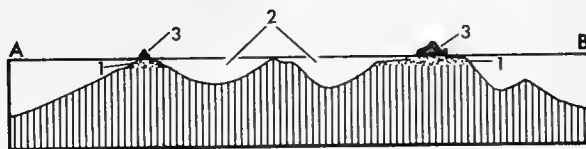
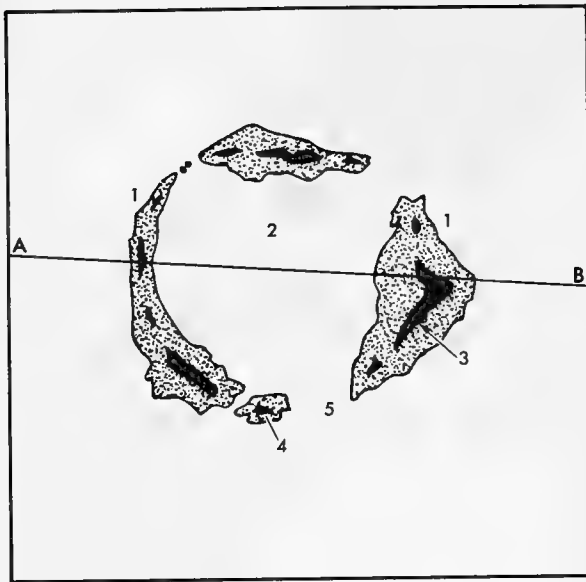
core—1. A vertical, cylindrical sample of the **bottom sediments** from which the nature and stratification of the bottom may be determined.

2. The central zone of the earth (*see* **centrosphere**). Its upper boundary is defined by a seismic discontinuity at 2,900 kilometers (Gutenberg-Wiechert discontinuity). (*See* figure for **earth structure**.)

core barrel—The tubular section of a core sampling device. Bottom sediment samples are collected either directly in the core barrel or in a plastic liner placed inside it. Barrel diameter may vary from 1½ inches to several inches.

core catcher—(or *core retainer*). Any device in the lower end of a **core barrel** designed to prevent collected **bottom sediments** from slipping out while the coring device is brought up to the surface. One type consists of an interleaved metal spring device which slips into the lower end of a core barrel.

core cutter—(or *cutting edge*). A device which fits over the end of the coring tube and holds the



CORAL REEF

1. Reef; 2. Lagoon; 3. Island; 4. Islet; 5. Lagoon channel

(NSA, JAPAN, 1952)

core catcher in place. It has a sharpened rim for penetrating the bottom and is attached with several steel bolts.

corer—A hollow tube that is driven into the ocean floor for the purpose of collecting a bottom sediment sample.

core retainer—*See* **core catcher**.

core sample—A sample of rock, soil, snow, or ice obtained by driving a hollow tube into the medium and withdrawing it with its contained sample or **core**. In general, the aim of core sampling is to obtain a specimen in its undisturbed natural state for subsequent analysis. (5)

coriolis force—An apparent force on moving particles resulting from the earth's rotation. It causes the moving particles to be deflected to the right of motion in the Northern Hemisphere and to the left in the Southern Hemisphere; the force is proportional to the speed and latitude of the moving particle and cannot change the speed of the particle.

corona discharge—A luminous and often audible, electric discharge that is intermediate in nature between a spark discharge and a point discharge. It occurs from objects, especially pointed ones, when the electric field strength near their surface attains a value near 1,000 volts per centimeter.

corosant—*See* **St. Elmo's fire**.

corrasion—Mechanical erosion performed by moving agents such as wear by glacial ice, wind, running water, etc., but is generally restricted to basal rather than lateral excavation.

corrected establishment—The mean high water interval for all stages of the tide.

correction for datum—A conversion factor used in the prediction of tides to resolve the difference between the **chart datums** of the **reference station**.

corrosion—The gradual deterioration of material by chemical processes, such as oxidation or attack by acids; if caused by an atmospheric effect, a form of weathering. (5)

cosine collector—In underwater optics a light collector which accepts **radiant flux** in accordance with the cosin law. (8)

cosmic rays—Radiation that has its ultimate origin outside of the earth's atmosphere, that is capable of producing ionizing events in passing through the air or other matter, and that includes constituents capable of penetrating many feet of material such as rock. The primary cosmic rays probably consist of atomic nuclei, mainly protons, some of which may have energies of the order of 10^{10} to 10^{15} electron volts. Secondary cosmic rays are produced when the primary rays interact with nuclei and electrons, for example, in the earth's atmosphere; they consist mainly of mesons, protons, neutrons, electrons, and photons that have less energy than the primary rays. Practically all of the primary cosmic rays are absorbed in the upper atmosphere, and almost all cosmic radiation observed at the earth's surface is of the secondary type. (41)

cosmic sediment—Particles of extraterrestrial origin identified in deep sea sediments as black magnetic spherules. (2)

cosmogenic radioisotopes—Those **radioisotopes** produced in the earth's gaseous envelope through the action of cosmic radiation. Examples of such radioisotopes include Carbon¹⁴, Tritium, Beryllium⁷, and Beryllium¹⁰.

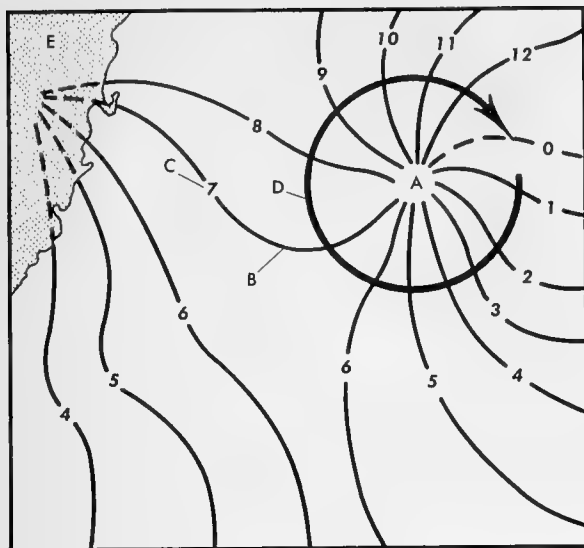
cospectrum—1. The spectral decomposition of the in-phase components of the covariance of two functions of time.

2. The real part of the **cross spectrum** of two functions. (5)

cotidal chart—A chart of **cotidal lines** that show approximate locations of **high water** at hourly intervals measured from a reference meridian, usually Greenwich.

cotidal hour—The average interval expressed in solar or lunar hours between the moon's passage over the meridian of Greenwich and the following **high water** at a specified place. (5) (*See* figure for **cotidal chart**.)

cotidal line—A line on a chart passing through all points where **high water** occurs at the same time.



COTIDAL CHART

A. Nodal point; B. Cotidal line; C. Cotidal hour;
D. Amphidromic region; E. Degenerate amphidromic system

The lines show the lapse of time, usually in lunar-hour intervals, between the moon's transit over a reference meridian (usually Greenwich) and the occurrence of high water for any point lying along the line. (See figure for **cotidal chart**.)

count—In radiation measurements, the external indication of a device designed to enumerate ionizing events. It may refer to a single detected event or to the total registered in a given period of time. The term often is erroneously used to designate a disintegration, ionizing event, or voltage pulse. (70)

counter—A special gear box that indicates the amount of oceanographic wire passed over the sheave of the **meter wheel**. The counter may be mounted directly on the meter wheel or connected by a flexible cable.

countercurrent—A current flowing adjacent to the main current but in the opposite direction.

counterradiation—(also called *back radiation*). The downward flux of atmospheric radiation passing through a given level surface, usually taken as the earth's surface and, more specifically in oceanography, the sea surface. (5)

counter resolving time—The minimum time interval between two distinct events which will permit both to be counted. It may refer to an electronic circuit, to a mechanical indicating device, or to a counter tube. (70)

countertrades—See *antitrades*.

cove—A small bay or baylike recess in the coast, usually affording anchorage and shelter to small craft.

crack—Any fracture or rift in sea ice not sufficiently wide to be described as a **lead (lane)**. (74)

cream ice—See *sludge*.

creek—A small, narrow bay which extends farther inland than a **cove** and is longer than it is wide. (68)

crest—1. The highest part of a wave.

2. A narrow rise of more or less irregular longitudinal profile which constitutes the top of an elevation of the sea bottom. (30)

crest length—See *crest width*.

crest of berm—The seaward margin of the **berm**. (See figure for *shore profile*.)

crest of wave—See *wave crest*.

crest width—(or *crest length*). The length of a wave along its **crest**. (61)

crinoid—(or *sea lily, feather star, sea feather*). One of a class (Crinoidea) of **echinoderms** most of which either permanently or when immature are attached by a long stalk to the bottom; species without stalks either creep slowly about or swim. Crinoids occur in shallow water as well as at great depths. About 2,000 fossil species are known.

crinoidal limestone—See *limestone*.

criquina—See *limestone*.

critical damping—The minimum **viscous damping** that will allow a displaced system to return to its initial position without oscillation. (6)

critical point—The thermodynamic state in which liquid and gas phases of a substance coexist in equilibrium at the highest possible temperature. At higher temperatures than the critical no liquid phase can exist. (5)

critical velocity—The speed at which a current can **scour** the bottom enough to maintain the required depth in a channel.

Cromwell Current—See *Cromwell Undercurrent*.

Cromwell Undercurrent—(or *Cromwell Current*). An eastward-setting subsurface current that extends about $1\frac{1}{2}$ degrees north and south of the Equator, and from about 150°E to 92°W . It is 300-kilometers wide and 0.2-kilometer thick; at its core the speed is 100 to 150 centimeters per second.

cross sea—The confused, irregular state of the sea which occurs where waves from two or more different storms have arrived at a point of observation. Sometimes the waves appear to be moving in the same direction as one of the original waves; sometimes in between. (46)

cross spectrum—The complex vector sum of the **cospectrum** and **quadrature spectrum**.

cross swell—(or *intersecting waves*). See *cross sea*.

cross tide—See *beam tide*.

crosswind—That wind vector component which is perpendicular to the course of an exposed moving object.

Wind blowing in a direction approximately 90 degrees from the course. One blowing in a direction approximately 90 degrees from the heading is called a **beam wind**. In common usage these two expressions are usually used synonymously, crosswind being favored by aviators, and beam wind by mariners. One blowing from ahead is called a **headwind**. One blowing from astern is called a **following wind** by marine navigators and a tailwind by air navigators.

crumble—See **disintegration**.

crust—The outer shell of the solid earth the lower limit of which is taken generally to be the **Mohorovičić discontinuity**. The crust varies in thickness from approximately 5 to 7 kilometers under the ocean basins to 35 kilometers under the continents. See **lithosphere**. (See figure for **earth structure**.)

crustacean—One of a class (Crustacea) of **arthropods** which breathe by means of gills or branchiae and with the body commonly covered by a hard shell or crust. The group includes the barnacles, crabs, shrimps, and lobsters.

crustacean borer—A member of any of three families (Limnoriidae, Sphaeromidae, and Cheluridae) of **crustaceans**, which, in the first two, resemble pill or sow bugs and in the last, sand fleas. These crustaceans excavate networks of shallow burrows in wood, the roofs of which are readily eroded by water action. Progressive burrowing and eroding remove a considerable thickness of wood. The most evident and damaging attack is on pilings within the **intertidal zone** and near the bottom. Continued attack results in the characteristic hourglass shape of severely damaged pilings. *Limnoria* usually is the initial and principal attacker. Members of the other two families generally inhabit and enlarge *Limnoria* burrows. The attack by at least one species of *Limnoria* is not inhibited by creosote. See **marine borer**.

cryoclinometer—A device for measuring horizontal dimensions of a sea ice field from an aircraft.

cryology—1. The study of ice and snow. (5)

2. The study of **sea ice**. (5)

3. In Europe, a synonym for **glaciology**. (5)

Note: The term cryology has become almost meaningless unless it is defined in context. (59)

crystalline—The term applied to rocks containing grains of regular polyhedral form bounded by plain surfaces and having an orderly molecular structure. Usually applied to **igneous** and **metamorphic rocks** but not to **sedimentary rocks**.

ctenophore—(or *comb jelly*). One of a phylum (Ctenophora) of spherical, pear-shaped, or cylindrical animals of jellylike consistency ranging from less than 1 inch to about 3 feet in

length. The outer surface of the body bears 8 rows of comblike structures. Many species produce **glowing-ball luminescence**.

cul-de-sac—1. An **inlet** with a single small opening.

2. A **blind lead**.

(68)

cum sole—With the sun; hence anticyclonic or clockwise; the opposite of *contra solem*. (5)

curie—(abbreviated c). 1. That quantity of a radioactive **nuclide** disintegrating at the rate of $3,700 \times 10^{10}$ atoms per second. Several fractions of the curie are in common usage.

Microcurie—(abbreviated μc). One-millionth of a curie (3.7×10^4 disintegrations per second).

Micro-microcurie—(abbreviated $\mu\mu\text{c}$). One-millionth of a microcurie (3.7×10^{-2} disintegrations per second or 2.22 disintegrations per minute). Sometimes called a picocurie.

Millicurie—(abbreviated mc). One-thousandth of a curie (3.7×10^7 disintegrations per second).

(70)

2. An earlier definition of the curie was: The quantity (grams) of radon in equilibrium with one gram of radium. (41)

current—A horizontal movement of water. See **ocean current**, **tidal current**, **nontidal current**, **flow**.

current base—The maximum water depth below which currents are ineffective in moving sediment. (2)

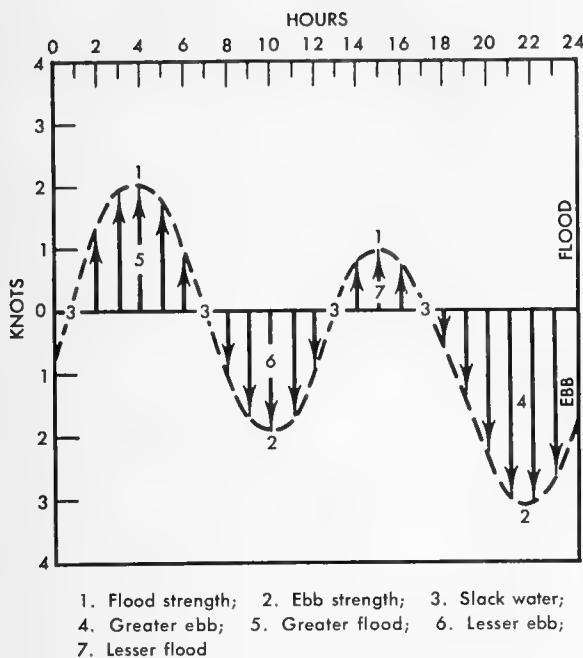
current chart—A map of a water area depicting current speeds and directions by **current roses**, vectors, or other means.

current cross section—A graphic presentation of the current shown as a vertical plane perpendicular to the axis of flow; the horizontal distance between the surface limits is represented by the abscissa, and the depth is shown by the ordinate which increases from the surface (zero) down to any depth. See **current profile**.

current curve—A graphic presentation of the speed and duration of the **tidal current** usually shown for areas of reversing tidal currents. The curve is referred to rectangular coordinates; the time is represented by the abscissa and the speed by the ordinate. The flood speeds are positive, and the ebb speeds are negative values measured from slack (zero speed).

current diagram—A graphic presentation showing the speed of the **flood** and **ebb currents** and the times of slack and strength over a considerable stretch of the channel of a tidal waterway, the times being referred to tide or current phases at some **reference station**. (50)

current difference—The difference between the time of **slack water** or **strength of current** in any locality and the time of the corresponding



CURRENT CURVE

phase of the current at a **reference station** for which predictions are given in **current tables**. (50)

current direction—The direction toward which a current is flowing, called the **set** of the current. (68)

current ellipse—A graphic representation of a **rotary current** in which the speed and direction of the current at different hours of the **tide cycle** are represented by radius vectors and vectorial angles. A line joining the extremities of the radius vectors will form a curve roughly approximating an ellipse.

current gradient—The rate of increase or decrease in the speed of a current relative to a given distance or period of time. The gradient is generally represented by a curve.

current hour—The mean interval between the transit of the moon over a reference meridian (usually Greenwich) and the time of the **strength of flood** current modified by the times of **slack water** and **strength of ebb** current.

current meter—Any one of numerous devices for the measurement of either speed alone or of both direction and speed (**set** and **drift**) in flowing water. (5)

current pattern—The horizontal distribution of the surface or subsurface currents at various levels in a specified area.

current pole—A pole used in measuring surface water current, especially from an anchored ship such as a lightship. The drift of the pole is timed as it is allowed to carry out a graduated

line, the azimuth and speed of the line gives the **current velocity**. (5)

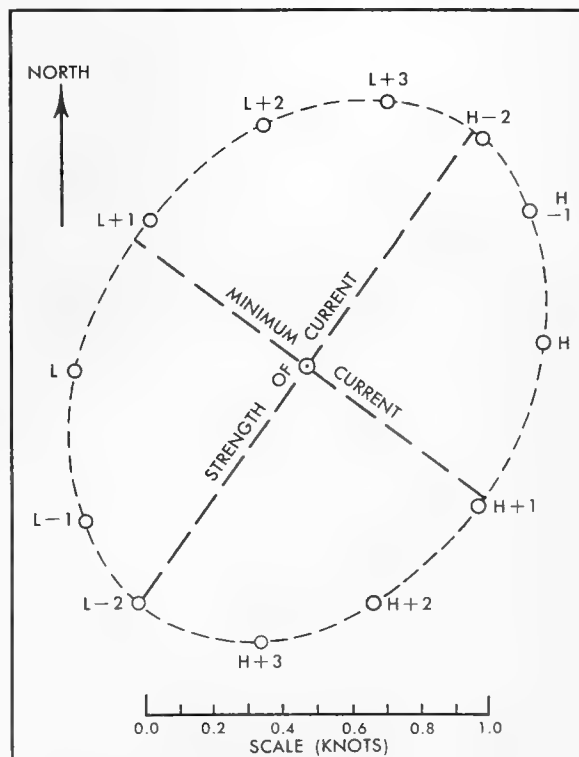
current profile—A graphic presentation of current flow from the surface to a specified depth. The speed of the current is generally represented by the abscissa and the depth by the ordinate which increases from the surface (zero) downward. See **current cross section**.

current rips—Small waves formed on the sea surface by the meeting of opposing currents.

current rose—A graphic presentation of currents for specified areas, utilizing arrows at the cardinal and intercardinal compass points to show the direction toward which the prevailing current flows and the percent frequency of **set** for a given period of time. The arrows on some presentations may be further subdivided (by thickness or pattern) to designate categories of **current speeds**.

current speed—The rate at which the water moves either horizontally or vertically; usually expressed in knots, miles per day, feet per second, or centimeters per second. See **current velocity**.

current tables—Tables which give daily predictions of the times, speeds, and directions of the currents. These predictions are usually supplemented by current differences and constants by means of which additional predictions can be obtained for numerous other places. (50)



CURRENT ELLIPSE

current vector—A geometric presentation showing both current direction and speed, generally by an arrow whose length is proportional to the speed and whose direction is resolved into points of the compass.

current velocity—A rate of motion in which direction as well as speed of flow is considered. *See* **current speed**.

curved path theory—A method for the analysis and plotting of seismic data which allows for the curvature of ray paths, resulting from increasing velocities with depth in the earth. (35)

curve fitting—(also called *graduation*). The appropriate representation of empirical data by a mathematical function, typically with arbitrary constants determined by **least squares**. (5)

cushion ice—Fine fragmented ice found between **ice floes**. It has the effect of cushioning the impact of floes on each other. (Rare)

cusp—*See* **beach cusp**.

cusped bar—A crescent-shaped **bar** uniting with the shore at each end. It may be formed by a single **spit** growing from shore turning back to again meet the shore, or by two spits growing from shore uniting to form a bar of sharply cusped form. (61)

cut—A notch, depression, or furrow produced by erosion or excavation of a slope. Many cuts of this type occur on the upper portion of a **continental shelf**.

cutting edge—*See* **core cutter**.

cycle—1. One complete and consecutive set of all the changes which occur in a recurrent action or phenomenon, starting from any point in the action and ending with all conditions as they were at the start.

2. A unit of wave frequency, actually one cycle per second.

(5)

cycloidal wave—A very steep, symmetrical wave whose crest forms an angle of 120 degrees. The wave form is that of a cycloid. A **trochoidal wave** of maximum steepness. (61)

cyclone—An atmospheric cyclonic circulation, a closed circulation. A cyclone's direction of ro-

tation (counterclockwise in the Northern Hemisphere) is opposite to that of an **anticyclone**.

Because cyclonic circulation and relatively low atmospheric pressure usually coexist, the term cyclone and **low** are used interchangeably in common practice. (5)

cyclonic—Having a sense of rotation about the local vertical the same as that of the earth's rotation: that is, as viewed from above, counterclockwise in the Northern Hemisphere, clockwise in the Southern Hemisphere, undefined at the Equator; the opposite of **anticyclonic**. (5)

cylindrical projection—A map projection in which the surface of a sphere is conceived as projected, in the geometrical sense, on a tangent cylinder, which is then developed on the plane.

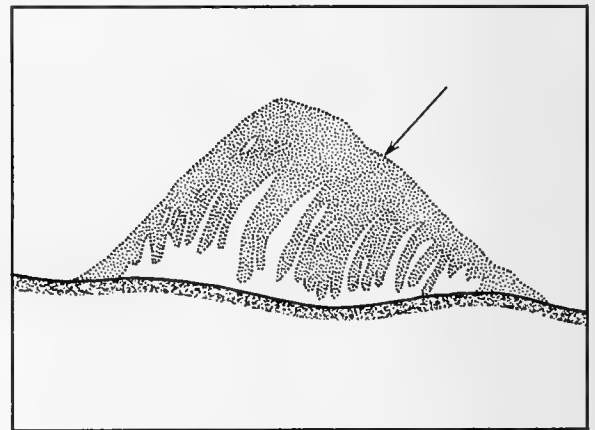
cylindrical spreading—*See* **spreading of sound**.

cylindrical wave—A wave in which the instantaneous free surface of the fluid takes the shape of a cylindrical surface with the horizontal generatrices describing the profile of the wave.

cyphonautes larva—The planktonic triangular-shaped young of a **bryozoan**, which is enclosed in a bivalve shell.

cyprid larva—(or *cypris*). The stage at which the young of **barnacles** attach.

cypris—*See* **cyprid larva**.



CUSPATE BAR

(NEB, TR-4, 1954)

D

daily—*See* **diurnal**.

daily inequality—*See* **diurnal inequality**.

Daily Memorandum—A publication issued by the U.S. Naval Oceanographic Office and several of its Branch Offices to disseminate ephemeral nautical information for a specific area, namely East Coast Edition; West Coast Edition; Pacific Edition; and Far East Edition.

daily retardation—The amount of time by which corresponding tidal phases grow later day by day (averages approximately 50 minutes). (61)

daily variation—*See* **magnetic diurnal variation**.

damping—The dissipation of energy with time or distance. (6)

dark bottle—*See* **black bottle**.

date-time group—(abbreviated DTG). The date and time, expressed in digits and zone suffix, at which the message was prepared for transmission. (Expressed as six digits followed by zone suffix; [generally Z for Greenwich time zone] first pair of digits denoting the date, second pair the hour, third pair the minutes.) (63)

datum—1. Any numerical or geometrical quantity or set of such quantities which may serve as a reference or base for other quantities.

For a group of statistical references, the plural form is data; as geographic data for a list of latitudes and longitudes. Where the concept is geometrical and particular, rather than statistical and inclusive, the plural form is datums, as, for example, two geodetic datums have been used in the U. S. in recent years. (37)

2. *See* **chart datum**.

3. *See* **geodetic datum**.

datum level—*See* **chart datum**.

datum plane—*See* **chart datum**.

datum point—Any reference point of known or assumed coordinates from which calculations or measurements may be taken. (63)

daughter—A synonym for a decay product. (70)

Davidson Current—(also called *Davidson Inshore Current*). A coastal **countercurrent** setting north inshore of the **California Current** along the west coast of the United States (from northern California to Washington to at least 48°N) during the winter months.

Davidson Inshore Current—*See* **Davidson Current**.

dead reckoning—A method of navigation utilizing only the speed and heading of the craft,

without reference to external aids. *See* **fix**. (5)

dead water—The phenomenon which occurs when a ship of low propulsive power negotiates water which has a thin layer of fresher water over a deeper layer of more saline water. As the ship moves, part of its energy goes into generation of an **internal wave** which causes a noticeable drop in efficiency of propulsion.

debacle—The rush of water or ice in a stream immediately following the **breakup**. (59)

debouchure—*See* **mouth**.

debris—*See* **detritus**.

debris ice—1. **Sea ice** which contains soil, stones, shells, and other materials.

2. Another name for **brash ice**.

(59).

debris line—A line near the limit of storm wave **uprush** marking the landward limit of debris deposits. (61)

decade scaler—A **scaler** whose scaling factor is a power of ten. (70)

decapod—1. One of an order (Decapoda) of **crustaceans** which includes the shrimps, lobsters, and crabs.

2. One of an order (Decapoda) of **cephalopods** which contains the **squids**.

decapod mollusk—*See* **squid**.

decay—1. As applied to ocean surface waves: The gradual decrease of surface wave heights owing principally to angular **spreading**, **dispersion**, and opposing winds.

2. *See* **disintegration**.

decay area—The area of lesser winds through which ocean waves travel after emerging from the generating area. (73)

decay constant—*See* **attenuation constant**.

decay distance—The distance through which ocean waves travel as **swell** after leaving the generating area. (61)

decay of waves—The change that waves undergo after they leave a generating area (**fetch**) and pass through a calm or region of lighter winds. In the process of decay, the **significant wave height** decreases and the significant wavelength increases. (61)

Decca*—A continuous-wave, hyperbolic radio aid to navigation in which a receiver measures and indicates the relative phase differences between signals received from two or more synchronized ground stations.

decibar—A unit of pressure used principally in oceanography. One decibar (10^5 dynes per square centimeter) equals 0.1 bar.

In the ocean, hydrostatic pressure in decibars very nearly equals the corresponding depth in meters. (5)

decibel—(abbreviated db). A value that expresses the comparison of sound of two different intensities. This value is defined as 10 times the common logarithm of the ratio of the two sound intensities.

declination—(also called *variation*). 1. At any given location, the angle between the geographical meridian and the magnetic meridian; that is, the angle between true north and magnetic north. Declination is either "east" or "west" according as the compass needle points to the east or west of the geographical meridian. (5)

2. The angle that the sun, moon, planets, or stars make with the plane of the Equator.

3. See **solar declination, lunar declination.**

declinational reduction—The processing of high and low water tide observations or flood and ebb tidal current observations to obtain quantities which result from the effect of changes in the declination of the moon.

decompression sickness—(also called *bends, caisson disease, compressed-air illness*). A condition resulting from the formation of gas bubbles in the blood or tissues of divers during ascent. Depending on their number, size, and location, these bubbles may cause a wide variety of symptoms including pain, paralysis, unconsciousness, and occasionally death.

deep—This term is no longer recommended by the ACUF for a relatively small area of exceptional depth found in a depression type of feature. The term was generally restricted to depths greater than 3,000 fathoms.

deepening—In meteorology, a decrease in the central pressure of a pressure system on a constant-height chart, or an analogous decrease in height on a constant-pressure chart; the opposite of **filling**. The term is usually applied to a **low** rather than to a **high**, although technically it is acceptable in either sense. (5)

deep scattering layer—(also called DSL, *false bottom, phantom bottom*). The stratified population(s) of organisms in most oceanic waters which scatter sound. The scattered sound is recorded on echo-sounder records as a uniform, horizontal band or stripe, and such layers generally are found during the day at depths from 100 to 400 fathoms. A layer rarely is less than 25 fathoms thick and may be as much as 100 fathoms thick. Several layers often are recorded at the same time and may be continuous horizontally for many miles. Most layers typically undergo diurnal vertical movements. See **shallow scattering layer, surface scattering layer, diurnal vertical migration.**

deep sea anchoring winch—A large size winch used to anchor an oceanographic/hydrographic ship in deep water. Ordinarily this type of winch uses steel wire rope in lengths of about 20,000 to 35,000 feet. Some types use specially tapered wire particularly when anchoring in great depths, while others use wire of about $\frac{1}{2}$ -inch diameter.

Deep Underwater Nuclear Counter—(abbreviated DUNC). A submersible **gamma ray spectrometer** used from ships for *in situ* detection of ocean gamma radiation. The DUNC system was developed by the U. S. Naval Ordnance Laboratory for the detection of artificially introduced radioactive constituents in the ocean. It represents the first successful application of gamma spectrometric technique to *in situ* ocean radioactivity measurements and has since been adapted for oceanographic usage by the U. S. Naval Oceanographic Office.

deep water—In wave forecasting deep water means that the depth of the water is large compared with the wavelength of the longest wave generated by the wind. In general, waves may be considered deepwater waves when the depth of the water layer is greater than one-half wavelength. (46)

deepwater wave—(also called *short wave*). A surface wave the length of which is less than twice the depth of the water. The velocity of deepwater waves is independent of the depth of the water. (5) See **shallow water wave.**

deflection of the vertical—The angle at a point on the earth (**geoid**) between the vertical and the direction of the normal to the spheroid of reference through the point.

degaussing—Neutralization of the strength of the magnetic field of a ship by means of suitably arranged electric coils permanently installed in the ship. (68) See **deperming.**

degenerate amphidromic system—A system of **cotidal lines** whose center or nodal (no-tide) point appears to be located on land rather than in the open ocean. (See figure for **cotidal chart**.)

degree—1. A unit of temperature.

2. A unit of angular distance; $\frac{1}{360}$ part of a circle.

(5)

degree-days of frost—The number of degrees that the mean daily air temperature fell below the **freezing point** of fresh or saline waters. The total number of degree-days of frost during a specific period is determined by adding the deficiency of the mean air temperature from the freezing point for each day in the period. Thus, if the mean air temperature on three consecutive days is 20°, 10°, and 0°F, the total number of degree-days of frost, taking the freezing point of sea water at 30°F, would be 10 + 20 + 30 = 60.

degree of polarization—If a polarized radiance meter with retardation plate removed is directed to accept the beam, the polarizer rotated 180 degrees and maximum and minimum radiances recorded, then the degree of polarization is the ratio of the difference between maximum and minimum radiances to the sum of them, that is, the ratio of the polarized fraction to the total energy. (8)

delta—An alluvial deposit, roughly triangular or digitate in shape, formed at the mouth of a stream or tidal inlet. *See bay delta, bird-foot delta, tidal delta.*

delta moraine—Glacial deposit in deep water with which delta deposits are associated. (2)

demersal—1. Fishes which live on or near the bottom.

2. The eggs of certain bony fishes, which have a hard and smooth or adhesive membrane and sink to the bottom. (43)

densitometer—A device for measuring the density of sea water or of bottom sediments.

density—1. The ratio of the mass of any substance to the volume occupied by it; the reciprocal of **specific volume**.

2. In oceanography, density is equivalent to **specific gravity** and represents the ratio, at atmospheric pressure, of the weight of a given volume of sea water to that of an equal volume of distilled water at 4.0°C (39.2°F). It is thus dimensionless and expressed in units of **sigma-t**.

density current—The flow (caused by density differences or gravity) of one current through, under, or over another; it retains its unmixed

identity because of density differences from the surrounding water. *See turbidity current.*

density layer—A layer of water in which density increases with depth enough to increase the buoyancy of a submarine. (Submariner's term for **pycnocline**.)

deperming—The process of changing the magnetic condition of a ship by wrapping a large conductor around it a number of times in a vertical plane, athwartships, and energizing the coil thus formed. If a single coil is placed horizontally around the ship and energized, the process is called **flashing** if the coil remains stationary, and wiping if it is moved up and down. *See degaussing.* (68)

deposit—Accumulations of solid material (of any type or from any source) on the sea bottom which eventually may become compacted and consolidated and form **sedimentary rock**. The process is deposition.

deposition—*See deposit.*

depression—1. This term is no longer recommended by ACUF for any low place, hollow, or basin of any size on the sea bed which is surrounded by higher elevations. *See basin, trench, trough, seachannel.*

2. In meteorology, an area of low pressure; a low or a trough. This is usually applied to a certain stage in the development of a tropical cyclone, to migratory lows and troughs, and to upper-level lows and troughs that are only weakly developed. (5)

depth—1. The vertical distance from a specified **sea level** to the sea floor. The charted depth is the recorded distance from the tidal datum to the bottom surface at the point, using an assumed velocity of sound in waters of 800 fathoms per second (U.S.) and with no velocity or slope corrections made.

2. Formerly used in combination with a ship name to designate a record deep sounding, for example, Milwaukee Depth; no longer recommended by the ACUF.

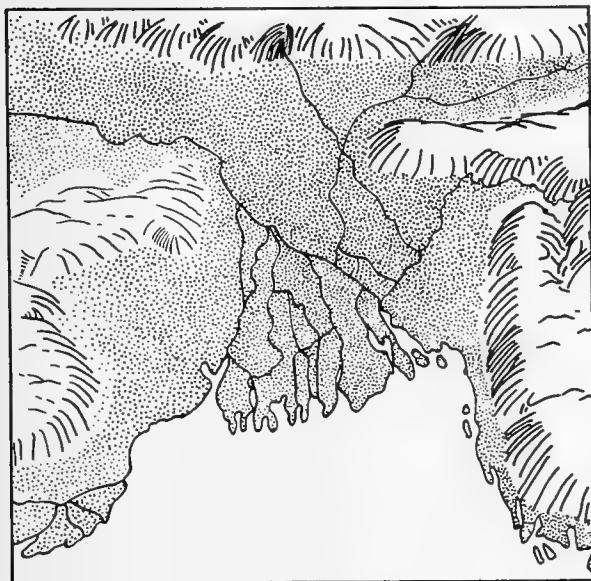
depth anomaly (ΔZ) graph—A graph constructed to determine the difference between the computed or **thermometric depth** and the ideal or assumed depth of reversal of thermometers attached to a **Nansen bottle**.

depth contour—*See isobath.*

depth curve—*See isobath.*

depth excess—The difference between the bottom depth and the depth at which the **sound velocity** is equal to either (1) the surface velocity, when there is no **layer depth**, or (2) the maximum velocity in the surface layer.

depth factor—The factor by which the apparent depth of the water measured stereoscopically is multiplied to give the true depth. This factor is a ratio of the tangent of the incidence angle to the tangent of the refraction angle. *See shoaling coefficient.* (73)



DELTA

(AFTER LOBECK, 1939.)

depth finder—An instrument for determining the depth of water, particularly an echo sounder. (68)

depth ice—1. *See anchor ice.*
2. Small particles of ice formed below the surface of the sea when it is churned by wave action.

depth of breaking—*See breaker depth.*

depth of compensation—*See compensation depth.*

depth of frictional influence—*See depth of frictional resistance.*

depth of frictional resistance—(or *depth of frictional influence*). The depth at which the wind-induced current direction is 180 degrees from that of the wind. (*See figure for Ekman Spiral.*)

derelict—Any property abandoned at sea, often of sufficient size as to constitute a menace to navigation. *See jettison.* (68)

desalination of sea water—The process by which enough dissolved salts are removed from sea water to render it potable. The most common method for desalting sea water is distillation, with the favored form being the “multi-flash” process whereby sea water is made to evaporate in low-pressure chambers. *See boiling point.*
Other methods employed for desalting include the separation of salts by freezing, the use of special membranes to extract all salts, and electro-dialysis, a method whereby the ions in sea water are drawn through plastic membranes by electric fields.

design wave—In the design of harbors, harbor works, etc., the type or types of wave selected as having the characteristics against which protection is desired. (73)

detritus—(or *debris*). Any loose material produced directly from rock disintegration.

deuterium—(symbol H_2 or D). *See heavy water.*

devilfish—*See octopus, manta ray.*

diadactic structure—*See graded bedding.*

diagenesis—The chemical and physical changes that sediments undergo after their deposition, compaction, cementation, recrystallization, and perhaps replacement, which result in **lithification**.

diastrophism—The process or processes by which the **crust** of the earth is deformed and continents and ocean basins, plateaus and mountains, flexures and folds of strata, and faults are produced.

diatom—One of a class (Bacillariophyceae) of microscopic **phytoplankton** organisms, possessing a wall of overlapping halves (valves) impregnated with silica. Diatoms are one of the most abundant groups of organisms in the sea

and the most important primary food source of marine animals. *See diatomaceous ooze.*

diatomaceous ooze—A pelagic siliceous sediment composed of more than 30 percent diatom **tests**, up to 40 percent calcium carbonate, and up to 25 percent mineral grains. This sediment generally is restricted to high latitudes or areas of upwelling such as the Gulf of California. *See ooze.*

diatom film—*See primary film.*

diffracted wave—A wave whose front has been changed in direction by an obstacle or other non-homogeneity in the medium other than by **reflection** or **refraction**. (3)

diffraction—The bending of waves (sound, water, light, etc.) around obstacles. For example, when a portion of a train of waves is interrupted by a barrier such as a breakwater, the effect of diffraction is manifested by propagation of waves into the sheltered region within the barrier's geometric shadow.

diffuse attenuation function—A mathematical formulation of the relationship between the **illuminance** (E_o) at the surface, the illuminance (E_x) at a depth (X), and the **attenuation coefficient** (k).

$$E_x = E_o e^{-k X}$$

(Strictly this equation relates to monochromatic light only, but it is a sufficient approximation to illuminance data for practical purposes.)

diffuser—A device used to alter the angular distribution of the **radiant flux** from a source, depending essentially on the phenomenon of **diffusion**. (8)

diffusion—The spreading or scattering of matter under the influence of a concentration gradient with movement from the stronger to the weaker solution.

diffusion coefficient—The constant of proportionality between the rate of diffusion across a plane area and the concentration gradient normal to that plane.

diffusivity—A measure of the rate of diffusion of a property, appearing as the factor K in the diffusion equation

$$\frac{\partial q}{\partial t} = K \nabla^2 q$$

where q is the property diffused, and ∇^2 is the Laplacian operator. The diffusivity has dimensions of a length times a velocity; it varies with the property diffused, and for any given property it may be considered a constant or a function of temperature, space, etc., depending on the context. (5)

dilatancy—The expansion of granular masses such as sand when deformed because of rearrangement of the grains. (2)

- dilution**—The reduction in the concentration of dissolved or suspended substances by mixing with water of a lower concentration.
- diluvium**—A general term for all glacial and fluvio-glacial deposits of continental glaciation. (2)
- dinoflagellate**—One of a class (Dinophyceae) of single-celled microscopic or minute organisms. Dinoflagellates may possess both plant (chlorophyll and cellulose plates) and animal (ingestion of food) characteristics. Many marine forms are luminescent and, when in great numbers, are responsible for **sheet-type luminescence**. In addition, dense concentrations may create a red discoloration, (**red tide**) and cause mass mortality of marine life. Other discolorations due to these organisms may be yellow, green, or shades of brown, but the majority of these concentrations are nontoxic to marine life.
- dip**—1. The angle at which the rock structure is inclined with a horizontal plane.
2. The angle formed by the lines of total magnetic force and the horizontal plane at the earth's surface; reckoned positive if downward. *See* **inclination**.
3. The increase in depth of a moored mine case (or buoy), due to current force against the case and cable.
- dip equator**—*See* **magnetic equator**.
- dipolar spreading**—*See* **spreading of sound**.
- directional hydrophone**—A hydrophone the response of which varies significantly with the direction of sound incidence. (69)
- direction response pattern**—(or *beam pattern*). The directional response pattern of a transducer used for sound emission or reception is a description, usually presented graphically, of the response of the transducer as a function of the direction of the transmitted or incident sound waves in a specified plane and at a specified frequency. In general, the beam pattern will change with a change in the operating frequency. (3)
- directional spectrum**—The spectral distribution of wave energy by both frequency and direction.
- directivity**—The confining of sound to a beam by mechanical and/or electronic means.
- directivity index**—A measure of **sound pressure level** in one direction compared to that in all other directions.
- direct path**—*See* **surface path**.
- direct tide**—A gravitational solar or lunar tide in the ocean which is in phase with the apparent motions of the attracting body, and consequently has its local maximums directly under the tide-producing body, on the opposite side of the earth. *See* **reversed tide**. (5)
- discharge**—The rate of flow of water or ice from a river, fiord, or harbor at a given instant in terms of volume per unit time, for example, cubic feet per second.
- discolored water**—Sea water having a color other than the blues and greens normally seen. Variations of the colors red, yellow, green, and brown, as well as black and white, have been reported. Discolorations may appear in patches, streaks, or large areas and may be caused by concentrations of inorganic or organic particles or **plankton**. *See* **red tide**.
- discontinuity**—The abrupt variation or jump of a variable at a line or surface. *See* **interface**. (5)
- discontinuity layer**—*See* **thermocline, pycnocline**.
- disintegration**—(also called *decay, rot, crumble*). A break down or decomposition of ice concentrations or complete disappearance thereof. *See* **radioactive decay**.
- dislocation**—(or *displacement*). Used in a general sense to refer to relative movements of rocks along a **fault**.
- dispersion**—1. The separation of a complex surface **gravity wave** disturbance into its component parts. (73)
2. *See* **acoustic dispersion**.
- disphotic zone**—The dimly lighted zone extending from about 250 to 650 or more feet. Little plant production can take place in this zone, and the plants found here have mostly sunk from the layer above. *See* **aphotic zone, euphotic zone**. (54)
- displacement**—*See* **dislocation**.
- displacement volume**—The volume of fluid displaced by **plankton** which has been drained of water and which is a measure of the planktonic **biomass**.
- displacement weight**—*See* **displacement volume**.
- display**—*See* **bioluminescent display**.
- dissected**—Cut by erosion into hills, ridges, valleys, etc. May be applied to a submarine shelf or slope cut into by submarine canyons or sea valleys.
- dissipation**—In thermodynamics, the conversion of kinetic energy into heat by work done against the viscous stresses. Sometimes the rate of conversion per unit volume is meant.
- distilled water**—*See* **pure water**.
- distortion**—An undesired change in waveform. Noise and certain desired changes in waveform, such as those resulting from modulation or detection, are not usually classed as distortion. (6)
- distortional wave**—*See* **transverse wave**.
- distribution**—Arrangement in time or space, as the distribution of temperature; or apportionment among various classes, or class intervals, especially ranges of values of a certain variable. (5)

distribution graph—In hydrology, a statistically derived **hydrograph** for a storm of specified duration, graphically representing the percent of total direct runoff passing a point on a stream, as a function of time. It is usually presented as a histogram or table of percent runoff within each of successive short time intervals. In principle it is the same as the unit hydrograph; both are used as tools in river forecasting and for other purposes such as the comparison of runoff characteristics of different drainage areas. (5)

diurnal—(or *daily*). 1. Daily, especially pertaining to actions which are completed within twenty-four hours and which recur every twenty-four hours; thus, most reference is made to diurnal cycles, variations, ranges, maximums, etc. (5)

2. Having a period or cycle of approximately one **lunar day** (24.84 solar hours): Certain tides and tidal currents are said to be diurnal when one **high water** and one **low water**, and one **flood** and one **ebb current**, occur each lunar day.

diurnal constituent—Any tide constituent whose period approximates that of a **lunar day** (24.84 solar hours). *See* **constituent**.

diurnal cooling—Heat lost by the surface of a body of water during the night. This radiational loss manifests itself in a small and transient positive gradient of temperature that is observed near the surface in calm weather. *See* **diurnal heating**.

diurnal current—The type of **tidal current** having only one flood and one ebb period in a tidal day. (73)

diurnal fluctuations—*See* **diurnal**.

diurnal heating—Solar radiation absorbed by a body of water during the daylight hours. This short-wave radiation, by heating the upper layer of the water, creates, in the absence of wind, a small and transient surface **thermocline**. *See* **diurnal cooling**.

diurnal inequality—(also called *daily inequality*). The difference in heights and durations of the two successive **high waters** or of the two successive **low waters** of each day; also, the difference in speed and direction of the two **flood currents** or the two **ebb currents** of each day.

diurnal range—1. The amount of variation between the maximum and minimum of any element during 24 hours.

2. Contracted form of **great diurnal range**.

diurnal tide—A **tide** in which there is only one **high water** and one **low water** each **lunar day**, (5) (*See* figure for **type of tide**.)

diurnal variation—*See* **magnetic diurnal variation**.

diurnal vertical migration—The daily vertical movement of certain members of the **plankton** and **nekton**. The movement usually is triggered

by a change in light intensity, and influenced by other factors such as temperature and gravity. The migration generally is upward at sunset and downward at sunrise. The rhythmic movements of these organisms are thought to be responsible for the typical movement of the **deep scattering layer**.

divergence—1. A horizontal flow of water, in different directions, from a common center or zone; often associated with **upwelling**.

2. In refraction phenomena, the increasing of the distance between **orthogonals** in the direction of wave travel. Denotes an area of decreasing **wave height** and energy concentration. (73)

divergence loss—The part of the **transmission loss** which is due to the spreading of sound rays in accordance with the geometry of the situation. For example, in the case of spherical waves emitted by a point source, the **sound pressure** at a point 20 yards distant from the source will be only half as great as the sound pressure 10 yards from the source.

diving rule—*See* **compression factor**.

diving saucer—A circular-shaped submersible for undersea exploration.

diving trim—The condition of a submarine which is so compensated that completing the flooding of the main ballast, safety, and bow buoyancy tanks, will cause it to submerge with neutral **buoyancy** and zero fore-and-aft **trim**. (64)

division—*See* **classification of organisms**.

doldrums—(also called *equatorial calms*). A nautical term for the equatorial trough, with special reference to the light and variable nature of the winds. *See* **equatorial air**. (5)

dolomite—A mineral or a rock composed of the mineral $CaMg(CO_3)_2$; also called magnesium limestone, which is deposited as dolomite or produced later by substitution of magnesium for some of the calcium.

dolphin—1. A member of the **cetacean** suborder Odontoceti. The name is used interchangeably with porpoise by some. More properly it is given generally to the beaked members of the family Delphinidae, except the larger members which have been given the name “whale”, such as the killer whale and pilot whale.

2. A pelagic fish of the genus *Coryphaena* noted for its brilliant colors.

3. A cluster of piles. (66)

dome—(or *kuppe*). 1. This term is no longer recommended by the ACUF for an elevation of small area, rising with a steep angle to a depth more than 200 meters (109 fathoms) below the water surface. *See* **seamount**, **knoll**.

2. A (acoustically transparent) transducer enclosure, usually streamlined, used with echanging or listening devices to minimize turbulence and **cavitation noises** arising from the passage of the **transducer** through the water.

dome-shaped iceberg—*See ice island iceberg.*

Doodson-Lege—A tide-prediction machine, used at Liverpool (England) Observatory and Tidal Institution.

Doppler—*See Doppler effect.*

Doppler effect—(also called *Doppler shift*). The change in frequency with which energy reaches a receiver when the receiver and the energy source are in motion relative to each other. (5)

Doppler shift—*See Doppler effect.*

dorsal—Pertaining to or lying near the back; opposite of **ventral**. (26)

dosage—*See dose.*

dose—(or *dosage*). According to current usage, the radiation delivered to a specified area or volume or to the whole body. Units for dose specification are **roentgens** for X- or gamma rays, **reps** or equivalent roentgens for beta rays. In radiology the dose may be specified in air, on the skin, or at some depth beneath the surface; no statement of dose is complete without specification of location. In recent years there has been an increasing tendency to regard a dose of radiation as the amount of energy absorbed by tissue at the site of interest per unit mass. *See radiation absorbed dose, Roentgen equivalent physical.* (70)

dosimeter—An instrument used to detect and measure an accumulated dosage of radiation; in common usage it is a pencil size ionization chamber with a built-in self reading electrometer; used for personnel monitoring. (70)

double ebb—An **ebb current** having two maximums of speed separated by a smaller ebb speed. (50)

double flood—A **flood current** having two maximums of speed separated by a smaller flood speed. (50)

double high water—*See double tide.*

double tide—(or *agger, double high water, gulder*). A **high water** consisting of two maximums of nearly the same height separated by a relatively small depression, or a **low water** consisting of two minimums separated by a relatively small elevation. (50)

Douglas scale—A series of numbers from 0 to 9 to indicate the condition of waves and swell. Replaced by WMO Code 75. (73)

<i>No.</i>	<i>State of Sea</i>	<i>Swell</i>
0	Calm-----	No swell.
1	Smooth-----	Low swell (short or average length).
2	Slight-----	Low swell (long).
3	Moderate-----	Moderate swell (short).
4	Rough-----	Moderate swell (average length).
5	Very rough---	Moderate swell (long).
6	High-----	Heavy swell (short).
7	Very high----	Heavy swell (average length).
8	Precipitous---	Heavy swell (long).
9	Confused----	Confused swell.

downdrift—The direction of predominant movement of **littoral** sediment.

downstream—Generally the direction toward which a fluid is moving, implying the horizontal component of the mean direction or direction of the basic current; the opposite of **upstream**. (5)

downward irradiance—The **radiant flux** on an infinitesimal element of the upper face (0 to 180 degrees) of a horizontal surface containing the point being considered, divided by the area of that element.

Unit of measurement is watt per square meter (W/m^2). (8)

downwelling—*See sinking* (sense 1).

dragon's tail—A towed **thermistor chain** used to measure sea temperature.

dredge—1. A simple cylindrical or rectangular device for collecting samples of **bottom sediment** and **benthic fauna**. These are generally made of heavy gauge steel plate or pipe and depend upon a scooping action to obtain the sample.

2. A ship designed to remove sediment from a channel or dock region to maintain draft depths.

dried ice—The ice surface from which the water has disappeared after the formation of **cracks** and **holes**. During the period of drying, the surface becomes increasingly white. (74)

dried weight—(or *dry weight, dry plankton*). The weight of organisms, such as **plankton**, **fouling**, or **benthos**, from which water has been driven but which has not been ignited. The term dry weight is more commonly used in the study of fouling.

dries—(or *uncovers*). An area of a reef or other projection from the bottom of a body of water which periodically is covered and uncovered by the water.

drift—1. The effect of the velocity of fluid flow upon the velocity (relative to a fixed external point) of an object moving within the fluid; the vector difference between the velocity of the object relative to the fluid and its velocity to the fixed reference. (5)

2. In publications for the mariner, drift is the speed of a current or **ice floe** usually given in nautical miles per day or in knots. For the oceanographer, drift is a wide, slow-moving current principally caused by winds.

3. Any rock material such as boulders, till, gravel, sand, or clay, transported by a **glacier** and deposited by the ice or by the water derived from melting of the ice. (2)

drift bottle—(also called *bottle post*). A bottle, of one of various designs, which is released into the sea for use in studying currents. It contains a card (bottle paper), identifying the date and place of release, to be returned by the finder with the date and place of recovery. *See drift card.* (5)

drift card—A card such as is used in a drift bottle, encased in a buoyant, waterproof envelope and released in the same manner as a drift bottle.

Cheaper and lighter than bottles, drift cards are especially suited to dropping in large quantities from aircraft, and it is supposed that the card, having less freeboard than a bottle, is less affected by wind. *See* **drift bottle**. (5)

drift current—(sometimes called *ocean current*).

1. A wide, slow-moving ocean current principally caused by winds. Example are the extension of the **North Atlantic Current** (the **North Atlantic Drift**) and the **West Wind Drift**. *See* **wind-driven current**.

2. The current determined from the differences between **dead reckoning** and a navigational **fix**.

3. A current defined by assuming that the wind stress is balanced by the sum of the Coriolis and frictional forces.

drift ice—(or *floating ice*). Any sea ice that has drifted from its place of origin. The term is used in a wide sense to include any area of sea ice, other than **fast ice**, no matter what form it takes or how disposed. *See* **close pack ice**. (5)

drift ice foot—*See* **ramp**.

driftmeter—(or *drift sight*). An instrument for measuring drift angle. *See* **Geomagnetic Electrokinetograph**. (68)

drift sight—*See* **driftmeter**.

drift station—A scientific station established on the ice of the Arctic Ocean. Most drift stations are based on **ice floes**, although two American stations (T-3 and ARLIS II) have been on **ice islands**.

U.S.S.R. stations are numbered consecutively from NP-1 (NP for North Pole) and are sometimes referred to as "SP" for the Russian "Severnny Polyus" (North Pole).

Drift Station Bravo—*See* **T-3**.

drogue—(or *parachute drogue*). A current measuring assembly consisting of a weighted parachute and an attached surface buoy. The parachute can be placed at any desired depth and current speed and direction determined by tracking and timing of the surface buoy.

drown—To submerge land beneath water either through a rise in the level of the water or by sinking of the land. (2)

drowned river mouth—*See* **estuary**.

drydock iceberg—*See* **valley iceberg**.

dry organic matter—**Dry plankton** less ash after ignition. The most reliable and the preferred weighing method in determining the **biomass**.

dry plankton—**Plankton** dried to a constant weight by a specified method. *See* **dried weight**.

dry weight—*See* **dried weight**.

duct—A layer in the ocean or atmosphere where **refraction** and, probably, **reflection** result in

the trapping of electromagnetic waves, or sound waves.

ducting—The trapping of sound or electromagnetic waves within a layer, resulting in extended ranges.

dugong—An aquatic herbivorous mammal, sometimes referred to as a sea cow, of the order Sirenia allied to the **manatee**, but with a bilobate tail like that of a whale.

dumped deposit—The accumulation of sediment deposited more rapidly than waves and currents are able to redistribute it. (2)

dumping ground—A sea area within which material dredged from other areas is deposited. *See* **spoil ground**.

duration—1. The interval of time of the rising or falling tide, or the length of time of flood or ebb tidal currents.

2. In wave forecasting, the length of time the wind blows in essentially the same direction over the fetch. (61)

dynamic calculations—The procedure based on the summation of dynamic depth intervals from the surface of the ocean to any specified level; dynamic differences between stations are derived and consequently the relative speed and direction of currents at different levels.

dynamic depth—*See* **dynamic height**.

dynamic height—(or *geodynamic height*). The amount of work done when a water particle of unit mass is moved vertically from one level to another; the dimensions are those of potential energy per unit mass.

dynamic height anomaly—(also called *anomaly of geopotential difference*). In oceanography, the excess of the actual geopotential difference, between two given **isobaric surfaces**, over the geopotential difference in a homogeneous water column of salinity 35 **per mille** (‰) and temperature 0°C.

The dynamic height anomaly between two isobaric surfaces is the product of the mean **specific volume anomaly** and the difference in pressure (in **decibars**); the latter is assumed to equal the difference in depth in meters. (5)

See **geostrophic current**.

dynamic meter—(or *geodynamic meter*). The standard unit of **dynamic height** expressed as 10 square meters per second per second. Its inclusion in the **hydrostatic equation** eliminates the factor of gravity acceleration in **dynamic calculations**.

dynamic oceanography—The study of oceanographic motions as solutions of the fundamental equations of hydrodynamics or other systems of equations appropriate to special situations.

The restrictions of this definition suffice to distinguish dynamic oceanography from other fields, for example, **physical oceanography** or **synoptic oceanography**, such distinctions being

a function of the state of the science rather than of the subject matter itself.

dynamic prediction—Methods of predicting the future state of the environments by using physical models—as opposed to empirical or statistical methods.

dynamic theory—A theory considering the horizontal **tide-producing forces** to be the most important factor in causing movement of water. The vertical tide-producing forces are simply considered small periodical variations in the acceleration of **gravity**.

dynamic topography—The configuration formed by the geopotential difference or **dynamic height** (measured in **dynamic meters**) between a given **isobaric surface** and a reference surface (for example, in the ocean the 2,000-decibar surface). A topographic chart formed may be used in determining **geostrophic currents** within the oceans. The current along the isopleths of dynamic height must be considered

to move relative to the motion of the water at the reference surface. If the water at the reference surface has no motion, the current direction along the isobaric surface is considered absolute.

dynamometer—(sometimes called *strain gauge*). An instrument used in bottom sampling or other oceanographic operations to indicate that bottom has been reached. The instrument measures variations on wire tension and is only effective to depths where the tension due to the weight of the sampling device is somewhat greater than the tension caused by the weight of the lowering cable and the variable loads produced by **ship motion**.

dyne—A force which, acting on a mass of one gram, imparts to that mass an acceleration of one centimeter per second per second. *See gal.*

The dyne is the unit of force of the **egs system**. Since 1930, **gravity** has been reported in terms of the gal, rather than the dyne. (37)

E

eager—*See* bore.

earbone—*See* otolith.

earth current—*See* telluric currents.

earthquake—A sudden, transient motion or trembling of the earth's **crust** resulting from the propagation in the earth of elastic waves caused by faulting of the rocks or by volcanic activity.

earthquake intensity—A number describing the effects of an **earthquake** on man, on man-made structures, and on the earth's surface. The number is rated on the basis of an "earthquake intensity scale." The scale in common use in the U. S. today is the modified Mercalli scale of 1931.

earth radiation—*See* terrestrial radiation.

earth structure—The postulated structure and composition of the earth by assuming concentric layering around a core based upon gravity, density distribution, seismology, and laboratory determinations of physical and chemical properties of rocks. *See* mantle, crust, centrosphere.

earth tide—The periodic movement of the earth's **crust** caused by the **tide-producing forces** of the moon and sun. (68)

East Africa Coast Current—(or *Somali Current*). A seasonal current influenced by the monsoon drifts of the Indian Ocean. It flows southwestward along the coast of Somalia in

the Northern Hemisphere winter and northeastward from about 10°S during the Northern Hemisphere summer.

East Australia Current—The current which is formed by part of the **South Equatorial Current** and flows southward along the east coast of Australia. The East Australia Current turns and joins the northeast flow through the Tasman Sea.

In the Southern Hemisphere summer a small part of this current flows westward along the south coast of Australia into the Indian Ocean.

East Greenland Current—A current setting south along the east coast of Greenland and carrying water of low salinity and low temperature. The East Greenland Current flows through Denmark Strait between Iceland and Greenland and joins the **Irminger Current**. The greater part of the current joins the counterclockwise circulation south of Greenland; part curves to the right around the tip of Greenland and flows northward into Davis Strait as the **West Greenland Current**.

The main discharge of the Arctic Ocean is via the East Greenland Current.

East Ice—1. The **sea ice** which drifts from the Arctic Ocean south along the east Greenland coast, around Kap Farvel, and up the southwest coast of Greenland. *See* storis.

2. To Norwegians, "East Ice," or "Des-isen" is the ice in the Barents Sea. (59)

East Wind Drift—A west-setting current close to the Antarctic Continent caused by the polar easterlies. (Approved ACUF name.)

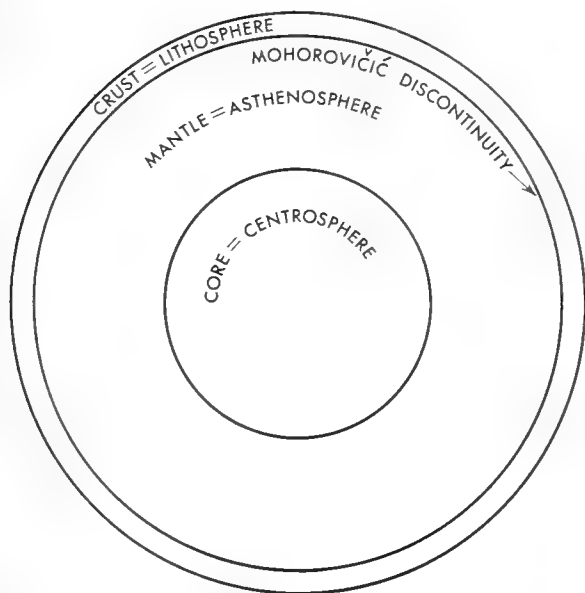
ebb axis—The average direction of the tidal current at **strength of ebb**. (59)

ebb current—The tidal current associated with the decrease in the height of a tide. Ebb currents generally set seaward, or in an opposite direction to the tide progression. Erroneously called ebb tide. (*See* figure for **current curve**.)

ebb interval—The interval between the transit of the moon over the meridian of a place and the time of the strength of the following ebb tidal current. (50)

ebb strength—The ebb tidal current at the time of maximum speed, usually associated with the lunar tide phases at springs near **perigee** and/or maximum river discharge. (*See* figure for **current curve**.)

ebb tide—*See* falling tide, ebb current.



EARTH STRUCTURE

- echinoderm**—One of a phylum (Echinodermata) of principally **benthic** marine animals having calcareous plates with projecting spines forming a rigid or articulated skeleton or plates and **spicules** embedded in the skin; the animals have radial symmetry, usually is a five-rayed body. Some echinoderms are the **sea stars**, **sea urchins**, **crinoids**, and **sea cucumbers**.
- echinopluteus**—The planktonic larva of a sea urchin.
- echo**—An acoustic signal which has been reflected or otherwise returned with sufficient magnitude and time delay to be detected as a signal distinct from that directly transmitted. (3)
- echogram**—1. The graphic presentation of **echo soundings** recorded as a continuous profile of the bottom.
2. Often erroneously called a **fathogram** when not recorded by a Fathometer*.
- echo ranging**—The determination of distance by measuring the time interval between transmission of a radiant energy signal (sound) and the return of its **echo**. (66)
- echo sounder**—*See* **echo sounding**.
- echo sounding**—(or *acoustic sounding*). Determination of the depth of water by measuring the time interval between emission of a sonic or ultrasonic signal and the return of its **echo** from the bottom. The instrument used for this purpose is called an echo sounder. (68)
- ecology**—*See* **marine ecology**.
- eddy**—A circular movement of water usually formed, where currents pass obstructions, between two adjacent currents flowing counter to each other, or along the edge of a permanent current.
- eddy-built bar**—Sediment deposit believed to be formed by the rotating action of eddies in a tidal lagoon. Ridges surrounding some emerged Carolina bays may have developed in this way. (2)
- eddy conduction**—*See* **eddy heat conduction**.
- eddy conduction coefficient**—*See* **eddy conductivity**.
- eddy conductivity**—(also called *coefficient of eddy diffusion*, *eddy conduction coefficient*). The exchange coefficient for **eddy heat conduction**. (5)
- eddy current**—*See* **eddy**.
- eddy diffusion**—(or *turbulent diffusion*). The transfer of matter by the turbulent eddies in a fluid.
- eddy flux**—The rate of transport (or flux) of fluid properties such as momentum, mass, heat, or suspended matter by means of eddies in a turbulent motion; the rate of turbulent exchange. (5)
- eddy heat conduction**—(or *eddy heat flux*, also called *eddy conduction*). The transfer of heat by means of eddies in turbulent flow, treated analogously to molecular **conduction**. (5)
- eddy heat flux**—*See* **eddy heat conduction**.
- eddy viscosity**—The turbulent transfer of **momentum** by eddies giving rise to an internal fluid friction, in a manner analogous to the action of molecular viscosity in laminar flow, but taking place on a much larger scale.
The value of the coefficient of eddy viscosity is of the order 10^4 square centimeters per second. (5)
- edge wave**—An ocean wave traveling parallel to a coast, with crests normal to the coastline. Such a wave has a height that diminishes rapidly seaward and is negligible at a distance of one wavelength offshore. (5)
- eelgrass**—*See* **seagrass**.
- effective acoustic center (apparent source)**—The effective acoustic center of an acoustic generator is the point from which the spherically divergent sound waves, observable at remote points, appear to diverge. (67)
- effective back radiation**—*See* **effective terrestrial radiation**.
- effective half-life**—The time required for a radioactive element fixed in the tissue of an animal body to be diminished 50 percent as a result of the combined action of radioactive decay and biological elimination. (70)
- effective radiation**—*See* **effective terrestrial radiation**.
- effective sound pressure**—The sound pressure at a point is the root-mean-square value of the instantaneous sound pressures over a time interval at the point under consideration.
- effective terrestrial radiation**—(or *effective radiation*, *effective back radiation*). The difference between the outgoing infrared **terrestrial radiation** of the earth's surface and the downward infrared **counterradiation** from the atmosphere. (5)
- ejecta**—(or *ejectamenta*). Material thrown out by a volcano, such as ash, **lapilli**, bombs. (2)
See **tephra**.
- ejectamenta**—*See* **ejecta**.
- Ekman current meter**—A mechanical device for measuring ocean current velocity. A sensitive impeller is turned by current action and the number of turns recorded on an attached dial. Speed is measured indirectly from the number of impeller revolutions by means of conversion tables. Lead shot are dropped into a compass box below the meter for a set number of impeller revolutions. Current direction is determined from the location of shot dropped in the compass box.
- Ekman Spiral**—A theoretical representation of the effect that a wind blowing steadily over an ocean of unlimited depth and extent and of uniform **viscosity** would cause the surface layer to drift at an angle of 45 degrees to the right of the wind direction in the Northern Hemisphere.

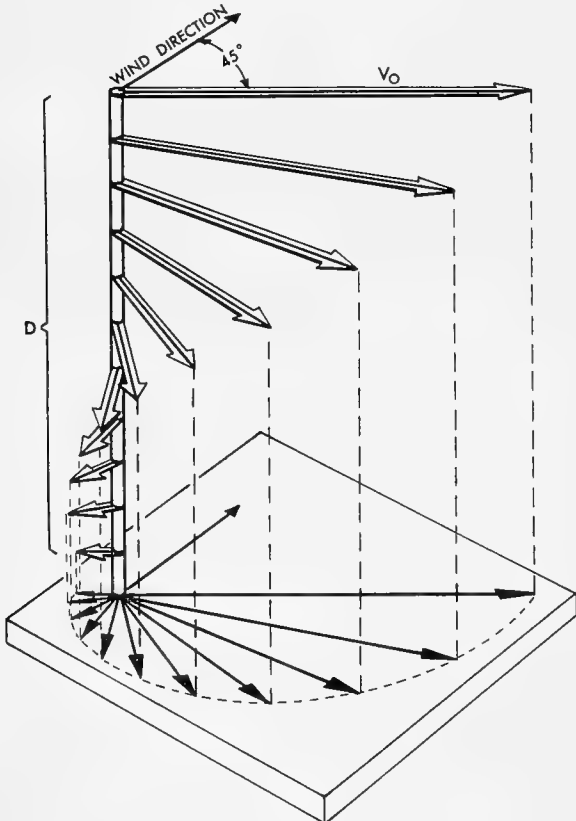
Water at successive depths would drift in directions more to the right until at some depth it would move in the direction opposite to the wind. Velocity decreases with depth throughout the spiral. The depth at which this reversal occurs is of the order of 100 meters. The net water transport is 90 degrees to the right of the direction of the wind in the Northern Hemisphere.

elasmobranch—Any of numerous cartilaginous fishlike vertebrates belonging to the subclass Elasmobranchii, which includes the sharks, skates, and rays.

elbow—1. A change in direction in the contour of a submerged **bank** or **shoal**; not a recognized term by the ACUF.

2. A sharp change in the direction of a **channel**. (30)

electrical conductivity—A unit measure of electrical conduction; the facility with which a substance conducts electricity, as represented by the current density per unit electrical-potential gradient in the direction of flow. Electrical conductivity is the reciprocal of electrical **resistivity** and is expressed in units such as mhos (reciprocal ohms) per centimeter. It is an intrinsic property of sea water and varies with temperature, salinity, and pressure.



EKMAN SPIRAL SHOWING DEPTH OF FRICTIONAL RESISTANCE (D)

electric log—A graphic recording of the various electrical properties of a sediment or rock through which a hole has been drilled. Obtained by lowering electrodes into the hole. (2)

electric ray—Any of the family (Torpedinidae) of rays possessing a pair of electric organs capable of delivering a strong shock to humans if handled. *See ray*.

electroacoustic transducer—A transducer for receiving waves from an electric system and delivering waves to an acoustic system, or vice versa. (69)

electrolyte—A substance which when dissolved in a suitable liquid, such as water, dissociates into ions and thus makes the liquid a conductor of electricity. Sodium chloride ($NaCl$) is the most common electrolyte in sea water.

electromagnetic energy—*See electromagnetic radiation*.

electromagnetic radiation—(or *electromagnetic energy*; often called, simply *radiation*). Energy propagated through space or through material media in the form of an advancing disturbance in electric and magnetic fields existing in space or in the media. The term radiation, alone, is used commonly for this type of energy, although it actually has a broader meaning. (5)

electromagnetic window—The concept that some portion of the spectrum, whether radio waves, ultraviolet rays, infrared (heat), radiant light or electrical energy of some sort can be made to penetrate the sea and exploit a "window" in the opacity of the sea.

electromechanical transducer—A transducer for receiving waves from an electric system and delivering waves to a mechanical system, or vice versa. (69)

electron—An elementary particle of rest mass m_e equal to 9.107×10^{-28} grams and charge equal to 4.802×10^{-10} statcoulombs. Its charge may be either positive or negative. The positive electron is usually called a positron; the negative electron is sometimes called the negatron. Most frequently the term electron means negatron. The negative electron is a constituent of all atoms. In a neutral atom the number of electrons is equal to the atomic number Z .

electronic bathythermograph (BT)—A bathythermograph which provides temperature readings to 1,350 feet by using a **thermistor** and pressure element to provide remote readout on deck.

electron-volt—(abbreviated **ev**). A unit of energy equivalent to the amount of energy gained by an **electron** in passing through a potential difference of one volt. Larger multiple units of the electron-volt are frequently used, namely; Kev for thousand- or kilo-electron-volts, Mev for million-electron-volts, and Bev for billion-electron-volts.

$$1 \text{ ev} = 1.6 \times 10^{-10} \text{ erg.}$$

(70)

electrostatic transducer—A **transducer** that consists of a capacitor and depends upon interaction between its electric field and the change of its electrostatic capacitance. (69)

element—1. One of the simpler parts of which a complex entity is composed; thus a part of an instrument, as the thermal element of a **bathythermograph** or a constituent of the atmosphere, such as nitrogen, oxygen, water vapor, carbon dioxide, etc.

2. In chemistry, a substance which cannot be broken down by ordinary chemical means into simpler components (although one element may be transformed into another by some form of subatomic bombardment).

(5)

elevated island—An island that rises to a few feet above high tide level on a **reef flat** and consists either of sand and debris or of solid reef rock. (2)

elevation—A general term for a relief feature of any size which rises above the surrounding sea bed.

elk kelp—One of a genus (*Pelagophycus*) of large **brown algae**, which consists of a massive **holdfast** and a long tough **stipe** terminated by a large bulbous **pneumatocyst** from which a single forked lamina-bearing branch radiates. The genus occurs only on the Pacific coast of North America from Point Conception, California southward along the coast of California and Baja California and reaches lengths of 100 feet or more.

Elmo's fire—See **St. Elmo's fire**.

El Niño—A warm current setting south along the coast of Ecuador. It generally develops just after Christmas concurrently with a southerly shift in the tropical rain belt. In exceptional years the current may extend along the coast of Peru to 12°S. When this occurs, **plankton** and fish are killed in the coastal waters and phenomenon somewhat like the **red tide** of Florida results. During this time **discolored water** and intense displays of **bioluminescence** are common. El Niño is much more widespread and destructive than the more local phenomenon of **aguaje**, which occurs every year. (5)

El Pintor—See **Callao Painter**.

embacle—A term, now rarely used, for the heaping up of ice in a stream following a freeze. (59)

embayment—An indentation in a **shoreline** forming an open bay.

embouchure—See **mouth**.

emergence—The fact that part of the ocean floor has become dry land but does not imply whether recession of the sea or elevation of the land was the specific cause. (2)

emissivity—(sometimes called *emissive power*). The ratio of the emittance of a given surface at a specified wavelength and emitting tempera-

ture to the emittance of an ideal black body at the same wavelength and temperature. The greatest value that an emissivity may have is unity, the least value zero.

It is corollary of **Kirchoff's law** that the emissivity of any surface at a specified temperature and wavelength is exactly equal to the absorptivity of that surface at the same temperature and wavelength. (5)

encrusting bryozoan—(or *coral patch*). A **bryozoan** which forms hard crusts on underwater surfaces.

endoergic reaction—A reaction which absorbs energy. (70)

endothermic reaction—A reaction which absorbs energy specifically in the form of heat. (70)

energetics—The branch of study dealing with the systematic description of the energy conversion and transfer processes which take place within a physical system. (5)

energy coefficient—The ratio of the energy in a wave per unit crest length transmitted forward with the wave at a point in shallow water to the energy in a wave per unit crest length transmitted forward with the wave in deep water. On **refraction diagrams** this is equal to the ratio of the distance between a pair of **orthogonals** at a selected point to the distance between the same pair of orthogonals in deep water. Also the square of the **refraction coefficient**. (61)

English system—A system of physical units based on the use of the foot, pound, and second as elementary quantities of length, mass, and time, respectively. This system, although being displaced by the **cgs system**, is still in use in many English-speaking countries.

ensemble average—An average determined over a finite subset of random time functions for some particular instant of time.

ensonify—The penetration of sound into any particular part of the sea.

entrainment—1. The transfer of fluid by friction from one **water mass** to another, usually occurring between opposing currents. The turbulence between the water masses results in mixing.

2. The pick-up and movement of sediment as bed load or in suspension by current flow.

entropy—1. A measure of the unavailable energy in a system, that is, energy that cannot be converted into another form of energy.

2. A measure of the degree of mixing of different kinds or sizes of sediments; high entropy approaches an unmixed sediment of one kind. (2)

environment—The sum total of all the external conditions which may affect an organism, community, material, or energy, if brought under the influence of these external conditions. (2)

environmental factors—In oceanography, the physical and chemical conditions such as tem-

- perature, salinity, light conditions, current velocity, etc., but usually excluding **biotic factors**.
- eolian sands**—(or *aeolian sands*, *blown sands*). Sediments of sand size or smaller which have been transported by winds. They may be recognized in marine deposits off desert coasts by the greater angularity of the grains compared with waterborne particles.
- Eötvös effect**—The east-west component of the movement of the ship, including the effect of marine currents, modifies the centrifugal force of the earth's rotation. It is a vertical force experienced by a body moving in an east-west direction on the rotating earth. In gravity measurements a positive correction is applied if moving eastward and a negative correction applied in moving westward.
- epieiric seas**—Shallow inland seas with restricted communication with the open ocean and having depths less than 250 meters (137 fathoms). Hudson Bay is an example. (2) *See* **inland seas**, **epicontinental seas**.
- epirotogenic movement**—*See* **epirogeny**.
- epirogeny**—(or *epirotogenic movement*). The broad uplift and subsidence of the whole or large portions of continental areas or oceanic basins. (2)
- Ephemeris**—A publication giving the computed places of the celestial bodies for each day of the year, or for other regular intervals. (63)
- epicenter**—The point on the earth's surface directly above the **focus** of an **earthquake**.
- epicontinental marginal sea**—A subdivision of the ocean, generally less than 7,500 feet deep, overlying a **continental shelf** and part of a **continental slope**, which is partly enclosed by extensions of the land, shallow banks, or islands (such as Laptev Sea).
- epicontinental sea(s)**—Shallow seas which occupy wide portions of a **continental shelf** or lie in the interior of a continent. *See* **epieiric seas**, **inland seas**, **shelf seas**.
- epilimnion**—The layer of water above the **thermocline** in a fresh water lake or pool; distinguished from **hypolimnion**, the layer below the thermocline. In the ocean, the equivalent is the **mixed layer**. (5)
- epipelagic**—The upper portion of the oceanic province, extending from the surface to a depth of about 100 fathoms (200 meters). (*See* figure for **classification of marine environments**.)
- epiphytic**—Growing attached to another plant. (13)
- epoch**—1. A particular instant for which certain data are given. (68)
2. A given period of time during which a series of related acts or events takes place. (68)
3. (or *tidal epoch*, *phase lag*, *phase difference*). Angular retardation of the maximum of a **constituent** of the observed tide behind the corresponding maximum of the same constituent of the hypothetical **equilibrium tide**. (68)
4. A division of geologic time.
- equal area projection**—(also called *authalic projection*). A map projection on which a constant ratio of areas is preserved; that is, any given part of the map on an equal area projection bears the same relation to the area on the reference surface which it represents.
- equation of continuity**—(or *continuity equation*). A hydrodynamical equation which expresses the principle of the conservation of mass in a fluid. It equates the increase in mass in a hypothetical fluid volume to the net flow of mass into the volume. (5)
- equation of motion**—The Newtonian law of motion states that the product of the mass of an elemental volume of fluid and acceleration equals the vector sum of the forces acting on the volume. In meteorological and oceanographic use, both sides of the equation of motion are divided by mass to give force per unit mass.
- The forces considered in ocean currents are gravity, coriolis force, pressure gradient force, and frictional forces.
- equatorial air**—According to some authors, the air of the **doldrums** of the equatorial trough, to be distinguished somewhat vaguely from the **tropical air** of the trade-wind zones. Tropical air becomes equatorial air when the former enters the equatorial zone and stagnates. There is no significant distinction between the physical properties of these two types of air in the lower troposphere. (5)
- equatorial calms**—*See* **doldrums**.
- Equatorial Convergence**—The zone along which waters from the Northern and Southern Hemispheres converge. This zone generally lies in the Northern Hemisphere, except in the Indian Ocean.
- Equatorial Convergence line**—*See* **Equatorial Convergence**.
- Equatorial Convergence zone**—*See* **Equatorial Convergence**.
- Equatorial Countercurrent**—An ocean current flowing eastward near the Equator.
- In the Atlantic Ocean, it flows east between the North and South Equatorial Currents across the full width of the ocean in northern summer, and across the eastern half of the ocean in northern winter. It eventually becomes the **Guinea Current**.
- In the Pacific Ocean, it flows east across the ocean between 3°N and 10°N. East of the Philippines it is joined by the southern part of the **North Equatorial Current**.
- In the Indian Ocean, it flows to the east between the monsoon drift and the **South Equatorial Current**; unlike the Equatorial Countercurrents of the Atlantic and Pacific Oceans, it is located south of the Equator. In northern

- summer, when the southwest monsoon forms a continuation of the southeast trade winds, the countercurrent flows with the monsoon drift.
- Equatorial Current**—*See* North Equatorial Current, South Equatorial Current.
- equatorial cylindrical orthomorphic projection**—*See* Mercator projection.
- equatorial tidal currents**—Tidal currents occurring approximately every two weeks when the moon is over the Equator. At these times, the **diurnal inequality** between successive periods of flood and ebb is at a minimum and the currents are most nearly **semidiurnal**.
- equatorial tides**—Tides that occur approximately every two weeks when the moon is over the Equator. At these times, the moon produces minimum inequality between two successive **high waters** and two successive **low waters**.
- equilibrium**—1. In thermodynamics, any state of a system which would not undergo change if the system were to be isolated. Processes in an isolated system not in equilibrium are irreversible and always in the direction of equilibrium.
2. In mechanics, a state in which the vector is zero. In hydrodynamics, it is usually further required that a steady state exists throughout the atmosphere or fluid model. The equilibrium may be stable or unstable with respect to displacements therefrom. (5)
- equilibrium argument**—The theoretical phase of a **constituent of the equilibrium tide**. *See* Greenwich argument.
- equilibrium range**—The high frequency band of wind waves whose frequency spectrum satisfies a minus five power law.
- equilibrium spheroid**—The shape that the earth would attain if it were entirely covered by a tideless ocean of constant depth. *See* **geoid**. (5)
- equilibrium theory**—A hypothesis which assumes an ideal earth which has no continental barriers and is uniformly covered with water of considerable depth. It also assumes that the water responds instantly to the **tide-producing forces** of the moon and sun to form a surface in **equilibrium** and moves around the earth without **viscosity** or friction.
- equilibrium tide**—(or *astronomic tide, astronomical tide, gravitational tide*). The hypothetical tide due to the **tide-producing forces** under the **equilibrium theory**; tide relating to the attractions of celestial bodies, particularly the sun and moon. (50)
- equilibrium vapor pressure**—The **vapor pressure** of a system in which two or more phases of a substance coexist in **equilibrium**. In oceanography the reference is to water substance unless otherwise specified. If the system consists of moist air in equilibrium with a plane surface of pure water or ice, the more specialized term **saturation vapor pressure** is usually employed, in which case the vapor pressure is a function of temperature only. (5)
- equinoctial**—The celestial equator. (50)
- equinoctial spring tides**—Those tides occurring near the equinoxes when the full or new moon and the sun have little or low **declination** and **spring tides** of greater range than the average occur, particularly if the moon is also nearly in **perigee**. (30)
- equinoctial tide**—Tide occurring when the sun is near equinox. During this period spring tide ranges are greater than average. (5)
- equinoxes**—The two points in the celestial sphere where the celestial equator intersects the ecliptic; also the times when the sun crosses the celestial equator at these points. (50)
- irradiation**—*See* **terrestrial radiation**.
- erect bryozoan**—(or *stolonate bryozoan*). A **bryozoan** which forms branching upright growths attached basally to underwater surfaces.
- erg**—The unit of energy in the centimeter-gram-second system of physical units; that is, one dyne centimeter. One erg is equal to 10^{-7} Joule or to 2.389×10^{-8} calories. (5)
- ergodic**—A hypothesis asserting statistical equivalence of **ensemble averages** and time averages when steady state conditions occur.
- erosion**—Any or all processes by which soil or rock is broken up and transported from one place to another. It is regarded as including weathering, **corrasion**, and transportation. (2)
- erosion ramp**—A sloping belt of reef rock immediately above the **reef flat** on an atoll islet where marine erosion is active. (2)
- erratic**—A transported rock fragment different from the **bedrock** on which it lies, either free or as part of a sediment. Such fragments are ice rafted or transported by **glacier ice** or by floating ice and are widely distributed on the sea floor in high latitudes.
- eruptive rocks**—Rocks which have formed from molten **magma** and which have either been intruded into older rocks or extruded at the earth's surface through volcanic cones or fissures.
- escarpment**—(or *fault scarp, scarp*). An elongated and comparatively steep slope of the **sea floor**, separating flat or gently sloping areas. (62)
- establishment**—*See* **lunitidal interval**.
- establishment of the port**—(or *high water full and change, common establishment, vulgar establishment*). The average interval between upper and lower lunar transit near time of new and full moon and the next **high water**. *See* **lunitidal interval**.
- estuarine muds**—Silts, often containing sufficient clay to impart some plasticity, and containing a considerable proportion of decomposed organic matter.
- estuary**—(or *drowned river mouth, branching bay, firth, frith*). A tidal bay formed by sub-

- mergence or drowning of the lower portion of a nonglaciated river valley and containing a measurable quantity of sea salt. *See* **inverse estuary**, **neutral estuary**, **positive estuary**, **sound** (sense 2), **slightly stratified estuary**, **vertically mixed estuary**, **highly stratified estuary**.
- Eulerian current measurement**—Direct observation of the current speed and/or direction during a period of time as it flows past a recording instrument such as the Ekman or Roberts current meter. *See* **Lagrangian current measurement**.
- eulittoral**—According to some authorities a zone extending from the high tide level to a depth of about 130 to 195 feet (40 to 60 meters). (54)
- euphausiid**—One of an order (Euphausiacea) of shrimplike, planktonic **crustaceans**, widely distributed in oceanic and coastal waters, and especially abundant in colder waters. Euphausiids grow to 3 to 4 inches in length, and nearly all possess luminous organs. Many of the species engage in typical **diurnal vertical migration** and may contribute to midwater sound scattering. Some are present near the sea surface at least during certain periods of the year, where they form the principal food for many of the baleen (whalebone) whales. *See* **krill**.
- euphotic zone**—The layer of a body of water which receives ample sunlight for the photosynthetic processes of plants. The depth of this layer varies with the water's **extinction coefficient**, the angle of incidence of the sunlight, length of day, and cloudiness; but it is usually 260 feet (80 meters) or more. The **compensation depth** is the lower boundary of the euphotic zone. (5)
- euryhaline**—Normally inhabiting salt water, but adaptable to a wide range of salinity. (58)
- eurythermic**—Tolerant of a wide range of temperature. (58)
- eustatic**—Pertaining to a simultaneous, worldwide change in sea level such as from melting of continental glaciers, but not a relative change in level resulting from local coastal subsidence or elevation. (2)
- eutrophic**—Pertaining to bodies of water containing abundant nutrient matter.
- euxinic deposition**—Deposition in a nearly isolated sea basin where for lack of circulation and mixing, the deep waters are deficient in oxygen and toxic to all life, but anaerobic bacteria and hydrogen sulfide muds rich in organic matter are produced. Examples are the Black Sea, Carioco Basin, and some fiords.
- evaporation**—(also called *vaporization*). The physical process by which a liquid or solid is transformed to the gaseous state; the opposite of **condensation**.
- Energy is lost by an evaporating liquid; and when no heat is added externally the liquid always cools. The heat thus moved is termed the latent heat of vaporization. (5)
- evaporite**—One of the sediments which are deposited from aqueous solution as a result of extensive or total evaporation of the solvent. (2)
- Ewing corer**—A piston-type coring device used to obtain 2½-inch diameter core samples. The sampler consists of a weight stand on which removable weights can be placed, a **core barrel** (generally of 20-foot length), a **core cutter**, and a **core catcher**.
- expendable bathythermograph**—*See* **airborne expendable bathythermograph**, **shipborne expendable bathythermograph**.
- explosives anchorage**—*See* **anchorage**.
- exposed anchorage**—*See* **anchorage**.
- exposure**—*See* **outcrop**.
- extinction coefficient**—A measure of the space rate of diminution, or extinction, of any transmitted light; thus, it is the **attenuation coefficient** applied to visible radiation.
- In oceanography, it is a measure of the **attenuation** of downward-directed radiation in the sea. (5)
- extracellular bioluminescence**—Light production outside the organism resulting from the secretion of photogenic material from special secretory glands. *Cypridina*, an ostracod, extrudes yellow granules of **luciferin** and small colorless granules of **luciferase** into the sea water. These granules dissolve and react to produce light. The deep sea squid, *Heteroteuthis dispar*, emits a luminous cloud much like other squid emit an ink cloud. *See* **photogenic granules**.
- extrapolation**—The extension of a relationship between two or more variables beyond the range covered by knowledge, or the calculation of a value outside that range. (5)
- extratropical cyclone**—(sometimes called *extratropical low*, *extratropical storm*). Any cyclonic-scale storm that is not a **tropical cyclone**, usually referring only to the migratory frontal cyclones of middle and high latitudes. (5)
- extratropical low**—*See* **extratropical cyclone**.
- extratropical storm**—*See* **extratropical cyclone**.
- extrusive rocks**—Igneous material which has forced its way through other rocks and flowed out upon the surface of the earth or the sea bottom before solidifying. The material may emerge as **volcanic ash** or as **lava flows** from fissures or cones. *See* **eruptive rocks**. (48)
- eye**—In meteorology, usually the "eye of the storm" (**hurricane**, **typhoon**); that is, the roughly circular area of comparatively light winds and fair weather found at the center of a severe **tropical cyclone**. The winds are generally 10 knots or less; no rain occurs; sometimes blue sky may be seen. Eye diameters vary from 4 miles to more than 40 miles; common magnitudes seem to be 12 to 25 miles. Modern observations indicate that the eye does not remain in steady state but is continuously undergoing changes in shape and size. (5)

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fabric—The relative size, shape, and spatial arrangement of grains or crystals in a sediment deposit or a rock. (2)

facies—A really segregated parts of a sedimentary deposit which differ in mineral composition, bedding, fossils, etc. but belong to any genetically related body of sedimentary deposits. (2)

Fahrenheit temperature scale—(abbreviated F). A temperature scale with the freezing point at 32 degrees and the boiling point of water at 212 degrees at standard atmosphere pressure.

fair tide—*See* **beam tide**.

Falkland Current—A current flowing northward along the Argentine coast. The Falkland Current originates from part of the **West Wind Drift**. At about 35°S it is joined by the **Brazil Current** where both turn to flow east across the South Atlantic.

falling tide—(sometimes called *ebb tide*). The portion of the tide cycle between **high water** and the following **low water**. (5)

falloff—In underwater sound, the decrease in acoustic energy as it travels away from the sound source.

fallout—The radioactive debris, usually from a nuclear detonation, which has been deposited on the earth after being airborne. Special forms of fallout are “dry fallout”, “rainout”, and “snowout”. (70)

false anticline—A structure resembling an **anticline** produced by compaction of sediment over a resistant mass such as a buried hill or reef. (2)

false bottom—*See* **deep scattering layer**.

false ice foot—Ice formed along a beach terrace just above **high water mark**, derived from snow melting above the beach terrace. (59) Rare. *See* **ice foot**, **quar ice**.

family—*See* **classification of organisms**.

fan—A gently sloping, fan-shaped feature normally located near the lower termination of a **canyon**. (62)

fan shooting—*See* **arc shooting**.

faro—A small atoll-shaped reef or coral knoll with lagoons a few to about 100 feet (30 meters) deep, forming part of a barrier or atoll rim. (2)

fast ice—1. **Sea ice** that generally remains in the position where originally formed and may attain a considerable thickness. It is formed along coasts where it is attached to the shore or over shoals where it may be held in position by islands, grounded icebergs, or grounded polar ice.

(Preferred definition) (74)

2. (also called *landfast ice*). Any type of sea ice attached to the shore (**ice foot**, **ice shelf**), beached (**shore ice**), stranded in shallow water, or frozen to the bottom of shallow waters (**anchor ice**). (5)

fast ice belt—*See* **ice foot**.

Fata Morgana—A complex mirage that is characterized by multiple distortions of images, generally in the vertical, so that such objects as cliffs and cottages are distorted and magnified into fantastic castles.

An unusual density stratification is required to produce this mirage, namely the joint occurrence, in vertically adjacent layers, of density gradients that would give an inferior mirage and a superior mirage. A strong inversion over a relatively warm sea may satisfy this requirement. The instability of the air layer lying immediately over the sea in the mirage characteristics, a circumstance that suggests the fairy-like features of the mirage forms. (5)

fathogram—1. The graphic presentation of the bottom profile determined by a **Fathometer***.

2. Often erroneously applied to any **echogram**.

fathom—The common unit of depth in the ocean for countries using the **English system** of units, equal to 6 feet (1.83 meters). It is also sometimes used in expressing horizontal distances, in which case 120 fathoms make one **cable** or very nearly 1-tenth nautical mile.

fathom curve—*See* **isobath**.

Fathometer*—Copyrighted trade name for a type of echo sounder. Often incorrectly used for any sonic submarine depth measuring system.

fault—A fracture or fracture zone in rock along which one side has been displaced relative to the other side. The intersection of the fault surface with any designated surface, such as the sea bottom, is called a fault line. If a fault is not a single clean fracture but a wide zone (hundreds or thousands of feet) with small interlacing faults and filled with **breccia**, it is called a fault zone.

fault block—A rock body bounded on at least two opposite sides by **faults**. It usually is longer than it is wide; when it is depressed relative to the adjacent regions it is called a graben, fault embayment, fault trough, or rift valley, and when it is elevated it is called a horst. Mozam-

- bique Channel and the Red Sea are examples of graben, fault embayment, fault trough, or rift valley fault blocks.
- fault coast**—(or *fault scarp coast*). A straight coast formed by a **fault**, consisting of a seaward facing **escarpment** and a downthrown block below sea level. (2)
- fault embayment**—See **fault block**.
- fault line**—See **fault**.
- fault-line coast**—See **wave-straightened coast**.
- fault scarp**—See **escarpment**.
- fault scarp coast**—See **fault coast**.
- fault trough**—See **fault block**.
- fault zone**—See **fault**.
- fauna**—The animal population of a particular location, region, or period.
- feather star**—See **crinoid**.
- fecal pellet**—(or *castings*). Excrement of marine animals frequently found in sediments. When fossilized they are often called coprolites, which may also connote a larger size. (2)
- feeder beach**—An artificially widened beach serving to nourish **downdrift** beaches by natural littoral currents or forces. (61)
- feeder channels**—Channels parallel to shore along which feeder currents flow before converging to form the **neck** of a **rip current**. See also **feeder current**.
- feeder current**—(or *rip feeder current*). The current which flows parallel to shore before converging and forming the **neck** of a **rip current**. (73) (See figure for **nearshore current system**.)
- feeling bottom**—The action of a deepwater wave on running into shoal water and beginning to be influenced by the bottom. (5)
- Fermat's principle**—The principle which states that the path along which **electromagnetic radiation** travels between any two points will be that path for which the elapse time for the travel is a minimum. (5) See **multipath transmission**.
- fetch**—1. (also called *generating area*). An area of the sea surface over which seas are generated by a wind having a constant direction and speed.
2. The length of the fetch area, measured in the direction of the wind in which the seas are generated.
- fetch length**—The horizontal distance (in the direction of the wind) over which a wind having a constant direction and speed, generates a sea.
- fiard**—A Swedish term for a glacially formed drowned valley with low glaciated sides which occurs in lowland regions. Fiards are shorter and shallower than **fiords**. (2)
- fibrous ice**—See **acicular ice**.
- fibrous sponge**—A **sponge** in which the internal skeletal elements are composed of **spongin** fibers. The commercial sponges are of this type.
- fiducial point**—A point (or line) on a scale used for reference or comparison purposes. In the calibration of oceanographic thermometers, for example, the fiducial points are 100°C (212°F) and 0°C (32°F), which correspond to the boiling point and ice point at standard pressure (760 millimeters of mercury). (5)
- field ice**—1. A general term used for all types of **sea ice** except **newly-formed ice**.
2. An obsolescent term for **consolidated ice**.
- field of ice**—See **ice field**.
- figure of merit**—The allowable **transmission loss** between a sonar and a target.
- filling**—In meteorology, an increase in the central pressure of a pressure system on a constant-height chart, or an analogous increase in height on a constant-pressure chart; the opposite of **deepening**. The term is commonly applied to a **low** rather than to a **high**. (5)
- film badge**—A pack of photographic film used for approximate measurements of radiation exposure for personnel monitoring purposes. The badge may contain two or three films of differing sensitivity, and it may contain a filter which shields part of the film from certain types of radiation. (70)
- filter**—In ocean-wave forecasting, a set of formulas that define the particular wave frequencies and directions in the **fetch** area which are of significance at the point of forecast. (5)
- filtering effect**—In wave hydrodynamics, the differential damping of pressures or of vertical oscillation of water particles with increasing depth, depending upon the **wave period**. At any given depth longer waves are damped less than shorter waves.
- filtration method**—A technique used in the quantitative estimation and identification of planktonic organisms. Organisms, usually **phytoplankton**, are removed from water by filtration and retained on the surface of the filter. The organisms can then be counted or identified by microscope after suitable preservation and staining of the organisms and subsequent clearing (making transparent) of the filter.
- finer**—The silt and clay fraction of a sediment.
- fiord**—(also spelled *fjord*). A narrow, deep, steep-walled **inlet** of the sea, formed either by the submergence of a mountainous coast or by entrance of the sea into a deeply excavated glacial trough after the melting away of the **glacier**. A fiord may be several hundred fathoms deep and often has a relatively shallow sill of rock or gravel across its entrance. (2) See **fiard**.
- fiord ice**—Winter ice formed in a **fiord**. (59)
- fire body**—See **pyrosome**.
- fire cylinder**—See **pyrosome**.
- fireworm**—A luminescent marine worm mainly in the Bermuda area. The swarming of this worm during certain phases of the moon creates luminescent displays. (23)

firn—(also called *névé*, *firm snow*). 1. *See firn snow* (sense 1).

2. Old snow that has become granular and compacted (dense) as the result of various surface metamorphoses, mainly melting and re-freezing but also including **sublimation**. The resulting particles are generally spherical and rather uniform. **Firnification** is the first step in the transformation of snow into land ice (usually **glacier ice**). Some authorities restrict the use of firn to snow that has lasted through one summer, thereby distinguishing it from spring snow. (5)

firnification—The process of **firn** formation. (5)

firn snow—(also called *névé*). 1. According to the adopted WMO definition, a snow which has become coarse grained and compact through temperature change, forming the transition stage to **glacier ice**. (74)

2. *See firn*.

First Approximation chart—*See historical chart*.

first ice—1. The first appearance of ice in the water at any particular location, whether locally formed (**grease ice**, **young ice**) or formed elsewhere (**drift ice**).

2. Sometimes, the first appearance of locally formed ice only.

first reduction—A name formerly given to a high and low water reduction in which the quantities sought were the mean high and low water intervals, the mean high and low water heights, and the mean range of tide. (50)

firth—(or *frith*). A long, narrow **arm** of the sea. (68) *See estuary*.

fish—1. Any towed sensing device.

2. A member of the class Pisces, which includes the true fishes (**elasmobranchs** excluded) having a bony endoskeleton, paired fins, and an operculum covering the gills.

fission—The splitting of a nucleus into two more-or-less equal fragments. Fission may occur spontaneously or may be induced by capture of bombarding particles. In addition to the fission fragments, neutrons and gamma rays are usually produced during fission. (41)

fissionable—Having the property of certain atomic nuclei, such as some **isotopes** of uranium and plutonium, of capturing neutrons and thereupon splitting into two particles with great kinetic energy. The term properly is applicable to nuclei that undergo fission by neutrons of thermal energies; but it sometimes is applied loosely to cases where the neutron must be of high energy, as in saying that U^{238} is fissionable by fast neutrons. (41)

fission fragments—The nuclear species which are first produced when an atom such as U^{238} or Pu^{239} undergoes **fission**. In slow neutron fission the fragments are seldom equal in mass but generally fall into a heavier group with masses

around 140 and a lighter group with masses around 95. The fragments are abnormally rich in neutrons and decay to stability by successive β -emissions, in decay chains, averaging 3 to 4 members. (41)

fission neutrons—Neutrons that are emitted as a result of nuclear fission. Prompt fission neutrons are those that are emitted during **fissions**. Delayed fission neutrons are those emitted by **fission products**. (41)

fission products—The **nuclides** produced by the **fission** of a heavy element nuclide such as U^{235} or Pu^{239} . Thirty-five fission product elements from zinc through gadolinium have been identified from slow neutron fission. (41)

fix—A relatively accurate position determined without reference to any former position. It may be classed as visual, sonic, celestial, electronic, radio, hyperbolic, Loran, radar, etc., depending upon the means of establishing it. A pinpoint is a very accurate fix, usually established by passing directly over or near an aid to navigation or a landmark of small area. (68) *See dead reckoning*.

fjord—*See fiord*.

flagellum—A whiplike process of protoplasm which provides locomotion for a motile cell. (13)

flashing—The process of reducing the amount of permanent magnetism in a ship by placing a single coil horizontally around the ship and energizing it. If the energized coil is moved up and down along the sides of the ship, the process is called wiping. (68) *See depersisting*.

flaw—A lead between fractured offshore ice and landfast ice.

flaw ice—*See fast ice*.

Fletcher's Ice Island—*See T-3*.

float—1. An air sac or other light structure containing air or gas serving to buoy up the body of a pelagic animal (as the Portuguese man-of-war); a **pneumatophore**.

2. A hollow vesicle found in certain **algae** (as of the genus *Fucus*) containing gases (as carbon dioxide) and serving to buoy up the plant.

float gage—*See box gage*.

floating ice—*See drift ice*.

floc—Small aggregate of tiny sedimentary grains. (2)

flocculate—To aggregate into lumps, as when fine or colloidal clay particles in suspension in fresh water clump together upon contact with salt water and settle out of suspension; a common depositional process in estuaries.

floe—*See ice floe*.

floe belt—A belt consisting of **ice floes**. (68)

floeberg—1. *See bergy bit*.

2. A mass of thick, heavily hummocked **sea ice** resembling an **iceberg** or **bergy bit**. Floebergs have been reported to be as high as 50

feet, and are considered to be the result of extreme **pressure ice** formation.

flood axis—The average direction of the **tidal current** at **strength of flood**.

flood current—The **tidal current** associated with the increase in the height of a tide. Flood currents generally set toward the shore, or in the direction of the tide progression. Erroneously called flood tide. (See figure for **current curve**.)

flood interval—The interval between the transit of the moon over the meridian of a place and the time of the strength of the following flood tidal current. (50)

flood strength—The flood tidal current at time of maximum speed, usually associated with the lunar tide phase and/or minimum river discharge at springs near **perigee**. (See figure for **current curve**.)

flood tide—See **rising tide**, **flood current**.

flora—The plant population of a particular location, region, or period.

florescence—The rapid reproduction of **plankton**. See **plankton bloom**.

Florida Current—A fast current with speeds of 2 to 5 knots that sets through the Straits of Florida to a point north of Grand Bahama Island where it joins the **Antilles Current** to form the **Gulf Stream**.

The Florida Current is traced to the Yucatan Channel where the greater part of the water flowing through that channel turns clockwise into the Straits of Florida.

flotsam—See **jettison**.

flow—The combination of tidal and nontidal current which represents the actual water movement.

flowmeter—1. A device employing propellers, savonius rotors and/or pressure sensors to measure water movement, such as currents, stream flow, etc.

2. A special type device employing a propeller-counting mechanism (which must be properly calibrated) is used to measure the amount of water passing through a **plankton net** or other sampling device.

flow noise—The **noise** produced by water movement past the transducer or hydrophone array housing, and the noise produced by breaking waves against the hull of a moving ship.

fluctuation—1. The variations of water level height from mean sea level that are not due to **tide-producing forces** and are not included in the predicted heights of the tide.

2. The change in average amplitudes of successive pulses; sound pulses that are projected with the same amplitude at intervals of a few seconds will, after transmission, differ from each other in amplitude.

fluorescence—1. The emission of **electromagnetic radiation** by a substance as the result of an

absorption of energy from some other radiation, either electromagnetic or corpuscular, and characterized by the fact that it occurs only so long as the stimulus responsible for it is maintained. The continued emission of light after the absorption of radiation has ceased is called phosphorescence.

2. The electromagnetic X-radiation so produced.

3. In X-rays, characteristic X-radiation emitted as a result of absorption of X-rays of higher frequency.

4. See **phosphorescence**.

(41)

flushing time—The time required to remove or reduce to a permissible concentration any dissolved or suspended contaminant in an estuary or harbor.

fluviomarine—Deposits carried into the sea from the land, re-sorted and redistributed by waves and currents, and mixed with the remains of marine animals.

flux—(or *transport*). The rate of flow of a quantity, as for example, heat flux.

flux-gate magnetometer—An instrument designed to measure the earth's **magnetic field**.

The flux-gate magnetometer, also known as the saturable reactor, makes use of a ferromagnet element of such high permeability that the earth's field can induce a magnetization that is a substantial proportion of the saturation value. If this field is superimposed upon a cyclic field induced by sufficiently large alternating current in a coil around the magnet, the resulting field will saturate the core. The phase of each energizing cycle at which saturation is reached gives a measure of the earth's ambient field. (35)

fluxmeter—An instrument for measuring the intensity of a **magnetic field**. (68)

fluxoturbidite—Strata deposited from **turbidity currents** later disturbed by sliding or slumping. (2)

flying bar—A looped **bank** or **spit** formed on the landward side of an island which remains after the island itself has been eroded to below sea level by wave attack. (2)

flying squid—See **sea arrow**.

foam line—The front of a wave as it advances shoreward after it has broken. (61) (See figure for **breaker**.)

focus—In seismology, the source of a given set of elastic waves. The true center of an **earthquake**, within which the strain energy is first converted to elastic wave energy. (2)

fog—A hydrometer consists of a visible aggregate of minute water droplets suspended in the atmosphere near the earth's surface. According to international definition, fog reduces visibility below one kilometer (0.62 statute mile). (5)

fog bank—Generally, a fairly well-defined mass of fog observed in the distance, most commonly at sea. This is not applied to "patches" of shallow fog. (5)

following sea—*See beam sea.*

following wind—Generally, same as tailwind; specifically, a wind blowing in the direction of ocean-wave advance; the opposite of **opposing wind**.

fondo—The sea floor exclusive of the **continental shelf** and **slope**. The sedimentary deposit is the **fondoform**, and the rock unit of the **fondoform** is the **fondothem**. (2)

fondoform—*See fondo.*

fondothem—*See fondo.*

food chain—The sequence of organisms in which each is food for a higher member of the sequence. (26)

food cycle—The production, consumption, and decomposition of food in the sea, and the energy relationships involved in this cycle. Decomposition products are transformed by bacteria into inorganic nutrients suitable for use by the producers (marine plants) which, directly or indirectly, are the food source for all animals in the sea.

food web—A group of interrelated **food chains**.

foot-pound—A unit of energy equal to 1.356 Joules. (5)

foram—*See foraminiferan.*

foraminifer—*See foraminiferan.*

foraminifera—*See foraminiferan.*

foraminiferal ooze—A pelagic sediment consisting of more than 30 percent calcium carbonate in the form of **foraminiferal tests**. *See also ooze.*

foraminiferan—(or *foraminifera*, *foraminifer*, *foram*). One of an order (Foraminifera) of benthic and planktonic **protozoa** possessing variously formed shells of calcium carbonate, silica, **chitin**, or an agglomerate of materials. Shells of an abundant planktonic genus, *Globigerina*, form an important part of a marine sediment called **globigerina ooze**.

forced wave—A wave generated and maintained by a continuous force, in contrast a **free wave** that continues to exist after the generating force has ceased to act. (68)

foredeep—A long, narrow, crustal depression, or furrow, bordering the convex or ocean side of a folded orogenic belt or **island arc**. *See trench*. (2)

foreland—A **promontory** or **cape**; a point of land extending into the water from the **shoreline**. (2)

Forel scale—1. A scale of yellows, greens, and blues for recording the color of sea water, as seen against the white background of a Secchi disk. (5)

2. As used in the U.S. Naval Oceanographic Office:

<u>Description</u>	<u>Code</u>
Deep blue-----	00
Blue-----	10
Greenish blue-----	20
Bluish green-----	30
Green-----	40
Light green-----	50
Yellowish green-----	60
Yellow green-----	70
Green yellow-----	80
Greenish yellow-----	90
Yellow-----	99

fore reef—The steeply dipping talus slope commonly found on the seaward side of an **organic reef**. (2)

forerunner—Low, long-period, ocean swell which commonly precedes the main swell from a distant storm, especially a **tropical cyclone**. (5)

foreset beds—The series of inclined layers of sediment deposited on the relatively steep frontal slope of a **delta**. (2) (*See figure for bottom-set beds.*)

foreshore—The zone that lies between the ordinary high and low water marks and is daily traversed by the oscillating water line as the tides rise and fall. (2) (*See figure for shore profile.*)

formation—A lithologically distinctive product of essentially continuous sedimentation selected from a local succession of strata as a convenient unit for mapping, description, and reference. (2)

form of floating ice—A categorical form used by WMO to denote the size type of the pack ice fragments; that is, ice crystal, small ice floes, vast ice floes, etc.

forward scatterance—The ratio of the **radiant flux** scattered through angles 0 to 90 degrees from a beam, to the incident flux. (8)

forward scattering coefficient—The coefficient which relates to **forward scatterance**. Unit of measurement is m^{-1} . (8)

fossil—The remains or traces of animals or plants which have been preserved by natural causes in the earth's **crust**, exclusive of organisms which have been buried since the beginning of historic time. (2)

foul—1. To attach to or come to lie on the surface of submerged manmade or introduced objects, usually in large numbers or amounts; as **barnacles** on the hull of a ship or silt on a stationary object.

2. To entangle or become entangled, as a propeller, cables, nets, or seaweed.

foul area—*See rocky area.*

foul bottom—A hard, uneven, rocky, or obstructed bottom having poor holding qualities for anchors, or one having rocks or wreckage that would endanger an anchored ship. (68)

fouler—*See fouling organism.*

foul ground—An area where the holding qualities for an anchor are poor, or where danger of strik-

ing or fouling the ground or other obstructions exists. *See* **foul bottom**. (68)

fouling—The mass of living and nonliving bodies and particles attached to or lying on the surface of a submerged manmade or introduced object; more commonly considered to be only the living or attached bodies. *See* **foul**.

fouling community—(or *fouling complex*). 1. The assemblage of plants and animals growing on a specific artificial surface or a specific type of surface.

2. An assemblage of plants and animals on an artificial surface dominated by one or more organisms, such as the *Mytilus* (**mussel**) community.

fouling complex—*See* **fouling community**.

fouling organism—(or *fouler*). A plant or animal that attaches to the surface of submerged manmade or introduced objects.

fouling panel—(or *fouling plate, test panel, test plate, test board*). An object of wood, metal, glass, or other solid material placed in water to determine various physical and/or biological aspects of fouling; the objects may be flat, curved, or bent plates or boards and square or rectangular blocks.

fouling plate—*See* **fouling panel**.

fracture—Breaks in rocks due to intense folding or faulting. (2)

fracture zone—An extensive linear zone of unusually irregular topography of the sea floor characterized by large **seamounts**, steep-sided or asymmetrical **ridges**, **troughs**, or **escarpments**. (62)

frazil—(or *frazil crystals*; also called *needle ice*). Ice crystals which form in supercooled water that is too turbulent to permit coagulation into **sheet ice**. This is most common in swiftly flowing streams, but also is found in a turbulent sea (where it is called *lolly ice*). It may accumulate as **anchor ice** on submerged objects and obstruct the water flow. (5)

frazil crystals—*See* **frazil, ice crystals**.

frazil ice—(or *needle ice, lolly ice, underwater ice*). An accumulation of **frazil** in a body of water. (5)

free-air anomaly—The difference between **observed gravity** and **theoretical gravity** which has been computed for latitude and corrected for elevation of the station above the **geoid**, by application of the normal rate of change of gravity for change of elevation, as in free air.

The elevation correction is for height above the geoid. No correction is applied for the effect of topography and **isostatic compensation**. (37)

free-air correction—A correction factor, usually expressed as milligals per meter, which is applied to **observed gravity** to reduce the value to sea level.

free sound field—A field in a homogeneous, isotropic medium free from boundaries. In practice it is a field in which the effects of the boundaries are negligible over the region of interest. (3)

free wave—Any wave not acted upon by any external force except for the initial force that created it; a wave solution satisfying a homogeneous equation of motion and homogeneous boundary conditions.

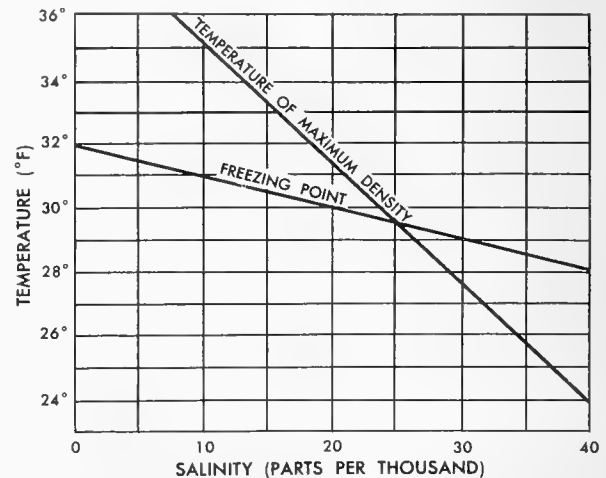
A free wave on a water surface is one created by a sudden impulse, thereafter influenced only by friction, the dimensions of the basin, and the dispersive character of the water medium it moves in. Most ocean surface waves except **tidal waves** are free waves. (5) *See* **oscillation**.

freezeup—The formation of a continuous ice cover. Generally, freezeup is restricted to the hardening of locally formed **young ice**, although the freezing together of pieces of **drift ice** also can be called freezeup.

freezing point—(also called *apparent freezing point*). The temperature at which a liquid solidifies under any given set of conditions. Pure water under atmospheric pressure freezes at 32°F (0°C). However, the freezing point of water is depressed with increasing **salinity**; thus sea water with a salinity of 35 per mille will freeze at about -1.9°C or 28.6°F. Both freezing point and **melting point** can be defined as the temperature at which both the solid and liquid forms of a substance can coexist.

frequency—The frequency of a function periodic in time is the reciprocal of the **primitive period**. The unit is the cycle per unit time and must be specified.

frequency distribution—A tabulation of frequency or relative frequency of occurrence of a



RELATIONSHIP BETWEEN FREEZING POINT AND TEMPERATURE OF MAXIMUM DENSITY FOR WATER OF VARYING SALINITY

- variable. It may be presented as a histogram, frequency curve, rose, or other graphic form.
- frequency of set**—The number of observations showing a current **set** in a particular direction. It is expressed as a percentage of the total observations in a specific area or location.
- frequency of sound**—The number of sound waves passing a point in a given time; usually measured as cycles per second.
- freshet**—An area of comparatively **fresh water** at or near the mouth of a stream flowing into the sea. (68)
- fresh ice**—1. Ice formed on fresh water.
2. **Young ice** of any kind.
3. Ice that has been salty but is now free of salt. (59)
- fresh water**—Water containing no significant amounts of salts, such as in rivers and lakes, as contrasted with **sea water**.
- frictional drag**—*See* **intrainment force**.
- frictional layer**—The layer of the ocean which is affected by wind action.
- friction factor**—The wave height reduction factor due to friction (along the bottom) alone. (10)
- friendly ice**—From the point of view of the submariner, an **ice canopy** containing many large **ice skylights** or other features which permit the submarine to surface. (7)
- fringing reef**—A **reef** attached directly to the shore of an island or continental landmass. Its outer margin is submerged and often consists of algal limestone, coral rock, and living coral.
- frith**—*See* **firth**, also **estuary**.
- frond**—*See* **lamina**.
- front**—1. In meteorology, generally, the interface or transition zone between two **air masses** of different density. Since the temperature distribution is the most important regulator of atmospheric density, a front almost invariably separates air masses of different temperature.
2. *See* **ice front**, **convergence**. (5)
- front bay**—A large irregular **bay** connected with the sea through passes between barrier islands. (2)
- front of the fetch**—The end of the generating area toward which the wind is blowing. (61)
- frost columns of ice**—*See* **candle ice**.
- frost smoke**—1. (sometimes called *barber*). Fog-like clouds, due to the contact of cold air with relatively warm sea water, which appear over newly-formed **leads** (**lanes**) and pools or leeward of the **ice-edge**. These clouds may persist while slush or **sludge** and **young ice** are forming. (74)
2. *See* **steam fog**.
- frustule**—The siliceous shell of a **diatom**, consisting of two valves, one overlapping the other. It is the principal constituent of marine **diatomaceous ooze**. (2)
- fulls**—*See* **beach ridge**.
- fully-arisen sea**—*See* **fully-developed sea**.
- fully-developed sea**—(also called *fully-arisen sea*). The maximum height to which ocean waves can be generated by a given wind force blowing over sufficient **fetch**, regardless of **duration**, as a result of all possible wave components in the spectrum being present with their maximum amount of spectral energy.
- fundamental unit**—A unit measure of basic physical quantity such as mass, length, time; for example, one gram, one centimeter, one second, respectively. Other quantities such as force, temperature, etc., may be considered fundamental and each assigned a fundamental unit. (5)
- fungus**—(or *mold*). A **thallophyte** lacking **chlorophyll**. Many marine fungi have been identified. Some are believed to add to the damage caused by **marine borers** by penetrating the wood around burrows of the borers.
- funnel sea**—A **gulf** or **bay**, narrow at its head and wide at its mouth and deepening rapidly from head to mouth. (2)

G

gabbro—*See* igneous rock.

gal—A unit of acceleration equal to one centimeter per second per second (1 cm/sec^2) or 1,000 milligals. A milligal is 0.001 gal. The term gal is not an abbreviation. It was invented to honor the memory of Galileo. (37)

Galofaro—A whirlpool in the Strait of Messina. Formerly called Charybdis. (68)

galvanometer—An instrument for measuring a small electric current, or for detecting its presence or direction by means of the movement of a magnetic needle or of a wire, or coil, in a magnetic field. String (wire) or mirror galvanometers are used in oscillographs and other instruments of applied geophysics. (35)

gam—(or *school*). A large school of whales (sperm whales travel about in small parties which sometimes join up to form schools, or gangs, of considerable size).

gametophyte—In the sexual generation of an **alga**, the male or female plant which produces motile or nonmotile gametes.

gamma—A small unit of magnetic field intensity generally used in describing the earth's **magnetic field**. It is defined as being equal to 10^{-5} oersted.

gamma ray—A quantum of **electromagnetic radiation** emitted by a nucleus, each such **photon** being emitted as the result of a quantum transition between two energy levels of the nucleus. Gamma rays have energies usually between 10 thousand-electron-volts and 10 million-electron-volts, with correspondingly short wavelengths and high frequencies. They are often associated with alpha and beta **radioactivity**, following transitions that leave the product nuclei in excited states; in general, they are more penetrating than alpha or beta particles. They also occur in isomeric transitions and in many induced nuclear reactions. A gamma ray spectrum consists of one or more sharp lines, each corresponding to an energy and intensity that are characteristic of the source. (41)

gamma ray spectrometer—An electronic device which counts and measures the energy of incident **gamma rays**. These data are presented as the number of gamma ray counts in small energy increments over a selected energy range; usually 0 to 3 million-electron-volts. Thus the spectra of emitted gamma ray energy from a radioactive substance (such as sea water) can be determined. Since each gamma ray emitting

radioisotope gives off one or more gamma rays of characteristic energy such measurements permit radioisotope identification and quantitative assessment. Techniques such as **spectrum stripping** are used to separate the spectrum contribution of individual radioisotopes in mixtures such as sea water. Some types of spectrometers are the shipboard gamma ray spectrometer and **deep underwater nuclear counter** (DUNC).

gamma scintillation spectrometer—*See* gamma ray spectrometer.

gap—A steep-sided depression cutting transversely across a **ridge** or **rise**. (62)

gas—A state of matter in which the molecules are practically unrestricted by cohesive forces. A gas has neither shape nor volume. (27)

gas bladder—*See* air bladder.

gas chromatography—A separation technique involving passage of a gaseous moving phase through a column containing a fixed phase. It includes (1) gas-liquid chromatography (GLC), or more precisely, gas-liquid partition chromatography, in which the fixed phase (column packing) is a liquid solvent distributed on an inert solid support; and (2) gas-solid chromatography (GSC), in which the fixed phase is a surface-active sorbent (charcoal, silica gel, activated alumina). Gas chromatography is used principally as an analytical technique for the determination of volatile compounds (gases and liquids) with boiling points up to 400°C or even higher. However, it is useful also as a research method for determining certain physical quantities such as distribution or partition coefficients and adsorption isotherms, and as a preparative technique for isolating pure components or certain fractions from complex mixtures.

gastroliths—Stones which have been transported in the stomach of marine animals such as walruses.

gastropod—(or *snail*). One of a class (Gastropoda) of **mollusks** in which the animals possess a distinct head, generally with eyes and tentacles, and a broad flat foot and usually are enclosed in a spiral shell.

gat—A natural or artificial **passage** or **channel** extending inland through shoals or steep banks. (68)

gauss—A unit of magnetic induction (or magnetic flux density) equal to one dyne per unit cgs magnetic pole. Prior to 1932, the gauss was used both as a unit of magnetic induction and as

- a unit of magnetic field intensity, but the latter quantity is now measured in **oersteds**. (5)
- Gaussian wave packet**—An isolated group of waves, with infinitely long crests in the direction perpendicular to the direction of propagation and with a constant wavelength in the direction of propagation, of the sine wave form, which is modulated mathematically according to the normal probability curve (or Gaussian curve). (73)
- Geiger counter**—Historically, a “point counter.” By popular usage, a **Geiger-Müller counter tube** or such a tube together with its associated electronic equipment. (41)
- Geiger-Mueller Counter (or tube)**—*See Geiger-Müller counter tube.*
- Geiger-Müller counter tube**—(or *Geiger-Mueller tube*). A gas-filled chamber usually consisting of a hollow cylindrical cathode and a fine wire anode along its axis. It is operated with a voltage high enough such that a discharge triggered by a primary ionizing event will spread over the entire anode until stopped by the reduction of the field by space charge. (41)
- generating area**—*See fetch.*
- generation of waves**—1. The creation of waves by natural or mechanical means. (61)
2. The creation and growth of waves caused by a wind blowing over a water surface for a certain period of time. The area involved is called the generating area or **fetch**.
- genus**—*See classification of organisms.*
- geo**—An Icelandic term for a narrow inlet walled in by steep cliffs. (2)
- geodesic**—A **geodesic line**. (37)
- geodesic line**—A line of shortest distance between any two points on any mathematically defined surface. Also termed a geodesic. (37)
- geodesy**—The investigation of any scientific question connected with the shape and dimensions of the earth. The term geodesy is often used to include both the science which must depend upon determinations of the figure and size of the earth from direct measurements made on its surface (triangulation, leveling, astronomic, and gravity determinations), and the art which utilizes the scientific determinations in a practical way. (37)
- geodetic datum**—A datum consisting of five quantities: the latitude and longitude of an initial point, the azimuth of a line from this point, and two constants necessary to define the terrestrial spheroid.
It forms the basis for the computation of horizontal control surveys in which the curvature of the earth is considered. (37)
- geodetic line**—A geodesic on the reference spheroid.
- geodynamic height**—*See dynamic height.*
- geodynamic meter**—*See dynamic meter.*
- geoid**—The figure of the earth considered as a mean sea level surface extended continuously through the continents. The actual geoid is an equipotential surface to which, at every point, the plumb line (direction in which **gravity** acts) is perpendicular. It is the geoid which is obtained from observed deflections of the vertical, and is the surface of reference for astronomical observations and for geodetic leveling. Theoretical geoids obtained with computed values of **deflections of the vertical** include the compensated geoid and the isostatic geoid. (37)
- geological oceanography**—The study of the floors and margins of the oceans, including description of submarine relief features, chemical and physical composition of bottom materials, interaction of sediments and rocks with air and sea water, and action of various forms of wave energy in the submarine crust of the earth.
- geologic time scale**—The divisions of time, from the formation of the earth to the present, into eras, periods, and epochs based primarily upon fossil evidence. *See table on next page.*
- Geomagnetic Electrokinetograph**—(abbreviated and also commonly called GEK). A shipboard current measuring device used in depths greater than 100 fathoms. It is dependent upon the principle that an **electrolyte** moving through a **magnetic field** (the earth's) will generate an electric current.
- geomagnetic equator**—A great circle on the earth's surface that is everywhere equidistant from the **geomagnetic poles**; that is, the equator in the system of geomagnetic coordinates.
- geomagnetic pole**—The point where the axis of a centered dipole that most nearly duplicates the earth's **magnetic field** would intersect the surface of the earth. The earth's geomagnetic poles are located approximately 78.5°N, 69.0°W and 78.5°S, 111.0°E. (36)
- geomagnetism**—(or *terrestrial magnetism*). 1. The magnetic phenomenon, collectively considered, exhibited by the earth and its atmosphere.
2. The study of the **magnetic field** of the earth. (5)
- geometric shadow**—In wave diffraction theory, the area outlined by drawing straight lines paralleling the direction of wave approach through the extremities of a coastal protective structure. It differs from the actual protected area to the extent that the diffraction and refraction effects modify the wave pattern. (61)
- geomorphology**—That branch of both geography and geology which deals with the form of the earth, the general configuration of its surface, and the changes that take place in the evolution of land forms.

GEOLOGIC TIME	ERA	PERIOD	EPOCH	MILLIONS OF YEARS
	CENOZOIC	QUATERNARY		RECENT PLEISTOCENE
TERTIARY				PLIOCENE
		MIOCENE	16	
		OLIGOCENE	12	
		EOCENE	20	
PALEOCENE	10			
MESOZOIC	CRETACEOUS		UPPER	70
			LOWER	
	JURASSIC		UPPER	25
			MIDDLE LOWER	
	TRIASSIC		UPPER	30
			MIDDLE LOWER	
PERMIAN		PROVINCIAL SERIES	25	
PENNSYLVANIAN MISSISSIPPIAN		NO FORMAL SUBDIVISION	55	
PALEOZOIC	DEVONIAN		UPPER	55
			MIDDLE LOWER	
	SILURIAN		UPPER	40
			MIDDLE LOWER	
	ORDOVICIAN		UPPER	80
MIDDLE LOWER				
CAMBRIAN		UPPER	80	
		MIDDLE LOWER		
PRE-CAMBRIAN				1600 +

THE DIVISIONS OF GEOLOGIC TIME

geophysics—The physics or nature of the earth. It deals with the composition and physical phenomena of the earth and its liquid and gaseous envelopes; it embraces the study of terrestrial magnetism, atmospheric electricity, and gravity; and it includes seismology, volcanology, oceanography, meteorology, and related sciences. (24)

geosphere—The "solid" portion of the earth, including water masses; the lithosphere plus the hydrosphere.

Above the geosphere lies the atmosphere and at the interface between these two regions is found almost all of the biosphere, or zone of life. (5)

geostrophic current—A current defined by assuming that an exact balance exists between the horizontal pressure gradient and the coriolis force. The usual manner of deriving geostrophic currents is to prepare a dynamic topography chart which is based on observations

of temperature and salinity at various depths for a network or a line of oceanographic stations. The direction of the current is indicated by the contours of dynamic topography and its speed by the spacing of the contours.

geostrophic equation—An equation which represents a balance between the horizontal pressure gradient and the coriolis force. The equation used to compute the speed of the current, is:

$$V = \frac{C(D_a - D_b)n}{L}$$

where

$$C = \frac{1}{2\omega \sin \phi \cdot 10^5}$$

$D_a - D_b$ = difference in dynamic height anomalies at stations A and B in dynamic meters,
 n = unit conversion factor,
 L = distance between stations (in kilometers or nautical miles),
 V = speed in knots,
 ω = angular velocity of the earth,
 ϕ = latitude.

geosyncline—A large generally linear subsident trough in which many thousands of feet of sediments are accumulating or have accumulated. Deep oceanic trenches paralleling island arcs are considered to be developing geosynclines. (2)

geothermal gradient—The change in temperature of the earth with depth, expressed either in degrees per unit depth, or in units of depth per degree. (35)

giant clam—One of a genus (*Tridacna*) of large bivalves inhabiting coral reefs in the Indo-Pacific region. The shells may attain weights of several hundred pounds and lengths to four or more feet. Although said to have caused fatalities by trapping divers and waders, documentation of such incidents is lacking.

giant floe—An obsolete term since adoption of WMO code; term now used is big ice floe.

giant kelp—One of a genus (*Macrocystis*) of large vinelike brown algae, which grow attached to the sea bottom by a massive holdfast and reach lengths to 150 feet. Members of this genus are the largest algae in existence.

giant squid—One of a genus (*Architeuthis*), particularly *Architeuthis princeps*, of large cephalopods. These animals inhabit the middepths in oceanic regions but may come to the surface at night normally or by accident. The body of one measured 10 feet long and the tentacles 42 feet long. It is food for the sperm whale but often may give battle. The fabulous sea monster, kraken, as originally drawn, resembles the giant squid. See squid.

gill—A platelike or filamentous outgrowth; respiratory organ of aquatic animals.

gill cover—*See* operculum.

glacial—Pertaining to the presence, size, composition, or activity of extensive masses of land ice. (59)

glacial deposit—*See* glacial drift.

glacial drift—(or *glacial deposits*). Sediments and rock fragments transported by **glaciers** or **icebergs** and deposited on land or in the sea.

glacial epoch—The Pleistocene epoch, the earlier of the two divisions of geologic time included in the Quaternary period; characterized by **continental glaciers** which covered extensive regions now free from ice. (2) *See* **geologic time scale**.

glacial trough—A U-shaped valley, excavated by a **glacier** either on land or sea bottom.

glaciated coast—A coast whose features indicate that it has been covered by **continental glaciers** of the Pleistocene epoch or a coast covered by glaciers at the present time. (2)

glacier—(or *land ice*). A mass of land ice, formed by the further recrystallization of **firn**, flowing slowly (at present or in the past) from an accumulation area to an area of **ablation**.

This term covers all such ice accumulations from the extensive **continental glaciers** of prehistoric ice ages to tiny snowdrift glaciers. (5)

glacier berg—A mass of **glacier ice** that has broken away from its parent formation on the coast, and either floats, generally at least 5 meters (16.4 feet) above sea level, or is stranded on a **shoal**. (74)

glacier ice—(or *land ice*). Any ice floating on the sea, such as an **iceberg**, which originated from a **glacier**. (74)

glacier iceberg—An **iceberg** derived from a **glacier** as distinguished from **tabular icebergs** derived from shelf ice. (59)

glacier tongue—Projecting seaward extension of a **glacier**, usually afloat. In the Antarctic, glacier tongues may extend over many tens of kilometers. (74)

glaciology—The study of snow and ice on the earth's surface, with specific concentration on the regime of **active glaciers**. *See* **cryology** (sense 3). (5)

glaçon—A fragment of **sea ice** ranging in size from **brash ice** to a **medium ice floe**. (59)

glade—*See* **polynya**.

glare ice—Any highly reflective sheet of ice on water, land, or glacier. (5)

glass ice—Rare. *See* **ice rind**.

glass sponge—A **sponge** in which the internal skeletal elements (**spicules**) are composed of silicic acid. These sponges are principally inhabitants of deep water to depths as great as about 16,400 feet (5,000 meters).

glass worm—*See* **arrow worm**.

glauconite—A green mineral, closely related to the micas and essentially a hydrous potassium iron silicate. Occurs in sediments of marine

origin and is produced by the alteration of various other minerals in a marine reducing or **anaerobic** environment.

glauconitic sand—*See* **green sand**.

glaze—A smooth, transparent or translucent coating of ice deposited by a heavy fall of freezing rain. Sometimes popularly called sleet. Called "glaze ice" in British terminology. (68)

glimmer ice—Ice newly formed in cracks, holes, or puddles on the surface of **old ice**. (59) Rare.

glitter—The spots of light reflected from a point source by the surface of the sea.

Statistical analysis of glitter patterns has revealed relationships from which the roughness of the sea can be determined by the study of photographs of the glitter. (5)

globe-type luminescence—*See* **glowing-ball luminescence**.

Globigerina—A common form of sediment-producing **foraminiferan**.

globigerina ooze—A pelagic sediment consisting of more than 30 percent calcium carbonate in the form of foraminiferal **tests** of which **Globigerina** is the dominant genus. *See* **ooze**.

glowing-ball luminescence—(or *globe-type luminescence*). A display of biological light appearing as distinct and separate flashes or blobs of light of various diameters, commonly having a disc or globular shape, and originating either at or below the surface of the sea. The organisms responsible for this type of display include **jellyfishes**, **ctenophores**, and **tunicates**. Glowing-ball type displays are seen more frequently in warmer waters. *See* **bioluminescence**.

gnomonic projection—A perspective map projection upon a tangent plane, with the point from which the projecting lines are drawn situated at the center of the sphere. The projection is neither conformal nor equal area. It is the only projection on which great circles on the sphere are represented as straight lines. (37)

goe—A Scottish term for a small sea-cut gorge eroded into a cliffed coast. (48)

goose barnacle—*See* **stalked barnacle**.

gooseneck barnacle—*See* **stalked barnacle**.

grab—An instrument in which jaws enclose a portion of the bottom for retrieval and study. The sample may be unrepresentative in coarse sediments where the jaws may be propped open by gravel or stones permitting part of the sample to wash out.

graben—*See* **fault block**.

graded bedding—(or *diadactic structure*). A type of stratification in which each stratum displays a gradation in grain size from coarse below to fine above. (2)

graded sediment—In geology, a sediment consisting principally of grains of the same size range. In engineering, a sediment having a

- uniform distribution of particles from coarse to fine. (2)
- graded shoreline**—A shoreline that has been straightened by the building of **bars** across **embayments** and by the cutting back of **headlands**. (2)
- grade scale**—A subdivision of an essentially continuous scale of particle size into a series of size classes. (2) *See* **Atterberg grade scale**, **phi grade scale**, **Tyler standard grade scale**, **Udden grade scale**, **Wentworth grade scale**.
- gradient**—The rate of decrease of one quantity with respect to another, for example, the rate of decrease of temperature with depth. *See* **ascendant**.
- gradient current**—A current defined by assuming that the horizontal pressure gradient in the sea is balanced by the sum of the coriolis and bottom frictional forces. At some distance from the bottom the effect of friction becomes negligible, and above this the gradient and **geostrophic currents** are equivalent.
- graduation**—*See* **curve fitting**.
- Graf sea gravimeter**—A balance-type gravity meter (heavily overdamped to attenuate shipboard vertical accelerations) which consists of a mass at the end of a horizontal arm that is supported by a torsion spring rotational axis. The mass rises and falls with gravity variation, but is restored to near its null position by a horizontal reading spring, tensioned with a micrometer screw. The difference between actual beam position and null position gives indication of gravity value after the micrometer screw position has been taken into account. (35)
- grail**—Coarse or medium sized sediment particles, that is, gravel or sand.
- grains**—(or *particle*). The individual particles which form a sediment which range in size from smaller than 0.0039 millimeter (clay particles) to larger than 256.0 millimeters (boulders). *See* **phi grade scale**.
- gram**—A cgs unit of mass; originally defined as the mass of 1 cubic centimeter of water at 4°C; but now taken as the one-thousandth part of the standard kilogram, a mass preserved by the *International Bureau of Weights and Measures* at Sevrés, France. (5)
- gram atom**—*See* **gram atomic weight**.
- gram atomic weight**—The mass of an element in **grams**, numerically equal to its **atomic weight**. Thus, the gram atomic weight of carbon is 12 grams (one gram atom of carbon weighs 12 grams).
- Dissolved elements in a unit volume of sea water are usually measured in milligram (or microgram) atoms per liter.
- gram calorie**—*See* **calorie**.
- gram mole**—*See* **gram molecular weight**.
- gram molecular weight**—The mass of a molecule in **grams**, numerically equal to its molecular weight. Thus, the gram molecular weight of molecular oxygen is 32 grams (one mole of O_2 weighs 32 grams).
- granite**—A crystalline plutonic rock consisting essentially of alkali feldspar and quartz. In seismology, a rock in which the compressional wave velocity varies approximately between 5.5 and 6.2 kilometers per second. Granitic is a textural term applied to coarse and medium-grained granular **igneous rocks**. (2)
- granitic**—*See* **granite**.
- granular ice**—Ice composed of many tiny, opaque, white or milky pellets or grains frozen together and presenting a rough surface. This is the type of ice deposited as rime and compacted as **névé**. (68)
- granule**—Rock fragments of overall gravel size larger than very coarse sand (2.0 millimeters) but smaller than pebbles (4.0 millimeters). *See* **phi grade scale**.
- granulometric facies**—Cumulative curves representing sedimentary grain size analyses; subdivided into linear, parabolic, logarithmic, and hyperbolic **facies** depending upon the shape of the curve. (2)
- grapestone**—A cluster of small calcareous pellets, resembling grapes, stuck together by incipient **cementation** shortly after deposition. (2)
- grass**—*See* **seagrass**.
- graticule**—The network of lines representing parallels and meridians on a map, chart, or plotting sheet. (68)
- gravel**—Loose detrital material ranging in size from 2 to 256 millimeters. *See* **stone**, **phi grade scale**.
- gravimeter**—A weighing device or instrument of sufficient sensitivity to register variations in the weight of a constant mass when the mass is moved from place to place on the earth and thereby subjected to the influence of **gravity** at those places.
- Gravimeters are employed in determining differences in the intensity of gravity between an initial or **base station** at which the value of gravity is known or assumed and at nearby points for which values of gravity are desired. Gravimeters are also termed gravity meters. (37)
- gravitation**—In general, the mutual attraction between masses of matter (bodies). In **geodesy**, the mutual attraction between the earth and bodies on or near its surface. Gravitation is the component of **gravity** which acts toward the earth. (37)
- gravitational tide**—*See* **equilibrium tide**.
- gravity**—That force which tends to pull bodies toward the earth: that is, to give bodies weight. Towards the earth is the resultant of two opposing forces: **gravitation** and the **centrifugal force** due to the rotation of the earth. (37)

gravity corer—Any type of **corer** that achieves bottom penetration solely as a result of gravitational force acting upon its mass.

gravity instruments—Devices for measuring the differences in the gravity force or acceleration at two or more points. They are of three principal types: (1) A static type in which a linear or angular displacement is observed or nulled by an opposing force. (2) A dynamic type in which the period of oscillation is a function of gravity and is the quantity directly observed. (3) A gradient measuring type, for example, Eötvös torsion balance.

gravity meter—*See gravimeter.*

gravity wave—A wave whose velocity of propagation is controlled primarily by **gravity**. Water waves of length greater than 2 inches are considered gravity waves. (61)

gravity wind—*See katabatic wind.*

gray ice—A Russian term for **sea ice** 10 to 30 centimeters (4 to 12 inches) in thickness. It is roughly comparable to **medium winter ice**.

gray mud—(or *gray ooze*). A deep sea deposit of grayish color which is intermediate in composition between red clay and **globigerina ooze**. (2)

gray ooze—*See gray mud.*

grazing—The feeding of zooplanktonic organisms upon phytoplanktonic organisms. Generally in reference to the feeding of **copepods** upon **diatoms**.

grazing angle—The angle that the sound **ray path** forms with the reflecting surface; usually applies to sound rays reflected from the bottom. Conventionally, the angle is measured from the horizontal.

grease ice—(also called *ice fat*, *lard ice*). A sludge of **ice crystals** in the sea that gives the sea surface a greasy appearance. (5)

great circle—The curve on the surface of a sphere traced by the intersection of the sphere and a plane containing the center of the sphere.

great diurnal range—(also called *diurnal range*). The average difference in height between all **mean higher high waters** and all **mean lower low waters** measured over a 19-year period, or its computed equivalent.

greater ebb—The stronger of two ebb currents occurring during a tidal day, usually associated with **tidal currents** of mixed characteristics. (66) *See mixed current.* (*See figure for current curve.*)

greater flood—The stronger of two flood tidal currents occurring during a tidal day, usually associated with **tidal currents** of mixed characteristics. (66) *See mixed current.* (*See figure for current curve.*)

great tropic range—(also called *tropic range*). The average difference in height between all **tropic higher high waters** and all **tropic lower low waters** which occur twice monthly when

the moon's north and south declination is greatest. *See lunar declination.*

green alga—One of a division or phylum (Chlorophyta) (the Chlorophyceae of another scheme) of grass-green, single-celled, filamentous, membranous, or branching plants in which the color, imparted by **chlorophylls a** and **b**, is not masked by the accessory pigments. Green algae are cosmopolitan in the upper littoral zone but are most abundant in warmer waters.

greenhouse effect—In the ocean where a layer of low salinity water overlies a layer of more dense water the short wavelength radiation of the sun is absorbed in the deeper layers. The radiation given off by the water is in the far infrared, and since this cannot radiate through the low salinity layer, a temperature rise results in the deeper layers.

In the atmosphere the same effect is produced by a layer of clouds and the long wave radiation is trapped between the clouds and the earth.

Greenland currents—*See East Greenland Current, West Greenland Current.*

green mud—1. A fine-grained terrigenous mud or oceanic **ooze** found near the edge of a **continental shelf**, and similar to other terrigenous muds except for the greenish color and, in some cases, less organic matter. It occurs at depths of 300 to 7,500 feet (91 to 2,286 meters).

2. A deep sea terrigenous deposit characterized by the presence of a considerable proportion of **glauconite** and CaCO_3 in variable amounts up to 50 percent.

(2)

green sand—(or *glauconitic sand*). A sand containing a considerable quantity of **glauconite** which gives it a green color. (2)

Greenwich argument—The equilibrium argument computed for the meridian of Greenwich. (50) *See equilibrium argument.*

Greenwich epoch—The phase difference between a tidal constituent and its **equilibrium argument** referenced to the corresponding Greenwich equilibrium argument.

Greenwich interval—An interval referred to the transit of the moon over the meridian of Greenwich as distinguished from the local interval which is referred to the moon's transit over the local meridian. (50)

Greenwich mean time—(abbreviated GMT). Local mean time at the Greenwich meridian. (68)

gribble—*See Linnoria.*

grit—Coarse sand or coarse-grained sandstone.

groin—A low artificial wall-like structure of durable material extending from the land to seaward for a particular purpose, such as to protect the coast or to force a current to **scour** a channel. (30)

gross primary production—*See primary production.*

grounded hummock—A hummock which has stranded on the bottom, either during its formation or later upon drifting into shallow water. Grounded hummocks appear either singly or in lines (or chains).

grounded ice—*See* **shore ice**.

ground ice—1. *See* **anchor ice** for preferred definition.

2. Glacial or sea ice that has been covered with soil.

ground motion—The displacement of the ground caused by the passage of elastic waves, arising from earthquakes, explosions, seismic shots, machinery, wind, traffic, and other causes. (35)

ground swell—A long high ocean swell; also, this swell as it rises to prominent height in shallow water, although usually not as high or dangerous as **blind rollers**. (61)

ground wave—The sound (seismic) wave whose path is partially through water and partially within the sediments, or rocks, beneath the ocean bottom. (35)

group velocity—The velocity of a wave disturbance as a whole, that is, of an entire group of component **simple harmonic waves**.

For water surface waves, the group velocity of **deepwater waves** is equal to one-half the velocity of individual waves in the group; for **shallow water waves**, it is the same as their velocity. (5)

growler—A piece of ice smaller than a **bergy bit**, which often appears greenish in color and barely shows above water. It may originate from **sea ice** and **glacier ice**. (74)

growler ice—An ice pack of **growlers**. (59)
Rare.

Guiana Current—A current flowing northward along the northeast coast of South America (the Guianas).

The Guiana Current is an extension of the **South Equatorial Current**. Eventually, it

joins the **North Equatorial Current** and sets through the Lesser Antilles to become the **Caribbean Current**.

Guinea Current—A current flowing eastward along the south coast of northwest Africa into the Gulf of Guinea.

The Guinea Current originates from the **Equatorial Countercurrent** which flows east across the equatorial Atlantic.

gulder—A double low water occurring on the south coast of England. *See* **double tide**. (68)

gulf—A large **embayment** in the coast in which the entrance generally is wider than the length.

gulf ice—**Winter ice** formed in a gulf or bay. (59) Rare.

Gulf Stream—A warm, well-defined, swift, and relatively narrow ocean current which originates north of Grand Bahama Island where the **Florida Current** and the **Antilles Current** meet. The Gulf Stream extends to the Grand Banks at about 40°N, 50°W where it meets the cold **Labrador Current**, and the two flow eastward as the **North Atlantic Current**.

The Florida Current, Gulf Stream, and North Atlantic Current together form the Gulf Stream system. Sometimes the entire system is referred to as the Gulf Stream. *See* **wind-driven current**.

Gulf Stream system—The **Florida Current**, **Gulf Stream**, and **North Atlantic Current**, collectively.

gulfweed—*See* **Sargassum**.

gully—This term is not recommended by the ACUF for a relatively narrow ravine in the ocean bed. *See* **seachannel**, **trench**.

gut—A narrow **channel** or **strait**. (68)

guyot—This term is not recommended by the ACUF for a **seamount**. *See* **tablemount**.

gyre—A closed circulatory system, but larger than a **whirlpool** or **eddy**.

H

haar—A wet sea fog which sometimes invades eastern Scotland and parts of eastern England, especially during summer. (68)

hachures—1. Short lines on topographic or nautical charts to indicate the slope of the ground or submarine bottom. They usually follow the direction of the slope. (68) *See* **contour**.

2. Inward pointing short lines or "ticks" around the circumference of a closed contour indicating a depression or a minimum. (60)

hadal—(also called *superoceanic deep*). Pertaining to the greatest depths of the ocean. (*See* figure for **classification of marine environments**.)

half-life—The average time, $t_{1/2}$, required for the decay of one-half the atoms of a sample of a radioactive substance. Each **radionuclide** has an unique half-life, which is related to its disintegration constant, λ , and mean life, τ , as follows:

$$t_{1/2} = 1n2/\lambda = 0.693/\lambda = 0.693 \tau.$$

See **radioactive half-life**. (41)

half-meter plankton net—A qualitative type filtering net with a half-meter opening tapering to a detachable bucket of a few inches diameter. The net is usually some grade of silk bolting cloth numbered 0000 to 25 depending upon the number of meshes per linear inch.

half tide—The condition or time of the tide when at the level midway between any given high tide and the following or preceding low tide. (68)

half-tide level—*See* **mean tide level**.

halmyrolysis—Chemical rearrangement and replacement, and weathering which occurs in sediment or rocks on the sea floor. (2)

halobolite—*See* **nodules**.

halocline—A well-defined vertical gradient of **salinity** which is usually positive.

halogen—Any of four elements (chlorine, bromine, iodine, and fluorine) found as **ions** in sea water.

halogenic deposits—Marine salt deposits. (2)

Halosphaera—A genus of green, single-celled marine **phytoplankton** of the class Xanthophyceae. The genus occurs in both warm and temperate waters and also has been reported to be very abundant at times in antarctic waters.

harbor—An area of water affording natural or artificial protection for ships.

Harbor Analog System—*See* **Nearshore Environmental Analog Prediction System**.

harbor area—The area of the water surface in a harbor or port, measured at a given **datum**.

harbor oscillation—(or *harbor surging*). The nontidal vertical water movement in a harbor or bay. Usually the vertical motions are low, but when oscillations are excited by a **tsunami** or **storm surge** they may be quite large. Variable winds, air oscillations, or **surf beat** also may cause oscillations. *See* **seiche**.

harbor surging—*See* **harbor oscillation**.

harbor volume—The volumetric water content of a harbor or port measured at a given **datum**.

hard bottom—The sea floor not covered by unconsolidated sediment. (2)

Hardy continuous plankton recorder—(or *Hardy recorder*). A **plankton sampler** designed to collect specimens of **plankton** during normal passage of a ship. The device consists of a towed container enclosing a continuously moving strip of silk gauze (about 60 meshes per inch) which filters and stores the plankton passing into the orifice of the container. Knowing the speed of travel of the gauze and the course and speed of the ship, it is then possible to determine the distribution of plankton along the ship's route.

Hardy recorder—*See* **Hardy continuous plankton recorder**.

harmonic—A sinusoidal quantity having a frequency that is an integral multiple of the frequency of a periodic quantity to which it is related. (6)

harmonic analysis—(or *harmonic reduction*).

1. A statistical method for determining the amplitude and period of certain harmonic or wave components in a set of data with the aid of Fourier series. (5)

2. The method by which the observed tide or tidal current at any place is separated into elementary harmonic constituents. (50)

harmonic analyzer—A machine designed to resolve a periodic curve into its harmonic constituents. (50)

harmonic constant—The amplitude and epoch of any harmonic constituent of the tide or tidal current at any locality. (50) *See* **constituent**.

harmonic constituent—*See* **constituent**.

harmonic function—1. Any solution of the Laplace equation. (5)

2. In tide and tidal current predictions, a quantity that varies as the cosine of an angle that increases uniformly with time. (68)

harmonic prediction—The method of predicting tides and tidal currents by combining the harmonic constituents into a single **tide curve**. (50)

harmonic reduction—*See* **harmonic analysis**.

harmonic synthesizer—A machine, such as the tide-predicting machine, which combines the elementary harmonic constituents into a single periodic function. *See* **tide-predicting machine**. (50)

harmonic tide plane—**Indian spring low water**. (68)

haul—(or *tow*). A single tow of a net.

haycock—An isolated conical pile of ice thrown up above the surface of land ice or shelf ice, resulting from pressure or ice movement. (68) Rare.

haze—Fine dust or salt particles dispersed through a portion of the atmosphere; a type of lithometeor. The particles are so small that they cannot be felt or individually seen with the naked eye, but they diminish horizontal visibility and give the atmosphere a characteristic opalescent appearance that subdues all colors. (5)

head—1. In hydraulics, the vertical distance between the surface of a liquid and another point in the column; thus, a measure of the force exerted at the lower point by the weight of the column.

2. That part of a **rip current** that has widened out seaward of the **breakers**. (61) (*See* figure for **nearshore current system**.)

3. A precipitous **cape** or **promontory** extending into a large body of water. *See* **headland**. (30)

heading—The direction toward which a ship is oriented. A heading is often designated as true, magnetic, compass, or grid north, respectively.

headland—(or *head, promontory, naze, ness*). A high, steep-faced **promontory** extending into the sea. Usually called **head** when coupled with a specific name.

head sea—*See* **beam sea**.

head tide—*See* **beam tide**.

head wind—*See* **crosswind**.

heart urchin—*See* **sea urchin**.

heat—(sometimes called *thermal energy*). A form of energy transferred between systems by virtue of a difference in temperature, and existing only in the process of energy transformation. By the first law of thermodynamics, the heat absorbed by a system may be used by the system to do work or to raise its internal energy. (5)

heat balance—1. The equilibrium which exists on the average between the **radiation** received by the earth and atmosphere from the sun and that emitted by the earth and atmosphere.

That the equilibrium does exist in the mean is demonstrated by the observed long term constancy of the earth's surface temperature. On

the average, regions of the earth nearer the Equator than about 35° latitude receive more energy from the sun than they are able to radiate, while latitudes higher than 35° receive less. The excess of heat is carried from low latitudes to higher latitudes by atmospheric and oceanic circulations, and is reradiated there.

2. The equilibrium which is known to exist when all sources of heat gain and loss for a given region or body are accounted for. In general this balance includes **advection**, **evaporation**, etc., as well as radiation.

(5)

heat budget—The accounting for the total amount of the sun's heat received on the earth during any one year as being exactly equal the total amount which is lost from the earth by **reflection** and **radiation** into space. The portion reflected by the atmosphere does not affect the earth's heat budget. The portion absorbed must balance the long-range radiation into space from the earth's entire system. That portion absorbed into the oceans causes the surface warming critical to the phenomenon of **layer depth**. Transport by currents further extends the distribution of heat. *See* **heat transport**.

heat capacity—(also called *thermal capacity*). The ratio of the heat absorbed (or released) by a system to the corresponding temperature rise (or fall). If this ratio varies with temperature, it must be defined as a differential dQ/dT where dQ is the infinitesimal increment of heat and dT the infinitesimal increment of temperature. (5)

heat conduction—The transfer of heat from one part of a body to another, or from one body to another in physical contact with it without displacement of the particles of the body, for example, the transfer of heat by conduction through the sea bottom. Since the amount is very small, 50 to 80 gram calories per square centimeter per year, it is neglected when considering the **heat budget**.

heat conductivity—*See* **thermal conductivity**.

heat equivalent of fusion—*See* **latent heat**.

heat transport—The process by which heat is carried past a fixed point or across a fixed plane; thus, a warm current such as the Gulf Stream represents a poleward flux of heat.

heat trap—A temperature increase just above the **thermocline**. A winter phenomenon due to surface cooling in areas of warm water **advection**.

heave—1. The motion imparted to a floating body by wave action. It includes both the vertical rise and fall, and the horizontal transport.

2. The up and down motion of the center of gravity of a ship. *See* **ship motion**.

(5)

heaving—*See* **heave**.

heavy floe—An ice floe more than 10 feet thick. (59) Obsolete.

heavy ice—Any mass of **sea ice** more than 10 feet thick. (59) Obsolete.

heavy minerals—Accessory detrital minerals of high **specific gravity**, 2.8 or more, in rock or sediments. Examples are magnetite, **ilmenite**.

heavy sea—A sea in which the waves run high. (73)

heavy water—1. Water in which the hydrogen of the water molecule consists entirely of the heavy hydrogen **isotope** of mass 2 (deuterium).

2. Written D_2O . Density, 1.1076 at 20°C. It is used as a moderator in certain types of nuclear reactors.

3. The term is sometimes applied to water whose deuterium content is greater than natural water.

(41)

heeling—Causing a ship to roll by mechanical means so as to enable it to gain headway when working in ice. (65)

height—*See wave height.*

height of the tide—The vertical distance from **chart datum** to the surface water level at any stage of the tide usually measured in feet; a predetermined reference plane.

height-period combination—Waves with specified height and period.

height ratio—*See ratio of ranges.*

hektoplankton—*See mu flagellates.*

hemipelagic-abyssal sediments—Deep sea deposits which contain terrestrial material. (2)

herd—A congregation of gregarious wild animals or of marine mammals. The term is most often applied to **pinnipeds** (herds of seal coming ashore to bear young), but is also used in reference to **cetaceans** (the dolphin herd playing through the swell).

hermatoboloth—*See hermatolith.*

hermatolith—Reef rock, also called hermatoboloth to indicate organic origin. (2)

hermatrypic—Reef building. (2)

herringbone cross-lamination—Thin layers of sand cross-laminated in opposite directions in alternating layers by frequently shifting currents in shallow water.

hertz—(abbreviated Hz). A unit of wave frequency, equal to one cycle per second.

hervidero—*See mud volcano.*

heteropod—One of a division (Heteropoda) of pelagic, free-swimming **gastropods** in which the foot is modified into a swimming organ consisting of a flattened fin and a posterior tail. The shell and body are transparent.

heterotrophic nutrition—That process by which an organism utilizes only preformed organic compounds for its nutrition. *See holozoic nutrition, saprophytic nutrition, parasitic nutrition, autotrophic nutrition, mixotrophic nutrition.*

high—1. In meteorology, elliptical for "area of high pressure" referring to a maximum of

atmospheric pressure in two dimensions (closed isobars) in the synoptic surface chart, or a maximum of height (closed contours) in the constant-pressure chart.

Since a high is, on the synoptic chart, always associated with **anticyclonic** circulation, the term is used interchangeably with **anticyclone**. (5)

2. No longer commonly used in combination form and not recommended by the ACUF for the least depth of a general use type of feature of any size, shape, or height.

high energy environment—A region characterized by considerable wave and current action which prevents the settling and accumulation of fine-grained sediment smaller than sand size. (2)

higher high water—(abbreviated HHW). The higher of two **high waters** occurring during a tidal day where the tide exhibits mixed characteristics. *See mixed tide.*

higher high water interval—(abbreviated HHWI). The interval of time between the transit (upper or lower) of the moon over the local or Greenwich meridian and the next **higher high water**. This expression is used when there is considerable **diurnal inequality**. *See lunital interval.* (68)

higher low water—(abbreviated HLW). The higher of two **low waters** of a tidal day where the tide exhibits mixed characteristics. *See mixed tide.*

higher low water interval—(abbreviated HLWI). The interval of time between the transit (upper or lower) of the moon over the local or Greenwich meridian and the next **higher low water**. This expression is used when there is considerable **diurnal inequality**. *See lunital interval.* (68)

highly stratified estuary—An estuary in which salinity increases significantly from head to mouth and surface to bottom; characterized by a density discontinuity separating surface river flow and bottom sea water.

high seas—*See oceanic.*

high-speed layer—A layer in which the compressional wave velocity is greater than in at least one adjacent layer. (2)

high tide—*See high water.*

high water—(abbreviated HW; also called *high tide*). The highest limit of the surface water level reached by the **rising tide**. High water is caused by the astronomic **tide-producing forces** and/or the effects of meteorological conditions.

high water full and change—(abbreviated HWF&C). *See establishment of the port.*

high water inequality—*See diurnal inequality.*

high water interval—(abbreviated HWI). *See lunital interval.*

- high water line**—The intersection of the plane of high water with the shore; it varies daily with changing lunar phases and meteorological conditions.
- high water lunitidal interval**—*See* lunitidal interval.
- high water mark**—An established reference mark on a structure or natural object which indicates the maximum observed stage of tide. (73)
- high water neaps**—*See* mean high water neaps.
- high water of ordinary spring tides**—(abbreviated HWOST). A tidal datum appearing in some British publications, based on high water of ordinary spring tides. (61)
- high water quadrature**—*See* mean high water neaps.
- high-water rock platform**—A coastal terrace a little below high tide level and coinciding with the ground-water table resulting from wave erosion of rocks which are relatively softer or more decomposed above the ground-water table than below.
- high water springs**—*See* mean high water springs.
- high water stand**—The condition at high tide when there is no change in the height of the water level. A similar condition at low tide is called low water stand. (68)
- hindcasting**—The determining of a predictand or predictands for some past situation using a known predictor or predictors. For example, a wave hindcast would be based upon wind direction, speed, duration, and perhaps fetch for some past situation. These data could be utilized in wave forecasting techniques to estimate the wave direction, height, and period.
- hinge crack**—(or *weight crack*). A crack in sea ice running parallel and adjacent to a pressure ridge. Hinge cracks are believed to be caused by the weight of the pressure ridge. (59)
- hinter deep**—A deep sea trough on the convex side of an island arc. (2) *See* deep, trench.
- hinter surf beds**—Littoral, lagoonal, deltaic, and tidal flat deposits which form the continental shelf. (2)
- histogram**—A graphical representation of a frequency distribution. The range of the variable is divided into class intervals for which the frequency of occurrence is represented by a rectangular column; the height of the column is proportional to the frequency of observations within the interval. (5)
- historical chart**—(or *First Approximation chart*). A chart based on data from previous years to determine probable oceanographic patterns for a specified time.
- hodograph**—In general (mathematics), the locus of one end of a variable vector as the other end remains fixed. A common hodograph in oceanography represents a tidal current or a component of a tidal current for a complete tide cycle. The current speed is shown by the length of the arrow; the change in time is shown by the different directions of the arrow from a common center. *See* Ekman Spiral, current ellipse.
- hogback coast**—*See* wave-straightened coast.
- holdfast**—A basal attachment structure of algae, ranging in complexity from the simple or modified cells of filamentous algae to the massive root-like structures of the kelp.
- holding ground**—The sea bottom of an anchorage designated as good or poor, depending upon whether an anchor holds, catches, or drags. Mud or silt usually is good holding ground. Rock, gravel, or hard packed sand often is poor holding ground, since an anchor often will drag, snag, or become fouled.
- hole**—1. An abrupt hollow in the ground or ocean floor.
2. An opening through a piece of sea ice, or an open space between ice cakes. Such an opening made to permit observation of the height of the tide is called a tide hole.
3. A small bay, particularly in New England. (68)
- holophytic nutrition**—(or *photoautotrophic nutrition, phototrophic nutrition*). That process by which an organism manufactures its food by using the energy of the sun. *See* autotrophic nutrition.
- holoplankton**—(or *permanent plankton*). Organisms living their complete life cycle in the floating state.
- holosteric barometer**—Rare. *See* aneroid barometer.
- holothurian**—*See* sea cucumber.
- holozoic nutrition**—That process by which an organism ingests solid food and digests it internally; typical of free living animals. *See* heterotrophic nutrition.
- homogeneous fluid**—A fluid within which the density is uniform. (5)
- homopycnal (equally dense) inflow**—A sediment-laden stream enters a basin filled with a water of comparable density, as when a stream enters a fresh-water lake. The resulting delta is the classical type with top-, fore-, and bottom-set beds. (2)
- homothermal**—*See* isothermal.
- honeycombing**—During the final disintegration of floating ice, the process of partial melting that leaves the piece of ice filled with pockets of water. Honeycombed ice is generally soft and spongy, and floats low in the water. Usually only small pieces of ice are found in a honeycombed state (such as growlers or brash ice), although occasionally in a calm sea icebergs or big ice floes may become honeycombed without breaking up.
- hook**—1. A spit or narrow cape of sand or gravel whose outer end bends sharply landward. (68)
2. *See* recurved spit.
- hooked bay**—An open bay or bight having only one headland. (2)

hooked spit—*See* **recurved spit**.

horizon—One of several lines or planes used as reference for observation and measurement relative to a given location. (5)

horizontal haul—(or *horizontal tow*). The towing of one or more nets for predetermined periods at a selected depth or depths. In this type of haul, attempts are made to minimize sampling from other levels. *See* **oblique haul**, **vertical haul**.

horizontal intensity—The intensity of the horizontal component of the **magnetic field** in the plane of the magnetic meridian.

horizontal tow—*See* **horizontal haul**.

horse latitudes—The belts of latitude over the oceans at approximately 30° to 35°N and S where winds are predominantly calm or very light and weather is hot and dry.

These latitudes mark the normal axis of the **subtropical highs**, and move north and south by about 5 degrees following the sun. The two calm belts are known as the calms of Cancer and calms of Capricorn in the Northern and Southern Hemispheres, respectively; and in the North Atlantic Ocean, these are the latitudes of the **Sargasso Sea**. (5)

horst—*See* **fault block**.

hostile ice—From the point of view of the submariner, an **ice canopy** containing no large **ice skylights** or other features which permit a submarine to surface. (7)

hove-to—The condition in which a ship is kept headed into the wind with no headway or by working engines as necessary.

Humboldt Current—*See* **Peru Current**.

hummock—1. A mound or hill in **pressure ice**; the corresponding submerged portion is called a **bummock**.

2. Occasionally, any form of pressure ice which has been smoothed and weathered is called a hummock.

3. Ice pieces piled one over another on a rather smooth ice surface. (74)

hummocked ice—**Pressure ice**, characterized by haphazardly arranged mounds or hillocks ("hummocks"). This has less definite form, and shows the effects of greater pressure than either **rafted ice** or **tented ice**, but in fact may develop from either of those. When hummocked ice has been weathered and snow-covered it resembles similarly metamorphosed rafted ice, the term "hummocked ice" is then applied to both formations. (5)

hummocky floe—An ice floe of **hummocked ice**. (68)

hummocky ice field—An ice field composed of **hummocked ice**. (68)

hurricane—A severe **tropical cyclone** in the North Atlantic Ocean, Caribbean Sea, Gulf of Mexico, and the eastern North Pacific off the west coast of Mexico. (5)

hurricane delta—A deposit formed in a lagoon by sand carried by **storm waves** washing across a **reef**.

hurricane surge—*See* **hurricane wave**, also **storm surge**.

hurricane tide—*See* **hurricane wave**.

hurricane wave—(also called *hurricane surge*, *hurricane tide*). As experienced on islands and along a shore, a sudden rise in the level of the sea associated with a **hurricane**.

In low latitudes, the hurricane wave appears to occur in the proximity of the storm's center. As the hurricane moves into higher latitudes, however, the maximum wave appears to become associated more and more with only the dangerous semicircle. *See* **storm surge**, **tsunami**. (5)

Huygen's principle—A very general principle applying to all forms of wave motion which states that every point on the instantaneous position of an advancing phase front (wave front) may be regarded as a source of secondary spherical "wavelets". The position of the phase front a moment later is then determined as the envelope of all of the secondary wavelets (*ad infinitum*).

This principle, stated by the Dutch physicist Christian Huygens (1629–1695), is extremely useful in understanding effects due to **refraction**, **reflection**, **diffraction**, and **scattering**, of all types of **radiation**, including sonic radiation as well as **electromagnetic radiation** and applying even to ocean wave propagation. (5)

hydraulic current—Gravity flow through a **channel** that results from a difference between water levels at the two ends of the channel because of a difference in phase and/or range of the tide. (50) *See* **head**.

hydraulic gradient—The slope of the profile of the static level for a hydraulic system. In open channel flow the hydraulic gradient is the slope of the water surface taken parallel to the flow. (5)

hydraulic jump—A steady-state, finite-amplitude disturbance in a channel, in which water passes turbulently from a region of (uniform) low depth and high velocity to a region of (uniform) high depth and low velocity. When applied to hydraulic jumps, the usual hydraulic formulas governing the relations of velocity and depth do not conserve energy. *See* also **bore**. (5)

hydraulic radius—The quotient of the cross-sectional area of a **channel** (below the water surface) divided by the wetted perimeter. (5)

hydrodynamic equations of motion—Three equations which express the net acceleration of a unit water particle as the sum of the five partial accelerations due to pressure gradient force, earth's deflecting force, frictional force, **geostrophic** and **hydrostatic equations** are

- simplified versions of the hydrodynamic equations.
- hydrodynamic noise**—Noise produced by the motion of the ship or sonar housing through the water.
- hydrodynamics**—The study of fluid motion. "Fluid" here refers ambiguously to liquids and gases. (5)
- hydrofoil**—Any surface, such as a wing or rudder, designed to obtain reaction upon it from the water through which it moves. In recent usage, it connotes a ship equipped with planes which provide lift when the ship is propelled forward.
- hydrogen sulfide mud**—*See* **black mud**.
- hydrograph**—A graphical representation of stage or discharge at a point on a stream as a function of time. The most common type, the observed hydrograph, represents river gage readings plotted at time of observation. Other types of hydrograph which are statistically derived from observed data include the **distribution graph** and the unit hydrograph. The possible hydrograph varieties are numerous, representing averages, storm units, seasonal characteristics, etc., in cumulative or differential form, and utilizing different graphing or tabulating methods. (5)
- hydrographic datum**—*See* **chart datum**.
- hydrographic station**—*See* **serial station**.
- hydrographic survey**—A survey of a water area, with particular reference to submarine relief, and any adjacent land. *See* **oceanographic survey**. (68)
- hydrography**—That science which deals with the measurement and description of the physical features of the oceans, seas, lakes, rivers, and their adjoining coastal areas, with particular reference to their use for navigational purposes. (66)
- hydroid**—The **polyp** form of a **hydrozoan**, as distinguished from the medusa or **jellyfish** form.
- hydrologic cycle**—The composite picture, including change of state and vertical and horizontal transport, of the interchange of water substance between the earth, the atmosphere, and the sea. (5)
- hydrology**—The scientific study of the waters of the earth, especially with relation to the effects of precipitation and evaporation upon the occurrence and character of water in streams, lakes, and on or below the land surface. (5)
- hydromedusa**—*See* **hydrozoan**.
- hydrometeor**—*See* **meteor**.
- hydrometer**—An instrument used for measuring the **specific gravity** of a liquid. (5)
- hydromica**—*See* **illite**.
- hydrophone**—An **electroacoustic transducer** that responds to water-borne sound waves and delivers essentially equivalent electric waves. (1)
- hydrophone effect**—*See* **machinery noise, propeller noise**.
- hydrophone loss**—Applied to a sonar **transducer** used for the reception of acoustic energy at a specified frequency; it may be defined as the **transmission loss** measured by the ratio of (1) the source power of the free-field acoustic energy available as plane sinusoidal waves from a water surface having an area of one square centimeter and lying perpendicular to the direction of the maximum response reference axis of the transducer at the point to be occupied by its effective center to (2) the resulting output power of the electric energy available from the transducer. (28)
- hydrophotometer**—An instrument used to measure the **extinction coefficient** or transmission of light in water. It consists of a constant light source placed at a specific distance from a photocell. When placed in the water, the electrical output of the photocell is proportional to the amount of light striking the cell which, in turn, depends upon the transparency of the water. The instrument is calibrated to read 100 percent light transmission in air.
- Hydroplastic corer**—(or *polyvinyl (PVC) corer*). A deep sea coring device, developed at the U.S. Naval Oceanographic Office, to obtain 3½-inch diameter cores up to 12 feet in length. The barrel is constructed of high-impact grade polyvinyl chloride plastic without an inner liner.
- hydropsis**—That part of oceanography concerned with continuous observations and data collecting and the reporting of oceanographic phenomena on a regular and prompt basis with the aim of supplying those that use the seas, particularly in commercial fishing, current information. Oceanographic counterpart to synopsis, or synoptic meteorology. (25)
- hydrosphere**—The water portion of the earth as distinguished from the solid part, called the **lithosphere**, and from the gaseous outer envelope, called the **atmosphere**. (5) *See* **biosphere, geosphere**.
- hydrostatic equation**—The form assumed by the vertical component of the vector **equation of motion** when all **coriolis force**, earth curvature, frictional, and vertical acceleration terms are considered negligible compared with those involving the vertical **pressure force** and the force of gravity. Thus
- $$\frac{\partial p}{\partial z} = -\rho g,$$
- where p is the pressure, ρ the density, g the acceleration of gravity, and z the geometric height. (5)
- hydrostatic equilibrium**—The state of a fluid whose surfaces of constant pressure and constant mass (or density) coincide and are horizontal throughout. Complete balance exists between the force of gravity and the **pressure force**. The relation between the pressure and the geo-

metric height is given by the **hydrostatic equation**. (5)

hydrostatic instability—*See instability.*

hydrostatic pressure—The pressure at a given depth due to the weight of the water column above that depth.

hydrotroilite—A black, finely divided colloidal material (*FeS*) reported in many muds and clays.

hydrozoan—(or *hydromedusa*). One of a class (Hydrozoa or Hydromedusae) of **coelenterates**. The highly branched **polyp** or **hydroid** stage of many members is an important component of **fouling**.

hyperpycnal (more dense) **inflow**—Sediment-laden water flowing down the side of a basin and then along the bottom as a **turbidity current**, with vertical mixing inhibited because the dense water seeks to remain at the lowest possible level. Delta formation by such flow is most frequent at the mouth of submarine canyons. (2)

hypolimnion—The layer of water below the **thermocline** in a fresh water lake or pool;

distinguished from **epilimnion**, the layer above the thermocline.

hypopycnal (less dense) **inflow**—Sediment-laden fresh water discharging into denser saline water of the ocean. The fresh water spreads over the surface of the sea water forming a lunate bar if discharge is small or cusped, **arcuate**, or **bird-foot deltas** if discharge is large. (2)

hypothermia—A fall in the temperature of an animal body below the usual level. This state is brought about when the homeostatic mechanisms fail to maintain adequate production of heat under conditions of extreme cold. (5)

hypographic chart—A chart or part of a chart showing land or submarine bottom relief in terms of height above **datum**; also a hypsometric chart which is a chart showing gradients by means of tints. Hypsography or hypsometry is the science of measuring or describing elevations above a datum.

hypsography—*See hypographic chart.*

hypsometric chart—*See hypographic chart.*

hypsometry—*See hypographic chart.*

I

Ice A—The indicator group in the WMO Ice code which denotes an aircraft ice observation.

ice age—*See* **glacial epoch**.

Ice B—The indicator group in the WMO Ice code which denotes a ship ice observation.

ice bar—An **ice edge** consisting of **ice floes** compacted by wind, sea, and swell, and difficult to penetrate. (74)

ice barrier—*See* **ice shelf**.

ice-basin lake—A lake, pond, or pool on sea or glacier ice. (59)

ice bay—(also called *ice bight*). 1. A bay-like recess in the edge of a large **ice floe** or **ice shelf**. (5)

2. An inward bend of the edge or limit of **pack ice**, formed either by wind or current. (65)

ice belt—*See* **belt**.

iceberg—(or *berg*). A large mass of detached land ice floating in the sea or stranded in shallow water. Irregular icebergs generally **calve** from **glaciers**, whereas **tabular icebergs** and **ice islands** are usually formed from shelf ice. Icebergs are the largest form of floating **glacier ice**, **berg bits** and **growlers** being generally the fragments of broken icebergs.

An iceberg is usually defined as being the size of a ship or larger, although any piece of glacier ice greater than 15 feet in height is often called an iceberg. The WMO code defines an iceberg as any piece of glacier ice more than 5 meters (16.4 feet) above sea level.

ice bight—*See* **ice bay**.

ice blink—A relatively bright, usually yellowish-white glare on the underside of a low cloud layer, produced by light reflected from a distant ice-covered surface such as **pack ice**. This term is used in polar regions with reference to the **sky map**; ice blink is not as bright as **snow blink**, but much brighter than **water sky** or **land sky**. (5)

ice boulder—A large fragment of **sea ice** stranded on shore, which has been shaped by ice and wave action into nearly spherical form. (59)

icebound—Surrounded so closely by ice as to be incapable of proceeding. If steering control is lost, the ship is **beset**. If pressure is involved, the ship is said to be **nipped**. (68)

icebreaker—A ship specially designed for breaking channels through floating ice. (59)

ice breccia—(or *ice mosaic*). Ice pieces of different age frozen together. (74)

Ice C—The indicator group in the WMO Ice code which denotes a shore ice observation.

ice cake—(or *cake, block*). An **ice floe** smaller than 10 meters (32.8 feet) across. (74)

ice canopy—**Pack ice** and its enclosed water areas from the point of view of the submariner.

ice cap—A perennial cover of ice and snow over an extensive portion of the earth's land surface. The most important of the existing ice caps are those on Antarctica and Greenland (the latter often called inland ice). (5)

ice clearing—*See* **polynya**.

ice cliff—*See* **ice front**.

ice cluster—A concentration of **sea ice** covering hundreds of square miles which is found in the same region every summer. (7)

ice crust—*See* **ice rind**.

ice crystals—(or *frazil crystals*). 1. Fine spicules or plates of ice suspended in water. (74)

2. *See* **frazil ice**.

ice day—In climatology, a day on which the maximum air temperature in a thermometer shelter does not rise above 32°F, and ice on the surface of water does not thaw.

This term is not used in the United States, but is used in Great Britain, throughout most of Europe, and probably in many other parts of the world. (5)

ice edge—The boundary at any given time between the open sea and sea ice of any kind, whether drifting or fast. (74)

ice face—*See* **ice front**.

ice fat—*See* **grease ice**.

ice field—(or *field of ice*). 1. Any area of **sea ice** of any size and of such extent that its limit cannot be seen from the crow's nest. (74)

2. An area of sea ice more than 5 n. miles across; the largest areal subdivision of sea ice. (59)

ice floe—(or *floe*). A single piece of **sea ice**, other than **fast ice**, large or small, described if possible as "light" or "heavy" according to thickness.

Vast—over 10 kilometers (5.4 n. miles) across.

Big—1 to 10 kilometers (3,281 feet to 5.4 n. miles) across.

Medium—200 to 1,000 meters (656 to 3,281 feet) across.

Small—10 to 200 meters (32.8 to 656 feet) across.

(74)

ice flowers—1. Formations of ice crystals on the surface of a quiet, slowly freezing body of water.

2. (also called *frost flowers*). Delicate tufts of hoarfrost that occasionally form in great abundance on an ice or snow surface (surface hoar); it also forms as a type of crevasse hoar or window frost.

3. See **Tyndall flowers**.

ice fog—A type of **fog**, composed of suspended particles of ice, partly ice crystals 20 to 100 microns in diameter but chiefly, especially when dense, droxtals (crystals) 12 to 20 microns in diameter. It occurs at very low temperatures, and usually in clear, calm weather in high latitudes. The sun is usually visible and may cause halo phenomena.

Ice fog is rare at temperatures warmer than -30°C or -20°F , and increases in frequency with decreasing temperature until it is almost always present at air temperatures of -45°C or -50°F in the vicinity of a source of water vapor. Such sources are the open water of fast-flowing streams or of the sea, herds of animals, volcanoes, and especially products of combustion from heating or propulsion. At temperatures warmer than -20°F , these sources can cause **steam fog** of liquid water droplets, which may turn into ice fog when cooled. See **frost smoke**. (5)

ice foot—(also called *bellicatter*, *ballycadder*, *catter*, *cadder*, *collar ice*, *fast ice belt*). **Sea ice** firmly frozen to the shore at the high tide line, and unaffected by tide. There are several varieties of ice foot. (74)

Ice foot is formed by the freezing of sea water during ebb tide, and of spray. It is separated from the floating sea ice by a **tide crack**; in many areas it offers a fairly level, continuous route for surface travel. (5)

ice free—Water surface completely free of ice. (74)

ice fringe—A **belt** of **sea ice** extending a short distance from the shore. (68)

ice front—(also called *front*, *ice cliff*, *ice face*, *ice wall*). 1. The seaward facing, cliff-like edge of an **ice shelf** (so called by the British Antarctic Place-names Committee).

2. Any vertical wall of ice. (5)

ice gang—See **debacle**.

ice gruel—A type of slush formed by the irregular freezing together of **ice crystals**. (68)

ice hummock—See **hummock**.

ice island—1. A large tabular fragment of shelf ice found in the Arctic Ocean. Nearly one hundred have been identified since the first one was discovered on aircraft radar in 1946. All have level, slightly undulating surfaces 10 to 25 feet above water, and most appear to have **calved** from the Ward Hunt **ice shelf** off the northern coast of Ellesmere Island. Ice islands are smaller than the largest tabular icebergs of the

antarctic, the largest one known being about 300 square miles in area. They are up to 175 feet thick and unlike the surrounding **pack ice**, they are influenced more by currents than by wind. Several ice islands have been occupied as **drift stations**.

2. Any **tabular iceberg**. (59) Rare.

3. A **giant floe**. (59) Rare.

4. An island completely covered by ice and snow. (59) Rare.

ice island iceberg—(also called *dome-shaped iceberg*). An **iceberg** having a conical or dome-shaped summit. Such icebergs are often mistaken by mariners for ice-covered islands. Also called **ice island**. (68) Obsolete term.

ice jam—Fields of lake or sea ice thawed loose from the shores in early spring, and blown against the shore, sometimes exerting great pressures. (5)

ice keel—From the point of view of the submariner, a downward projecting ridge on the underside of the **ice canopy**; the submerged counterpart of a **pressure ridge**. Ice keels may extend as much as 50 meters (164 feet) below sea level. (7)

Icelandic low—The low pressure center located near Iceland (mainly between Iceland and southern Greenland) on mean charts of sea-level pressure. It is a principal **center of action** in the atmospheric circulation of the Northern Hemisphere. (5)

ice ledge—See **ice foot**.

ice limit—The average position of the **ice edge** in any given month or period, based on observations over a number of years. (74)

ice mosaic—See **ice breccia**.

ice pack—1. See **pack ice**.

2. See **arctic pack**.

3. See **ice cluster**.

ice pan—(also called a *pan*). A large flat piece of **sea ice** protruding from a few inches to 3 feet above the water, usually composed of **winter ice**. (59) Rare.

ice pedestal—(or *mushroom ice*, *ice pillar*). A pillar of ice with a round, expanded top formed when a portion of an ice-covered area is protected from the melting effect of sunlight by some surface object. (59)

ice period—The time between first appearance and final clearance of ice during any year.

ice piedmont—Ice covering a coast strip of low-lying land backed by mountains. The surface of an ice piedmont slopes gently seaward, may range from a width of about 50 meters (164 feet) to 50 kilometers (27 n. miles) and fringes long stretches of coastline with ice cliffs. Ice piedmonts frequently merge into **ice shelves**. (7)

ice pillar—1. See **ice pedestal**.

2. Any ice formation of columnar shape. (59)

ice point—The true **freezing point** of water; the temperature at which a mixture of air-saturated pure water and pure ice may exist in equilibrium at a pressure of one standard atmosphere.

The ice point is often used as one **fiducial point** (0°C or 32°F) in establishing a thermometric scale because it is reproduced relatively easily under laboratory conditions.

The ice point is frequently called the freezing point, but the latter term should be reserved for the much broader reference to the solidification of any kind of liquid under various conditions. (5)

ice pole—(or *pole of inaccessibility*). The area round which the more consolidated part of the arctic ice pack is located and therefore the most difficult point to reach by surface travel. At present its location is about 84°N and 160°W. (59)

ice port—An **embayment** in an **ice front**, often of a temporary nature, where ships can tie up and unload directly onto the **ice shelf** or thick sea ice.

ice potential—The potential amount of ice that would be formed in a given **water mass** if surface heat loss provided the **thermohaline circulation**.

icequake—The concussion attending the breaking up of masses of ice. (68)

ice rafting—The transportation of sediments and rock fragments of all sizes by floating ice. Such material is widely distributed in marine sediments along the paths of melting **icebergs** and is identified by glacial abrasion marks, composition, angularity (in contrast to rounded, water-worn alluvial-marine sediments), and size too large for any but ice-rafting method of transportation.

ice rind—(or *glass ice, ice crust*). A thin, elastic, shining crust of ice, formed by the freezing of **ice slush** or **sludge** on a quiet sea surface. It has varying degrees of whiteness depending on its age, thickness, and the rapidity of freezing. It is easily broken by wind or **swell**, and is generally less than 5 centimeters (2 inches) in thickness. (74)

ice routing—Optimal routes for ships in ice-infested water provided through forecasting future ice conditions.

ice run—*See debacle.*

ice sheet—Any large area of continuous ice overlying a land surface. (65)

ice shelf—(also called *shelf ice*; formerly *barrier ice*). 1. A thick ice formation with a fairly level surface, formed along a polar coast and in shallow bays and inlets, where it is fastened to the shore and often reaches bottom. It may grow hundreds of miles out to sea. It is usually an extension of land ice, and the seaward edge floats freely in deep water.

The calving of an ice shelf forms **tabular icebergs** and **ice islands**. (5)

2. More specifically, a **level ice** formation over 2 meters (6.6 feet) above the sea surface which originates from annual accumulations of **firn snow** layers on **bay ice** or on the seaward extension of a **glacier**. (74)

ice skylight—From the point of view of the submariner, thin places of the **ice canopy**, usually less than 1 meter thick and appearing from below as relatively light translucent patches in dark surroundings. The undersurface of an ice skylight is normally flat. Ice skylights are called large if big enough for a submarine to attempt to surface through them (120 meters or 393.7 feet) or small if not. (7) *See lead.*

ice slush—An accumulation on the water surface of ice needles that are frozen together; it forms patches or a thin compact layer of a grayish or leaden-tinted color. The surface of the area covered with ice slush has a dim tint. (74)

ice stream—1. A **glacier**, usually an outlet glacier, located on the periphery of an **ice cap**.
2. *See strip.*

ice strip—*See strip.*

ice table—A mass of **level ice**. (68)

ice tongue—Any narrow extension of a **glacier** or **ice shelf**, such as a projection floating in the sea or an outlet glacier of an **ice cap**. (5)

ice tongue afloat—A terminal extension of a **glacier** which extends so far into the sea that its end is buoyed. This is primarily an antarctic phenomenon but occurs occasionally in the arctic. (59)

ice wall—*See ice front.*

ice yawling—A long, high-pitched sound accompanying the formation of contraction cracks in ice. (59)

icing—1. The formation of ice on aircraft surfaces, within aircraft engines, or on ships.

2. **Glaze.**

(59)

ideal sea level—The theoretical sea surface which is everywhere normal to the plumb line. Reference of all depth soundings to this level would make them all comparable.

ideal transducer—A hypothetical passive **transducer** that transfers the maximum possible power from the source to the load, in regard to connecting a specified source to a specified load.

igneous rock—Rock formed by solidification of molten material or **magma**. (2)

illite—(or *hydromical*). A group of clay minerals composed of interlayered mica and **montmorillonite** and intermediate between muscovite and montmorillonite.

illumiance—The total luminous flux received on a unit area of a given real or imaginary surface, expressed in such units as the foot-candle, lux, or phot.

The only difference between this term and illumination is that the latter always refers to light incident upon a material surface.

A distinction should be drawn, as well, between illumination and luminance. The latter is a measure of the light coming from a surface; thus, for a surface which is not self-luminous, luminance is entirely dependent upon the illuminance upon that surface and its reflection properties. (5)

ilménite—A mineral, $FeTiO_3$, the principal ore of titanium. Sometimes mined from beach and shallow water sand deposits.

immobile ice—A Russian term for **fast ice**.

impedance—The total opposition (in ohms) offered to the flow of an alternating current. It may consist of any combination of resistance, inductive reactance, or capacitive reactance.

incised—Pertaining to a steep-sided trench or notch cut into a plane surface or slope by current erosion, as a sea **valley** or submarine **canyon** cut into a **continental shelf** or **slope**.

inclination—(also called *dip*). In terrestrial magnetism, the angle which the total magnetic field vector makes with its horizontal component. (15)

incoming solar radiation—*See insolation*.

index contours—Certain contour lines (usually every fifth) accentuated by use of a line heavier than the intervening ones. (2)

index of refraction—(or *refractive index*; also called *absolute index of refraction*, *absolute refractive index*, *refractivity*). 1. A measure of the amount of **refraction** (a property of a dielectric substance). It is the ratio of the wavelength or phase velocity of an electromagnetic wave in a vacuum to that in the substance. It can be a function of wavelength, temperature, and pressure. (5)

2. (or *refractive index*; also called *relative index of refraction*). A measure of the amount of refraction experienced by a ray as it passes through a refractive interface, that is, a surface separating two media of different densities. It is the ratio of the absolute indices of refraction of the two media (*see* definition 1 above). (5)

3. As related to ocean waves, it is the measurement of the amount of refraction (or turning) of an ocean wave front as the wave passes from deeper into shallower water. It is a function of wavelength, water depth, and the angle that the approaching wave makes with the depth contour. *See wave refraction*.

Indian Ocean—That ocean area bounded on the north by the southern limits of the Arabian Sea, Laccadive Sea, Bay of Bengal, the limits of the East Indian Archipelago and the Great Australian Bight; on the east from South East Cape (the southern point of Tasmania) down the meridian to the Antarctic Continent; and on the west from Cape Agulhas southward to the Antarctic Continent.

The limits of the Indian Ocean exclude the seas lying within it.

Indian spring low water—The approximate mean water level determined from all **lower low waters** at **spring tides**. It is also the computed plane located below mean sea level by an amount equal to the sum of the amplitudes of the **harmonic constants** M_2 , S_2 , K_1 , and O_1 .

Indian tide plane—The datum of **Indian spring low water**. (73)

indicator species—A species of marine **plankton** that is characteristic of a certain **water mass** to which it is restricted, so that, with proper precautions, its presence can be taken as an indication of the presence of water of that origin. Species of medusae, chaetognaths, euphausiids, pteropods and tunicates, among others have been shown to be indicator species.

induced magnetism—The field produced in a magnetic material when it is placed in an ambient magnetic field. In the earth's field, the induced magnetism is in the direction of the field and the strength is proportional to it.

induced radioactivity—That radioactivity produced in a substance after bombardment with neutrons or other particles. The resulting activity is **natural radioactivity** if formed by nuclear reactions occurring in nature and **artificial radioactivity** if the reactions are caused by man. *See nuclear reaction*. (70)

induration—The hardening of sediments through **cementation**, pressure, heat, or other processes. (2)

inertia currents—Currents resulting after the cessation of wind in a generating area or after the water movement has left the generating area. *See swell*.

infralittoral—Below the region of **littoral deposits**. (2)

infraneritic—According to some authorities, this term refers to the marine environment in a zone between 120 and 600 feet (36 and 183 meters) below sea level.

infrared—*See infrared radiation*.

infrared radiation—(abbreviated IR; also called *long-wave radiation* or *infrared*). **Electromagnetic radiation** lying in the wavelength interval from about 0.8 micron to an indefinite upper boundary sometimes arbitrarily set at 1,000 microns (0.01 centimeter). At the lower limit of this interval, the infrared radiation spectrum is bounded by visible radiation, while on its upper limit it is bounded by microwave radiation of the type important in radar technology. (5)

initial angle—The angle that a sound ray leaving a sound source makes with a horizontal plane.

initial range—The horizontal distance between the source and the closest point of the reswept (convergence) zone.

injection probe—A **thermistor** that is installed in the ship's sea water injection intake pipe (engine room).

injection temperature—The temperature of the sea water as measured at the sea-water intakes in the engine room of a ship.

Because the injectors are commonly located well below the surface, and because the temperature may be influenced by the heat of engines or boilers, injection temperature is not considered as reliable as **bucket temperature** for sea surface temperature. (5)

Electronic temperature probes have been developed (surtems) to improve the procedure mentioned above.

inland ice—*See* **continental glacier**.

inland sea(s)—A sea surrounded by land which connects with an ocean or another sea by one or more narrow **straits**. Examples are the Mediterranean and Baltic Seas. *See* also **epeiric sea(s)**, **epicontinental sea(s)**.

inlet—A short, narrow waterway connecting a bay or lagoon with the sea. When it is a natural inlet maintained by **tidal currents**, the name tidal inlet or tidal outlet is applied.

inner space—A nickname given to an area involved in modern marine research, especially in regard to underwater exploration. (35)

inquilinism—A special kind of **commensalism** in which one organism lives within another, usually in the digestive tract or respiratory chamber, without being harmful to its host. Some authorities consider that relationship where one species lives in the burrow or nest of another is a form of inquilinism. *See* **commensalism**, **mutualism**, **symbiosis**.

insertion loss—Applied to a **transducer** connecting an energy source and an energy load it is the **transmission loss** measured by the ratio of (1) the load power which would be measured if the load were connected directly to the source, to (2) the actual load power when source and load are connected by the transducer in question.

inshore—In beach terminology, the zone of variable width between the **shoreface** and the seaward limit of the **breaker zone**. (2) (*See* figure for **shore profile**.)

inshore current—The horizontal movement of water inside the **surf zone**, including **longshore** and **rip currents**. (*See* figure for **nearshore current system**.)

inshore water—Water contiguous to land in which the physical properties are considerably influenced by continental conditions.

in situ—A Latin term meaning "in place"; in the natural or original position.

insolation—(contracted from *incoming solar radiation*). 1. In general, solar radiation received at the earth's surface.

2. The rate at which direct solar radiation is incident upon a unit horizontal surface at any point on or above the surface of the earth. (5)

insonification—The penetration of sound into any particular part of the sea.

instability—(or *static instability*, *hydrostatic instability*). A property of the steady state of a system such that certain disturbances or perturbations introduced into the steady state will increase in magnitude, the maximum perturbation amplitude always remaining larger than the initial amplitude. In oceanography, usually refers to the vertical displacements of a parcel in **hydrostatic equilibrium**.

insular shelf—*See* **continental** (or island) **shelf**.

insular slope—*See* **continental** (or island) **slope**.

intake temperature—*See* **injection temperature**.

intensity—In general, the degree or amount, usually expressed by the elemental time rate or spatial distribution, of some condition or physical quantity, such as rainfall, electric field, sound, etc. (5)

intensity level—The intensity level, in **decibels**, of a sound is 10 times the logarithm to the base of 10 of the ratio of the intensity of this sound to the reference intensity. The reference intensity shall be stated explicitly. (6)

interbedded—(or *interlaminated*, *interstratified*, *intercalated*). Occurring between **beds** or in beds parallel to other beds of a different material. (2)

intercalated—*See* **interbedded**.

interdeep—This term is not recommended by the ACUF for a trench or trough lying between inner and outer **island arcs**. *See* **trench**, **trough**.

interface—(also called *internal boundary*, *surface of discontinuity*, or *boundary surface*). A surface separating two media, across which there is a discontinuity of some property, such as density, velocity, etc., or of some derivative of one of these properties in a direction normal to the interface. (5)

interfacial tension—*See* **surface tension**.

interference filter—An **optical filter** which transmits, at normal incidence, only a narrow band of wavelengths, other wavelengths being suppressed by the destructive interference of waves transmitted directly through the filter and those reflected $2n$ times, where n is an integer (from back and front faces of the filter). (8)

interfinger—Interlocking or overlapping wedge-shaped sediment or rock layers.

interlaminated—*See* **interbedded**.

intermediate water—*See* **water mass**.

intermediate waves—Waves under conditions where the relative depth (or the ratio of water depth to wavelength) lies between 0.5 and 0.04.

intermittent current—An unidirectional current interrupted at intervals. (68)

internal boundary—*See* **interface**.

internal friction—*See* **viscosity**.

internal wave—A wave that occurs within a fluid whose density changes with depth, either abruptly at a sharp surface of discontinuity (an **interface**) or gradually. Its amplitude is greatest at the density discontinuity or, in the case of

a gradual density change, somewhere in the interior of the fluid and not at the free upper surface where the surface waves have their maximum amplitude. (61)

Because of the small density gradient involved, compared to that at the surface, a relatively small amount of energy is required to set up and maintain an internal wave. Wave heights, periods, and lengths are usually large as compared to surface waves.

International Gravity Formula—A development of the formula for **theoretical gravity**, based on the assumptions that the spheroid of reference is an exact ellipsoid of revolution having the dimensions of the International Ellipsoid of Reference, rotating about its minor axis once in a sidereal day; that the surface of the ellipsoid is a level surface; and that gravity at the Equator equals 978.049 gals.

international low water—(abbreviated ILW). A plane of reference below **mean sea level** by the following amount; half the range between **mean lower low water** and **mean higher high water** multiplied by 1.5.

International Synoptic Code—A synoptic code approved by the World Meteorological Organization in which the observable meteorological elements are encoded and transmitted in "words" of five numerical digits length. (5)

intersecting waves—(or *sugarloaf sea*, *pyramidal sea*). One of the component waves which, when superimposed on others, produces cross swells.

interstitial water—Water contained in the pore spaces between the grains in rock and sediments.

interstratified—*See interbedded.*

intertidal—*See littoral.*

intertidal zone—(also called *littoral zone*). Generally considered to be the zone between **mean high water** and **mean low water** levels. (*See figure for classification of marine environments.*)

intracellular bioluminescence—A widespread form of biological light production usually associated with special luminous organs (**photophores**) or luminous cells which contain **photogenic granules**. In some organisms intracellular light may be produced by luminous bacteria living within special sacs or organs. In all organisms, the light emitted is internal, below the body surface.

intrainment force—(or *frictional drag*). Motion induced in water in physical contact with a region of relatively high velocity. (20)

intrusive rocks—(or *irruptive rocks*). **Igneous rocks** which while molten, have penetrated into and between other rocks but which have solidified before reaching the surface of the earth or the sea floor/water **interface**. They may either have penetrated fissures in the original rocks or absorbed and replaced the original rocks.

inverse cylindrical orthomorphic projection—*See transverse Mercator projection.*

inverse estuary—An estuary in which evaporation exceeds land drainage plus precipitation, with resulting mixture of high salinity estuarine water and sea water.

inverse law—*See spreading of sound.*

inverse Mercator projection—*See transverse Mercator projection.*

inversion layer—A layer of water in which temperature increases with depth. (25)

invertebrate—Any animal without a backbone or spinal column.

inverted tide—*See reversed tide.*

ion—An electrically charged group of atoms either negative or positive. The dissolved salts in sea water dissociate into ions.

ion exchange—A chemical process involving the reversible interchange of **ions** between a solution and a particular solid material such as an ion exchange resin consisting of a matrix of insoluble material interspersed with fixed ions of opposite charge. (70)

ionization—Any process by which a neutral atom or molecule loses or gains electrons, thereby acquiring a net charge; the process of producing **ions**. (41)

ionizing particle—A particle that directly produces **ion pairs** in its passage through a substance. In practice it is a charged particle having considerably greater kinetic energy than the ionizing energy appropriate to the medium. (41)

ionizing radiation—Any electromagnetic or particulate radiation capable of producing **ions**, directly or indirectly, in its passage through matter. (70)

ion pair—A positive ion (**cation**) and a negative ion (**anion**) (usually, an **electron**) that have charges of the same magnitude and are formed from a neutral atom or molecule by the action of radiation. A primary ion pair is an ion pair produced by a primary particle or **photon**. (41)

Irish moss—(or *carrageen*, *carragheen*). One of several species of **red algae**, but particularly *Chondrus crispus*, having a short bushy form and often forming a carpet on rocks in the lower **intertidal zone**. Carrageenin, or carrageenin is prepared from this alga.

Irminger Current—An ocean current that is one of the terminal branches of the **Gulf Stream system** (part of the northern branch of the **North Atlantic Current**); it flows west off the south coast of Iceland.

A small part of the Irminger Current turns clockwise around the west coast of Iceland but the greater amount turns southwest, and joins the **East Greenland Current**.

irradiance—(or *irradiation*). The total **radiant flux** received on a unit area of a given real or imaginary surface. This is a general term for

the flux density of **electromagnetic radiation**, and is to be distinguished from **illuminance**. (5)

irradiance (at a point of the surface)—The **radiant flux** incident on an infinitesimal element of surface containing the point under consideration, divided by the area of that element. Unit of measurement is watt per square meter (W/m^2). (8)

irradiance meter—A radiant flux meter with plane (usually circular) cosine collecting surface (usually an opal glass) of effective area A . If F is the **radiant flux** recorded by the meter, then the associated irradiance is by definition $E = F/A$. (8)

irradiance (on a vertical plane)—The **radiant flux** on an infinitesimal element of a vertical surface (90 degrees) containing the point under consideration, divided by the area of that element. Unit of measurement is watt per square meter (W/m^2). (8)

irradiance ratio (reflectance)—The ratio of the **upward** to the **downward irradiance** at a depth in the sea. (8)

irradiation (at a point of a surface)—The product of an **irradiance** and its duration. Unit of measure is **Joule** per square meter (J/m^2). (8)

irrotational wave—A wave in which the particles have an irrotational movement, that is, the rotation vector is nil and consequently the speeds are derived from potential energy.

In a rotational movement the rotation vector is not nil, there is no velocity potential; any infinitely small element of the liquid is moved not only by translation along three axis (producing a change in form) but also by a rotation.

irruptive rocks—See **intrusive rocks**.

Isaac-Kidd midwater trawl—A device designed to collect actively swimming marine organisms from subsurface ocean layers. The **midwater trawl** consists essentially of a towing bridle, a net, and an inclined-plane surface placed in front of the net to act as a depressor. When streamed, the trawl shape is that of an asymmetrical cone with a large pentagonal mouth opening on one end and a small perforated collecting can on the other.

isabnormal—See **isanomal**.

isallotherm—Lines connecting points in which an equal temperature variation is observed within a definite interval.

isanomal—A line connecting points of equal variations from a normal value.

isaurore—See **isochasm**.

isentropic—Of equal or constant **entropy** with respect to either space or time. (5)

island—A body of land surrounded by water; relatively smaller than a continent. (30)

island arc—A term used for a group of islands usually having a curving archlike pattern, generally convex toward the open ocean, with a

deep **trench** or **trough** on the convex side and usually enclosing a deep sea **basin** on the concave side; not considered a recommended term by the ACUF.

island ice—An ice sheet covering an island. See **ice island**. (68)

island shelf—(or *insular shelf*). See **continental shelf**.

island slope—(or *insular slope*). See **continental slope**.

islet—A small island. (30)

isoanomal—See **isanomal**.

isoballast lines—A set of lines, on the submarine bathythermograph chart, starting from a set of selected points on the temperature scale and passing through all points for which the net change in **buoyancy** resulting from changes in water temperature and depth, is zero for a submarine of given compression.

isobar—1. A line on a chart connecting all points of equal or constant pressure; an **isopleth** of pressure. (5)

2. One of several **nuclides** having the same number of nucleons in their nuclei and hence having approximately the same atomic mass. For example, P^{32} and S^{32} are isobars. Commonly, one of several nuclides of the same mass number but different atomic numbers. Originally called isobares but the name isobars is now general employed. (41, 70)

isobaric surface—A surface where the pressure is everywhere the same. This is not necessarily a horizontal surface. If several parallel equally spaced plane surfaces are used to cut an isobaric surface into horizontal sections a pattern of isobaric lines is formed. If the lines are closely spaced, the pressure gradient is strong, less close spacing indicates a weaker gradient.

isobath—(sometimes called *fathom curve*, *depth contour*, and *depth curve*). A contour line connecting points of equal water depths on a chart.

isobathytherm—A line or surface showing the depths in oceans or lakes at which points have the same temperature. Isobathytherms are usually drawn to show cross sections of the **water mass**. (5)

isochasm—(also called *isaurore*). A line connecting points having the same average frequency of **auroras**. (68)

isochrone—A line on a chart connecting all points having the same time of occurrence of particular phenomenon or of a particular value of a quantity, for example, a line representing all points having the same time difference in the reception of signals from two radio stations such as the master and slave stations of a Loran rate.

isoclinic line—A line drawn through all points on the earth's surface having the same magnetic inclination. The particular isoclinic line drawn through points of zero inclination is given the special name of **acclinic line**. (5)

isodynamic—A line connecting points of equal magnitude of any force. (5)

isogal—A contour line of equal gravity values on the surface of the earth.

isogonic line—In the study of terrestrial magnetism, a line drawn through all points on the earth's surface having the same magnetic declination; not to be confused with magnetic meridian. The particular isogonic line drawn through all points having zero declination is called the **agonic line**. (5)

isogram—(or *isoline*). See **isopleth**.

isohaline—1. Of equal or constant salinity.

2. A line on a chart connecting all points of equal salinity; an **isopleth** of salinity.

(5)

isohyete—1. A line drawn through geographical points recording equal amounts of precipitation during a given time period or for a particular storm. (5)

2. A line which connects places with equal average total precipitation.

isoline—See **isopleth**.

isomegathy—A chart showing the distribution of sediments in terms of median grain size. Isomegathies are lines connecting points of equal median grain size. (2)

isomer—1. An element, compound, or atomic nucleus having the same atomic number and mass number but differing in one or more properties, as is the rate of radioactive decay.

One of several **nuclides** having the same number of neutrons and protons but capable of existing, for a measurable time, in different quantum states with different energies and radioactive properties. Commonly, the isomer of higher energy decays to one with lower energy by the process of isomeric transition. (70)

2. Literally, equal parts. A British term for a line on a chart along which an equal percentage of the annual precipitation falls in a given month or season.

isopach—(or *isopachous*, *isopachyte*). A contour line on a chart drawn through points of equal thickness of a sedimentary layer.

isopachous—See **isopach**.

isopachyte—A British term for **isopach**.

isopag—A line connecting points where ice is present for the same number of days per year. (68)

isoplectic—A line connecting points at which ice begins to form at the same time of the winter. A line connecting points at which ice melts at the same time of the spring is called an **isotac**. (68)

isopiestic—A term denoting equal or constant pressure.

isopleth—A line of equal or constant value of a given quantity, with respect to either space or time.

isopod—One of an order (Isopoda) of generally flattened **crustaceans**. They are mostly scavengers. Several members burrow into wood. See **marine borers**.

isopor—A line sometimes found on magnetic charts showing points of equal annual change. (28)

isopycnic—1. Of equal or constant **density**, with respect to either space or time; equivalent to an **isostere**.

2. A line on a chart connecting all points of equal or constant density; an **isopleth** of density.

3. Short form for **isopycnic line**.

isopycnic line—A line of equal or constant **density**. It is equivalent to an **isostere**. (5)

isopycnic surface—A surface of constant **density**.

A particle of water of a certain density moves along an isopycnic surface or, if forced away from this surface, will seek to return to it.

isostasy—A condition of approximate equilibrium in the outer part of the earth, such that the gravitational effect of masses extending above the surface of the **geoid** in continental areas is approximately counterbalanced by a deficiency of density in the material beneath those masses, while the effect of deficiency of density in ocean waters is counterbalanced by an excess of density of the material under the oceans.

isostatic adjustment—The process of restoring and maintaining that condition of equilibrium in the so-called crust of the earth which is known as **isostasy**.

The distribution of material in the outer part of the earth is undergoing continual change by the operation of erosion, sedimentation, and other natural forces. The unbalanced condition which would naturally result from such disturbing processes is offset by the movement of material at considerable depths below the surface of the earth. (37)

isostatic anomaly—The difference between an observed value of **gravity** and a theoretical value at the point of observation which has been corrected for elevation of the station above the **geoid** and for the effect of topography over the whole earth and for its **isostatic compensation**. (37)

isostatic compensation—The departure from normal density of material in the lower part of a column of the earth's crust which balances (compensates) landmasses (topography) above sea level and deficiency of mass in ocean waters, and produces the condition of approximate equilibrium of the earth's crust known as **isostasy**. (37)

isostatic correction—The adjustment made to values of **gravity** or to **deflections of the vertical** observed at a point to take account of the assumed mass deficiency under topographic features for which a topographic correction is also made.

isostatic equilibrium—*See* **isostasy**.

isostere—A line of equal or constant **specific volume**. It is equivalent to an **isopycnic**. (5)

isotac—A line connecting points at which ice melts at the same time of the spring. A line connecting points at which ice begins to form at the same time of the winter is called an **isopectic**. (68)

isotach—A line connecting points of equal rates of speed; for example, the flow of currents.

isotherm—A line on a chart connecting all points of equal or constant temperature; an **isopleth** of temperature. (5)

isothermal—Of equal or constant temperature, with respect to either space or time. (5)

isothermal layer—*See* **mixed layer**.

isothermal layer depth—*See* **layer depth**.

isotherm follower—1. A device which plots the time change in depth of an **isotherm** on a chart.

2. An instrument used to study the movement of subsurface layers of oceanic water.

isotope—1. One of several **nuclides** having the same number of protons in their nuclei, and hence belonging to the same element, but differing in the number of neutrons and therefore in mass number A , or in energy content (**isomers**). Small quantitative differences in chemical properties exist between isotopes.

2. A synonym for **isotopic tracer**.

3. A **radionuclide** or a preparation of an element with special isotopic composition (allobar) as an article of commerce, so called because of the principal use of such materials as isotopic tracers.

4. In common usage, synonym for **nuclide** (not recommended). (41)

isotopic tracer—The **isotope** or non-natural mixture of isotopes of an element which may be incorporated into a sample to make possible observation of the course of that element, alone or in combination, through a chemical, biological, or physical process. The observations may be made by measurement of radioactivity or of isotopic abundance. (70)

isotropic—Having the same physical properties in all directions. (68)

isovelocity—Having equal values of **sound velocity** in all parts of a given water column; no change in sound velocity with depth.

isovelocity conditions—Those conditions which occur when the **sound velocity** within a layer is constant, that is, the temperature gradient is $< 0.2^{\circ}\text{C}$ per 30 meters.

isthmus—A narrow strip of land, bordered on both sides by water, that connects two larger bodies of land. (2)

J

Japan Current—*See* **Kuroshio**.

jellyfish—(or *medusa*). 1. Any of various free-swimming **coelenterates** having a disc- or bell-shaped body of jellylike consistency. Many have long tentacles with **nematocysts** (stinging cells). Some are capable of producing **glowing ball luminescence**.

2. Any jellylike free-floating organism. The term jellyfish often is applied to the **ctenophores** and may be to certain **tunicates**.

jetsam—*See* **jettison**.

jettison—The throwing overboard of objects, especially to lighten a craft in distress. Jettisoned objects that float are termed **flotsam**; those that sink, **jetsam**; and heavy articles that are buoyed for future recovery, **lagan**. *See* **derelict**. (68)

jetty—1. In United States terminology a structure, such as a wharf or pier, so located as to influence current or protect the entrance to a harbor or river. A jetty extending into the sea to protect the coast from erosion is called a **groin**. A jetty which breaks the force of the sea at any place is called a **breakwater**. A jetty, wall, or bank, often submerged, built to direct or confine the flow of a river or tidal current is called a **training wall**. A wall or embankment along a waterfront, to resist encroachments of the sea, is called a **sea wall**.

2. In British terminology a pier, usually of solid construction, intended as a berthing place for ships.

(68)

jingle shell—One of a family (*Anomiidae*) of rounded **bivalves** with asymmetrical, thin almost transparent valves. The individuals are attached to firm surfaces by a calcified **byssus** projecting through a hole in the lower smaller valve. These organisms are abundant foulers in some regions.

Jog-Log—A towed electrode that can detect ocean electric current induced by magnetic disturbances.

joint—A fracture in a rock, generally vertical or transverse to bedding, along which no appreciable movement has occurred. (2)

Joule—A unit of energy equal to 10^7 ergs or to 0.2389 calories. (5)

juvenile water—Water that enters for the first time into the **hydrologic cycle**. It is released from **igneous rocks** through volcanic activity at a rate probably not exceeding 0.1 cubic kilometer per year. (32)

juvenile wave platform—A shoal nearshore bottom consisting of rock, jagged reefs, cobbles, and boulders and having little material easily movable by waves. It represents the stage before planation by wave erosion.

K

kalema—A very heavy surf breaking on the Guinea coast of Africa during the winter. (5)

kaolin—*See* kaolinite.

kaolinite—A common clay mineral, hydrous aluminum silicate, formed by the replacement or alteration of feldspars or other minerals. Kaolin is rock composed principally of kaolinite.

katabatic wind—(or *gravity wind*). Any wind blowing down an incline. If the wind is warm, it is called a foehn; if cold, it may be a fall wind or a gravity wind.

kay—*See* cay.

kelp—1. One of an order (Laminariales) of usually large, blade-shaped, or vinelike brown algae (principally American usage). Representative species are the **giant kelp** (*Macrocystis pyrifera*), **bull kelp** (*Nereocystis luetkeana* or *Durvillea antarctica*), **elk kelp** (*Pelagophycus porra*), and laminarians (species of *Laminaria*).

2. The burnt ash of rockweeds or laminarians produced by Europeans since the 17th century and still used around the world as a source of sodium carbonate, potash, and iodine.

Kelvin temperature scale—(abbreviated K; also called *absolute temperature scale*). An absolute temperature scale independent of the thermometric properties of the working substance. For convenience the Kelvin degree is identified with the Celsius degree ($0^{\circ}\text{K} = -273.16^{\circ}\text{C}$). Therefore, the **ice point** in the Kelvin scale is 273.16°K . (5)

Kelvin wave—A type of tide progression in relatively confined water bodies (such as the North Sea) where because of coriolis force the **tide wave** is higher to the right of direction of advance (in the Northern Hemisphere). However, upon reflection from a landmass the progression reverses direction and consequently the tide wave is higher on the opposite coast.

key—A low island or a reef. *See* cay. (68)

killer whale—The largest member (*Orcinus orca*) of the dolphin family (Delphinidae), having worldwide distribution. Although this animal has been implicated in several attacks upon boats containing men and in bumping sea ice bearing men, no documented fatality is known.

Kilogram-calorie—(abbreviated K cal, kg-cal, Cal). *See* calorie.

kilometer—(abbreviated km). The unit of distance measurement in the metric system equal to 0.62 statute mile or 0.54 nautical mile. A statute mile equals 1.61 kilometers; a nautical mile equals 1.85 kilometers. (4)

kinetic energy—The energy which a body possesses as a consequence of its motion, defined as one-half the product of its mass and the square of its speed, $\frac{1}{2}mv^2$. The kinetic energy per unit volume of a fluid parcel is thus $\frac{1}{2}\rho v^2$, where ρ is the density and v the speed of the parcel. (5)

In a progressive oscillatory wave, a summation of the energy of motion of the particles within the wave. This energy does not advance with the wave form.

kingdom—*See* classification of organisms.

Kirchoff's law—The radiation law which states that at a given temperature the ratio of the **emissivity** to the **absorptivity** for a given wavelength is the same for all bodies and is equal to the emissivity of an ideal black body at that temperature and wavelength. (5)

kneaded gravel—Gravel or conglomerate transported by mud flows. (2)

knoll—An elevation rising less than 500 fathoms (1,000 meters) from the sea floor, and of limited extent across the summit. (62)

knot—A speed unit of one nautical mile (6,076.12 feet) per hour. It is equivalent to a speed of 1.688 feet per second or 51.4 centimeters per second.

Knudsen's Tables—Tables published by Martin Knudsen in 1901 ("Hydrographical Tables"), to facilitate the computation of results of sea water **chlorinity** titrations and hydrometer readings, and their conversion to **salinity**, **density**, and **sigma-t**. (5)

K₁ constituent—The lunisolar diurnal constituent of the theoretical **tide-producing forces**. (*See* figure for **partial tide**.)

kraken—*See* giant squid.

krill—(Norwegian kril). A term used by whalers and fishermen for **euphausiids**.

K₂ constituent—The lunisolar semidiurnal constituent of the theoretical **tide-producing forces**. (*See* figure for **partial tide**.)

Kullenberg corer—A coring device (piston or gravity fall) used to obtain 2-inch diameter **core samples**. The sampler consists of a weight stand on which removable weights can be placed,

a **core barrel** (generally of 12-foot length), **core cutter**, core catcher, and a tripping arm if used with piston.

kuppe—The German term for **dome**.

Kuroshio—(also called *Japan Current*). A fast ocean current (2 to 4 knots) flowing northeastward from Taiwan to Ryukyu Islands and close to the coast of Japan to about 150°E.

The Kuroshio originates from the greater part of the **North Equatorial Current**, which divides east of the Philippines. Beyond 150°E it widens to form the slower moving **North Pacific Current**.

Kuroshio extension—A general term for the warm, eastward-transitional flow that connects the **Kuroshio** and the **North Pacific Current**.

Kuroshio system—A system of ocean currents which includes part of the **North Equatorial Current**, the Tsushima Current, the **Kuroshio**, and the **Kuroshio extension**.

K value—The reciprocal of the difference between the **coefficient of the thermal expansion** of mercury and that of the type glass used in a thermometer. (67)

kymatology—The science of waves and wave motion.

L

Labrador Current—A current that flows southward from Baffin Bay, through the Davis Strait, and southeastward along the Labrador and Newfoundland coasts. East of the Grand Banks of Newfoundland the Labrador Current meets the **Gulf Stream**, and the two flow eastward as the **North Atlantic Current**.

LaCoste-Romberg (zero length spring) **gravimeter**—A long-period vertical seismograph suspended system adapted to the measurement of **gravity** differences.

LaFond's Tables—A set of tables and associated information for correcting **reversing thermometers** and computing **dynamic height anomalies**, compiled by E. C. LaFond and published by the U.S. Naval Oceanographic Office as H.O. Publication 614.

lagan—*See* **jettison**.

lag coefficient—*See* **time constant**.

lagging of the tide—(also called *daily retardation, retardation*). The periodic retardation in the time of occurrence of **high** and **low water** due to changes in the relative positions of the moon and the sun. The opposite effect is called **priming of the tides**.

lag gravel—Residual accumulations of coarse particles from which the fine material has been winnowed by currents unable to move the coarse material.

lagoon—A shallow **sound**, pond, or lake generally separated from the open sea. (*See* figures for **atoll** and **coral reef**.)

lagoon beach—The lagoonward facing beach of reef islands. (56) (*See* figure for **atoll**.)

lagoon channel—Properly refers to a navigational **channel** or **pass** through a **reef** and into and through the **lagoon**. It has been applied to the lagoon itself. (*See* figure for **coral reef**.)

lagoon cycle—The time required and sequence of events involved in the filling of a **lagoon** by sediments followed by their erosion by wave action and eventual refilling by deposition.

lagoon floor—The undulating to nearly level floor of the **lagoon**. (56) (*See* figure for **atoll**.)

lagoon reef margin—The lagoonward margin of the reef or island in an **atoll**. (56) (*See* figure for **atoll**.)

lagoon slope—The border zone of the lagoon that slopes downward from the **lagoon reef margin** or **lagoon beach** to the **lagoon floor**. (56) (*See* figure for **atoll**.)

Lagrangian current measurement—Direct observation of the current speed and/or direction by a recording device such as a parachute **drogue**, which follows the movement of a **water mass** through the ocean. *See* **Eulerian current measurement**. (73)

laguna—A shallow coastal **sound**, channel, or lake connected with the sea. (48)

Lambert conformal conic projection—A **conformal projection** in which all materials are represented by straight lines that meet in a common point beyond the limits of the map, and the parallels, are concentric circles whose center is at the point of intersection of the meridians. Meridians and parallels intersect in right angles, and angles on the earth are correctly represented on the projection. This projection may have one standard parallel along which the scale is held exact; or there may be two such standard parallels, both maintaining exact scale. (37)

Lambert's formula—A formula for computing the mean wind direction from a series of observations. It may be written:—

$$\tan \alpha = \frac{E - [W(\text{NE} + \text{SE} - \text{NW} - \text{SW}) \cos 45^\circ]}{N - [S(\text{NE} + \text{NW} - \text{SE} - \text{SW}) \cos 45^\circ]}$$

where α is the mean wind direction, and each point of the compass replaced by the number of observations of wind from that direction. (5)

lamellibranch—*See* **bivalve**.

lamina—1. A sediment or sedimentary rock layer less than one centimeter thick visually separable from the material above and below. Lamination refers to the alternation of such layers which differ in grain size or composition. (2)

2. (or *blade, frond*). The expanded and/or elongate portion of the thallus of an **alga**.

laminar flow—(also called *sheet flow, streamline flow*). A flow in which the fluid moves smoothly in streamlines in parallel layers or sheets; a nonturbulent flow. *See* **turbulent flow**. (5)

lamination—*See* **lamina**.

lamp shell—*See* **brachiopod**.

land and sea breeze—The combination of a **land breeze** and a **sea breeze** as a diurnal phenomenon. (61)

land breeze—A light wind blowing from the land caused by unequal cooling of land and water masses. (61)

landfast ice—*See* **fast ice**.

land floe—An unusually thick fragment of **fast ice** which has become detached from the parent formation and is afloat. (59)

land ice—*See* glacier, glacier ice.

landlocked—A body of water enclosed or nearly enclosed by land, thus protected from the sea. San Francisco Bay is a classic example.

land sky—The relatively dark appearance of the underside of a cloud layer when it is over land that is not snow covered. This term is used largely in polar regions with reference to the **sky map**; land sky is brighter than **water sky**, but is much darker than **ice blink** or **snow blink**. (5)

lane—1. *See* lead.

2. A narrow, not necessarily navigable, crack in **pack ice**. It may widen into a lead. (5) Obsolete.

3. An electronically defined area and system of measurement used in certain electronic controlled systems, such as Decca survey and LORAC. A proportional reading of the distance between the two rates which define a lane are taken and define a line of position.

langley—A unit of energy per unit area commonly employed in radiation theory; equal to one gram calorie per square centimeter. (5)

lanternfish—*See* myctophid.

lanthanides—The rare-earth elements from atomic numbers 58 to 71 inclusive. They have chemical properties similar to lanthanum. (41)

lapilli—Volcanic **ejecta** ranging from 4 to 32 millimeters in diameter. (2)

lapped ice—*See* anchor ice.

lard ice—Rare. *See* grease ice.

large calorie—(abbreviated Cal). *See* calorie.

large field of ice—*See* large ice field.

large ice field—(or *large field of ice*). 1. An ice field over 20 kilometers (10.8 n. miles) across. (74)

2. A Russian term for an ice field of 2 to 10 kilometers (1.1 to 5.4 n. miles) in width. All large ice fields would fall into the current WMO definition of big ice floe.

large ice skylight—*See* ice skylight.

large scale—*See* scale.

larva—An embryo which becomes self-sustaining and independent before it has assumed the characteristic features of its parents. (26)

last ice—The last appearance of ice in the waters of a particular location, whether it melts locally or is carried off by winds or currents.

latent heat—The heat released or absorbed per unit mass by a system in a reversible, isobaric-isothermal change of phase. At 0°C, the latent heats of vaporization (or condensation), fusion, and sublimation of water substance are, respectively,

$$L_v = 597.3 \text{ cal/gm}$$

$$L_f = 79.7 \text{ cal/gm}$$

$$L_s = 677.0 \text{ cal/gm}$$

latent heat of evaporation—That amount of heat required to change one gram of water into water vapor without a change in temperature. For

example, 536 calories are required to change one gram of water to water vapor at 100°C at standard atmospheric pressure.

lateral line—A system of sense organs possessed by fishes, usually arranged in a single series along the side of the body, and functioning in part to detect low frequency vibrations such as those produced by local disturbances in the water.

lateral shift—The offset of the position of the peak of an **anomaly** with the mass of magnetization (or gravitation).

latitude correction—The amount of the adjustment of **observed gravity** values to an arbitrarily chosen base latitude.

lava—Molten rock which issues from a volcano or a fissure in the earth's surface and solidifies upon cooling. (*See* figure for **compound volcano**.)

lava delta—A delta like body of lava formed where a lava flow enters the sea. A coast consisting of such deltas formed by recent lava flows has a convex shoreline and is called a lava-flow coast.

lava-flow coast—*See* lava delta.

Law of Constancy of Relative Proportions—

Regardless of the absolute concentration of total dissolved solids in sea water, the ratios between the more abundant substances are virtually constant in the world's oceans.

Law of Universal Gravitation—Newton's law of gravitation. Gravitation is directly proportional to the product of the masses of the two bodies and inversely proportional to the square of the distance between them. (37)

layer—*See* stratum.

layer depth—(or *isothermal layer depth, mixed layer depth*). In oceanography, the thickness of the **mixed layer**; or the depth to the top of the **thermocline**. (5)

layer depth effect—The weakening of the sound beam owing to abnormal spreading as it passes from an isothermal or a positive gradient layer to an underlying negative layer.

layer of no motion—A layer, assumed to be at rest, at some depth in the ocean. This implies that the **isobaric surfaces** within the layer are level, and hence they may be used as reference surfaces for the computation of absolute gradient currents.

This same concept can define a level of no motion or a surface of no motion. (5)

lead—(or *channel, lane*). A navigable passage through **pack ice**. (74)

A lead may be covered by **young ice**. From the point of view of the submariner it becomes an **ice skylight**.

lead line—(or *sounding line*). A line, wire, or cord used in **sounding**. It is weighted at one end with a plummet (sounding lead). (61)

lead smoke—*See* frost smoke.

least squares—Any procedure that involves minimizing the sum of squared differences. For example, the deviation of the mean from the population is less, in the squared sense, than any other linear combination of the population values. (5)

ice—Shelter, or the part or side sheltered or turned away from the wind or waves. (61)

lee tide—*See leeward tidal current.*

leeward—The direction toward which the wind is blowing; the direction toward which waves are travelling. (61)

leeward tidal current—A tidal current setting in the same direction as that in which the wind is blowing. (68)

leeward tide—Obsolete form. *See leeward tidal current.*

lenticular—In the shape of a double convex lens. Applied to commonly occurring lens-shaped sediment or rock bodies of all sizes. Also applied to clouds that attain this shape in the process of dissipation.

leptocephalus—The small, elongate, transparent, planktonic larva of the eel (*Anguilla*).

lesser ebb—The weaker of two ebb tidal currents occurring during a tidal day, usually associated with tidal currents of mixed characteristics. (66) *See mixed current.* (*See figure for current curve.*)

lesser flood—The weaker of two flood tidal currents occurring during a tidal day, usually associated with tidal currents of mixed characteristics. (66) *See mixed current.* (*See figure for current curve.*)

levee—An embankment bordering one or both sides of a **seachannel** or the low-gradient seaward part of a **canyon** or **valley**.

level ice—Ice with a flat surface, which has never been hummocked; typical with regard to bays, gulfs, straits, archipelagoes, and shallow waters, where the ice formation occurs in undisturbed conditions. (74)

level of no motion—*See layer of no motion.*

level surface—A surface which at every point is perpendicular to the plumb line of the direction in which **gravity** acts.

light absorption—*See absorption.*

light and dark bottle technique—*See oxygen technique.*

light bottle—A container used for measuring photosynthetic activity of primary producers.

light floe—In sea ice reporting, an **ice floe** generally less than 2 feet thick. (59)

light ice—**Sea ice** less than 2 feet thick. (68)

light ice floe—*See light floe.*

light intensity—*See luminous intensity.*

light minerals—Detrital minerals in rock or sediments that have a **specific gravity** of less than 2.8 and usually are light in color. Examples are quartz, feldspar, calcite. (2)

lightship—(or *light vessel*). A distinctively-marked ship, anchored or moored at a charted point, to serve as an **aid to navigation**. (66)

light vessel—*See lightship.*

lily-pad ice—**Pancake ice** when the cakes are not more than about 18 inches in diameter. (68)

liman—Shallow coastal **lagoon** or **embayment** with a muddy bottom; also a region of **mud** or **slime** deposited near a stream mouth. (2)

lima coast—An alluvial coast usually characterized by many **lagoons**.

limestone—A general term for a class of rocks which contain at least 80 percent of the carbonates of calcium or magnesium. Varieties of limestone take their names from the source material, for example, **algal limestone**, reef limestone, **coquina**, **crinoidal limestone**, etc.

limited form wave—Deformation of the wave by the formation of a sharp crest followed by a propagation with bubbling of water on the front face until the final breaking into a **roller**.

limiting ray—The sound ray which becomes tangent at the depth where the **sound velocity** is at maximum.

limnology—The physics and chemistry of fresh water bodies and of the classification, biology, and ecology of the organisms living in them. (5)

Limnoria—(or *gribble*). 1. A genus of crustacean borers.

2. The common name of this group. Members of this group are the most destructive of the crustacean borers.

3. *See crustacean borer* and **marine borer**.

limpet—One of several suborders (Docoglossa, Patellacea, Fissurellidae, or Zygobranchia) of flattened cone-shaped **gastropods** in which the spiral of the shell is absent or not apparent.

linear amplifier—A pulse amplifier in which the output pulse height is proportional to an input pulse height for a given pulse shape up to a point at which the amplifier overloads. (70)

linear transducer—A **transducer** for which the pertinent measures of all sound waves concerned are linearly related. (69)

line hydrophone—A **directional hydrophone** consisting of a single, straightline element, or any **array** of contiguous or spaced electroacoustic transducing elements, disposed on a straight line, or the acoustic equivalent of such an array. (69)

line spectrum—A **spectrum** whose components occur at a number of discrete frequencies.

liquid—A state of matter in which the molecules are relatively free to change their positions with respect to each other but restricted by cohesive forces so as to maintain a relatively fixed volume. (27)

liquid limit—*See Atterberg limits.*

lithifaction—*See lithification.*

- lithification**—(or *lithifaction*). The processes of induration, cementation, petrification, consolidation, and crystallization which convert **magma** and newly deposited sediments into **rock**.
- lithofraction**—Fragmentation of rocks by wave action on beaches.
- lithoid tufa**—Gray algal reeflike material forming **beds** and the core of reef domes.
- lithology**—The study and description of rocks based upon magascopic and microscopic examination of samples.
- lithometeor**—*See meteor*.
- lithosphere**—The outer, solid portion of the earth; the **crust** of the earth; usually used in contexts wherein the lithosphere is said to make contact with the **atmosphere** and the **hydrosphere**. *See also biosphere, geosphere.* (5) (*See figure for earth structure.*)
- lithostrome**—*See lithotope*.
- Lithothamnion ridge**—A ridge, composed of the calcium carbonate secretions of *Lithothamnion* and other red calcareous algae, which rises about 3 feet above sea level at the seaward edge of a **reef flat**. The secretions of *Lithothamnion* and related genera may compromise 50 percent or more of a **coral reef**.
- lithotope**—An area and environment of uniform sedimentation. The layer or deposit of uniform or uniformly heterogeneous composition and texture produced in a lithotope is called a lithostrome.
- littoral**—(or *intertidal*). The benthic zone between high and low water marks. According to some authorities the benthic zone between the shore and water depths of approximately 100 fathoms (200 meters). It is also called the littoral benthic which is subdivided into the **eulittoral** and the **sublittoral**. The usage and interpretation of this term varies widely in the literature. (*See figure for classification of marine environments.*)
- littoral benthic**—*See littoral*.
- littoral current**—A current, caused by wave action, that sets parallel to the shore; usually in the nearshore region within the **breaker zone**. *See longshore current*.
- littoral deposits**—Deposits of **littoral drift**, that is, sand, gravel, and other material which moves along the shore between high and low water marks. Littoral drift also refers to the longshore movement or **littoral transport** of such material by **longshore currents**.
- littoral drift**—The material moved in the littoral zone under the influence of waves and currents. (61) *See littoral deposits*.
- littoral transport**—The movement of material along the shore in the littoral zone by waves and currents. (61) *See littoral deposits*.
- littoral zone**—*See intertidal zone*.
- live weight**—*See biomass*.
- load**—The quantity of sediment transported by a current. It includes the suspended load of small particles, which float in suspension distributed through the whole body of the current, and the traction load, bottom load, or bed load of large particles which move along the bottom by traction, that is, saltation, rolling, and sliding.
- loam**—A soil composed of clay, silt, sand, and organic matter. The term occasionally is used to describe a marine sediment. (2)
- lobes**—If a three-dimensional representation of a transducer directivity is made by rotating the two-dimensional directivity pattern these sectors generate zones, or regions, on the constant distance surface. These regions are known as lobes. The term is also used with reference to the corresponding portions of the directivity pattern. The region, or sector, which includes the reference axis is known as the primary lobe; the remaining regions, or sectors, are known as the secondary lobes. (28)
- local winds**—Winds which, over a small area, differ from those which would be appropriate to the general pressure distribution, or which possess some other peculiarity. (5)
- loch**—(or *lough*). An **inlet** or **arm** of the sea, often nearly **landlocked**. (68)
- log line**—A graduated line used to measure the speed of a ship through the water, or to measure the speed of the current from a ship at anchor. (59)
- lolly ice**—*See frazil ice*.
- longcrested wave**—A wave, the **crest width** of which is long compared to the **wavelength**. (73)
- longitudinal wave**—(also called *pressure wave, compressional wave, irrotational wave*). A wave in which the direction of displacement of each particle in the medium is perpendicular to the wave front.
- long-period constituent**—A tide or tidal current constituent with a period that is independent of the rotation of the earth but which depends upon the orbital movement of the moon or of the earth. The period is usually longer than a day and in general a half month or larger. *See constituent*.
- longshore bar**—(or *ball*). *See ball, bar*.
- longshore current**—(also called *littoral current*). The resultant current produced by waves being deflected at an angle by the shore. In this case the current runs roughly parallel to the **shoreline**. (*See figure for nearshore current system.*)
The longshore current is capable of carrying a certain amount of material depending upon its velocity and the particle size of the material; however, any obstruction, such as a submarine rock ridge or a land point cutting across the path of the current will cause loss of velocity and consequent loss of carrying power.

long wave—In oceanography, same as **shallow water wave**. (5)

long-wave radiation—*See* **infrared radiation**.

looming—An apparent elevation of distant terrestrial objects caused by abnormal atmospheric **refraction**. Because of looming, objects below the horizon are sometimes visible. The opposite is **sinking**. (68)

loop—1. That part of a **standing wave** or **clapotis** where the vertical motion is greatest and the horizontal velocities are least. Loops (sometimes called antinodes) are associated with clapotis and with **seiche** action resulting from resonant wave reflections in a harbor or bay. (61)

2. A pattern of field observations. Such a pattern is useful in correcting for drift in gravity meter observations.

loop bar—A **bar** formed by the junction of the ends of two **spits** on the mainland side of an offshore island undergoing wave erosion.

loose ice—*See* **broken ice**.

loose pack ice—**Broken ice** which is easily navigable. (59)

Loran—A long-range electronic navigation system which uses the time divergence of pulse-type transmission from two or more fixed stations. (This term is derived from the words "long-range navigation.") (63)

lough—*See* **loch**.

love wave—(or *Q wave*). A **transverse wave** propagated along the boundary or two elastic media, both of which have rigidity; that is, both media must be capable of propagating transverse waves. A surface seismic wave in which the particles of an elastic medium, vibrate transverse to the direction of the wave's travel, with no vertical component. (35)

low—1. A **cyclone**, or area of low atmospheric pressure. (68)

2. A submarine depression of any size or shape; also called a bathymetric low.

low energy environment—A region characterized by a general lack of wave or current motion, permitting the settling and accumulation of very fine-grained sediment (silt and clay). (2)

lower high water—(abbreviated LHW). The lower of two **high waters** of any tidal day where the tide exhibits mixed characteristics. *See* **mixed tide**.

lower high water interval—(abbreviated LHWI). The interval of time between the **transit** (upper or lower) of the moon over the local or Greenwich meridian and the next **lower high water**. This expression is used when there is considerable **diurnal inequality**. *See* **lunitidal interval**. (68)

lower low water—(abbreviated LLW). The lower of two **low waters** of any tidal day where the tide exhibits mixed characteristics. *See* **mixed tide**.

lower low water datum—An approximation of **mean lower low water** that has been adopted as a standard datum for a specific area although it may differ slightly from a later determination.

lower low water interval—(abbreviated LLWI). The interval of time between the **transit** (upper or lower) of the moon over the local or Greenwich meridian and the next **lower low water**. This expression is used when there is considerable **diurnal inequality**. *See* **lunitidal interval**. (68)

lower transit—*See* **transit**.

lowest low water—(or *lowest normal low water*). A plane of reference whose distance below **mean sea level** corresponds with the mean level of lowest low water of any normal tide.

lowest low water springs—A plane of reference approximating the mean level of **lowest low water** during **syzygy** (**spring tides**).

lowest normal low water—*See* **lowest low water**.

low tide—*See* **low water**.

low velocity layer—Any layer in which the velocity of compressional wave propagation is lower than in the adjacent layers. Such a layer can act as an efficient channel for the propagation of elastic waves for great distances. (2)

low water—(abbreviated LW; or *low tide*). The lowest limit of the surface water level reached by the lowering tide. Low water is caused by the astronomic **tide-producing forces** and/or the effects of meteorological conditions.

low water datum—An approximation of **mean low water** which has been adopted as a standard datum for a specific area although it may differ slightly from a later determination.

low water equinoctial springs—Low water springs near the times of the **equinoxes**.

low water full and change—The average interval of time between the **transit** (upper or lower) of the full or new moon and the next **low water**. (68)

low water inequality—*See* **diurnal inequality**.

low water interval—(abbreviated LWI). *See* **lunitidal interval**.

low water line—The intersection of the plane of **low water** with the **shore**; it varies daily with changing lunar phases and meteorological conditions.

low water lunitidal interval—*See* **lunitidal interval**.

low water neaps—*See* **mean low water neaps**.

low water of ordinary spring tides—(abbreviated LWOST). A tidal datum appearing in some British publications, based on low water of ordinary spring tides. (61)

low water quadrature—*See* **mean low water neaps**.

low water springs—*See* **mean low water springs**.

low water stand—The condition at low tide when there is no change in the height of the water level. A similar condition at high tide is called **high water stand**. (68)

loxodrome—*See rhumb line.*

luciferase—An enzyme which is heat labile, has protein characteristics, and catalyzes the oxidation of **luciferin** in **bioluminescence**.

luciferin—A group of heat-stable compounds containing amino acids and showing properties of polypeptides. **Bioluminescence** is produced when these compounds are oxidized by the catalytic action of **luciferase**. *See also oxyluciferin.*

lumachelle—Shell conglomerate formed of mollusk shells which have been consolidated into cemented aggregates. (2)

luminance—(also called *brightness*). In photometry, a measure of the intrinsic **luminous intensity** emitted by a source in a given direction. It may be defined as the **illuminance** produced by light from the source upon a unit surface area oriented normal to the line of sight at any distance from the source, divided by the solid angle subtended by the source at the receiving surface. It is assumed that the medium between source and receiver is perfectly transparent; therefore, luminance is independent of extinction between source and receiver. The source may or may not be self-luminous.

Luminance is a measure only of light; the comparable term for **electromagnetic radiation** in general is **radiance**. (5)

luminescence—(or *bioluminescence, phosphorescence*). Any emission of light at temperatures below that required for incandescence. (5)

luminous intensity—(or *candle power, light intensity*). The **intensity** (flux per unit solid angle) of visible radiation weighted to take into account the variable response of the human eye as a function of the wavelength of radiation. The basic unit for luminous flux is the lumen. (5)

lunar day—(or *tidal day*). The interval between two successive upper **transits** of the moon over a local meridian. The period of the mean lunar day, approximately 24.84 solar hours, is derived from the rotation of the earth on its axis relative to the movement of the moon about the earth.

lunar declination—The angular distance of the moon expressed in degrees north or south of the celestial equator; it is indicated as positive when north, and negative when south of the equator.

Maximum declination is about $28\frac{1}{2}$ degrees and minimum declination about $18\frac{1}{2}$ degrees, depending on the longitude of the moon's node. Tides or tidal currents occurring near times of maximum north or south declination are called **tropic tides** or tidal currents. The moon's declinational cycle of $27\frac{1}{3}$ days is called a tropical month. (50)

lunar interval—The time difference between the moon's **transit** of the Greenwich meridian and a local meridian. (50)

lunar tide—That part of the tide caused solely by the **tide-producing forces** of the moon as distinguished from that part caused by the forces of the sun. (50)

lunar transit—*See transit.*

lunate bar—*See bar.*

lunation—The period during which the moon completes all its phases from one new moon to the next new moon; approximately 29.5 days.

lunicurrent interval—1. The interval between the moon's **transit** (upper or lower) over a local or the Greenwich meridian and a specified phase of the tidal current following the transit, such as **strength of flood** and **ebb** or **slack water**. The interval is described as local or Greenwich according to whether the reference is to the moon's transit over the local or Greenwich meridian. (50)

2. *See strength of flood interval, strength of ebb interval.*

lunitidal interval—The interval between the moon's **transit** (upper or lower) over the local or Greenwich meridian and the following **high** or **low water**. The average of all high water intervals for all phases of the moon, the mean high water lunitidal interval, is abbreviated to high water interval. Similarly, the mean low water lunitidal interval is abbreviated to low water interval. The high water or low water interval is described as local or Greenwich according to whether the reference is to the transit over the local or the Greenwich meridian. (50)

lutaceous—*See lutite.*

lutite—(sometimes spelled lutyte). Sediments or sedimentary rock composed of mud (silts and/or clays). (2)

L-Z graph—A graph used to determine *in situ* depths of oceanographic observations by the wire depth minus **thermometric depth** method.

M

machinery noise—Noise produced by the main propulsion plant, reduction gears, propeller shafts, auxiliary machinery, and the underwater discharges from the ship.

macroplankton—Plankton organisms within the size range 1 millimeter to 1 centimeter. Sometimes referred to as mesoplankton. Formerly the term included megaloplankton forms. *See megaloplankton, mesoplankton.*

madrepore—A branching or stag-horn coral, also any perforated stone coral. (2)

maelstrom—A confused and often destructive current usually caused by the combined effects of high, wind-generated waves and a strong opposing tidal current; the rapid flows may follow eddying patterns or circular paths with **whirlpool** characteristics. Named after the frequently cited phenomenon along the south shore of Moskenesoy Island in the Lofoten Islands off the Norway coast; here, the maelstrom reaches its strength when the tidal current ebbs westward with speeds up to 9 knots at springs during a strong opposing westerly wind. Similar phenomena occur in Pentland Firth, Scotland and off Cape de la Hague, Normandy.

magma—Mobile rock material generated within the earth from which **igneous rock** is derived by solidification. When extruded it is called **lava**. (*See figure for compound volcano.*)

magnetic anomaly—A distortion of the regular pattern of the earth's **magnetic field** due to local concentrations of ferromagnetic minerals.

magnetic declination—At any point, the angle between the direction of the horizontal component of the earth's **magnetic field** and true north.

magnetic deviation—The angle between the magnetic meridian and the axis of a compass card, expressed in degrees east or west to indicate the deviation in which the northern end of the compass card is offset from magnetic north. Deviation is caused by disturbing magnetic influences in the immediate vicinity of the compass, as within the craft. (68)

magnetic dip—(also called *dip, inclination*). The angle which the magnetic lines of force make with the plane of the horizon. (42)

magnetic disturbance—(also called *magnetic storm*). Irregular, large amplitude, rapid time changes of the earth's **magnetic field** which occur at approximately the same time all over the earth. (24)

magnetic diurnal variation—(also called *diurnal variation, daily variation*). Oscillations of the earth's magnetic field which have a periodicity of about a day and that depend to a close approximation only on local time and geographic latitude. (15)

magnetic elements—The **declination** (D), the **horizontal intensity** (H), the **vertical intensity** (Z), the **total magnetic intensity** (F), the **inclination** or dip (I), the strength of the force toward geographic north (X), and the strength of the force toward geographic east (Y).

magnetic equator—(also called *acclinic line, dip equator*). The imaginary line on the earth's surface where the magnetic inclination is zero degrees, that is, the **magnetic field** is horizontal.

magnetic field—A region in which a magnetic influence exists. *See magnetic field intensity.*

magnetic field intensity—(also called *magnetic intensity, magnetic field, magnetic field strength*). The magnetic force exerted on an imaginary unit **magnetic pole** placed at any specified point of space. It is a vector quantity. Its direction is taken as the direction toward which a north magnetic pole would tend to move under the influence of the field. If the force is measured in **dynes** and the unit pole is a cgs unit pole, the field intensity is given in **oersteds**.

Prior to 1932 the oersted was called the **gauss**; but the latter term is now used to measure magnetic induction (within magnetic materials), while oersted is reserved for magnetic force. By definition, one magnetic line of force per square centimeter (in air) represents the field intensity of one oersted. (5)

magnetic field strength—*See magnetic field intensity.*

magnetic inclination—(or *dip*). *See magnetic dip.*

magnetic intensity—*See magnetic field intensity.*

magnetic latitude—At any point on the earth's surface the angle whose tangent is one-half the tangent of the **magnetic dip** at that point. (36)

magnetic meridian—At any point, the direction of the horizontal component of the earth's **magnetic field**.

magnetic pole—1. (also called *dip pole*). A place where the actual earth's magnetic pole is vertical.

2. In magnetic theory, a fictitious entity analogous to a unit electric charge of electrostatic

- theory. In nature only dipoles, not isolated magnetic poles, exist. (5)
- magnetic secular change**—The slow change over many years of either intensity or direction of the earth's magnetic field due to causes lying deep within the earth.
- magnetic storm**—*See magnetic disturbance.*
- magnetic variation**—1. Changes in the **magnetic field** with time or space.
2. **Magnetic declination.**
- magnetometer**—An instrument for measuring the **intensity** and/or direction of the earth's **magnetic field.**
- magnetostriction transducer**—A **transducer** that depends for its operation on the interaction between the magnetization and the deformation of a material having magnetostrictive properties.
- magnitude**—1. In mathematics, a number assigned to a quantity, by which the quantity may be compared with other quantities of the same class.
2. A quantity which represents the total energy released by an earthquake, as contrasted to "intensity," which describes its effects at a particular place. In 1935 C. F. Richter devised the magnitude scale in current use. The Richter magnitude scale ranges numerically from near 0 to about 8.5. The smallest shocks felt have a magnitude of 1.5, which represents an energy release of about 10^{21} ergs. A magnitude 5 shock represents the release of 10^{21} ergs of energy, which is equivalent to the energy released by 20,000 tons of TNT.
3. The intensity of a short-period magnetic fluctuation, usually expressed in milligausses or gammas.
- major constituents**—Those chemical elements present in sea water which together make up over 99.9 percent of the known dissolved solid constituents of sea water. These include the following ions: chloride, sulfate, bicarbonate, bromide, fluoride, boric acid, sodium, magnesium, calcium, potassium, and strontium.
- makatea**—The raised fin of a **coral reef.**
- manatee**—Any of the three species of **sea cow** which constitute the genus *Trichechus*. All three are confined to shallow tropical marine waters, estuaries, and rivers on both sides of the Atlantic Ocean. The tail is broad and rounded, not whalelike as in the **dugong.**
- manateegrass**—*See seagrass.*
- manganese nodules**—*See nodules.*
- mangrove**—One of several genera of tropical trees or shrubs which produce many prop roots and grow along low-lying coasts into shallow water.
- manta ray**—(or *devilfish*). One of a family (Mobulidae) of large rays. This is the largest of the rays, with widths over 20 feet and weights over 3,000 pounds having been recorded. *See ray.*
- mantle**—(also called *asthenosphere*). The relatively plastic region between the **crust** and **core** of the earth. (*See figure for earth structure.*)
- mantle rock**—*See regolith.*
- many-year ice**—*See arctic pack* (sense 2).
- map**—A representation on a plane surface, at an established scale, of the physical features (natural, artificial, or both) of a part or the whole of the earth's surface, by means of signs and symbols, and with the means of orientation indicated. (37)
- marginal basin**—This term is not recommended by the ACUF for a basin at the foot of a **continental slope** bounded by an outer ridge. *See basin.*
- marginal conglomerate**—Coarse pebble deposits along the shore which form the landward margins or **facies** of other types of sediments into which they grade. (2)
- marginal crushing**—The destruction of the outer edges of **ice cakes** because of collision of the cakes. (65)
- marginal deep**—This term is not recommended by the ACUF for a narrow linear zone of deep water adjacent to an **island arc.** *See trench, trough.*
- marginal platform**—This term is not recommended by the ACUF for a shelf adjacent to a continent and similar topographically to a **continental shelf** but located at a greater depth that may reach 1,250 fathoms. *See terrace, plateau.*
- marginal seas**—(or *adjacent seas*). Semienclosed seas adjacent to, widely open to, and connected with the oceans at the water surface but bounded at depth by submarine ridges; for example, Yellow Sea. When shallow (less than about 150 fathoms) they are called **shelf seas**; for example, Hudson Bay.
- marginal trench**—This term is not recommended by the ACUF for a trench which parallels the continental trend between the base of the **continental slope** and **abysal plain.** *See trench, trough.*
- marginal zone**—The outer (seaward) ridge and generally the highest portion of a **coral reef.** (2)
- marigram**—A graphic record of the rise and fall of the tide in the form of a curve which shows the time of any stage of the tide represented by abscissas and the height in feet by ordinates. (50) (*See figure for tide curve.*)
- marigraph**—*See tide gage.*
- marine abrasion**—The erosion of a bedrock surface by wave movement of sand and gravel.
- marine alluvium**—A contradiction in terms which is best avoided. Use marine sediment.
- marine arch**—*See sea arch.*
- marine bench**—A small wave eroded **terrace** along the shore which is level or gently inclined seaward.

marine biogeography—The description of the distribution of marine animals and plants, and analyses of those factors which determine the distribution and abundance of a given species. (25)

marine biology—The study of the plants and animals living in the sea. *See* **biological oceanography**.

marine borer—Any marine invertebrate that excavates tunnels, holes, or depressions in one or more of a variety of materials by abrasive, chewing, or chemical action. Marine borers exist in several phyla, including the **sponges, annelids, arthropods, mollusks,** and **echinoderms**. The most destructive of the borers on a worldwide basis are the **shipworms, crustacean borers,** and **rock borers**.

marine bridge—*See* **sea arch**.

marine-built terrace—A **terrace** seaward of a **marine-cut terrace**, shore platform, or plain of marine abrasion which consists of materials eroded from the marine-cut terrace. (2)

marine cave—*See* **sea cave**.

marine cliff—A cliff or slope marking the inshore limit of beach erosion. It may vary from an inconspicuous slope to an **escarpment** hundreds of feet high. (68)

marine climate—(also called *maritime climate, oceanic climate*). A regional climate which is under the predominant influence of the sea, that is, a climate characterized by **oceanicity**; the antithesis of a continental climate.

Such a climate is found where the prevailing winds blow onshore as on oceanic islands and on the western coasts of the continents in middle latitudes. It extends inland either until it meets a climatic divide or, in level country, until it becomes modified and gradually attains greater continentality. A marine climate is characterized by small diurnal and annual ranges of temperature, with retardation of the annual extremes until one or two months after each solstice. (5)

marine-cut terrace—(or *wave-cut terrace*). The level or gently sloping submerged shelf formed along a sea coast by the erosive action of waves and currents.

marine ecology—The science which embraces all aspects of the interrelations of marine organisms and their environment and the interrelations between the organisms themselves. (38)

marine environments—*See* **classification of marine environments**.

marine geology—*See* **geological oceanography**.

marine meteorology—That part of meteorology which deals mainly with oceanic areas, including island and coastal regions. In particular it serves the practical needs of surface and air navigation over the oceans.

Since there is a close interaction between ocean and atmosphere, and oceanic influences upon weather and climate can be traced far

inland over the continents, modern meteorology uses this name mainly for making regional or administrative distinctions. (5)

marine salina—A body of salt water separated from the sea by a sand or gravel barrier through which sea water percolates. Marine salinas are found along arid coasts where little or no inflow of fresh water occurs. (2)

marine snow—*See* **sea snow**.

marining—The submergence of low-lying land by an **epicontinental sea**. (2)

maritime air—A type of air whose characteristics are developed over an extensive water surface and which, therefore, has the basic maritime quality of high moisture content in at least its lower levels. (5)

maritime climate—*See* **marine climate**.

marl—A calcareous clay, or a mixture of clay and particles of calcite or dolomite and shell fragments. Often applied to calcareous sediments ranging in size from clay through sand. *See* **tosca**.

marl ball—*See* **algal biscuits**.

marlite—*See* **marlstone**.

marlstone—(or *marlite*). An indurated mixture of calcium carbonate and clay of which clay comprises 25 to 75 percent. (2)

Marsden chart—A system introduced by Marsden early in the nineteenth century for showing the distribution of meteorological data on a chart especially over the oceans. A Mercator map projection is used; the world between 90°N and 80° S being divided into Marsden "squares" each of 10 degrees latitude by 10 degrees longitude. These squares are systematically numbered to indicate position. Each square may be divided into quarter squares, or into 100 one-degree subsquares numbered from 00 to 99 to give the position to the nearest degree. (5)

marsh—An area of soft wet land. Flat land periodically flooded by salt water is called a salt marsh. Sometimes called **slough**. (68)

marsh bar—A narrow ridge of sand at the edge of a **marsh** undergoing wave attack.

mascaret—*See* **bore**.

mass movement—Unit movement or slippage of a mass of sediment down a slope, such as in a submarine **canyon**, which often initiates a **turbidity current**.

mass transport—The transfer of water from one region to another originating from the orbital motion of waves. (*See* figure for **nearshore current system**.)

mass transport speed—The speed of the current originating from waves.

matrix—Rock or sediment in which larger grains are imbedded in a mass of smaller grains.

mature wave platform—A platform of marine abrasion which has an abundance of rocky debris not yet reduced to **pebble** size by wave action.

- maximum**—The greatest value attained (or attainable) by a function; the opposite of **minimum**. (5)
- maximum ebb**—The greatest speed of an ebb tidal current. (66)
- maximum flood**—The greatest speed of a flood tidal current. (66)
- maximum sound pressure**—For any given cycle of a periodic wave, the maximum absolute value of the instantaneous **sound pressure** occurring during that cycle.
- mean**—*See arithmetic mean.*
- mean chart**—(or *mean map*). Any chart on which **isopleths** of the mean value of a given oceanographic element are drawn.
- mean current**—(or *average current, scalar mean*). The current speed and direction determined to be the average of a total number of observations for a specified area.
- meander**—A deviation of the flow pattern of a current.
- mean diurnal high water inequality**—(abbreviated DHQ). Half the average difference between the heights of the two **high waters** of each tidal day over a 19-year period, obtained by subtracting the mean of all high waters from the mean of the **higher high waters**. (68)
- mean diurnal low water inequality**—(abbreviated DLQ). Half the average difference between the heights of the two **low waters** of each tidal day over a 19-year period, obtained by subtracting the mean of the **lower low waters** from the mean of all low waters. (68)
- mean higher high water**—(abbreviated MHHW). The average height of all the daily **higher high waters** recorded over a 19-year period, or a computed equivalent period. It is usually associated with a tide exhibiting mixed characteristics. *See mixed tide.*
- mean higher high water springs**—(abbreviated MHHWS). The average height of all **higher high waters** recorded during **syzygy** over a 19-year period, or a computed equivalent period.
- mean high water**—(abbreviated MHW). The average height of all the **high waters** recorded over a 19-year period, or a computed equivalent period. (*See figure for tide range.*)
- mean high water lunitidal interval**—*See lunitidal interval.*
- mean high water neaps**—(abbreviated MHWN). The average height of all **high waters** recorded during **quadrature** over a 19-year period, or a computed equivalent period. (*See figure for tide range.*)
- mean high water springs**—(abbreviated MHWS). The average height of all **high waters** recorded during **syzygy** over a 19-year period, or a computed equivalent period. (*See figure for tide range.*)
- mean horizontal sound speed**—The mean velocity along the horizontal for one cycle of a sound ray path.
- mean lower low water**—(abbreviated MLLW). The average height of all the **lower low waters** recorded over a 19-year period, or a computed equivalent period. It is usually associated with a tide exhibiting mixed characteristics. *See mixed tide.* (*See figure for surf zone.*)
- mean lower low water springs**—(abbreviated MLLWS). The average height of all **lower low waters** recorded during **syzygy** over a 19-year period, or a computed equivalent period.
- mean low water**—(abbreviated MLW). The average height of all the **low waters** recorded over a 19-year period, or a computed equivalent period. (*See figure for tide range.*)
- mean low water lunitidal interval**—*See lunitidal interval.*
- mean low water neaps**—(abbreviated MLWN). The average height of all **low waters** recorded during **quadrature** over a 19-year period, or a computed equivalent period. (*See figure for tide range.*)
- mean low water springs**—(abbreviated MLWS). The average height of all **low waters** recorded during **syzygy** over a 19-year period, or a computed equivalent period. (*See figure for tide range.*)
- mean map**—*See mean chart.*
- mean neap range**—(abbreviated Np). The average semidiurnal range occurring at the time of **quadrature**. It is smaller than the **mean range** where the type of tide is either semidiurnal or mixed and is of no practical significance where the type of tide is diurnal. (*See figure for tide range.*)
- mean neap rise**—The height of **mean high water neaps** above the **chart datum**. (68) (*See figure for tide range.*)
- mean range**—(abbreviated Mn). The difference in height between **mean high water** and **mean low water**, measured in feet or meters. (*See figure for tide range.*)
- mean rise**—The height of **mean high water** above **chart datum**. (50) (*See figure for tide range.*)
- mean rise interval**—(abbreviated MRI). The time interval in hours and minutes between the **transit** of the moon and the height of the tide measured above **chart datum**. The mean rise interval may be referred either to the local or Greenwich meridian.
- mean river level**—The average height of the surface of a river at any point for all stages of the tide over a 19-year period, usually determined from hourly height readings. Unusual variations of river level due to discharge or runoff may be excluded in computation.
- mean sea level**—(abbreviated MSL; or *sea level datum*). The mean surface water level determined by averaging heights at all stages of the tide over a 19-year period. Mean sea level is usually determined from hourly height readings

- measured from a fixed predetermined **reference level (chart datum)**.
- mean sounding velocity**—Mean values for velocity of sound through the vertical water column of specific depths based on different velocities of sound in different sections of the column. These values yield more nearly correct depths when sonic depth finding machines are used. The velocity of sound at any specific depth may differ considerably from the mean.
- mean sphere depth**—The uniform depth to which the water would cover the earth if the solid surface were smoothed off and were parallel to the surface of the **geoid**. This depth would be about 8,000 feet (2,440 meters). (5)
- mean spring range**—(or *spring range*). The average semidiurnal range of tide at time of **syzygy**. It is greater than the **mean range** where the **type of tide** is either semidiurnal or mixed and is of no practical significance where the type of tide is diurnal. (See figure for **tide range**.)
- mean spring rise**—(or *spring rise*). The surface water level height of **mean high water springs** measured above the basic reference plane (**chart datum**). (See figure for **tide range**.)
- mean tide level**—(abbreviated MTL; or *half-tide level, ordinary tide level*). The reference plane midway between **mean high water** and **mean low water**. (See figure for **tide range**.)
- mean tropic range**—The mean of the **great tropic range** and the **small tropic range**. (68) See **lunar declination**.
- mean water level**—(abbreviated MWL). The mean surface level determined by averaging the height of the water at equal intervals of time, usually at hourly intervals, over a considerable period of time.
- mechanical analysis**—Measurement of the particle size distribution of a sediment. (2)
- mechanical mixing**—Action of waves in mixing the surface layer of the ocean.
- median**—Pertaining to a series of numbers, the median is the middle term when the numbers are arranged in algebraic order. If the number of terms is even, the median is taken halfway between the two middle terms. (5)
- medimarimeter**—An instrument for measuring **mean sea level**. The term is not generally used in the United States. (68)
- mediterranean**—A large body of salt water or **inland sea** surrounded by land, which may have one or more narrow openings to the ocean or another sea.
- medium field of ice**—See **medium ice field**.
- medium floe**—See **medium ice floe**.
- medium ice field**—(or *medium field of ice*). An **ice field** 15 to 20 kilometers (8.1 to 10.8 nautical miles) across. (74).
- medium ice floe**—1. An **ice floe** of sea ice 600 to 3,000 feet across. (59)
2. See **ice floe**.
- medium scale**—See **scale**.
- medium winter ice**—1. **Winter ice** thicker than 15 to 30 centimeters (6 to 12 inches). (74)
2. See **winter ice**.
- medusa**—See **jellyfish**.
- megaloplankton**—**Plankton** larger than 1 centimeter; includes the larger forms of the plankton, such as **salps** and large **jellyfishes**.
- megaripple**—(or *sand wave*). A large wavelike sediment feature in very shallow water composed of sand. The wavelength may reach 100 meters, and amplitude is about 0.5 meter.
- meizoseismal**—Refers to the maximum destructive effects of an earthquake. A line or curve connecting points of maximum destruction around an earthquake **epicenter** is a meizoseismal curve. (48).
- meizoseismal curve**—See **meizoseismal**.
- melting point**—The temperature at which a solid substance changes from the solid to the liquid form. Although sea ice melts at a specific temperature, it actually begins to disintegrate and weaken when its temperature approaches the melting point.
- membrane filter**—A strainer used for the quantitative extraction of phytoplankton and bacteria from water samples by **vacuum filtration** and usually consisting of a collodion membrane with fine pores of uniform size.
- Mercator projection**—(also called *equatorial cylindrical orthomorphic projection*). A **conformal projection** derived by mathematical analysis in which the meridians and parallels are portrayed as parallel straight lines at right angles to one another. The scale is chosen to be true along the Equator. This projection can be equivalently described as the development of a rhumb line on the earth, being portrayed as a straight line on the projection.
- meridian**—A north-south reference line, through the geographical poles of the earth from which longitudes and azimuths are measured. (68)
- meridional flow**—The current moving along a meridian. (32)
- mermaid's hair**—See **blue-green alga**.
- mermaid's purse**—See **sailor's purse**.
- meroplankton**—Chiefly the floating developmental stages (eggs and larvae) of the **benthos** and **nekton**. These forms are especially abundant in **neritic** waters.
- mesopelagic**—That portion of the oceanic province extending from about 100 fathoms (200 meters) down to a depth of about 500 fathoms (1,000 meters). (See figure for **classification of marine environments**.)
- mesoplankton**—**Plankton** within the size range 0.5 to 1.0 millimeter. Rarely used in this meaning since it is also used to designate all plankton living in middepths.
- messenger**—A cylindrical metal weight approximately 3 inches long and 1 inch in diameter; it is usually hinged and with a latch and is at-

- tached around an oceanographic wire and sent down to actuate the tripping mechanism on oceanographic devices such as **Nansen bottles** and **current meters** after they have been lowered to the desired depth.
- metamorphic rock**—Rocks which have undergone structural and mineralogical changes, such as recrystallization, in response to marked changes of temperature, pressure, and chemical environment. (2)
- metaripples**—*See ripple marks.*
- metasediments**—*See quick.*
- meteor**—A general term for any atmospheric phenomenon including hydrometeors (such as rain, cloud, fog, and mist) and lithometers (atmospheric dust or salt particles). The term now is usually restricted to astronomical meteors which are bodies travelling through interplanetary space whose remnants occasionally reach the earth's surface as meteorites.
- meteorological tide**—The change in water level due to meteorological conditions, such as wind and barometric pressure. (66)
- meter**—The basic unit of length of the metric system, equal to 1,650,763.73 wavelengths of Kr^{85} orange-red radiation. On October 14, 1960 the *11th General Conference on Weights and Measures* adopted this standard to replace the platinum-iridium meter bar which had been kept in Paris as the international standard of lengths since 1889 under the *Treaty of the Meter*.
2. A device for measuring, and usually indicating, some quantity. (68)
- meter wheel**—A special block used to support the oceanographic wire payed out over the side of a ship. Attached to or connected by means of a speedometer cable is a gear box to measure the length of wire. On some meter wheels the gear box or counter is an integral part of the wheel.
- Metonic cycle**—A period of approximately 19 years, during which all phase relationships between moon, sun, and earth occur.
- During any cycle, new and full moon will recur on approximately the same day of the same year. (68)
- microatoll**—A circular growth of **coral** with a central depression and a breadth of only a few feet. (2)
- microcoquina**—Partially cemented sand-size (2 millimeters and smaller) shell fragments. (2)
- microcurie**—(abbreviated μc). One-millionth of a **curie** (10^{-6} curie). (41)
- micron**—(abbreviated μ). A unit of length equal to one-millionth of a **meter** or one-thousandth of a millimeter. The micron is a convenient length unit for measuring wavelengths of infrared radiation, diameters of atmospheric particles, etc. (5)
- microplankton**—**Plankton** within the size range 60 **microns** to 1 millimeter. Most **phytoplankton** forms are included in this group and the **nannoplankton**.
- microseism**—A feeble oscillatory disturbance of the earth's **crust**, detectable only by very sensitive seismographs.
- Certain types of microseisms seem to be closely correlated with atmospheric disturbances and can be used to locate such disturbances, especially in the case of **tropical cyclones**. In addition, traffic, industrial activities, and wind flexure of trees and tall structures can create microseisms. (5)
- middle ground**—Bar deposits formed by ebb and flood tides in the middle of the **channel** at the entrance and exit of a **strait**. They result from the decrease in current velocity and deposition of suspended material with the widening of the channel at either end of the constriction.
- middle pack**—*See Baffin Bay pack.*
- Middle Passage**—The route across Melville Bugt (made possible by the breaking up of the **pack ice** in the center of Melville Bugt) which is a direct course from Upernavik to Kap York, Greenland. (21)
- mid-extreme tide**—A level midway between the extreme high water and extreme low water occurring at a place. *See mean tide level.* (68)
- Midocean Canyon**—This term is not recommended by the ACUF for an Atlantic Ocean **seachannel**.
- midocean canyon**—This term is not recommended by the ACUF for a steep-walled, flat-floored continuous depression up to 5 miles wide and 100 fathoms in relief that crosses a **plain** and often leads into or out of a **gap**. *See seachannel.*
- midoceanic islands**—Isolated volcanic islands rising from the deep sea floor, composed of basaltic **lava** or limestone **reefs** on a base of volcanic rock. (2)
- midocean ridge**—A great median arch or sea bottom swell extending the length of an ocean basin and roughly paralleling the **continental margins**. *See cordillera.* (2)
- midocean rift**—This term is not recommended by the ACUF for a deep, narrow-notched, cleft valley, or graben, which is reportedly found almost continuously along the crest of a cordillera or **ridge**. *See cordillera.*
- midwater trawl**—A bag-type net generally towed laterally at depths ranging from just above the bottom to the surface. Two types are:
- (1) Rigid—with a metal frame to form the shape of the open end of bag.
- (2) Nonrigid—depends on floats, paravanes, weights and/or depressors to form the shape of the open end.
- migrating inlet**—A tidal **inlet**, such as one connecting a coastal lagoon with the open sea, which shifts its position in the direction of the **long-shore current flow**. (2)
- military oceanography**—The study of those specific characteristics and phenomena of the deep sea environment which may influence the design

- and performance of ships, equipment, or weapons. (39)
- milky sea**—*See* **sheet-type luminescence**.
- milky weather**—*See* **whiteout**.
- Millepore * filter**—A copyrighted trade name for a membrane filter.
- millicurie**—(abbreviated mc). One-thousandth of a curie. (41)
- milligauss**—A unit of magnetic force equal to 0.001 gauss (oersted) or 100 gammas.
- million-electron-volt**—(abbreviated Mev). A common unit of energy in nuclear science, equivalent to 10^6 electron-volts. (41)
- milliroentgen**—One-thousandth of a roentgen. (41)
- minimum**—The least value attained (or attainable) by a function; the opposite of **maximum**. (5)
- minimum current**—The phase of the **tidal current** when the speed is least; usually referenced in knots and in hours before or after **low** and **high water**. (*See* figure for **current ellipse**.)
- minimum duration**—The time necessary for steady state wave conditions to develop for a given wind velocity over a given **fetch length**. (61)
- minimum ebb**—The lowest speed of a continuously outflowing current during the period of ebb tidal current, usually in a river or **estuary**; where currents are solely tidal, the lowest speed of an **ebb current** is at or near **slack water**. *See* **river discharge**.
- minimum flood**—Where currents are solely tidal, the lowest speed of a **flood current** is at or near **slack water**.
- minor constituents**—Those chemical elements present in sea water which together comprise approximately 0.1 percent of the total known dissolved solid constituents. Nearly all of the elements occur in sea water, although most are present in extremely small amounts. *See* **constituents of sea water**.
- mixed current**—The type of **tidal current** characterized by a conspicuous difference in speed and duration between the two successive flood or two successive ebb currents occurring during any tidal day. (50)
- mixed layer**—The layer of the water which is mixed through wave action or **thermohaline convection**.
- mixed layer depth**—The depth of the bottom of the **mixed layer**.
- mixed tide**—The type of tide in which a diurnal wave produces large inequalities in heights and/or durations of successive **high** and/or **low waters**. This term applies to the tides intermediate to those predominantly semidiurnal and those predominantly diurnal. (*See* figure for **types of tide**.)
- mixotrophic nutrition**—The process by which an organism obtains its food by both autotrophic and heterotrophic modes. *See* **autotrophic nutrition, heterotrophic nutrition**.
- mixture**—Mixtures consist of two or more substances intermingled with no constant percentage composition, and with each component retaining its essential original properties. (27)
- moat**—An annular depression that may not be continuous, located at the base of many **sea-mounts** or **islands**. (62)
- mode**—The item, in a series of statistical data, which occurs most often.
- modified Mercalli scale**—*See* **earthquake intensity**.
- Mohole**—A proposed deep **borehole** to penetrate the earth's **crust** and into the earth's **mantle** below the **Mohorovičić discontinuity**. (2)
- Mohorovičić discontinuity**—(abbreviated Moho). The sharp discontinuity in composition between the outer layer of the earth (the **crust**) and the next inner layer (the **mantle**). This was discovered by Mohorovičić from seismograms. The thickness of the crust has been determined by the **refraction** of seismic waves at this discontinuity which is situated about 35 kilometers below the continents and about 10 kilometers below the ocean basins and defines the top of the mantle. (*See* figure for **earth structure**.)
- Mohr-Knudsen method**—A chemical method for estimating the **chlorinity** of sea water. In this method, the volume of silver nitrate necessary to precipitate the sample in relation to the volume of silver nitrate necessary to precipitate **normal water** is determined by titration using potassium chromate as an indicator.
- The chlorinity is calculated by **Knudsen's Tables**.
- moisture flux**—*See* **eddy flux**.
- mold**—*See* **fungus**.
- mole**—1. *See* **gram-molecular weight**.
2. A massive structure of masonry or large stones serving as a pier or **breakwater**, or both. (68)
- molecule**—The smallest unit quantity of matter which can exist by itself and retain all the properties of the original substance. (27)
- mollusk**—(also spelled mollusc). One of a phylum (Mollusca) of soft unsegmented animals, most of which are protected by a calcareous shell. The phylum is second only to the insects in number of species. Some members are an important food source, some are dangerous to man, some are notable **fouling organisms**, and others are destructive to wood, concrete, and other submerged materials. The group includes the **snails, bivalves, chitons, squid, and octopus**.
- momentum**—That property of a particle which is given by the product of its mass with its velocity.
- momentum flux**—*See* **eddy flux**.

- monitoring**—Periodic or continuous determination of the amount of ionizing radiation or radioactive contamination present in an occupied region as a safety measure for purposes of health protection. (70)
- monsoon**—A name for seasonal winds (derived from Arabic “mausim,” a season). It was first applied to the winds over the Arabian Sea, which flow for six months from northeast and for six months from southwest, but it has been extended to similar winds in other parts of the world. (5)
- monsoon current**—A seasonal wind-driven current occurring in the northern part of the Indian Ocean and the northwest Pacific Ocean.
- montmorillonite**—A group of clay minerals characterized by swelling in water.
- moraine**—Rock debris, deposited chiefly by direct glacial action, and having various constructional topographic features independent of control by the underlying preglacial surface. Where glaciers float upon or discharge into the sea, or glaciated regions are drowned by the sea, moraines form marine deposits.
- moraine bar**—A bar, rising from deep water on both sides, which is composed of glacial detritus including large boulders. It is deposited as a terminal moraine by a valley glacier and extends across a fiord.
- moss animal**—See bryozoan.
- mouth**—The place of discharge of a stream into the ocean or entrance to a bay from the ocean.
- moving average**—See consecutive mean.
- Mozambique Current**—The part of the South Equatorial Current that turns and flows along the African coast in the Mozambique Channel. It is considered part of the Agulhas Current.
- M₂ constituent**—The principal lunar semi-diurnal constituent of the theoretical tide-producing forces. (See figure for partial tide.)
- mud**—Pelagic or terrigenous detrital material consisting mostly of silt and clay-sized particles (less than 0.06 millimeter) but often containing varying amounts of sand and/or organic materials. It is a general term applied to any sticky fine-grained sediment whose exact size classification has not been determined.
- muddy ice**—See debris ice.
- mud flat**—A muddy or sandy coastal strip usually submerged by high tide. (2)
- mud flow**—See turbidity current.
- mud lumps**—Small transient sigmoidal islands of bluish-gray clay squeezed up by the pressure of surface sediments or buried clays off the Mississippi River delta. They rise to 5 or 10 feet above sea level and are an acre or more in extent.
- mudstone**—A rock consisting of an indefinite mixture of clay, silt, and sand particles, the proportions varying from place to place. May also be applied to shales. See pelite.
- mud volcano**—(or *hervidero*). A cone-shaped clay mound composed of clay and usually formed by the eruption of sulfurous and bituminous mud from a central orifice or vent. There are both land and submarine forms.
- mu (μ) flagellates**—(or *hekistoplankton*). The extremely tiny phytoplankters measured in microns and bearing one or more whiplike hairs (flagella).
- multichannel analyzer**—See pulse height analyzer.
- multipath transmission**—The process, or condition, in which radiation travels between source and receiver via more than one path. Since there can be only one “direct” path, some process of reflection, refraction, or scattering must be involved. (5)
- multiple tide staff**—A succession of tide staffs placed on a sloping shore, so that the vertical graduations on the several staffs from a continuous scale with reference to the same datum. (68)
- mush**—Rare. See brash ice.
- mushroom ice**—See ice pedestal.
- mussel**—One of a family (Mytilidae) of elongate, tapering bivalves, usually dark colored, growing in masses on stationary and floating objects, underwater structures, rocks and rocky cliffs, or ships’ hulls, covering mud flats in the intertidal zone, and boring into rock. Mussels attach by means of a mass of threads called the byssus. They are one of the most notable groups of fouling organisms.
- mutualism**—A symbiotic relationship between two species in which both are benefitted. An example of mutualism is the attachment of certain sponges and coelenterates to the shells of crabs. The attached animal is carried about to fresh feeding areas, and the crab is camouflaged by the animal on its back and may be thus protected from enemies. See commensalism, inquilinism, symbiosis.
- myctophid**—(or *lanternfish*). One of a family (Myctophidae) of small oceanic fishes which normally live at depths between about 100 and 2,000 fathoms (200 and 4,000 meters). They characteristically have numerous small photophores on the sides of the body. Many species undergo extensive diurnal vertical migrations and are thought to contribute to sound scattering layers in the sea.
- mysid**—One of an order (Mysidacea) of elongate crustaceans which usually are transparent (or nearly so) and benthic or deep living.
- mysticete**—See baleen whale.

N

nadir—The point on the celestial sphere vertically below the observer, or 180 degrees from zenith. (66)

nannoplankton — (or *centrifuge plankton*).

Plankton within the size range 5 to 60 microns. Includes many **dinoflagellates** and smaller **diatoms**. Individuals will pass through most nets and usually are collected by centrifuging water samples. This spelling is as originally coined; the spelling nanoplankton used by some authorities is etymologically correct.

nanocurie—Equals 10^{-9} curie.

Nansen bottle—A device used by oceanographers to obtain subsurface samples of sea water.

The "bottle" is lowered by wire; its valves are open at both ends. It is then closed *in situ* by allowing a weight (called a **messenger**) to slide down the wire and strike the reversing mechanism. This causes the bottle to turn upside down, closing the valves and reversing the **reversing thermometers** which are mounted in a special thermometer case on it. If, as is usually done, a series of bottles is lowered, then the reversal of each bottle releases another messenger to actuate the bottle beneath it. (5)

Nansen cast—See **oceanographic cast**.

narrows—A narrow **passage** or **strait**. (2)

natural arch—See **sea arch**.

natural frequency—The characteristic frequency, that is, the number of vibrations or oscillations per unit time of a body controlled by its physical characteristics (dimensions, density, etc.). In a harbor, the natural frequency gives rise to waves, called **seiches**, which have periods and amplitudes dependent on the physical characteristics of the harbor.

natural radioactivity—1. The property of **radioactivity** exhibited by more than fifty naturally occurring **radionuclides**.

2. The natural radioactive constituents of sea water include Potassium⁴⁰, Rubidium⁸⁷, Uranium²³⁵, Uranium²³⁸, Thorium²³², Radium²²⁶, Carbon¹⁴, and Hydrogen³ (Tritium). Of these Potassium⁴⁰ is by far the largest contributor to the oceans natural radioactivity.

(70)

natural scale—The ratio between the linear dimensions of a chart, drawing, etc., and the actual dimensions represented, expressed as a proportion. (68)

nature of the bottom—See **character of the bottom**.

nauplius—A limb-bearing early larval stage of many **crustaceans**.

nautical almanac—A periodical publication (usually annual) of astronomical statistics useful to and designed primarily for marine navigation. (68)

nautical mile—(abbreviated n. mile). In general a unit used in marine navigation equal to a minute of arc of a **great circle** on a sphere. Depending upon the radius of the sphere, various lengths of nautical miles have been defined. The adopted value in the United States since July 1, 1959 is one international nautical mile equals 6,076.11549 U.S. feet (approximately).

nautilus—1. Any of a genus (*Nautilus*) of **cephalopods** of the South Pacific and Indian Oceans having a spiral chambered shell, pearly on the inside, whence the name Pearly Nautilus.

2. An eight-armed cephalopod (*Argonauta*) related to the **octopus**, the female having a fragile, papery, unchambered shell, called also Paper Nautilus.

navigation season—The average statistical dates for commencement and ending of shipping within or through a port or given area and controlled generally by ice and weather conditions.

Naval Oceanographic and Meteorological Automatic Device—(abbreviated NOMAD).

A deep sea moored buoy which provides automatic radio transmission of surface weather and subsurface temperature.

naze—See **headland**.

neap high water—See **mean high water neaps**.

neap low water—See **mean low water neaps**.

neap range—See **mean neap range**.

neap rise—See **mean neap rise**.

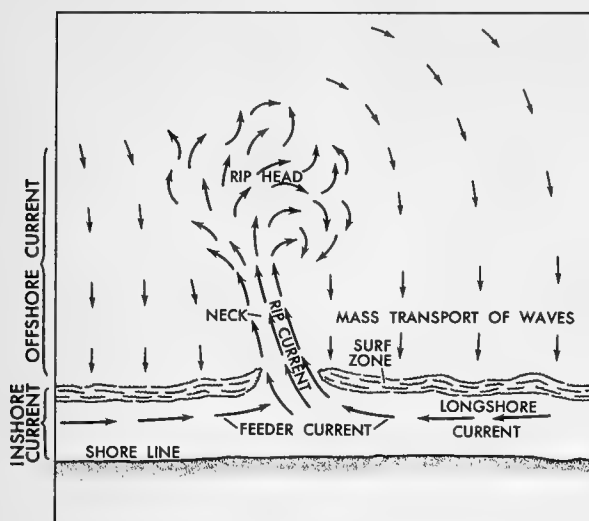
neaps—See **neap tide**.

neap tidal currents—Tidal currents of decreased speed occurring at the time of **neap tides**. (68)

neap tide—(or *neaps*). Tide of decreased range which occurs about every two weeks when the moon is in **quadrature**. (50) (See figure for **tide cycle**.)

nearshore circulation—The ocean circulation composed of the nearshore currents and coastal currents. (61)

nearshore current system—The current system caused by wave action in and near the **surf zone**. The nearshore current system consists of four parts: the shoreward **mass transport** of water, **longshore currents**, **rip currents**, and longshore movement of expanding **heads** of rip



NEARSHORE CURRENT SYSTEM

(AFTER WIEGEL, 1953)

currents. Sometimes called **inshore currents**. (73)

Nearshore Environmental Analog Prediction System—(formerly called *Harbor Analog System*). A technique used at the U.S. Naval Oceanographic Office to classify nearshore areas (shore to 30 fathoms) so that characteristics of unsurveyed locations can be inferred from surveyed locations in a similar class.

nearshore water—*See inshore water*.

nearshore zone—Pertaining to the zone extending seaward from the **shore** to an indefinite distance beyond the **surf zone**.

near surface path—*See surface path*.

neck—The narrow band of water flowing swiftly seaward through the **surf**. *See rip current*. (73) (*See figure for nearshore current system*.)

nectochaeta larva—A stage of the young of certain **annelids**, more advanced than the **polytrochular larva**, in which muscle-powered **parapodia** provide the swimming power.

needle ice—*See candle ice, frazil ice*.

negative gradient—A layer of water where temperature decreases with depth.

negative pressure duration—The length of time the **bottom pressure** is affected by the passage of the trough of a wave. It is approximately equal to one-half the **wave period**.

negative pressure response—The maximum amount (in inches or feet of water) the **bottom pressure** is reduced by the passage of the trough of a wave.

nekton—Those animals of the **pelagic division** that are active swimmers, such as most of the adult squids, fishes, and marine mammals.

nematocyst—The stinging mechanism of **coelenterates**, consisting of a chitinous sac filled with venom and elongated at one end into a long

narrow pointed hollow thread, which normally lies inverted and coiled up within the sac but can be everted by mechanical or chemical stimuli.

nepheloid zone—A suspension of fine organic matter and clay-sized sediment particles in sea water which forms a zone about 200 to 1,000 meters thick near the bottom of the **continental slope** and rise in the western North Atlantic. One theory holds that it results from the stirring up of sea floor sediments by the turbulent flow of **bottom water**. (16)

neritic—That portion of the **pelagic division** extending from low water level to the approximate edge of a **continental shelf**. Some writers have used this term in describing bottom organisms of a continental shelf, but its recommended usage is restricted to the waters overlying a **shelf**. (*See figure for classification of marine environments*.)

neritic province—*See pelagic division*.

neritic zone—*See neritic*.

ness—*See headland*.

net plankton—*See microplankton*.

net primary production—The total amount of organic matter produced by photosynthetic organisms, minus the amount consumed by these organisms in their own respiratory processes. *See primary production*.

net radiometer—A device which measures the net radiation by subtracting the outgoing long-wave energy total from the incoming or reradiated short-wave energy.

network—In surveying and gravity prospecting, a pattern or configuration of stations, often arranged as to provide a check on the consistency of the measured values, that is, a level network, a gravity network based on the integration of torsion balance gradients.

neuston—The group of organisms living in association with the surface film; the majority are fresh water forms, since the ocean surface generally is too rough to support such a group. The marine strider *Halobates* and surface floaters, such as the Portuguese man-of-war, may be considered to be neuston forms.

neutral estuary—An estuary in which neither **fresh water** inflow nor **evaporation** dominates.

neutral filter—An **optical filter** which reduces the magnitude of the radiant energy without changing its relative spectral distribution. (8)

neutral shoreline—That shoreline whose essential features do not depend on either submergence of a former land surface or the emergence of a former subaqueous surface.

neutron—An elementary nuclear particle with a mass approximately the same as that of a hydrogen atom and electrically neutral; its mass is 1.008982 mass units. Neutrons are commonly divided into sub-classifications according to their energies as follows: thermal, around 0.025 **electron-volts**; epithermal, 0.1 to 100 electron-volts; slow, less than 100 electron-volts; intermediate,

- 10² to 10⁵ electron-volts; fast, greater than 0.1 million-electron-volts. (70)
- névé**—See **firn**, **firn snow**.
- névé iceberg**—An **iceberg** similar in appearance and color to a iceberg, but composed of **névé (firn)**. (68)
- new ice**—A general term which includes **frazil ice**, **sludge**, **medium winter ice**, **pancake ice**, and **ice rind**. (74)
- newly formed ice**—(also called *fresh ice*). Ice in the first stage of formation and development. See **young ice**. (68)
- newly frozen ice**—See **newly formed ice**.
- niggerhead**—1. Large blocks of **coral** torn loose from the outer face of a reef and tossed on to the **reef flat** by **storm waves** or **tsunamis**. The blocks are blackened by a crust of lichens after detachment from the reef.
2. See **reef patch**.
- night-sky light**—See **airglow**.
- nilas**—A Russian term for gray or dark-colored ice that forms in a sheet on a calm sea.
- nip**—The cut made by waves in a shoreline of emergence. (61)
- nipped**—Pertaining to a ship which is **icebound** and subjected to pressure from ice, sometimes to the extent that the ship is damaged and even sunk. (59) See **beset**.
- nipping**—(or *pinching*). The closing of ice around a ship so that the ship is **beset** and subjected to pressure from the ice. (59)
- nitrate nitrogen**—The most abundant and readily assimilable form of nitrogen for marine organisms. Like phosphate, it is an essential nutrient. Estimates of primary productivity have been made by determining the concentrations of nitrates in a water sample.
- nitrogen cycle**—The series of chemical changes that nitrogen undergoes in its use by plants and animals. Inorganic nitrogenous compounds (nitrates, nitrites, and ammonium) and, to a small extent, organic nitrogenous compounds in the sea are utilized by marine plants, which form other nitrogenous compounds, such as amino acids. More complex amino acids and proteins are synthesized from these by the marine animals, which feed on the plants. Finally, these compounds, in the waste products and the dead bodies of the animals, are broken down by bacteria into inorganic compounds and simple organic compounds, completing the cycle.
- nitrogen narcosis**—(or *rapture of the deep*). An intoxicating or narcotic effect of gaseous nitrogen, produced in divers breathing air at depth. Usually the effect first becomes noticeable at a depth of 100 feet or more, although individuals vary in their susceptibility.
- no-bottom**—A notation appearing on nautical charts indicating that the sounding did not reach the bottom.
- Noctiluca**—A genus of usually pale pink luminescent **dinoflagellates** large enough to be seen by the unaided eye. This particular organism is responsible for much of the **sheet-type luminescence** noted in coastal waters of various parts of the world ocean. A green form occurring in coastal regions of the Far East is not luminescent.
- nocturnal radiation**—Long-wave back radiation from the sea surface. A misnomer since back radiation is a continuous process.
- nodal line**—In a tide area, the line about which the tide oscillates and where there is little or no rise and fall of the tide. (59)
- nodal point**—See **amphidromic point**.
- nodal zone**—An area at which the predominant direction of the **littoral transport** changes. (61)
- node**—That part of a **standing wave** or **clapotis** where the vertical motion is least and the horizontal velocities are greatest. Nodes are associated with clapotis, and with **seich** action resulting from resonant wave reflections in a harbor or bay. (61)
- node cycle**—The time required for the regression of the moon's nodes (the points where the plane of the moon's orbit intersects the ecliptic) to complete a circuit of 360 degrees of longitude; a period of approximately 18.6 years. It is accompanied by a corresponding cycle of changing inclination of the moon's orbit relative to the plane of the earth's Equator, with resulting inequalities in the rise and fall of the tide and speed of the tidal current. (50)
- nodules**—(or *halobolite*, *pelagite*). Concretionary lumps of manganese, cobalt, iron, and nickel found widely scattered on the ocean floor. Rocks of various sizes and shapes often are encrusted with these metals.
- noise**—Any undesired sound. By extension, noise is any unwanted disturbance within a useful frequency band, such as undesired electric waves in a transmission channel or device. (69)
- noise level**—The comparison of sound intensity, usually measured in **decibels**, to a **reference level**. Underwater **sound pressures** are commonly expressed in decibels or **dynes** per square centimeter.
- noise spectrum**—The relative amplitude of the several frequencies present in a complex tone (sound).
- nomogram**—(or *alignment chart*, also called *nomograph*, *nomographic chart*). The graphical representation of an equation of three variables $f(u, v, w) = 0$, by means of three graphical scales (not necessarily straight), arranged in such a manner that any straight line, called an index line, cuts the scales in values of u , v , and w satisfying the equation. By introducing auxiliary variables and constructing auxiliary scales, equations containing more than

- three variables may also be represented by nomograms. (5)
- nomograph**—*See* **nomogram**.
- nomographic chart**—*See* **nomogram**.
- nonastacin carotenoid**—Any of a group of plant pigments, such as carotenes and xanthophylls, exclusive of astacin carotenoids, which are also animal pigments. The measurement of the concentration of these pigments in addition to various **chlorophylls** is useful in estimating the rate of **photosynthesis (primary production)** or as an index of the standing crop (**biomass**) of plant forms.
- nonharmonic constant**—A **tidal constant** such as a **lunitidal interval**, range, or inequality which may be derived directly from **high** and **low water** observations without regard to the harmonic **constituents** of the tide. The term is also applicable to tidal currents. (59)
- nonlinear waves**—Waves in relatively **shallow water**, with no superimposition of motion. (35)
- nontidal current**—Any current that is caused by other than **tide-producing forces**. This includes all permanently established oceanic currents as well as all temporary ocean currents caused by winds. (59)
- normal gravity**—The value of **gravity** at sea level according to a theoretical formula which assumes the earth to be a spherical or of some similar regular shape.
- normal ripples**—Simple asymmetrical ridges made in sediments by water currents.
- normal stresses**—The components of the **stress tensor** which are normal to the faces of the fluid element.
- normal temperature and pressure**—(abbreviated N.T.P.). *See* **standard temperature pressure**.
- normal water**—(also called *Copenhagen water*, *standard sea water*). A standard sea water preparation, the **chlorinity** of which lies between 19.30 and 19.50 **per mille** and has been determined to within ± 0.001 per mille.
- Normal water is used as a convenient comparison standard for chlorinity measurements of sea water samples by titration. It is prepared by the Hydrographical Laboratories, Copenhagen, Denmark. (5)
- normal winter**—Refers to normal ice season, that is, the average ice conditions based on a number of recorded winters in a given area.
- North-About Route**—The coastal route through Melville Bugt from Upernavik to Kap York, Greenland, by going along the Greenland coastal **fast ice** or **floe leads**. This passage usually offers the earliest route to Thule and the “**North Open Water**,” and can generally be effected before the end of August, even in the worst season.
- North Atlantic Current**—A wide slow-moving continuation of the **Gulf Stream** originating in the region east of the Grand Banks of New
- foundland at about 40°N and 50°W. The North Atlantic Current is often masked by shallow and variable wind-driven surface movements. Branches of the North Atlantic Current form the **Norway Current** and the **Irminger Current**.
- North Atlantic Drift**—The weak, sluggish, northeast part of the **North Atlantic Current** that is easily influenced by winds; currents have been observed to change speeds and directions frequently, and at times reverse directions.
- North Cape Current**—A warm current flowing northeastward and eastward around northern Norway, and curving into the Barents Sea. The North Cape Current is a continuation of the **Norway Current**.
- North Equatorial Current**—Ocean currents driven by the northeast trade winds blowing over the tropical oceans of the Northern Hemisphere. In the Atlantic Ocean it is known as the Atlantic North Equatorial Current and flows west between the Atlantic Equatorial Countercurrent and the Sargasso Sea.
- In the Pacific Ocean it is known as the Pacific North Equatorial Current and flows westward between 10° and 20°N. East of the Philippines it divides, part turning south to join the **Equatorial Countercurrent**, and part going north to form the **Kuroshio**.
- In the North Indian Ocean there is no equatorial current; monsoon drifts dominate.
- northern lights**—*See* **aurora borealis**.
- North Open Water**—(or *North Water*). A considerable area of open navigable water in northern Baffin Bay roughly oval in shape, with its major axis orientated north to south. It is bounded by the **fast ice** of Smith Sound to the north and by the **Baffin Bay pack** to the south. Its southern boundary is usually a little north of the 75th parallel. North Open Water usually appears during April and May. (21)
- North Pacific Current**—The warm branch of the **Kuroshio extension** flowing eastward across the Pacific Ocean.
- North Pole 1**—(abbreviated NP-1). *See* **drift station**.
- North Water**—*See* **North Open Water**.
- Norway Current**—(sometimes called *Norwegian Current*). A continuation of the **North Atlantic Drift**, which flows northward along the coast of Norway.
- Norwegian Current**—*See* **Norway Current**.
- notch**—A deep narrow cut in the base of a sea cliff made by breaking waves. *See* **nip**.
- Notice to Mariners**—A periodic publication containing information affecting the safety of navigation.
- N₂ constituent**—The larger lunar elliptic **semi-diurnal constituent** of the theoretical **tide-producing forces**. (*See* figure for **partial tide**.)

nuclear fission—The division of a heavy nucleus into two approximately equal parts. For the heaviest nuclei the reaction is highly exothermic, the release of energy being about 170 million-electron-volts per fission. A well-known example is the fission of the compound nucleus formed when U^{235} captures a slow neutron. The approximate equality of the fission fragments distinguishes fission from such processes as spallation, in which, relatively small fragments are ejected, leaving only one large residual nucleus. Fission has been induced by **neutrons**, charged particles, and **photons**. When induced by photons, it is called photofission. (41)

nuclear fusion—The act of coalescing two or more atomic nuclei. See **thermonuclear reaction**. (70)

nuclear isomer—One of two or more **nuclides** having the same mass number A and atomic number Z , but existing for measurable times in different quantum states with different energies and radioactive properties. (41)

nuclear oceanography—The study of the nuclear properties of the marine environment and the nuclear phenomena occurring therein. This is a broad oceanographic discipline which includes **radioisotopic oceanography** and the application of nuclear science and technology to oceanographic investigations.

nuclear precession magnetometer—A **magnetometer** that utilizes the precessional characteristics of hydrogen nuclei when in an ambient magnetic field. The data output of this instrument is in the form of a frequency measurement, which in turn is proportional to the **magnetic field intensity**.

nuclear reaction—An induced nuclear disintegration, that is, a process occurring when a nucleus comes into contact with a **photon**, an elementary particle, or another nucleus. In many cases the reaction can be represented by the symbolic equation: $X + a \rightarrow Y + b$ or, in abbreviated form, $X(a,b)Y$, in which X is the target nucleus, a is the incident particle or photon, b is an emitted particle or photon, and Y is the product nucleus. (70)

nuclear reactor—An apparatus in which **nuclear fission** may be sustained in a self-supporting **chain reaction**. It includes fissionable material (fuel) such as uranium or plutonium, and moderating material (unless it is a fast reactor) and usually includes a reflector to conserve escaping neutrons, provision for heat removal, and measuring and control elements. The terms pile and reactor have been used interchangeably, with

reactor now becoming more common. They usually are applied only to systems in which the reaction proceeds at a controlled rate, but they also have been applied to bombs. (70)

nuclear sediment density meter—An oceanographic instrument which employs the back-scattered radiation from a small sealed radioactive source for the *in situ* measurement of sediment densities in the upper 5 meters of the ocean floor. The instrument is a tubelike device, about 25 feet in length overall, which is lowered to the ocean floor and projected vertically in the **bottom sediment** for measurement. The radioactive source with a G-M detector rides up and down in the tube stopping at 2-foot intervals for measurement of backscattered radiation. Such counts are inversely proportional to sediment density. Recording is accomplished photographically in the upper enlarged barrel of the probe.

nuclear species—1. A kind of atom characterized by the charge, mass number, and quantum state of its nucleus; a **nuclide**.

2. A nucleus of a given charge, mass number, and quantum state. Also a collection of such nuclei.

(41)

neutron—A constituent particle of the atomic nucleus; therefore, according to present theory, a **proton** or a **neutron**. (41)

nuclide—A species of atom characterized by the constitution of its nucleus. The nuclear constitution is specified by the number of **protons**, number of **neutrons**, and energy content, or alternatively, by the atomic number, mass number, and atomic mass. To be regarded as a distinct nuclide, the atom must be capable of existing for a measurable lifetime (generally greater than 10^{-10} second). Thus **nuclear isomers** are separate nuclides, but promptly decaying excited nuclear states and unstable intermediates in nuclear reactions are not so considered. (41)

nudibranch—(or *sea slug*). One of the order (Nudibranchia) of **gastropods** in which the shell is entirely absent in the adult. The body bears projections which vary in color and complexity among the species.

nutrient—In the ocean any one of a number of inorganic or organic compounds or **ions** used primarily in the nutrition of primary producers. Nitrogen and phosphorus compounds are essential nutrients. Silicates are essential for the growth and development of **diatoms**. Vitamins such as B_{12} are essential to many **algae**.

O

oarweed—The British term for a blade-shaped brown alga. *See kelp.*

oblique haul—(or *oblique tow*). The retrieval of an open **plankton net** from a certain depth at a certain rate while the ship is underway. *See horizontal haul, vertical haul.*

oblique tow—*See oblique haul.*

observed depth—*See accepted depth.*

observed gravity—The uncorrected value of gravity at a station as determined from the gravity meter.

ocean—(or *sea*). 1. The intercommunicating body of salt water occupying the depressions of the earth's surface.

2. One of the major primary subdivisions of the above, bounded by continents, the Equator, and other imaginary lines.

(5)

ocean basin—That part of the floor of the ocean that is more than about 100 fathoms below sea level. (2)

ocean current—A movement of ocean water characterized by regularity, either of a cyclic nature or more commonly as a continuous stream flowing along a definable path.

Three general classes, by cause, may be distinguished: (1) currents related to sea water density gradients, comprising the various types of **gradient currents**; (2) **wind-driven currents**, which are those directly produced by the stress exerted by the wind upon the surface and; (3) currents produced by long-wave motions. The last is principally the **tidal currents**, but may 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. (5)

oceanic—(or *high seas, open ocean*). That portion of the **pelagic division** seaward from the approximate edge of a **continental shelf**. (*See figure for classification of marine environments.*)

oceanic anticyclone—*See subtropical high.*

oceanic climate—*See marine climate.*

oceanic crust—A mass of gabbroic material approximately 5-kilometers thick which lies under the ocean bottom and may be more or less continuous beneath the continental crust. (35)

oceanic high—*See subtropical high.*

oceanicity—(or *oceanity*). The degree to which a point on the earth's surface is in all respects subject to the influence of the sea; the opposite of continentality. Oceanicity usually refers to climate and its effects. One measure for this characteristic is the ratio of the frequencies of maritime to continental types of **air masses**. (5)

oceanic polar front—*See Antarctic Convergence, Arctic Convergence.*

oceanic province—*See pelagic division.*

oceanity—*See oceanicity.*

oceanogenic sedimentation—Sediments exclusively marine, siliceous, chemical, or organic in origin which accumulate in **abyssal** depths far from land.

oceanographic cast—A single lowering of a series of **Nansen bottles** at an **oceanographic station**.

oceanographic analysis—The science of manual or automatic production of charts of oceanographic **parameters** in which **isopleths** are drawn to indicated data by some rational theory.

oceanographic equator—(or *thermal equator*). The zone of maximum sea surface temperature located near the geographic equator. It generally lies north of this line; but crosses during the southern summer in the Indian Ocean, western Pacific Ocean, and western Atlantic Ocean. Some oceanographers define the oceanographic equator more specifically as the zone within which the sea surface temperature exceeds 28°C (82.4°F).

oceanographic forecasting—The production by automatic or manual means of charts showing forecasted values of oceanographic **parameters**, similar to weather charts.

oceanographic model—A theoretical representation of the marine environment. Generally, a pattern or expression which relates known with derived oceanographic properties. These oceanographic properties may be physical, chemical, geological, and/or biological.

oceanographic slide rule—A specially designed slide rule used for calculating the correction of thermal expansion of a deep sea **reversing thermometer**.

oceanographic station—A term used to designate oceanographic observations taken at a geographic location from a ship that is lying to or anchored at sea.

oceanographic station location—The accepted geographical position at which an **oceanographic station** was taken.

oceanographic survey—A study or examination of conditions in the ocean or any part of it, with reference to animal or plant life, chemical elements present, temperature gradients, etc. *See hydrographic survey.* (68)

oceanographic tracer—A foreign substance introduced into the ocean by natural or artificial means which enables determination of the ocean water movement through measurement of the distribution or location of the substance at some later time. Such oceanographic tracers include Tritium (H^3), Carbon¹⁴, other **radioisotopes**, as well as non-radioactive tracers such as fluorescent dyes and various chemical substances.

oceanographic winch—A medium size winch used for most oceanographic instrument lowering and raising. This winch is a high-speed type holding about 20,000 to 30,000 feet of wire rope.

oceanography—1. 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.

2. In strict usage oceanography is the description of the marine environment, whereas oceanology is the study of the oceans and related sciences.

oceanology—*See oceanography.*

ocean station—(or *station*). As defined by the *International Civil Aviation Organization*, a specifically located area of ocean surface, roughly square and 200 nautical miles on a side. An **ocean station vessel** on patrol is said to be "on station" when it is within the perimeter of the area. (5)

ocean station vessel—(abbreviated OSV; also called *ocean weather ship*, *weather patrol ship*, *weather ship*). An ocean-going ship assigned to patrol an **ocean station**.

These ships are specially equipped to take comprehensive meteorological and some oceanographic observations of conditions both at the surface, subsurface, and aloft. The United States ships are provided by the U.S. Coast Guard, and the meteorological personnel and equipment are provided by the U.S. Weather Bureau. (5)

ocean water—Water having the physical-chemical characteristics of the open sea, where continental influences are at a minimum.

ocean weather ship—*See ocean station vessel.*

ocean weather station—As defined by the World Meteorological Organization, a specific maritime location occupied by a ship equipped and staffed to observe weather and sea conditions and report the observations by international exchange. (5)

octopus—(or *devilfish*). One of a family (Octopodidae) of **cephalopods** with round or saclike bodies, eight arms, no shell, and generally with-

out fins. Although there are no known documented fatalities from attacks by these animals, many documented attacks on humans are recorded.

odontocete—*See toothed whale.*

oersted—The basic unit of **magnetic field intensity**. A magnetic field with an intensity of one oersted will exert a force of one **dyne** upon a unit **magnetic pole**. *See gauss.*

off-reef facies—*See reef talus.*

offshore—The comparatively flat zone of variable width which extends from the outer margin of the rather steeply sloping **shoreface** to the edge of the **continental shelf**. (2) (*See figure for shore profile.*)

offshore bar—*See bar.*

offshore barrier—*See barrier beach.*

offshore current—1. A prevailing **nontidal current** usually setting parallel to the shore outside the surf zone. *See coastal current.* (*See figure for nearshore current system.*)

2. Any current flowing away from shore.

offshore water—Water adjacent to land in which the physical properties are slightly influenced by continental conditions.

offshore wind—A wind blowing seaward from the land in a coastal area; a **land breeze**. (61)

old ice—Any **sea ice** more than one year old. (68)

oligotrophic—Pertaining to water bodies containing nutrient matter.

olistostrome—A deposit produced by sliding or slumping of a submarine sediment mass.

omnidirectional hydrophone—A **hydrophone** whose response is essentially independent of angle of arrival of the incident sound wave. (69)

one-year ice—1. **Sea ice** formed the previous season, not yet one year old.

2. A Russian term for 'sea ice thicker than **white ice**. By the end of spring it reaches a thickness of 1.5 to 2.0 meters (4.9 to 6.6 feet) or more. Usually during the summer this ice does not entirely disappear and becomes **two-year ice** or **young polar ice**. (59)

onshore—A direction landward from the sea. (61)

onshore wind—A wind blowing landward from the sea in a coastal area; a **sea breeze**. (61)

on station—*See ocean station.*

oöid—*See oölite.*

oölite—(or *oöolith*, *oöid*). A spherical or ellipsoidal particle of sand or granule size (0.25 to 2.00 millimeters in diameter) with concentric or radial structure, which usually is calcareous but may be siliceous or hematic. It is formed by replacement or by accretion of concentric layers of lime around a quartz grain nucleus in shallow, wave agitated, limy water.

oöolith—*See oölite.*

O₁ constituent—The lunar diurnal constituent of the theoretical tide-producing forces. (See figure for **partial tide**.)

ooze—1. A soft mud or slime.
2. A fine-grained pelagic sediment containing undissolved sand- or silt-sized, calcareous or siliceous skeletal remains of small marine organisms in proportion of 30 percent or more, the remainder being amorphous clay-sized material. Deep sea oozes often are characterized by markedly bi-modal grain-size distributions, one mode being in the sand or silt range, the other in the clay range. See also **diatomaceous**, **foraminiferal**, **globigerina**, **pteropod**, and **radiolarian oozes**.

open drift ice—See **open pack ice**.

open ice—See **broken ice**.

open ice edge—Unsteady and not sharply defined ice edge limiting an area of open ice, usually located to the leeward. (74)

opening—Any break in **sea ice** which reveals the water.

open lead—A lead that is not covered with ice. (68)

open ocean—See **oceanic**.

open pack ice—(or *open drift ice*). Ice floes of sea ice that are seldom in contact with each other; generally covering between 4- and 6-tenths (or 3- to 5-eighths) of the sea surface. (74)

open port—A port which is not icebound during winter.

open sound—A bay similar to a lagoon but with large openings between the protecting islands. (2)

open water—1. A relatively large area of free navigable water in an ice filled region. (68)
2. More specifically, water which has less than one-tenth of its surface covered with floating ice. (59)

operculum—(or *gill cover*). In fishes, a bony or membranous flap covering the external openings of the gill slits.

ophiopluteus—The planktonic larva of a brittle star.

opposing wind—Generally, same as headwind; specifically, a wind blowing in the direction opposite to ocean-wave advance; the opposite of **following wind**. (5) See **crosswind**.

opposition—The situation of two celestial bodies with their celestial longitudes (the angular distance measured east of the vernal equinox along the ecliptic) differing by 180 degrees; for example, opposition occurs when the moon and the sun are directly in line with the earth and on opposite sides of the earth. (66) (See figure for **tide cycle**.)

optical filter—A device which changes, by absorption or interference, the magnitude or the spectral distribution of the radiant energy passing through it. (8)

optical length—The geometrical length of a path multiplied with the total attenuation coefficient associated with the path. (8)

optimum ship routing—A technique for routing ships, based on knowledge of sea currents, weather, and wave conditions to get a ship to its destination in the quickest time and with least damage to cargo or discomfort to passengers.

orange peel sampler—A bottom sediment sampling device capable of obtaining as much as 1/2 cubic foot of sample from the ocean floor. Named for its likeness to an orange that has its peel quartered.

orbit—In water waves, the path of a water particle affected by the wave motion. In **deepwater waves** the orbit is nearly circular, and in **shallow water waves** the orbit is nearly elliptical. In general, the orbits are slightly open in direction of wave motion, giving rise to **mass transport**. (61) See figure on next page.

orbital current—The flow of water accompanying the orbital movement of the water particles in a wave. Not to be confused with wave-generated littoral currents. (6) See **mass transport**.

orbital energy—The total energy associated with the orbital motion of all water particles.

orbital energy difference—The excess of orbital energy of water particles in orbital motion at any depth over that at any lower depth of the same water column.

orbital motion—See **orbit**.

orbital period—The time required for a water particle in orbital motion to complete one orbit.

orbital speed—The speed of water particles in orbital motion along their orbits.

order—See **classification of organisms**.

ordinary tide level—See **mean tide level**.

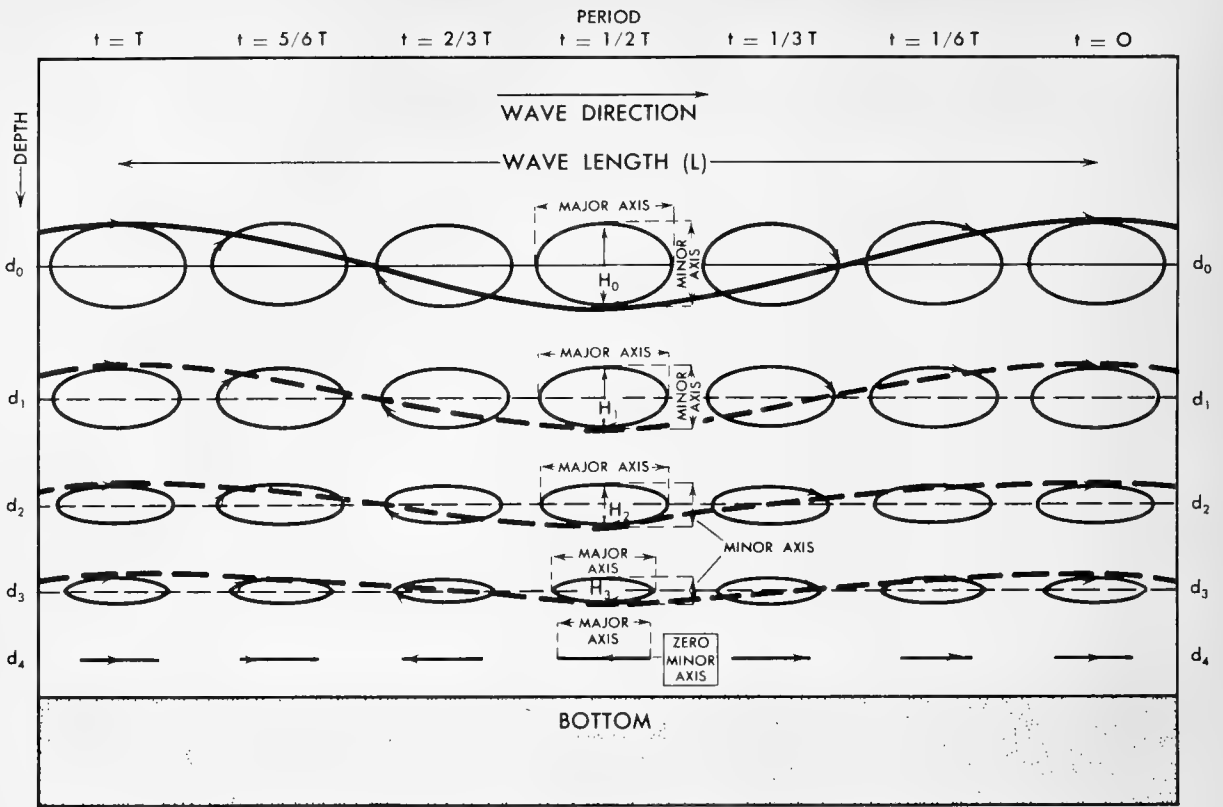
ordinary tides—The word “ordinary” may be used in tides as the equivalent of the word “mean.” (50)

organic bank—See **organic reef**.

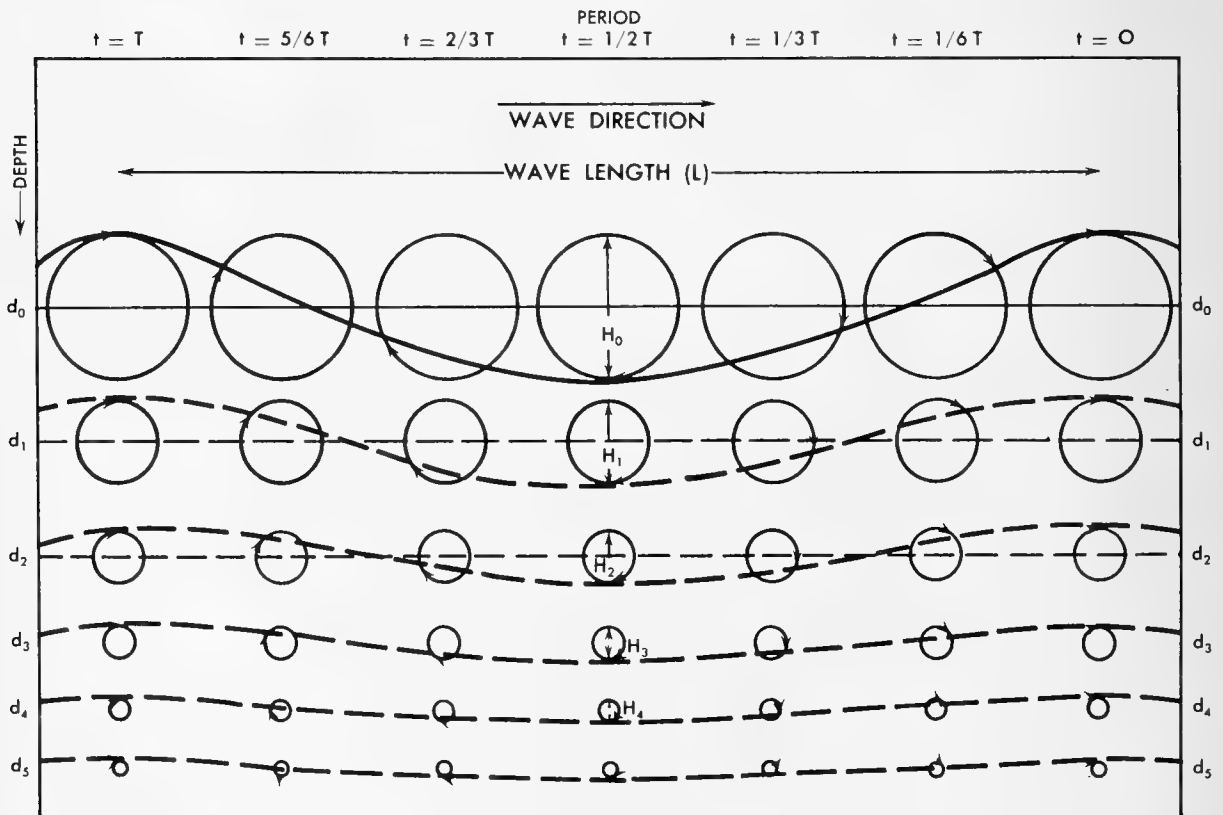
organic reef—A sedimentary rock aggregate composed of living and dead colonial organisms such as **algae**, **coral**, **crinoids**, and **bryozoa**. When it is covered by more than 6 fathoms of water, it is an organic bank.

orogeny—Large scale regional mountain forming processes by folding, faulting, and thrusting.

orthogonal—(or *wave ray*). A member of a family of curves everywhere perpendicular to the family of curves representing wave crests on a refraction diagram; analogous to rays in the theory of geometrical optics. (73) (See figure for **refraction diagram**.)



ELLIPTICAL ORBITS, SHALLOW WATER (BOTTOM DEPTH 500 FEET)



CIRCULAR ORBITS, DEEP WATER (BOTTOM DEPTH 500 FEET)

oscillation—The variation, usually with time, or the magnitude of a quantity with respect to a specified reference when the magnitude is alternately greater and smaller than the reference. (6)

oscillation ripple—Tiny sediment waves with sharp, narrow, symmetrical crests and broader, more rounded troughs formed by the action of currents of equal speed alternating in opposite directions. (2)

oscillatory wave—A wave in which each individual particle oscillates about a point with little or no permanent change in position. The term is commonly applied to progressive oscillatory waves in which only the form advances, the individual particles moving in closed orbits. Distinguished from a **wave of translation**. See also **orbit**. (61)

ostracod—One of a subclass (Ostracoda) of minute **crustaceans**, the individuals of which are unsegmented, laterally compressed, and enclosed in a bivalve shell (**carapace**). Some members are benthic; others are planktonic. Many species are luminescent, and the dried bodies of one genus often are used to demonstrate **bioluminescence**.

otolith—(or *earbone*). An earbone of a fish or marine mammal (such as a whale). Such bones are more resistant to decomposition, digestion, or solution than other bones and frequently occur in marine sediment samples.

otter trawl—A large commercial fishing trawl using kitelike wooden boards at the corners of the mouth of the net. The boards are attached to long cables and so angled that water pressure drives them apart and keeps the net well spread as it drags along the sea floor. (35)

outcrop—(or *exposure*). Naturally protruding, or erosionally exposed or uncovered part of a rock, bed, or formation, most of which is covered by overlying material.

outer ridge—See **ridge, rise**.

outer slope—The steeply descending outer slope of the **reef** below the dwindle point of abundant living **coral** and **coralline algae**, which is ordinarily at about 10 fathoms. (56) (See figure for **atoll**.)

outflow—1. The flow of water from the river or its **estuary** to the sea.

2. Total volume for any given period of time.

outlet glacier—A stream of ice from an **ice cap** to the sea. (68)

overfalls—Breaking waves caused by opposing currents or by the wind moving against the current. (73)

overlapping mean—See **consecutive mean**.

overtide—A shallow water harmonic tide constituent with a speed that is a multiple of the speed of one of the basic constituents of the **tide-producing force**. (49) See **shallow water constituent**.

overtopping—The amount of water passing over the top of a structure as a result of wave **run-up** or surge action. (61)

overturn—(also called *convective overturn*). The renewal of bottom water that occurs annually in lakes and ponds in regions wherever winter temperatures are cold enough. As the surface waters are cooled in the autumn and early winter, they become denser and therefore sink, until the whole body of water is at 4°C, the temperature of maximum density. Further cooling is restricted to the surface layers, since both ice and water colder than 4°C are less dense than the underlying waters at 4°C.

This phenomenon does not take place over most areas in the ocean because of the salinity stratification, and usually the resulting **brine** is dense enough to sink to the bottom only in the extreme polar regions, where extensive freezing occurs. (5)

overwash—That portion of the **uprush** that carries over the **crest of a berm** or of a structure. (61)

own-ship's noise—(or *self noise*). Often the limiting **noise** registered by a sonar receiver produced by the ship (or equipment) itself or as a result of its motion. (28)

oxygen—The element occurring as a free gas in the atmosphere and as a dissolved gas in sea water, where it is usually measured in milliliter per liter. The concentration of dissolved oxygen in the sea generally at **N.T.P.** ranges between 0 and 8 milliliters per liter. Its saturation concentration decreases with increasing temperature and salinity.

The oxygen content of sea water generally decreases from a maximum at and near the surface to a minimum between 500 and 1,500 meters (1,640 and 4,921 feet), then increases with depth.

oxygen minimum layer—A subsurface layer in which the dissolved oxygen content is very low or nil. (25)

oxygen technique—(or *light and dark bottle technique*). A method of measuring gross **photosynthesis** by following the changes in dissolved oxygen in a water sample containing **phytoplankton**. The method involves the use of **light bottles** for indicating net photosynthesis (oxygen evolution) and the use of dark bottles to indicate loss of oxygen due to respiration. Gross photosynthesis then equals the amount of oxygen gained in the light bottle plus the amount of oxygen lost through respiration in the dark bottle.

oxyluciferin—An end product of oxidized **luciferin** compounds. In a generalized reaction oxyluciferin, water, and energy released as a form of visible light are produced during a chemiluminescent reaction involving a luciferin compound and **luciferase**, a biological catalyst.

Oyashio—A cold current flowing from the Bering Sea southwest along the coast of Kamchatka, past the Kuril Islands, continuing close to the northeast coast of Japan and reaching nearly 35°N. The Oyashio turns east into the **Kuroshio extension**.

oyster—A member of one of several families, but better known as one of the families Ostreidae and Spondylidae, of irregularly shaped **bi-valves**, which are cemented to a firm surface by the larger valve. They are notable **fouling organisms** in some regions.

P

Pacific anticyclone—*See* **Pacific high**.

Pacific high—(or *Pacific anticyclone*). The nearly permanent **subtropical high** of the North Pacific Ocean, centered in the mean, at 30° to 40°N and 140° to 150°W.

On mean charts of sea level pressure, this high is a principal **center of action**. (5)

Pacific Ocean—The ocean area bounded on the east by the western limits of the coastal waters of southwest Alaska and British Columbia, the southern limits of the Gulf of California, and from the Atlantic Ocean by the meridian of Cape Horn to Antarctica; on the north by the southern limits of Bering Strait and the Gulf of Alaska; on the west by the easternly limits of the Sea of Okhotsk, Japan Sea, Philippine Sea, the East Indian Archipelago from Luzon Island to New Guinea, Bismarck Sea, Solomon Sea, Coral Sea, Tasman Sea, and from the Indian Ocean by a line from Southeast Cape (the southern point of Tasmania) down the meridian to the Antarctic Continent. The Equator separates the Pacific Ocean into the North and South Pacific Oceans.

The limits of the Pacific Ocean exclude the seas lying within it.

pack—A short term for ice pack or **pack ice**. (65)

packed ice—*See* **close ice**.

pack ice—(also called *drift ice*, *ice pack*, *pack*).

1. The term used to denote any area of **sea ice** other than **fast ice**, no matter what form it takes or how disposed. (74)

The WMO Code defines **very open pack ice** as ice of 1- to 3-tenths concentration, **open pack ice** as 4- to 6-tenths concentration, **close pack ice** as ice of 7- to 9-tenths concentration, and **very close pack ice** as ice of 10-tenths concentration.

2. A large area of floating ice which has been driven together. The concentration can generally vary between 1- and 10-tenths. Other terms that can be applied to pack ice include: broken, loose, consolidated, and unbroken. The terms pack ice and ice pack have been used indiscriminately for both the sea area containing floating ice and the ice itself.

packing—The spacing or density pattern of the mineral grains in a rock or sediment. (2)

painter—(also called *Callao painter*, *El Pintor*). A fog frequently experienced on the coast of Peru. The brownish deposit which it often

leaves upon exposed surfaces is sometimes called Peruvian paint. (5)

pair production—An absorption process for X- and gamma radiation in which the incident **photon** is annihilated in the vicinity of the nucleus of the absorbing atom with subsequent production of an electron and positron pair. This reaction only occurs for incident photon energies exceeding 1.02 million-electron-volts. (70)

paleocrystic ice—Old **sea ice**, generally considered to be at least ten years old; it is nearly always a form of **pressure ice**, and often is found in **floebergs** and in the **pack ice** of the central Arctic Ocean. (5)

paleomagnetism—Remanent magnetism produced by the earth's field when a material was initially formed.

Palolo worm—A species (*Eunice viridis*) of **polychaete** worms which spawns in vast, freeswimming swarms over the reefs of the Samoan and Fiji Islands during the last quarter of the moon at the lowest tides during October and November.

pan—An individual piece of **pancake ice**. (68)

pancake ice—(also called *lilly-pad ice*, *plate ice*).

1. Pieces of **newly-formed ice**, usually approximately circular, about 30 centimeters (12 inches) to 3 meters (10 feet) across, and with raised rims caused by the striking together of the pieces as a result of wind and swell. (74)

2. One or more pieces of newly-formed floating ice, usually between 1 and 6 feet in diameter, with raised rims and circular outline caused by rotation and collision with other ice fragments. (59)

Paper Nautilus—*See* **nautilus**.

parachute drogue—*See* **drogue**.

parallax—1. A tide term referring to the angle at the center of a celestial body between a line to the center of the earth and a line tangent to the earth's surface; the ratio of the mean radius of the earth to the distance of the tide-producing body. The term is usually applied to inequalities in the tide which result from the continually changing distance of the principal tide-producing body, the moon. *See* **parallax inequality**. (50)

2. The change in apparent position of a nearby object compared with more remote reference objects when the nearby object is viewed from two different points in space.

In reading several different types of oceanographic instruments, errors of parallax are easily introduced if the line of sight is not carefully maintained perpendicular to the reading scale. Parallax errors are of particular concern in reading liquid-in-glass thermometers.

parallax inequality—The variation in the range of tide or in the speed of tidal currents because of the continual change in the distance of the moon from the earth. The range of tide and speed of tidal currents tend to increase as the moon approached **perigee** and to decrease as it approached **apogee**. (50)

parallel—See **parallel of latitude** (sense 1).

parallel of latitude—1. (also called *parallel*). A circle (or approximation of a circle) on the surface of the earth, parallel to the Equator, and connecting points of equal latitude.

2. (also called *circle of longitude*). A circle of the celestial sphere, parallel to the ecliptic, and connecting points of equal celestial latitude. (68)

paralytic shellfish poisoning—An intoxication in humans resulting from the ingestion of marine **mollusks**, usually mussels or soft clams, that become toxic during periods of high concentrations of certain **dinoflagellates**. The effects range from mild discomfort to fatal respiratory paralysis, with symptoms including tingling or burning of the lips, gums, tongue, and face followed by numbness of the extremities, a general feeling of weakness and dizziness, inability to coordinate muscular movements, and respiratory distress.

parameter—1. In general, any quantity of a problem that is not an independent variable. More specifically, the term is often used to distinguish, from dependent variables, quantities which may be more or less arbitrarily assigned values for purposes of the problem at hand.

(Note: Carelessly used by many oceanographers for almost any oceanographic quantity or element.)

2. In statistical terminology, any numerical constant derived from a population or a probability distribution. Specifically, it is an arbitrary constant in the mathematical expression of a probability distribution.

(5)

parapodium—A paired lateral locomotive structure on body segments of **polychaetes**.

parasitic nutrition—That process by which an organism absorbs organic food directly from the body of its host. See **heterotrophic nutrition**.

parasitism—A relationship between two species in which one lives on or in the body of its host, and obtains food from its tissues. Some authorities distinguish between a “commensal parasite,” which obtains nourishment from its host without causing harm, and a “pathogenic

parasite,” which benefits at the expense of its host.

parent—A **radionuclide** that upon disintegration yields a specified **nuclide**, either directly or as a later member of a **radioactive series**. (70)

partial node—The point, line, or surface, in a **standing wave** system where some characteristic of the wave field has a minimum amplitude differing from zero. (6)

partial tide—(also called *tidal component, tidal constituent*). One of the harmonic components comprising the tide at any point. The periods of the partial tides are derived from various combinations of the angular velocities of earth, sun, moon, and stars relative to each other. See **constituent**. (5)

NAME OF PARTIAL TIDE	SYMBOL	PERIOD (HRS.)	ANGULAR VELOCITY (DEGREES/HR.)
SEMIDIURNAL			
PRINCIPAL LUNAR	M ₂	12.42	28.9841
PRINCIPAL SOLAR	S ₂	12.00	30.0000
LARGER LUNAR ELLIPTIC	N ₂	12.66	28.4397
LUNI-SOLAR	K ₂	11.97	30.0821
DIURNAL			
LUNI-SOLAR	K ₁	23.93	15.0411
PRINCIPAL LUNAR	O ₁	25.82	13.9430
PRINCIPAL SOLAR	P ₁	24.07	14.9589

THE BASIC COMPONENTS OF THE TIDE-PRODUCING FORCES

(AFTER SVEDRUP, ET. AL., 1949)

particles—See **grains**.

particle velocity—In ocean wave studies, the instantaneous velocity of a water particle undergoing orbital motion. At the crest, its direction is the same as the direction of progress of the wave, and at the trough it is in the opposite direction. (5)

parts per thousand—See **per mille**.

Pascal's law—Pressure exerted at any point upon a confined liquid is transmitted undiminished in all directions.

pass—A narrow connecting **channel** between two bodies of water; also the **inlet** through a barrier reef atoll or sand bar or a navigable channel at a river's mouth. (2)

passage—A narrow navigable **pass** or **channel** between two landmasses or **shoals**. (68)

passive sonar—A method or equipment by which information concerning a distant object underwater is obtained by evaluating the sound generated by the object itself. (3)

patch—1. A collection of **pack ice**, less than 10 kilometers (5.4 nautical miles) across. (74)

2. An irregular cluster of floating sea ice fragments of any concentration. (59)

path function—The radiance per unit length in the direction of the line of sight, generated by the scattered light of a beam.

peak—(or *seapeak*). See **seamount**.

peak sound pressure—The peak sound pressure for any specified time interval is the maximum absolute value of the instantaneous **sound pressure** in that interval. (6)

peak-to-peak value—For an oscillating quantity, the algebraic difference between the extremes of the quantity. (6)

Pearly Nautilus—See **nautilus**.

pebbles—Usually smooth and rounded stones ranging in diameter between 4 and 64 millimeters. (2) See **phi grade scale**.

pedicellaria—One of the minute pincerlike appendages of **sea urchins** (and some starfishes), borne abundantly on the **test** between the spines, and consisting of three movable jaws (rarely two, four, or five) mounted on a stalk. In some species these organs are provided with poison glands.

pelagic—See **pelagic division**.

pelagic-abyssal sediments—Deep sea sediments that are free of terrestrial material except for a small proportion of very fine clay.

pelagic division—A primary division of the sea which includes the whole mass of water. The division is made up of the neritic province which includes the water shallower than 100 fathoms (200 meters), and the oceanic province which includes that water deeper than 100 fathoms. (See figure for **classification of marine environments**.)

pelagic limestone—A rock formed principally of the calcareous **tests** of pelagic foraminifera. It usually is deposited in deep water.

pelagite—See **nodules**.

pelecypod—See **bivalve**.

pelite—(or *mudstone*, *pelite*). Clastic sediments composed of **clay**, minute particles of **quartz**, **rock flour**, or **volcanic ash** (pelitic tuff) and which may be calcareous.

peltic tuff—See **pelite**.

pelyte—See **pelite**.

pendulum—1. A body so suspended from a fixed point as to swing freely to and fro under the combined action of gravity and momentum.

2. A vertical bar so supported from below by a stiff spring as to vibrate to and fro under the combined action of gravity and the restoring force of the spring.

peninsula—A body of land nearly surrounded by water and connected with a large body by a **neck** or **isthmus**; also any piece of land jutting out into the water. (2)

penknife ice—See **candle ice**.

percolation—The process by which water is forced by wave action through the interstices of the bottom sediment and has a tendency to reduce **wave heights**.

percolation factor—A quantity by which the **wave heights** are reduced through **percolation** alone.

perennial ice—Sea ice more than two years old. (59)

performance figure—A numerical value (in decibels) given to illustrate the operational effectiveness of a sonar device, that is, the **source level** minus the **background noise level**.

perigean range—(abbreviated Pn). The average of all monthly tide ranges occurring at the time of **perigee**. It is larger than the mean range, where the **type of tide** is either semidiurnal or mixed, and is of no practical significance where the type of tide is diurnal. (73)

perigean tidal currents—Tidal currents of increased speed occurring at the time of **perigean tides**. (68)

perigean tide—Tides of increased range occurring monthly near the time of the moon's **perigee**.

perigee—The point in the orbit of the moon (or any other earth satellite) nearest to the earth; opposed to **apogee**. (50)

perihelion—The point in the earth's orbit nearest to the sun. (50)

periodic current—See **tidal current**, **reversing current**.

periscope depth range—(abbreviated PDR). The maximum range at which active sonar echo ranging contact can be made with a submarine operating at periscope depth.

permafrost—1. A layer of soil or bedrock at a variable depth beneath the surface of the earth in which the temperature has been below freezing continuously from a few to several thousands of years. Permafrost exists where the summer heating fails to descend to the base of the layer of frozen ground. A continuous stratum of permafrost is found where the annual mean temperature is below about 23°F.

2. As limited in application by P. F. Svetsov: soil which is known to have been frozen for at least a century.

(5)

permanent aurora—See **airglow**.

permanent current—A current such as the **Kuroshio**, which flows continuously and whose speed and direction is little changed by the tide and meteorological factors. A permanent current also includes the continuous outflow of fresh river water discharge. (50). See also **ocean current**.

permanent ice foot—An **ice foot** that does not melt completely in summer. (68)

permanent plankton—See **holoplankton**.

per mille—(symbol ‰). Per thousand or 10⁻³; used in the same way as percent (%), per hundred or 10⁻². Per mille (by weight) as commonly used in oceanography for **salinity** and **chlorinity**; for example, a salinity of 0.03452 (or 3.452 percent) is commonly stated as 34.52 per mille (parts per thousand). (5)

persistence—1. In general, the tendency for the occurrence of a specific event to be more probable, at a given time, if that same event has occurred in the immediately preceding time period.

2. (also called *constancy, steadiness*). With respect to the long term nature of the wind at a given location, the ratio of the magnitude of the mean wind vector to the average speed of the wind without regard to direction.

(5)

persistencey—*See constancy of the current.*

Peru Current—(also called *Humboldt Current*).

The cold ocean current flowing north along the coasts of Chile and Peru. The Peru Current originates from the **West Wind Drift** in the subantarctic Pacific Ocean. The northern limit of the current can be placed a little south of the Equator, where the flow turns toward the west, joining the **South Equatorial Current**.

Petersen grab—A type of **bottom sampler** consisting of two hinged semicylindrical buckets held apart by a cocking device. On striking the bottom the locking device is released so that, on hauling, the buckets revolve and come together, enclosing a sample of the bottom.

Phaeocystis—A genus of brown, unicellular, and colonial, marine **phytoplankton** of the class Chrysophyceae. Colonies are surrounded by large gelatinous sheaths. This **alga** appears in vast concentrations at times, especially in neritic parts of the North Atlantic, coloring the water brown and imparting an offensive odor to it. Plankton nets towed through such masses are clogged rapidly. Herring reportedly avoid these concentrations.

phantom bottom—*See deep scattering layer.*

pharyngeal teeth—Specialized dentition on various gill arch elements in fishes; in some species these teeth are used in sound production.

phase—The state of aggregation of a substance, for example, solid (ice), liquid (water), or gas (vapor). (5)

phase angle—The angular measure along a simple harmonic wave. (5)

phase difference—*See epoch.*

phase inequality—1. Variations in the tide or tidal currents associated with changes in the phase of the moon. At new and full moon (springs) the **tide-producing forces** of the sun and moon act in conjunction, resulting in greater than average tide and tidal currents. At first and last quarters of the moon (neaps) the tide-producing forces oppose each other result in smaller than average tide and tidal currents. (*See figure for tide cycle.*)

2. *See spring tide, neap tides, tidal currents.*

(50)

phase lag—*See epoch.*

phase reduction—A processing of high and low water observations to obtain quantities such as spring and neap tide ranges and tidal currents,

which are associated with the changing phase of the moon.

phase speed—*See wave velocity.*

phase velocity—Velocity, measured over a short time period, at which a particular **wave crest** is propagated through water or rock media. (35)

phasor—The complex quantity measuring an **impedance**. It may be computed as the quotient of two other complex quantities, which are also called phasors, and which are derived from sinusoidally varying magnitudes of the stimulus and the response in question. (28)

phi grade scale—A logarithmic transformation of the Wentworth grade scale for size classifications of sediment grains based on the negative logarithm to the base 2 of the particle diameter.

Phi Grade Scale	Modified Grades (Millimeters)	Wentworth Sediment Class
-8	>256.0	Boulders, Rock-----
-7	128.0	Cobbles-----
-6	64.0	
-5	32.0	Pebbles-----
-4	16.0	
-3	8.0	
-2	4.0	Granules-----
-1	2.0	
0	1.0	Very Coarse-----
+1	0.5	Coarse-----
+2	0.25	Medium-----
+3	0.125	Fine-----
+4	0.0625	Very Fine-----
+5	0.0313	Silt
+6	0.0156	
+7	0.0078	
+8	0.0039	Clay
+9	0.00195	
+10	0.00098	
+11	0.00049	
+12	0.00024	Colloids-----
>+12	<0.00024	

Phleger corer—A gravity sampling tube used to obtain 1½-inch diameter samples up to 4 feet long. The sampler consists of a tailfin assembly with attached weight, a **core barrel** with a plastic liner inside it, a **core cutter**, and a **core catcher**. When fully rigged, the corer weighs about 100 pounds.

pholad—*See rock borer.*

phosphate phosphorus—An ionic form of phosphorus occurring in nature; an essential nutrient for marine organisms. Estimates of primary productivity have been made by determining phosphate concentrations in a water column during different seasons.

phosphor—*See scintillator.*

phosphorescence—1. The production of light without sensible heat.

2. Emission of **electromagnetic radiation** by a substance as a result of previous absorption of radiation of shorter wavelength. In contrast to **fluorescence**, the emission may continue for a considerable time after cessation of the existing irradiation.

3. Often erroneously used for **bioluminescence**, which is a **chemiluminescence**.

phosphorescent wheel—A phenomenon which when fully developed gives the appearance of a wheel of light revolving around a point source on or just beneath the sea surface. Various stages of development and sizes of wheels have been reported. The vast majority of wheels have been observed in oceans bordering southern Asia and in the Indonesian Archipelago.

photic zone—*See* **euphotic zone**. (*See* figure for classification of marine environments.)

photoautotrophic nutrition—*See* **holophytic nutrition**.

photoconductive cell—A photocell whose electrical conductance changes under irradiation. A voltage supply is required in the cell circuit. (8)

photoelectric effect—A process by which a **photon** ejects an **electron** from an atom. All the energy of the photon is absorbed in ejecting the electron and in imparting **kinetic energy** to it. (70)

photoemissive cell—A photocell whose working depends upon the **photoemissive effect**, that is, the capacity of certain surfaces to release electrons under the influence of **radiant energy**. (8)

photogenic granules—Chemical substances in the form of granules associated with **bioluminescence**. The granules may be within luminous organs (**photophores**) or scattered within the surface layer of the body, or they may be secreted into the environment where they create **extracellular bioluminescence**.

photomultiplier cell—A tube (valve) in which secondary emission multiplication is used to increase the output for a given incident **radiant energy**. (8)

photomultiplier tube—An electronic device which converts **photon** interactions at the photocathode into measurable electrical pulses.

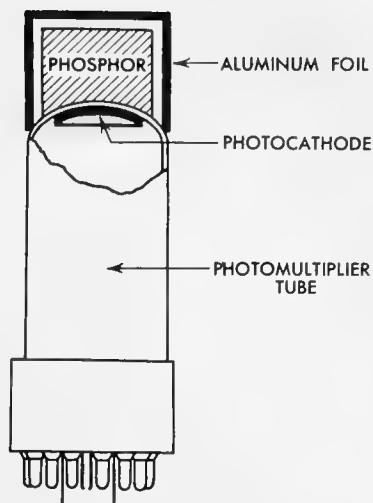
It is utilized for measuring light intensity in the ocean and in gamma ray detection instrumentation.

photon—A quantity of electromagnetic energy whose value in **ergs** is the product of its frequency (ν) in cycles per second and **Planck's constant** (h). The equation is: $E = h\nu$. (70)

photophore—A luminous organ, resembling an eye, within which light is produced either by chemical reactions controlled by the organism or by luminous bacteria living within the cells. Photophores occur most commonly in marine organisms inhabiting the middepths.

photosynthesis—The manufacture of carbohydrate food from carbon dioxide and water in the presence of **chlorophyll**, by utilizing light energy and releasing oxygen.

phototrophic nutrition—*See* **holophytic nutrition**.



DIAGRAMMATIC REPRESENTATION OF A SCINTILLATION COUNTER

photovoltaic cell—A photocell which sets up a potential difference between its terminals when exposed to **radiant energy**. It is a self contained current and voltage generator.

Note: The term "barrier-layer" cell is deprecated. (8)

phyllosoma larva—A modified **schizopod stage** of the **spiny lobsters**; it is planktonic, paper thin, and transparent.

phyllum—*See* **classification of organisms**.

physical oceanography—The study of the physical aspects of the ocean, such as its density, temperature, ability to transmit light and sound, and sea ice; the movements of the sea, such as tides, currents, and waves; and the variability of these factors both geographically and temporally in relationship to the adjoining domains, namely, the atmosphere and the ocean bottom.

physical properties—The physical characteristics of sea water; for example, temperature, salinity, density, velocity, sound, electrical conductivity, and transparency. (35)

phytoplankton—The plant forms of **plankton**. They are the basic synthesizers of organic matter (by **photosynthesis**) in the **pelagic division**. The most abundant of the phytoplankton are the **diatoms**.

phytoplankton bottle—1. A container for taking up a sample of water at a desired depth in order to obtain a quantitative sample of **phytoplankton** by filtration in the laboratory.

2. *See* **vacuum filtration, Millepore* filter**.

phytoplankton equivalent—*See* **plankton equivalent**.

picocurie—One micro-microcurie or 10^{-12} **curie**.

piezoelectric effect—The phenomenon, exhibited by certain crystals, in which mechanical compression produces a potential difference between opposite crystal faces, or, an applied electric

- field produces corresponding changes in dimensions.
- Pilot Chart**—A chart of a major ocean area published, for the benefit of mariners, by the U.S. Naval Oceanographic Office in cooperation with the U.S. Weather Bureau. These charts contain information required for safe navigation, including ocean currents, ice at sea, wind roses, storm tracks, isotherms, magnetic variation, great circle routes, limits of trade winds, etc. *See sailing directions.*
- pilot whale**—(or *blackfish*). Any of several species of a genus (*Globicephala*) of large dolphins, having worldwide distribution. These animals commonly travel in schools, and many strandings of them have been reported.
- pinching**—*See nipping.*
- ping**—An acoustic pulse signal projected by an underwater transducer.
- pinger**—A battery powered acoustic device equipped with a transducer that transmits sound waves. When the pinger is attached to a wire and lowered into the water, the direct and bottom reflected sound can be monitored with a listening device. The difference between the arrival time of the direct and reflected waves is used to compute the distance of the pinger from the ocean bottom.
- pingo**—A hill or mountain completely covered by an ice sheet, but revealing its presence by surface indications. (2)
- pinnacle**—A sharp pyramidal or cone-shaped rock partly or completely covered by water. Also a small coral spire which lies near the water surface in a lagoon.
- pinnacled iceberg**—An iceberg formed and weathered in such manner as to produce spires or pinnacles. (68)
- pinniped**—A marine mammal of the order Pinnipedia, which comprises the seals, sea lions, and walrus.
- pinpoint**—*See fix.*
- pip**—An echo trace on an electronic indicator screen.
- pisolites**—Rounded granule-sized concretions larger than oölites, found in land and marine deposits. They form pisolitic limestone when cemented together.
- pistol shrimp**—*See snapping shrimp.*
- piston-type corer**—A corer equipped with a piston inside the core tube that is connected to the lowering cable. When the corer penetrates the ocean bottom, the piston, in effect, provides a suction which overcomes the frictional forces acting between the sediment sample and the inside wall of the coring tube. *See Kullenberg, Ewing, and Hydroplastic corers.*
- pitch**—*See ship motion.*
- Pit log**—Short form for **Pitometer log**.
- Pitometer log**—A log consisting essentially of a Pitot tube projecting into the water, and suitable registering devices. (68)
- plain**—A flat, gently sloping or nearly level region of the sea floor. (62)
- Planck's constant**—A natural constant of proportionality (h) relating the frequency (ν) of a quantum of energy to the total energy (E) of the quantum:
- $$h = \frac{E}{\nu} = 6.624 \times 10^{-27} \text{ erg-sec.}$$
- (70)
- plane of reference**—*See chart datum.*
- planform**—The outline or shape of a body of water as determined by the still water level. (61)
- plankter**—A single organism in the plankton.
- plankton**—The passively drifting or weakly swimming organisms in marine and fresh waters. Members of this group range in size from microscopic plants to jellyfishes measuring up to 6 feet across the bell, and included the eggs and larval stages of the nekton and benthos. *See phytoplankton, zooplankton.*
- plankton bloom**—(or *sea bloom*). An enormous concentration of plankton (usually phytoplankton) in an area, caused either by an explosive or a gradual multiplication of organisms (sometimes of a single species) and usually producing an obvious change in the physical appearance of the sea surface, such as discoloration. Blooms consisting of millions of cells per liter often have been reported. *See red tide.*
- plankton centrifuge**—A device for separating plankton from water samples by centrifugal force.
- plankton equivalent**—A relationship between various chemical constituents or characteristics of plankton whereby the measurement of one characteristic can be used to derive the quantity of other characteristics. In phytoplankton studies, 1.0 milligram (mg) of carbon is equivalent to 2.3 milligrams of dry organic matter, 42.0 milligrams of biomass, and 3.3 milligrams of dry plankton. In zooplankton studies, 1.000 milligram of carbon is equivalent to 0.170 milligram of nitrogen, 0.013 milligram of phosphorus, 8.300 milligrams of plankton biomass, and 1.700 milligrams of dry plankton.
- plankton haul**—(or *plankton tow, haul, tow*). A single tow of a plankton net.
- plankton indicator**—*See plankton sampler.*
- plankton net**—A net for collecting plankton. A great variety of plankton nets have been constructed in attempts to fulfill specific requirements. Typically, the nets are cone shaped, but several modifications of this shape as well as completely different shapes exist. Variations in design involve: mouth diameter, net length, mesh aperture size, material, type of collecting bucket, and opening or closing capability. Many nets are used without any attachment (except the necessary collecting bucket and mouth ring). Others are attached to hollow cylinders bearing

- flowmeters and closing devices, or are enclosed within devices that may permit one or more of the following: high-speed towing, quantitative sampling, multiple sampling, and strip sampling.
- plankton pump**—A device to raise water from desired depths in order to collect **plankton** existing at those depths; the water is filtered at the surface.
- plankton recorder**—*See* **plankton sampler**.
- plankton sampler**—(or *plankton recorder, plankton indicator*). A device for collecting **plankton**, usually designed to take quantitative samples. *See* **plankton net**.
- plankton snow**—*See* **sea snow**.
- plankton tow**—*See* **plankton haul**.
- planula**—A young ovoid planktonic larva of a **coelenterate**.
- plastic flow**—A phenomenon in which **bottom sediments** under pressure of a weight may flow out from under the weight allowing partial or complete burial.
- plastic limit**—*See* **Atterberg limits**.
- plateau**—A comparatively flat-topped elevation of the sea floor of considerable extent across the summit and usually rising more than 100 fathoms (200 meters) on all sides. (62)
- plate ice**—*See* **pancake ice**.
- platform**—Any manmade structure (aircraft, ship, buoy, or tower) from or on which oceanographic instruments are suspended or installed.
- platform reef**—An **organic reef** with a flat upper surface. (2) *See* **table reef**.
- pleuston**—A community of macroorganisms floating on the surface of the sea, for example **siphonophores, barnacles, isopods, gastropods, etc.** *See* **neuston**. (44)
- plunge point**—1. For a plunging wave, the point at which the wave curls over and falls. (*See* figure for **surf zone**)
2. The final breaking point of the waves just before they rush up on the beach. (61)
- plunging breaker**—*See* **breaker**.
- pluteus**—A free-swimming larva of the sea **urchins** and **brittle stars**, from supposed resemblance to an upturned easel.
- plutonic rock**—**Igneous rock** which has cooled some distance below the surface and usually is characterized by a coarse grained structure. (35)
- pneumatocyst**—(or *vesicle, air bladder, float*). An air or gas bladder or float; structures so called in **siphonophores** and in several species of **brown algae**.
- pneumatophore**—In certain organisms, a gas-filled, saclike structure, such as the float of the Portuguese man-of-war, which generally serves as a buoyant mechanism.
- pocket**—*See* **blind lead**.
- pod**—(or *school*). A number of animals (as seals or whales) closely clustered together. ("We lowered for a pod of four or five whales."—Herman Melville). School (pod is usually used for groups smaller than a school, as, "pods of 15 to 25 seals detached from the main group."—M. E. Stansby).
- point**—The extreme end of a **cape**; or the other end of any area protruding into the water, usually less prominent than a cape. (61)
- polar air**—A type of air whose characteristics are developed over high latitudes, especially within the subpolar **highs**. Continental polar air (*cP*) has low surface temperature, low moisture content, and, especially in its source regions, has great stability in the lower layers. It is shallow in comparison with **arctic air**. Maritime polar air (*mP*) initially possesses similar properties to those of continental polar air, but in passing over warmer water it becomes unstable with a higher moisture content. (5)
- polar anticyclone**—*See* **arctic high**.
- polar cap ice**—*See* **polar ice**.
- polar convergence**—A line along which cold polar intermediate water sinks under the warmer subpolar water in its movement toward lower latitudes. It is marked by a sharp change in surface temperatures, particularly in the Southern Hemisphere. *See* **Arctic Convergence, Antarctic Convergence**.
- polar drift ice**—**Drift ice** composed exclusively of **polar ice**.
- polar fast ice**—1. **Fast ice** formed by the grounding and cementing together of **polar ice**. (74)
2. Fast ice of more than one winter's growth
- polar high**—*See* **arctic high**.
- polar ice**—(or *polar-cap ice*). 1. **Sea ice** that is more than one year old (in contrast to **winter ice**). It is usually the thickest form of sea ice, occasionally exceeding a thickness of ten feet. The WMO Code defines it as any sea ice more than one year old and more than 3 meters (9.8 feet) thick.
2. *See* **arctic pack** (sense 3).
3. A Russian term for any sea ice more than two years old.
- pole of inaccessibility**—*See* **ice pole**.
- pollutants**—Waste products from industry or in sewage. (35)
- polychaete**—One of an order (Polychaeta) of **annelids** which includes most of the marine segmented worms, some of which are the tubeworms of **fouling**. Some of these worms are luminescent during spawning. *See* **tubeworm**.
- polyconic projection**—A projection where the latitude curves are developed as a series of tangent cones. The scale is chosen to be true along a selected central meridian. This projection is neither conformal nor equal area.
- polynya**—(or *clearing, ice clearing*). 1. A water area enclosed in ice, generally fast; this water area remains constant and usually has an oblong shape; sometimes limited to one side by the coast. (74)

2. Any enclosed sea water area in **pack ice** other than a **lead**, not large enough to be called **open water**. If a polynya is found in the same region every year, for example, off the mouths of big rivers, it is called a recurring polynya. A temporary small clearing in pack ice which consists of **small ice floes** and **brash ice** in continuous local movement is called an unstable polynya; an opening which is flanked by large floes and therefore appears to be relatively stable is called a stable polynya. When frozen over, a polynya becomes an **ice skylight** from the point of view of the submariner. (7)
- polynya off edge of shore ice**—A polynya between **shore ice** and **drift ice** formed by squeezing winds and currents. (74)
- polyp**—An individual sessile **coelenterate**.
- polytrocular larva**—An advanced stage of the planktonic young of certain **annelids**, in which several segments, each bearing a ring of **cilia**, are present.
- Polyvinyl (PVC) corer**—*See* **Hydroplastic corer**.
- polyzoa**—*See* **bryozoan**.
- polyzoan**—*See* **bryozoan**.
- P_1 constituent**—The principal solar diurnal constituent of the theoretical **tide-producing forces**. (*See* figure for **partial tide**.)
- pool**—Any enclosed relatively small sea area in **pack ice**, **drift ice** other than a **lead** or **lane**. (74) *See* **polynya**, **puddle**.
- population**—The total collection of units being considered statistically. (22)
- porosity**—The ratio of the aggregate volume of pore space in a rock or sediment to its total volume, usually expressed as a percentage. (2)
- porpoise**—A small to moderate sized member of the **cetacean** suborder **Odontoceti**. The name is used interchangeably with **dolphin** by some. More properly it is given to the small and beakless members of the family **Delphinidae**, which have a triangular dorsal fin and spade-shaped teeth.
- port plan**—A geographical outline of a port area showing piers, railroad extensions, repair facilities, pilot office, customhouse, and other applicable non-navigational features.
- positive estuary**—An **estuary** in which there is a measurable dilution of sea water by land drainage.
- positive gradient**—A positive rate of change with depth.
- potential density**—The density that a parcel of water would have if raised adiabatically to the surface, that is, if determined from the parcel's *in situ* salinity and **potential temperature**.
- potential energy**—The energy resulting from the elevation or depression of the water surface from the undisturbed level. This energy advances with the wave form. (61)
- potential temperature**—In oceanography, the temperature that a water sample would attain if raised adiabatically to the sea surface. For the deepest points of the ocean, which are just over 10,000 meters, the adiabatic cooling would be less than 1.5°C. (5)
- potrero**—An accretionary ridge separated from the coast by a lagoon and barrier island, as along the Texas coast. (2)
- potted**—Instruments, connections, or fittings encapsulated in a waterproof plastic material.
- power gain**—The amount (in **decibels**) by which the output power level exceeds the input power level. Thus, if the output power of a device is 10 times that of the input, the power gain is 10 decibels. On the other hand, if the output is one hundred times that of the input, the gain is 20 decibels. (3)
- power level**—Power level, in **decibels**, is 10 times the logarithm to the base 10 of the ratio of a given power to a reference power. The reference power must be indicated. (6)
- power spectrum**—The decomposition of the variance of a random process over frequency intervals.
- precision**—*See* **accuracy**.
- pressure fluctuation**—*See* **bottom pressure fluctuation**.
- pressure force**—(or *pressure gradient force*). The force due to differences of pressure within a fluid mass. The force per unit volume is equal to the **pressure gradient**, and the force per unit mass is equal to the product of the volume force and the **specific volume**. (5)
- pressure gage**—A **tide gage** that is operated at the bottom of a body of water and which records tide heights by the change in pressure due to the rise and fall of the tide. (50)
- pressure gradient**—The rate of decrease (**gradient**) of pressure in space at a fixed time. The term is sometimes loosely used to denote simply the magnitude of the gradient of the pressure field. (5)
- pressure gradient force**—*See* **pressure force**.
- pressure gradient hydrophone**—A **hydrophone** in which the electric output substantially corresponds to a component of the gradient (space derivative) of the sound pressure. (69)
- pressure hydrophone**—A **hydrophone** in which the electric output substantially corresponds to the instantaneous sound pressure of the impressed sound wave. (69)
- pressure ice**—(or *screw ice*). **Sea ice** (or river or lake ice) which has been deformed or altered by the lateral stresses of any combination of wind, water currents, tides, waves, and surf. This may include ice pressed against the shore or over another piece of ice. **Rafted ice**, **tented ice**, **pressure ridges**, and **hummocks** are forms of pressure ice.
- pressure ice foot**—An **ice foot** formed along a shore by the freezing together of stranded **pressure ice**. (68)

pressure level—The sound intensity, as measured in **decibels** relative to units of dynes per square centimeter, such as 0.0002 dyne per square centimeter, 20 times the common logarithm of the **acoustic pressure**.

pressure ridge—A ridge or wall of **hummocks** where one **ice floe** has been pressed against another. (74)

Ridges may be several miles long and up to 100 feet high. A corresponding ridge may also occur on the underside of the **ice canopy** and is called an **ice keel**. (7)

pressure wave—A short-period oscillation of pressure such as that associated with the propagation of sound through the atmosphere; a type of **longitudinal wave**. (5)

prevailing current—The flow most frequently observed during a given period, usually a month, season, or year.

Price-Gurley current meter—A battery powered electromechanical current meter which measures current speed only.

primary bench mark—*See* **bench mark**.

primary film—(or *slime film, diatom film, bacterial film*). The thin slimy layer that usually forms initially on a surface placed in sea water; it is composed of bacteria, diatoms, or both, and is believed by some to be a necessary precursor to attachment of larger **fouling organisms**.

primary production—(or *gross primary production, primary productivity*). The amount of organic matter synthesized by organisms from inorganic substances in unit time in a unit volume of water or in a column of water of unit area cross section and extending from the surface to the bottom. (40)

primary productivity—*See* **primary production**.

primary tide station—A place at which continuous tide observations are made over a number of years. (68) *See* **reference station**.

prime meridian—The meridian of longitude 0 degrees, used as the origin for measurements of longitude. The meridian of Greenwich, England is the internationally accepted prime meridian on most charts. However, local or national prime meridians are occasionally used.

priming of the tides—The periodic acceleration in the time of occurrence of **high** and **low water** because of changes in the relative positions of the moon and the sun. The opposite effect is called **lagging of the tides**.

primitive period—The primitive period of a periodic quantity is the smallest increment of the independent variable for which the function repeats itself. (6)

principal axis—In a **transducer** used for sound emission or reception, a reference direction for angular coordinates used in describing the directional characteristics of the transducer. It is usually an axis of structural symmetry or the direction of maximum response, but if these do

not coincide, the reference direction must be described explicitly. (69)

probability—The chances that a prescribed event will occur, represented as a pure number p in the range $0 \leq p \leq 1$. The probability of an impossible event is zero and that of an inevitable event is unity.

Probability is estimated empirically by relative frequency, that is, the number of times the particular event occurs divided by the total count of all events in the class considered. (5)

probability theory—*See* **probability**.

probe—A measuring device or **sensor** inserted into the environment to be measured. As applied to oceanography the term is used for devices which are lowered into the sea for *in situ* measurements.

production—The sum of the organic matter produced by living organisms in a given area or volume in a given time, inclusive of such organisms which might have developed and disappeared in the given time.

productivity—An inexact term, indicating the fertility of an ocean area. Most authorities have abandoned the term and use **primary production** or **production** instead to which specific definitions have been assigned.

profile—1. A drawing showing a vertical section along a surveyed line.

2. A graph showing as ordinate the variation of some oceanographic quantity along a straight line against horizontal distance on this line as abscissa.

3. *See* **trace**.

progressive wave—A wave which is manifested by the progressive movement of the wave form. (61) (*See* figure for **standing wave**.)

prohibited anchorage—*See* **anchorage**.

promontory—A high point of land extending into a body of water. (30) *See* **cape, headland, bluff**.

propagation—The transmission of energy through a medium.

propagation anomaly—In underwater acoustics the difference between the actual **propagation loss** for a given length of water path and the nominal value of propagation loss identified with the distance covered by that path. (28)

propagation loss—The **transmission loss** associated with any given length of ray path in the water. (28)

propeller noise—Noise produced by **cavitation** at the propellers.

protected thermometer—A **reversing thermometer** which is encased in a strong glass outer shell that protects it against **hydrostatic pressure**. (5)

proton—An elementary nuclear particle with a positive electric charge equal numerically to the charge of the electron and a mass of 1.007594 mass units. It is one of the constituents of every nucleus. (70)

Protozoa—1. A phylum of mostly microscopic, one-celled animals. This group constitutes one of the largest populations in the sea, including some bioluminescent genera.

2. An often used common name for the members of the phylum.

protozoan—One of a phylum (Protozoa) of single-celled animals. *See* **Protozoa**.

proud of the bottom—Resting on the surface of the bottom, that is, not imbedded in the bottom.

province—A region composed of a group of similar bathymetric features whose characteristics are markedly in contrast with surrounding areas. (62)

psammite—(or spelled psammyte). *See* **sandstone**.

psephite—A coarse fragmental rock (conglomerate) or deposit composed of rounded **pebbles**. (2)

pteropod—(or *sea butterfly*). One of an order (Pteropoda) of pelagic, free-swimming **gastropods** in which the foot is modified into fins; both shelled and nonshelled forms exist. The accumulated shells of these organisms form a type of bottom sediment called **pteropod ooze** in some ocean areas. *See* **ooze**.

pteropod ooze—A pelagic sediment containing at least 30 percent calcium carbonate in the form of **tests** of marine animals, the dominant form being **pteropods**. *See* **ooze**.

puddingstone—*See* **conglomerate**.

puddle—(also called *pool*, *snow puddle on the ice*). 1. *See* **snow water on the ice**.

2. A small body of water, usually fresh melt water, in a depression or hollow on ice. (68)

pulse height analyzer—An electronic circuit which sorts and records pulses according to height (energy).

Such electronic devices are used for sorting of pulses from gamma ray interactions in the detector of a **gamma ray spectrometer**. Observed pulses are sorted into adjacent energy

channels enabling determination of the energy spectra or energy frequency distribution of observed **gamma rays** in a selected energy range (usually 0 to 3 million-electron-volts for gamma ray emitting **radioisotopes**). Pulse height analyzers may be single or multichannel devices. All multichannel analyzers consist of (1) an analog-to-digital converter which assigns a channel to each input pulse according to its amplitude (energy), (2) a memory which records the number of counts falling into each channel and, (3) a display or readout device indicating the number of counts in each channel. (70)

pumice—An excessively cellular, glassy **lava**. It is very light and can float on water until it becomes waterlogged and sinks.

pure water—(or *distilled water*). Water that contains no impurities. Compare with **fresh water**.

purse seine—A large net, used in commercial fisheries, placed in a circle around a school of fish and drawn together. (35)

pycnocline—The vertical gradient of **density**.

pycnogonid—*See* **sea spider**.

pyramidal iceberg—A **pinnacled iceberg** of pyramidal shape. (59)

pyramidal sea—*See* **intersecting waves**.

pyrheliometer—A general term for the class of actinometers which measure the intensity of direct solar radiation. In oceanography, this instrument measures the total sun and sky radiation received on a horizontal surface.

pyrosome—(or *fire body*, *fire cylinder*). One of a genus (*Pyrosoma*) of luminescent, pelagic, colonial **tunicates**. Individuals form thimble-shaped colonies commonly 3 or 4 inches long but reaching a length of at least 2 feet. They occur only in warm waters and produce brilliant **luminescence** resembling long incandescent gas mantles.

Q

Q factor—1. The pressure coefficient of the **unprotected thermometer** expressed in °C. (67)

2. *See quality factor.*

quadrature—The position in the phase cycle when the two principal tide producing bodies (moon and sun) are nearly at a right angle to the earth; the moon is then in quadrature in its first quarter or last quarter. (*See figure for tide cycle.*)

quadrature spectrum—The spectral decomposition of the 90-degree out-of-phase components of the covariance of two functions of time.

qualitative plankton sampler—A sampler that sieves out organisms from the water but does not measure the volume of water filtered.

quality factor—(also called *Q factor*). The quantity, *Q*, is a measure of the sharpness of resonance of frequency selectivity of a resonant vibrator system having a single degree of freedom, either mechanical or electrical. A high value for *Q* means that the **resonance** is sharp, that is, any small change in the frequency of the excitation causes a large drop in the response of the system. (3)

quantitative plankton sampler—A sampler that sieves out organisms from the water and measures the volume of water filtered.

quantity of radiant energy—The quantity of energy transferred by **radiation**. Unit of measurement is in **Joules** or **ergs**. (8)

quar ice—A Labrador term for ice formed in spring from melt water draining on to a **beach, ice foot, or fast ice**, where it refreezes. (8)
Rare.

quarter-diurnal tide—The tide resulting from the distortion of the normal tide in shallow wa-

ter, with four **high water** and four **low waters** during one day. (32)

quartering sea—*See beam sea.*

quartz—A form of silicon dioxide. The most common inorganic constituent of marine sediments. (9)

quasi-synoptic—Nearly simultaneous environmental measurements.

quenching—The great reduction in underwater sound transmission or reception resulting from **absorption** and **scattering** of sound energy by air bubbles entrapped around the sonar dome. Roll and pitch of the ship in relatively rough water is the primary cause of air bubble entrapment.

quench/ping ratio—In sound ranging, a measure of the sound lost from **quenching**. Based on the ratio of the number of echoes received (quench) to the number of pulses emitted (ping).

quick—Sediment of clay to sand size which by absorption or admixture of water becomes loose, incoherent, unstable, liquid or semiliquid, and capable of flowing easily under load or by force of gravity. Quick clay of glacial or marine origin becomes metastable or "quick" as a result of the leaching out of salts and their replacement by water. Any shock may cause a re-orientation of the grain structure with squeezing out of the interstitial water and conversion of the clay into a plastic or semiliquid state in which the clay will flow and fail under load.

quick clay—*See quick.*

quicksand—*See quick.*

Q wave—*See Love wave.*

R

race—A very fast current flowing through a relatively narrow **channel**. (50)

radiance—In radiometry, a measure of the intrinsic radiant intensity emitted by a radiator in a given direction. It is the **irradiance** (radiant flux density) produced by radiation from the source upon a unit surface area oriented normal to the line between source and receiver, divided by the solid angle subtended by the source at the receiving surface. It is assumed that the medium between the radiator and receiver is perfectly transparent; therefore, radiance is independent of **attenuation** between source and receiver. (5)

radiance meter—An **irradiance meter** which collects **radiant energy** from a set of directions and which has its field of view limited to a circular solid angle of Ω magnitude (defined, for example, by a cylindrical tube) whose axis is fixed normal to the plane of the collecting area of the meter. If E is the reading of the meter, the associated **radiance** is $L = E/\Omega$. (8)

radiant emittance (at a point on a surface)—The **radiant flux** emitted by an infinitesimal element of surface containing the point under consideration, divided by the area of that element. Unit of measurement is watt per square meter (W/m^2). (8)

radiant energy—(also called *radiation*). 1. The energy of any type of **electromagnetic radiation**.

2. Infrequently, any energy that may be radiated, as, for example, sonic energy.

radiant flux—The time rate of flow of **radiant energy**. Unit of measurement is watts. (8)

radiant intensity (of a source in a given direction)—The **radiant flux** emitted by a source, or by an element of a source, in an infinitesimal cone containing the given direction, divided by the solid angle of that cone.

Note: For a source which is not a point source; the quotient of the radiant flux received on an elementary surface by the solid angle which this surface subtends at any point of the source, when this quotient is taken to the limit as the distance between the surface and the source is increased.

Unit of measurement is watt per steradian (W/sr). (8)

radiated noise—The underwater sound energy emitted by ships, submarines, and torpedoes.

radiation—1. The emission and propagation of energy through space or through a material medium in the form of waves; for instance, the emission and propagation of electromagnetic waves, or of sound and elastic waves.

2. The energy propagated through space or through a material medium as waves; for example, energy in the form of electromagnetic waves or of elastic waves. The term radiation or **radiant energy**, when unqualified, usually refers to **electromagnetic radiation**; such radiation commonly is classified according to frequency, as Hertzian, infrared, visible (light), ultra-violet, X-ray, and gamma ray. (*See photon*).

3. By extension, corpuscular emissions, such as alpha and beta radiation, or rays of mixed or unknown type, as cosmic radiation. (70)

radiation absorbed dose—(abbreviated rad). A measure of the dose of any ionizing radiation to body tissues in terms of the energy absorbed per unit mass of the tissue. One rad is the dose corresponding to the absorption of 100 ergs per gram of tissue. One millirad (mrad) equals 0.001 rad. (As defined by the *Atomic Energy Commission*.)

radiation detector—Any device for converting **radiant energy** to a form more suitable for observation. (Reactor engineering) An instrument used to determine the presence and sometimes the amount of radiation or neutron flux. (70)

radioactive age determination—The determination of the age of a rock or sediment by measuring the proportion of the **radioisotope** Carbon¹⁴ in the organic material it contains. A method (radiocarbon dating) is based upon the known rate of conversion of carbon to its isotope and is accurate to a maximum age of about 30,000 years. Other chemical elements can be used similarly for age determination.

radioactive decay—The disintegration of the nucleus of an unstable **nuclide** by the spontaneous emission of charged particles and/or **photons**. (70)

radioactive equilibrium—A condition which may occur in the course of the decay of a radioactive **parent** having shorter-lived descendants, in which the ratio of the activity of the parent to that of a descendant is independent of time.

This condition can exist only when no activity longer-lived than that of the parent is interposed in the decay chain. (41)

radioactive half-life—The time required for a radioactive substance to lose 50 percent of its activity by decay. Each **radionuclide** has an unique half-life. (70)

radioactive series—A succession of **nuclides**, each of which transforms by radioactive disintegration into the next until a stable nuclide results. The first member is called the **parent**, the intermediate members are called **daughters**, and the final stable member is called the end product. Three such series are encountered in **natural radioactivity**, and many others are encountered in **induced radioactivity**, particularly among the heavy elements and fission products. (41)

radioactive tracer—A **radionuclide** used as an oceanographic tracer having **radioactivity** as its distinguishing property. Radioactive oceanographic tracers include Tritium (H^3), Carbon¹⁴, and fallout **radioisotopes** (fission products).

radioactivity—1. The process whereby certain **nuclides** undergo spontaneous disintegration in which energy is liberated, generally resulting in the formation of new nuclides. The process is accompanied by the emission of one or more types of radiation, such as alpha particles, and gamma photons.

2. A particular radiation component from a radioactive source, such as gamma radioactivity.

3. A **radionuclide**, such as a radioactivity produced in a bombardment.

(70)

radiobiology—That branch of biology which deals with the effects of radiation on biological systems. (41)

radiocarbon age—This age is calculated from the specific activity, due to Carbon¹⁴, of the carbon in a once-living object; such radiocarbon dating is possible because Carbon¹⁴ is produced in the atmosphere by cosmic rays and is incorporated into all living objects; after death the Carbon¹⁴ activity decays exponentially with a half-life of 5,568 years. (41)

radiocarbon dating—*See* **radioactive age determination**.

radiochemistry—The aspects of chemistry connected with **radionuclides** and their properties, with the behavior of minute quantities of radioactive materials by means of their **radioactivity** and with the use of radionuclides in the study of chemical problems. (70)

radioisotope—1. Any radioactive **isotope** of an element.

2. A word loosely used as a synonym for **radionuclide**.

(41)

radioisotopic oceanography—That oceanographic discipline dealing with the measure-

ment and distributional analysis of ocean-borne **radioisotopes**.

Radiolaria—*See* **radiolarian**.

radiolarian—One of an order (Radiolaria) of single-celled planktonic **protozoa** possessing a skeleton of siliceous spicules and radiating threadlike pseudopodia. Most members are pelagic, and many are luminescent.

radiolarian ooze—Deposits of siliceous sediments distinguished by large proportions of minute opaline silica shells (tests) of **radiolarians**. Water depths between about 13,000 and 25,000 feet are most favorable for the preservation of radiolarian tests. *See* **ooze**.

radionuclide—A synonym for radioactive **nuclide**. (41) *See* **radioisotope**.

rafted ice—(also called *telescoped ice*). **Pressure ice** in which one **ice floe** overrides another. (74)

rafting—1. The process by which **rafted ice** is formed. (65)

2. The transporting of sediment, rocks, silt, and other matter of land origin out to sea by ice, logs, etc., with subsequent deposition of the rafted matter when the carrying agent disintegrates. (68)

ram—1. (also called *spur* or *apron*). An underwater ice projection from an **iceberg** or a hummocked ice floe. Its formation is usually due to a more intensive melting of the submerged part of the floe. (47)

2. In ice navigation, to charge obstructing ice with a ship. (59)

ramp—(also called *drift ice foot*). An accumulation of snow that forms an inclined plane between land or land ice elements and **sea ice** or **shelf ice**. *See* **bridge**. (65)

random noise—An oscillation whose instantaneous magnitude is not specified for any given instant of time. The instantaneous magnitudes of a random noise are specified only by probability distribution functions giving the fraction of the total time that the magnitude, or some sequence of magnitudes, lie within a specified range. (6)

range—1. The difference between the maximum and minimum of a given set of numbers; in a periodic process it is twice the amplitude, that is, the wave height.

2. The distance between two objects, usually an observation point and an object under observation.

3. A maximum distance attributable to some process, as in visual range or the range of an aircraft.

(5)

rapture of the deep—*See* **nitrogen narcosis**.

rate of decay—The time rate at which the sound pressure level, or any other stated characteristic, decreases at a given point in a given time. A commonly used unit to express the rate of decay

is the decibel per second. (3) *See* **decay, radioactive decay.**

ratio of ranges—(or *height ratio*). The ratio of the height of the tide at the secondary station to the height of the tide at the **reference station.**

ray—Any of a large number of elasmobranchi of the order Batoidei, in which the body generally is compressed dorso-ventrally, the eyes are on the upper surface, the gill clefts on the lower surface, and the tail often is reduced to a whiplike appendage. The order includes the electric rays, stingrays, and manta rays.

rayl—*See* **specific acoustic impedance.**

ray path—The energy associated with a point on a wave front that moves along an imaginary line known as a ray path. The ray paths encountered in acoustics, which are commonly called sound rays, are analogous to the light rays of optics. Ray paths and wave fronts are mutually perpendicular.

ray pattern—A graphic presentation of the paths of sound rays in relation to depth and range.

ray theory—A method for determining the path of transmitted underwater sound based on **Snell's law.** This law describes the change in the sound ray path as it passes through different density (sound velocity) layers.

reach—1. An arm of the sea extending into the land.

2. A straight section of restricted waterway of considerable extent; may be similar to a **narrows**, except much longer in extent.

(73)

recession—(also called *retrogression*). 1. A continuing landward movement of the **shoreline.**

2. A net landward movement of the shoreline over a specified time.

(61)

recognition differential—The recognition differential for a specified listening system is that amount by which the signal level exceeds the **noise level** presented to the ear when there is a 50 percent probability of detection of the signal.

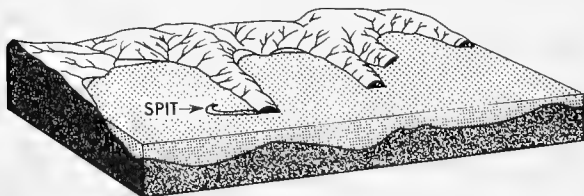
(3)

recrystallization—The formation of new mineral grains in a rock while in the solid state.

rectilinear current—*See* **reversing current.**

recurring polynya—*See* **polynya.**

recurved spit—(or *hook, hooked spit*). A hook developed when the end of a **spit** is turned toward the shore by current deflection or by the opposing action of two or more currents.



RECURVED SPIT

AFTER LEET, DON & JUDSON, SHELDON PHYSICAL GEOLOGY, NEW YORK: PRENTICE-HALL, INC. 1954 p. 264.)

red alga—One of a division or phylum (Rhodophyta) (the Rhodophyceae of another scheme) of reddish, filamentous, membranous, encrusting, or complexly branched plants in which the color is imparted by the predominance of *r*-phycoerythrin over the **chlorophylls** and other pigments. Some notable members of the group are the sources of agar-agar, such as *Gelidium*, *Gracilaria*, and *Eucheuma*, Irish moss, *Chondrus*, and the encrusting calcareous *Lithothamnion* of coral reefs. Red algae are worldwide in their distribution, being more abundant in temperate waters and ranging to greater depths than other algae.

red mud—A reddish-brown terrigenous deep sea mud containing up to 25 percent calcium carbonate which accumulates on the sea floor near deserts and off the mouths of large rivers. (48)

red tide—A red or reddish-brown discoloration of surface waters, most frequently in coastal regions, caused by concentrations of certain microscopic organisms, particularly **dinoflagellates.** Toxins produced by the dinoflagellates can cause mass kills of fishes and other marine animals. Airborne particles which are optic and respiratory irritants to humans and animals, may be carried from red tide areas overland. Red tides may develop rapidly, apparently as a result of an abrupt change in one or more environmental factors. In some regions at least, notably off the west coast of Florida, the onset of red tide appears to follow increased rainwater runoff from the land; the introduction by this means of one or more scarce nutrient elements into the sea is believed to permit the dinoflagellates to multiply rapidly. *See* **discolored water.**

red water—*See* **red tide, discolored water.**

reef—An offshore consolidated rock hazard to navigation with a least depth of 10 fathoms (20 meters) or less. (62) *See* **shoal.** (*See* figure for **atoll** and **coral reef.**)

Note: For many years, a depth of 6 fathoms has been considered critical for navigational safety. Because of the increased drafts of modern ships, a depth of 10 fathoms is now considered critical.

reef complex—The solid reef core and all contiguous detrital limestone and coral and genetically related sediments or rocks. (2)

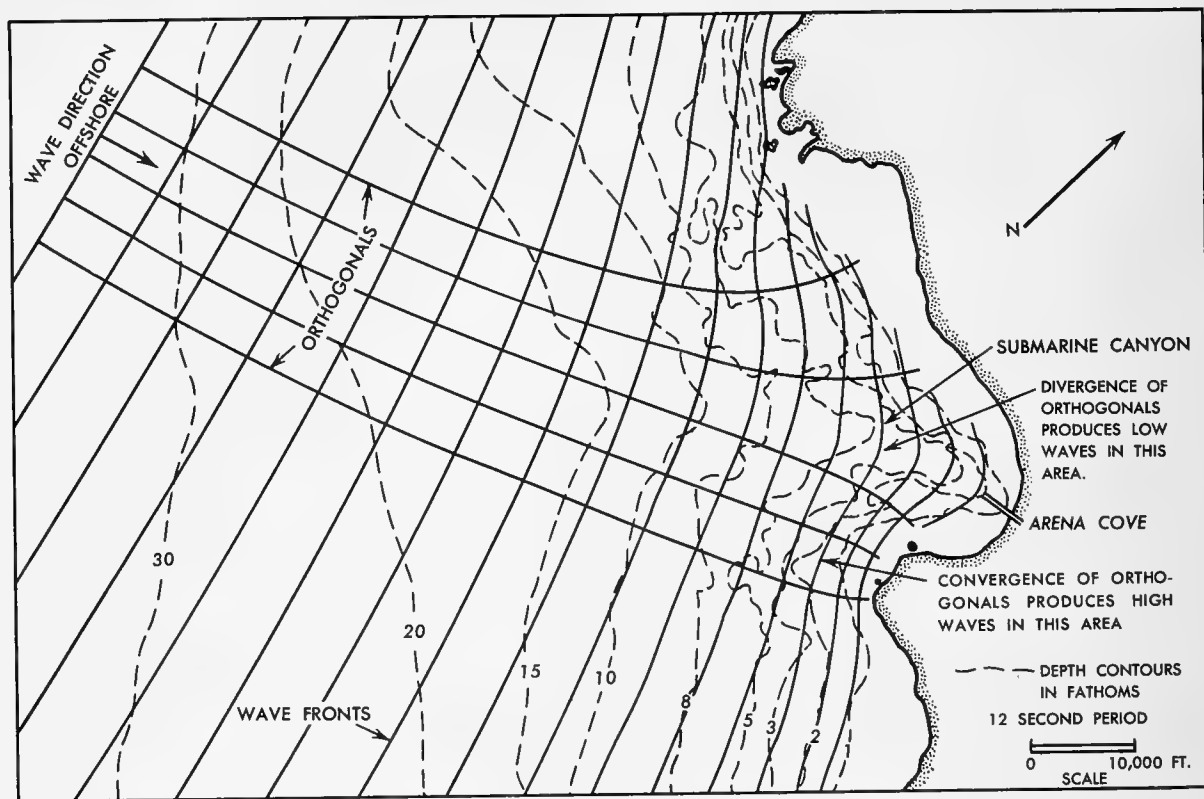
reef conglomerate—*See* **reef talus.**

reef flank deposit—*See* **reef talus.**

reef flat—A flat expanse of dead reef rock which is partly or entirely dry at low tide. Shallow pools, potholes, gullies, and patches of coral debris and sand are features of the reef flat. It is divisible into outer and inner sections. (2) (*See* figure for **atoll.**)

reef front—The upper seaward face of the **reef**, extending above the dwindle point of abundant living **coral** and **coralline algae** to the reef edge. This zone commonly includes a shelf,

- bench, or terrace that slopes to 8 to 15 fathoms, as well as the living wave-breaking face of the reef. The terrace is an eroded surface or is veneered with organic growth. The living reef front above the terrace in some places is smooth and steep; in other places it is cut up by grooves separated by ridges that together have been called groove and spur systems, forming comb-tooth patterns. (56) (*See* figure for **atoll**.)
- reef patch**—A term for all coral growths that have grown up independently in lagoons of barriers and atolls. They vary in extent from expanses measuring several kilometers across to coral pillars or even mushroom-shaped growths consisting of a single large colony. The smaller representatives are called coral knolls or **coral heads**. (2) (*See* figure for **atoll**.)
- reef segment**—That portion of an **organic reef** lying between passes, gaps, or channels. (2)
- reef talus**—(or *reef conglomerate*, *reef flank deposit*, *off-reef facies*). Massive inclined beds of debris derived principally from a **reef** and deposited along the seaward margin of a living reef.
- reference level**—1. In underwater sound, the standard to which other sound levels can be related. Two reference levels commonly used are: 1 dyne per square centimeter and 0.0002 dyne per square centimeter.
2. *See* **chart datum**.
- reference plane**—*See* **chart datum**.
- reference point**—A specified location (in plan and/or elevation) to which measurements are referred. (61)
- reference station**—(or *standard station*, *standard port*). A place where tide or tidal current constants have been determined from observations, and which is used as a standard for the comparison of simultaneous observations at a **subordinate station**. It is also a place for which independent daily predictions are given in the tide or tidal current tables, from which corresponding predictions are obtained for other locations by means of differences or factors.
- reflectance**—The ratio of light given off by an object to the amount of light striking the object, expressed as percentage.
- reflectance function**—The ratio of the upwelling **irradiance** at a depth to the downwelling irradiance at the same depth.
- reflected wave**—The wave that is returned seaward when a wave impinges upon a very steep beach, barrier, or other reflecting surface. (61)
- reflection**—The process whereby a surface of discontinuity turns back a portion of the incident **radiation** into the medium through which the radiation approached. (5)
- reflection loss**—The reflection loss at the junction between an energy source and an energy load is the **transmission loss** measured by the ratio of (1) the load power which would be measured if source and load were connected by a hypothetical **transducer** having an input **impedance** equal to the source impedance of the source, an output impedance equal to the load terminals as are developed at its source terminals, to (2) the actual load power when source and load are connected directly to each other. (28)
- reflection of sound**—The process whereby a surface of discontinuity turns back a portion of the incident sound into the medium through which the sound approached. (5)
- reflectivity**—A measure of the fraction of **radiation** reflected by a given surface; defined as the ratio of the **radiant energy** reflected to the total that is incident upon that surface.
- refraction**—The process in which the direction of energy propagation is changed as the result of a change in density within the propagating medium, or as the energy passes through the **interface** representing a density discontinuity between two media. (5)
- refraction coefficient**—In wave hydrodynamics, the square root of the ratio of the spacing between adjacent **orthogonals** in deep water to that at a selected point in shallow water. When multiplied by the **shoaling coefficient**, this becomes the **wave height coefficient** or the ratio of the refracted wave height at any point to the deepwater wave height. Also the square root of the energy coefficient. *See* **wave refraction**, **refraction of water waves**, **index of refraction** (sense 3).
- refraction diagram**—A drawing showing positions of **wave crests** and/or **orthogonals** in a given area for a specific deepwater wave period and direction. (61) *See* figure on next page.
- refraction index**—*See* **index of refraction**.
- refraction loss**—That part of the **transmission loss** due to **refraction** resulting from nonuniformity of the medium. (6)
- refraction of water waves**—1. The process by which the direction of a wave moving in shallow water at an angle to the contours is changed. That part of the wave advancing in shallower water moves more slowly than the other part still advancing in deeper water, causing the **wave crest** to bend toward alignment with the underwater contours.
2. The bending of wave crests by currents. (61)
- refractive index**—*See* **index of refraction**.
- refractivity**—Rare. *See* **index of refraction** (sense 1).
- regelation**—The melting of ice by the application of pressure and the refreezing of melt water upon release of that pressure. (59)
- regional clearing**—*See* **polynya**.
- regional gradient**—*See* **regional gravity**, **regional magnetism**.
- regional gravity**—(or *regional gradient*). In gravity prospecting, contributions to the observed **anomalies** due to density irregularities at much greater depths than those of the possible



REFRACTION DIAGRAM

(WIEGEL, 1953)

structures, the location of which was the purpose of the survey.

regional magnetism—In terrestrial magnetism, that part of the observed magnetic field that is attributed to the earth's magnetic field or to effects which are too deep, too broad, or too great in relief to be possible expressions of structure or other features of interest.

regolith—(or *mantle, rock, saprolith*). The surface layer of sediment, rock waste, alluvium, volcanic ash, glacial drift, organic matter and windblown material which lies above bedrock.

regressive—Applied to bodies of water and sediments deposited therein during withdrawal of the water and/or emergence of the land. (2)

regressive reef—One of a series of reefs or **bioherms** developed close to and generally parallel to the shore as a result of a retreating sea or rising landmass. (2)

relative biological effectiveness—(abbreviated RBE). A factor which is used to compare the biological effectiveness of absorbed radiation doses (that is, rads) due to different types of ionizing radiation. More specifically, it is the ratio of an absorbed dose of X-rays or gamma rays to the absorbed dose of a certain particulate radiation required to produce an identical biological effect in a particular experimental organ-

ism or tissue. This ratio is sometimes called the relative biological efficient factor. (70)

relative current—The current which is a function of the dynamic slope of an **isobaric surface** and which is determined from an assumed **layer of no motion**. The current flows along the contours of **dynamic topography**; the surface slopes upward to the right of the current in the Northern Hemisphere and to the left in the Southern Hemisphere.

relative current speed—The speed determined by the spacing of dynamic contours drawn at equal intervals of **dynamic height anomaly**; the speed is inversely proportional to the distance between contours.

relative index of refraction—See **index of refraction**.

relative response—The relative response of a **transducer**, in **decibels**, is the amount by which the response under some particular condition exceeds the response under a reference condition that should be stated explicitly. (69)

relaxation time—In general, the time interval required for a system exposed to some discontinuous change of environment to under the fraction ($1-e^{-1}$), or about 63 percent, of the total change of state which it would exhibit after an indefinitely long time.

The relaxation time of an instrument is commonly called its **time constant** or lag coefficient. (5)

relief—The inequalities (elevations and depressions) of the sea bottom. (2)

remanent magnetism—Permanent magnetism included in a material by an applied magnetic field. (2)

Rennell's Current—A relatively strong (1.0 to 1.5 knots) nonpermanent current that sets northward across the western approaches to the English Channel. The current appears to be independent of the **North Atlantic Drift** or local winds and occurs most frequently during winter.

replacement—A nearly simultaneous capillary solution and deposition by which a new mineral may grow in the body of an old mineral or mineral aggregate. (2)

residual deposits—Material formed by the decay or disintegration of rock in place.

residual gravity—In gravity prospecting, the portion of a **gravity** effect remaining after removal of some type of regional, usually the relatively small or local anomaly components of the total or observed gravity field.

residual magnetic field—(also called *anomalous field*). That part of the observed magnetic field that remains after removal of the regional magnetic field.

resistivity—The electrical resistance per unit length and per unit reciprocal cross section area of a given material at a specified temperature. It is also possible to define the resistivity of a substance as the resistance of a cube of that substance having edges of unit lengths, with the understanding that the current flows normal to opposite faces and is distributed uniformly over them. Resistivity is commonly expressed in units of ohm centimeters.

The reciprocal of resistivity is **conductivity**. (5)

resolution—1. In gravity or magnetic prospecting, the indication in some measured quantity, such as the vertical component of gravity, or the presence of two or more close but separate disturbing bodies.

2. In wave theory, the separation of spectral components.

resolution limit—In gravity and magnetic prospecting, the separation of two disturbing bodies at which some obvious indication in a measured quantity of the presence of two separate bodies, ceases to be visible.

resonance—1. The phenomenon of amplification of a **free wave** or oscillation of a system by a forced wave or oscillation of exactly equal period. The forced wave may arise from an impressed force upon the system or from a boundary condition. The growth of the resonant amplitude is characteristically linear in time. (5)

2. In tides, the water movement resulting from the natural period of oscillation of a body of water which approximates the period of one of the **tide-producing forces**.

resonance angle—The angle at which the components of the wind speed acting in the direction of the waves is equal to the wave speed. It is expressed as $V \cos \theta = C$, where V is the wind speed, θ the resonance angle, and C the wave speed.

respiration—An oxidation-reduction process by which chemically bound energy in food is transformed to other kinds of energy upon which certain processes in all living cells are dependent. The measurement of carbon dioxide as a product of respiratory activity in marine **phytoplankton** is essential in determining the net productivity. (57)

response—The response of a device or system is the motion or other output resulting from an excitation or stimulus under special conditions. (3)

response time—*See time constant.*

resultant current—(or *vector mean*). The vectorial average of all current observations for a specified area, usually for a specified period of time.

resurgence—The continued rising and falling of a **bay** or semienclosed water body many hours after the passage of a severe storm.

retardation—The amount of time by which corresponding tidal phases grow later day by day (averages approximately 50 minutes). (61)

reticulated bars—Bars with a criss-cross pattern, with both sets diagonal to the **shoreline**. (73)

retrogression of a beach—*See recession.*

reverberation—Sound scattered towards the source, principally from the ocean surface (surface reverberation) or bottom (bottom reverberation), and from small scattering sources in the medium such as bubbles of air and suspended solid matter (volume reverberation).

reverberation index—The measure of the ability of an echo-ranging **transducer** to distinguish the desired echo from the **reverberation**. Computed from the directivity patterns as ratio in **decibels** of the bottom, surface, or volume reverberation response of a specific transducer to the corresponding response of a nondirectional transducer.

reverberation strength—The difference between the level of a plane wave producing in a nondirectional **transducer**, a response equal to that produced by the **reverberation** corresponding to a range of one yard from the effective center of the transducer and the index level of the pulse transmitted, on any bearing, by the same nondirectional transducer. (28)

reversed tide—A gravitational tide which is completely out of phase with the apparent

motions of the principal attracting body; the least heights are directly under the tide-producing body, on opposite sides of the earth. *See direct tide.*

reversible transducer—*See bilateral transducer.*

reversing current—(or *alternating current, rectilinear current*). A tidal current that flows alternately in approximately opposite directions, with a period of **slack water** at each reversal of direction. Reversing currents usually occur in rivers and straits where the flow is restricted. When the flow is toward shore, the current is flooding; when in the opposite direction, it is ebbing.

reversing thermometer—A mercury-in-glass thermometer that records temperature upon being inverted and thereafter retains its reading until returned to the first position. It consists of a conventional bulb connected to a capillary in which a constriction is placed so that upon reversal the mercury column breaks off in a reproducible manner. The mercury runs into a smaller bulb at the other end of the capillary, which is graduated to read temperature. A 360° turn in a locally widened portion of the capillary serves as a trap to prevent further addition of mercury if the thermometer is warmed and the mercury expands past the break-off point.

In measuring temperatures at depths in the sea, both **protected thermometers** and **unprotected thermometers** are used, each of which is provided with an auxiliary thermometer. They are generally used in pairs on **Nansen bottles**. They are usually read to 0.01°C, and after the proper corrections have been applied, their readings are considered reliable to 0.02°C. (Details of the correction procedure are given in **LaFond's Tables** (*H.O. Publication 614*). (5)

Reynolds number—The nondimensional ratio of the inertial force to the viscous force in fluid motion,

$$Re = \frac{LU}{\nu},$$

where L is a characteristic length, ν the kinematic viscosity, and U a characteristic velocity.

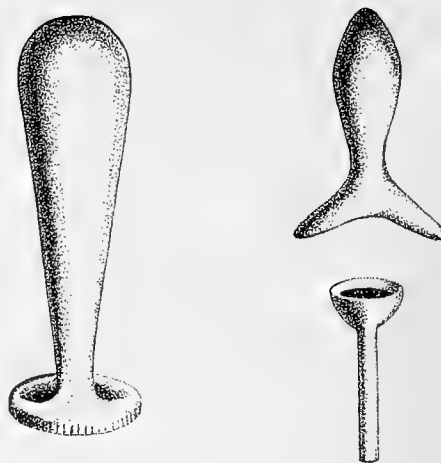
The Reynolds number is of great importance in the theory of hydrodynamic stability and the origin of **turbulence**. (5)

rhabdolith—Minute calcareous bodies contained in deep sea **ooze**, classed as **protozoans** by some investigators and as **algae** by others. (53)

rheologic settling—The failure of a sediment under load through plastic flow. *See rheology.*

rheology—The study of the flow of materials, particularly the plastic flow of solids. (2)

rhizoid—A unicellular or uniseriate rootlike filament serving for attachment of **algae**. (13)



RHABDOLITHS (× 2000)

(SHROCK & TWENHOFEL, 1953)

rhizome—A rootlike stem that creeps just below the surface of the bottom, bearing at the nodes erect stems or leaves and one or more roots.

rhodamine B dye—A synthetic red or pink dye sometimes used as a tracer in studies of flow of water, turbulence, pollution, etc., in rivers, estuaries, and the ocean.

rhumb line—(or *loxodrome*). A curve which crosses all meridians at a constant angle. (37)

ria—Any broad river opening into the ocean. Not necessarily a submerged river mouth or open valley in a mountainous coast.

ria coast—A coast having drowned river valleys characterized by long fiordlike bays which have few branches. The bays differ from fiords in origin and are shorter, shallower, and more funnel shaped, broadening and deepening seaward. The type example is northwestern Spain. (2)

Richter magnitude scale—*See magnitude* (sense 1).

ride-up—*See run-up.*

ridge—A long, narrow elevation of the sea floor with steep sides and irregular topography. (62)

ridged ice—**Pressure ice** in linear formation.

ridging—The process that leads to the formation of **ridged ice**. (65)

rift valley—*See fault block.*

rill mark—A small groove, furrow, or channel made in mud or sand on a beach by tiny streams following an outflowing tide. (2)

rip current—The return flow of water piled up on shore by incoming waves and wind; a strong narrow surface current flowing away from the shore. A rip current consists of three parts: the **feeder current** flowing parallel to the shore inside the **breakers**; the **neck**, where the feeder currents converge and flow through the breakers in a narrow band or "**rip**"; and the **head**, where the current widens and slackens outside the

- breaker line. (*See* figure for nearshore current system.)
- rip feeder current**—*See* feeder current.
- ripple**—1. The ruffling of the surface of water, hence a little curling wave or undulation. (61)
2. A wave controlled to a significant degree by both **surface tension** and gravity.
- ripple marks**—Undulating surface features of various shapes produced in unconsolidated sediments by wave or current action. Compound ripples are characterized by systematically offset crests and are produced by simultaneous interference of wave oscillation with current action. Metaripples are asymmetrical sand ripples. As size increases, ripples grade into sand waves, sand ridges, sand dunes, and migratory sandbanks or shoals.
- rips**—A turbulent agitation of water generally caused by the interaction of currents and wind; in nearshore regions rips may also be caused by currents flowing swiftly over an irregular bottom.
- rip surf**—*See* rip current.
- rip tide**—*See* rip current.
- rise**—1. A long, broad elevation that rises gently and generally smoothly from the sea floor. (62)
2. The water level height measured above **chart datum**.
- rise of the tide**—The height of the tide measured above **chart datum**. (50)
- rising tide**—(sometimes called *flood tide*). The portion of the tide cycle between **low water** and the following **high water**. (5)
- river discharge**—(also called *river outflow*, *river runoff*). The rate of flow of water past a point in a stream, expressed as volume per unit time (usually cubic feet per second, cfs). More specifically, the volume of river water that flows into the sea, usually measured in cubic kilometers, cubic miles, cubic meters, or cubic feet, and sometimes **acre-feet**.
River discharge may affect tidal currents considerably, especially during rainy seasons, by increasing the strength and duration of ebb and decreasing the strength and duration of flood.
- river ice**—Any ice formed in or carried by a river. (68)
- river outflow**—*See* river discharge.
- river runoff**—*See* river discharge.
- Roberts radio current meter**—An electro-mechanical current meter which measures current speed and direction. This meter can be suspended below an anchored buoy or ship which is equipped with a radio transmitter that transmits the current measurements to a ship or shore based monitor station.
- rock**—The naturally occurring material that forms the firm, hard, and solid masses of the ocean floor. Also a collective term for masses of hard material generally not smaller than 256 millimeters. *See* **acid rock**, **basic rock**.
- rock barnacle**—*See* **acorn barnacle**.
- rock borer**—A member of any one of several families, including the Mytilidae, Saxicavidae, and the Pholadidae, of **bivalves** that live in cavities they bore in soft rock, concrete, and other materials. Boring generally is accomplished by rotating the shell, which bears toothed or rasplike projections; chemical solution of the rock may be a method used additionally by some. *See* **marine borer**.
- rock flour**—Finely ground rock particles, chiefly silt size, resulting from glacial abrasion. A component of marine deposits off glacial stream mouths. (2)
- rockweed**—(or *wrack*). One of a group of marine plants, principally of an order (Fucales) of the **brown algae**, mostly multibranched and leathery, which grow attached to rocks in the **intertidal zone** by means of an organ called a **holdfast**. The rockweed of the New England clambake belongs to the genera *Fucus* and *Ascophyllum*.
- rocky area**—(or *foul area*). An area with a rocky bottom.
- roentgen**—(abbreviated r). An exposure dose of X- or gamma radiation such that the associated corpuscular emission per 0.001293 grams of air produces, in air, ions carrying 1 electrostatic unit of quantity of electricity of either sign. (70)
- Roentgen equivalent man**—(abbreviated rem). A measure of any ionizing radiation to body tissue in terms of its estimated biological effect relative to a dose of one **roentgen** (r) of X-rays. The relation of the rem to other dose units depends upon the biological effect under consideration and upon the conditions of the irradiation. Practically speaking each of the following is considered to be equivalent to a dose of one rem: (1) A dose of 1 roentgen due to X- or gamma radiation; (2) A dose of 1 rad due to X-, gamma, or beta radiation; (3) A dose of 0.1 rad due to neutrons or high energy protons; and (4) A dose of 0.5 rad due to particles heavier than protons. (As defined by the *Atomic Energy Commission*.) *See* **radiation absorbed dose**.
- Roentgen equivalent physical**—(abbreviated rep). The rep is defined as the quantity of corpuscular radiation which produces in tissue, per gram of tissue, ionization equivalent to the quantity of ionization of 1 roentgen of gamma radiation in air. However, in early practice the rep was widely accepted as a unit of absorbed dose representing 93 to 97 ergs per gram of soft animal tissue. Although the rep unit is still being used in some food irradiation studies and other miscellaneous radiation experiments, it is quite rapidly being replaced by the more easily defined rad units. (70) *See* **radiation absorbed dose**.

roll—*See* **ship motion**.

roll angle—*See* **angle of roll**.

roller—1. An indefinite term, sometimes considered to denote one of a series of long-crested, large waves which roll in upon a coast, as after a storm.

2. Large **breakers** on exposed coasts formed by **swell** coming from a great distance.

3. *See* **comber**.

(61)

ropak—An extreme formation of **ridged ice**; a pinnacle or slab of heavy sea ice standing vertically on edge. (59)

rorqual—Any **baleen whale** of the family Balænopterae, a group characterized by having a triangular dorsal fin and a series of parallel grooves running longitudinally on the under surface of the throat and chest region; for example, the blue whale, fin whale, sei whale, minke whale, and humpback whale.

Rossel Current—A seasonal current flowing westward and northwestward along both the southern and northeastern coasts of New Guinea during May to September; the southern part flows through Torres Strait and loses its identity in the Arafura Sea, and the northern part curves northeastward to join the Pacific **Equatorial Countercurrent**. The Rossel Current is a weak branch of the **South Equatorial Current**. During the Northern Hemisphere winter it is replaced by an east-flowing current from the Indian Ocean.

rot—*See* **disintegration**.

rotary current—A **tidal current** that flows continually, with the direction of flow changing through all points of the compass during a **tide cycle**. Rotary currents usually occur offshore where the direction of flow is not restricted; unless modified by local conditions, the change in direction is generally clockwise in the Northern Hemisphere and counterclockwise in the Southern Hemisphere. The speed of the current usually varies throughout the tide cycle, passing through two maximums in approximately opposite directions and two minimums where the direction of the current is approxi-

mately 90 degrees from the direction at time of maximum speed. (*See* figure for **current ellipse**.)

rotten ice—(also called *spring sludge*). Ice that has become honeycombed in the course of melting and is in an advanced state of **disintegration**. (74)

Rotten ice may appear transparent (and thus dark) when saturated with sea water, and thus may easily be confused with newly forming **black ice**. *See* **candle ice**. (5)

rough ice—An expanse of ice having an uneven surface caused by **pressure ice** formations or **growlers** frozen in place. (59)

rubber ice—Elastic young sea ice, not strong enough to bear the weight of a man standing still. (59) Rare.

rubble—1. Fragments of hard sea ice, roughly spherical and up to 5 feet in diameter, resulting from the **disintegration** of larger ice formations. When afloat, commonly called **brash ice**. (59)

2. Loose angular rock fragments.

rudite—(or *rudyte*). Rock or sediment deposits composed of grains larger than 2 millimeters. *See* **psephite**.

rudyte—*See* **rudite**.

runnel—A trough or corrugation formed in the **foreshore** or in the bottom, immediately offshore, formed by waves or tidal currents. (2)

running ice—Ice in motion or capable of rapid drifting. (59) Rare.

running mean—*See* **consecutive mean**.

runoff—The water derived from precipitation that ultimately reaches stream channels; has a direct influence upon the volume of **river discharge**.

runoff cycle—The part of the **hydrologic cycle** undergone by water between the time it reaches the land as precipitation and its subsequent evapotranspiration or discharge through stream channels. (5)

run-up—(or *uprush*). The rush of water up a structure on the breaking of a wave. The amount of run-up is the vertical height above **still water level** that the rush of water reaches. (61)

S

sabellid—*See tubeworm.*

sac—1. An indentation in the contours on a chart showing submarine relief which is analogous to a **gulf** on the surface. The opposite term is **submarine peninsula**.

2. In biology, a sack, bag, or pouch.

saddle—A low part on a **ridge** or between **seamounts**. (62)

sailing directions—Information published in book form describing coasts, waters, channels, harbor facilities, etc., for use of mariners. (30)

sailing ice—*See scattered ice.*

sailor's purse—(or *mermaid's purse*, *skate barrow*). The tough egg capsule of skates and certain rays, usually deposited on mud and sand flats. The capsules are oblong with a horn extending lengthwise from each of the four corners and are blackish when seen on the beach.

St. Elmo's fire—(also called *Elmo's fire*, *corposant*). A **corona discharge**.

salgaso—*See aguaje.*

salient point—A **point** formed by a conspicuous projection extending outward from the general trend of the coast.

salina—A **salt marsh** or salt pond separated from the sea but flooded by high tides. Shallow salt ponds are used to evaporate the water in the commercial production of salt and are called salt gardens or salterns.

salinity—A measure of the quantity of dissolved salts in sea water. It is formally defined as the total amount of dissolved solids in sea water in parts per thousand (‰) by weight when all the carbonate has been converted to oxide, the bromide and iodide to chloride, and all organic matter is completely oxidized. These qualifications result from the chemical difficulty in drying the salts in sea water. In practice, salinity is not determined directly but is computed from **chlorinity**, **electrical conductivity**, refractive index, or some other property whose relationship to salinity is well established.

Because of the Law of Constancy of Proportions, the amount of chlorinity in a sea water sample is used to establish the sample's salinity.

The relationship between chlorinity Cl and salinity S as set forth in **Knudsen's Tables** is:

$$S = 0.03 + 1.805 Cl.$$

A joint committee of IAPO, UNESCO, ICES, and SCOR proposed the universal adoption of the following equation for determining

salinity from chlorinity: $S = 1.80655 Cl$. It was adopted by IAPO in 1963 and ICES in 1964.

salinity bridge—*See salinometer.*

salinometer—(or *salinity bridge*). Any device or instrument for determining **salinity**, especially one based on **electrical conductivity** methods. (5)

salp—Any one of a class (Thaliacea) of marine animals which are transparent pelagic representatives of the **tunicates**. The body is more or less cylindrical and possesses conspicuous ring-like muscle bands, the contraction of which propels the animal through the water. Several kinds are bioluminescent.

salt—Any substance which yields **ions**, other than hydrogen or hydroxyl ions. A salt is obtained by displacing the hydrogen of an acid by a metal. (27)

saltation—That method of sand movement in a fluid in which individual particles leave the bed by bounding nearly vertically and, because the motion of the fluid is not strong or turbulent enough to retain them in suspension, return to the bed at some distance downstream. (61)

salt crust—Salt that is forced out of young sea ice by crystal growth, pushed upward, and deposited on the surface of the ice. (A salt crust surface is wet even at low temperatures.) (59)

salterns—*See salina.*

salt flower—*See ice flower.*

salt gardens—*See salina.*

salt marsh—Flat, poorly drained coastal swamps which are flooded by most high tides.

salt pans—Shallow pools of brackish water used for the natural evaporation of sea water to obtain salt. (2, 30)

salt water—*See sea water.*

salt water wedge—An intrusion in a tidal **estuary** of sea water in the form of a wedge characterized by a pronounced increase in salinity from surface to bottom.

sand—Loose material which consists of grains ranging between 0.0625 and 2.0000 millimeters in diameter. *See phi grade scale.*

sand apron—Sand deposited along the shore of a reef lagoon. (2)

sand bar—1. *See bar.*

2. In a river, a ridge of sand built up to or near the surface by river currents. (61)

sand dollar—*See sea urchin.*

sand horn—A pointed sand deposit extending from shore into shallow water. *See also sand lobe.* (2)

sand lobe—A rounded sand deposit extending from shore into shallow water. *See also sand horn.* (2)

sand reef—*See bar.*

sandstone—(also called *arenite, arenyte, psammitite, psammyte*). Rock composed of cemented sand sized grains, predominantly quartz.

sand wave—*See megaripple.*

saprolith—*See regolith.*

sapropel—An aquatic ooze or sludge that is rich in organic matter. (2)

saprophytic nutrition—That process by which an organism absorbs organic food from its surroundings, usually after digesting it externally. *See heterotrophic nutrition.*

sargasso—1. *See Sargassum.*
2. Loosely, a large floating mass of seaweed. (68)

Sargasso Sea—The region of the North Atlantic Ocean to the east and south of the **Gulf Stream system**. This is a region of convergence of the surface waters and is characterized by clear, warm water, a deep blue color, and large quantities of floating *Sargassum* or gulfweed. (5)

sargasso weed—*See Sargassum.*

Sargassum—(or *gulfweed, sargasso weed*). 1. A genus of **brown algae**.
2. The common name of a plant of this genus, characterized by a bushy form, a substantial **holdfast** when attached, and a yellowish brown, greenish yellow, or orange color. Species of the group have a large variety of forms and are widely distributed in warm seas as attached and free-floating plants. Two species (*S. fluitans* and *S. natans*) make up 99 percent of the macroscopic vegetation in the **Sargasso Sea**.

sastrugi—Wavelike ridges of hard snow formed on a level surface by the action of the wind. (65)

satins ice—*See acicular ice.*

saturation—The condition in which the partial pressure of any fluid constituent is equal to its maximum possible partial pressure under the existing environmental conditions, such that any increase in the amount of that constituent will initiate within it a change to a more condensed state. In molecular-kinetic terms, saturation is attained when the rate of return of molecules of a substance from the dissolved liquid or vapor phase to the more condensed parent phase is exactly equal to the rate of escape of molecules from the parent phase. (5)

saturation vapor pressure—1. The vapor pressure of a system, at a given temperature, where in the vapor of a substance is in equilibrium with a plane surface of that substance's pure liquid or solid phase; that is, the vapor pressure of a system that has attained **saturation** but not supersaturation. The saturation vapor pressure of

any pure substance, with respect to a specified parent phase, is an intrinsic property of that substance, and is a function of temperature alone.

2. *See equilibrium vapor pressure.*

(5)

Savonius rotor current meter—A low-threshold current speed sensor composed of two semicylindrical vanes disposed to form an S-shaped rotor responsive to a wide spectrum of horizontal flow components. Present instruments generally utilize paired Savonius rotors with axes displaced by 90 degrees for a more nearly uniform omnidirectional torque distribution. (19)

scalar irradiance—A quantitative measure of the total **radiant flux** arriving at a point for all directions about a point. It is the measure of the amount of radiant energy per unit volume of space at a given point.

scalar mean—*See mean current.*

scale—The ratio between the linear dimensions of a chart, drawing, etc., and the actual dimensions of the object represented, expressed as a proportion. Chart or map scales are conventionally classed as large (larger than 1:1,000,000), medium (1:600,000 to 1:1,000,000), or small (smaller than 1:600,000).

scale error—*See calibration error.*

scaler—An electronic device which registers current pulses received over a given time interval. (70)

scaophod—*See tooth shell.*

scarp—*See escarpment.*

scatterance—The ratio of the **radiant flux** scattered from a beam, to the incident flux. (8)

scatterance meter—An assembly of a collimated light source and a **radiance meter** which directly measures the **scatterance** values of an optical medium. Scatterance meters fall into three main classes: free-angle, fixed-angle, and integrating scatterance meters. The first type is designed to determine in principle all values of the volume **scattering function** at a given point; the second is designed to determine the function for a fixed angle; and the third type is designed to integrate directly the function over all angles so as to record the total **scattering coefficient**. (8)

scattered ice—(also called *sailing ice*). **Sea ice** that covers from 1- to 5-tenths of the sea surface. (65)

Note: This term is being superseded by the WMO term "very open pack ice".

scattering—1. The random dispersal of sound energy after it is reflected from the sea surface or sea bottom and/or off the surface of solid, liquid, or gaseous particles suspended in the water.

2. The dispersion of light when a beam strikes very small particles suspended in air or water.

Theoretically, in light scattering, there is no loss of intensity, but only a redirection of light.

3. Change of direction of a subatomic particle or **photon** as a result of a collision or interaction. (70)

scattering coefficient—(or *total scattering coefficient*). A measure of the **attenuation** due to scattering of radiation as it traverses a medium containing scattering particles. (5)

scattering function—The intensity of scattered radiation in a given direction per lumen of flux incident upon the scattering material.

When the collection of scattering particles is taken to be those in one unit volume, the associated scattering function is known as the volume scattering function. (5)

scattering loss—That part of the **transmission loss** which is due either to scattering within the medium or due to roughness of the reflecting surface. (6)

schistosome dermatitis—(or *swimmer's itch, seabather's eruption*). An irritating skin condition incurred by bathers in both fresh and salt waters and characterized by the eruption of reddish wheals and a severe itching sensation. The cercarian larvae of certain parasitic trematode worms produce the dermatitis when they enter the skin and die.

schizopod stage—That stage in the development of a **decapod** crustacean when it resembles an adult. (26)

school—A large number of one kind of fish or other aquatic animals swimming or feeding together (a school of herring). *See* **shoal**.

scintillation—1. A flash of light produced in a phosphor by an ionizing agent. (41)

2. A generic term for rapid variations in apparent position, brightness, or color of a distant luminous object viewed through the atmosphere. (5)

scintillation counter—The combination of phosphor, **photomultiplier tube**, and associated circuits for counting light emissions produced in the phosphors. (70) (*See* figure for **photomultiplier tube**.)

scintillation spectrometer—A **scintillation counter** adapted to the study of energy distributions. (41)

scintillator—(or *phosphor*). A transparent material, either crystalline, organic, or liquid, which produces a flash of light as a result of fluorescent radiation emitted by atoms of the material when they return to their normal energy state after having been ionized or excited by charged particles passing through the material. (18)

scoopfish bottom sampler—A small bottom sediment sampling device for underway use which consists essentially of a streamlined weighted tube with stabilizing fins. The leading end of the tube is completely open so that a scooping effect is achieved when the sampler is towed.

Bottom contact releases a spring activated cover over the tube's open end so that any sediment sampled can be brought to the surface.

scoria—Volcanic rock fragments usually of basic composition, characterized by marked vesicularity, dark color, high density, and a partly crystalline texture. Fragments between 4 and 32 millimeters are equivalent to volcanic cinders.

scour—The downward and sideward erosion of a sediment bed by wave or current action.

scree—*See* **talus**.

screw ice—1. *See* **pressure ice**.

2. Small ice fragments in heaps or ridges produced by the crushing together of **ice cakes**. Also applied to small formations of **ridged ice**, **rafted ice**, and **hummocked ice**. (59)

screwing pack—An **ice pack** in which the **ice floes** or **ice cakes** are in rotary motion due to the influence of wind and current. (68)

scyphozoan—One of a class (Scyphozoa or Scyphomedusae) of **coelenterates** in which the **polyp** or **hydroid** stage is minimized or insignificant and the medusoid stage is well developed. The true jellyfishes belong to this group.

sea—1. *See* **ocean**. (5)

2. A subdivision of an ocean.

All seas except **inland seas** are physically interconnected parts of the earth's total salt water system. Two types are distinguished, mediterranean and adjacent. Mediterranean are groups of seas, collectively separated from the major water body as an individual sea. Adjacent seas are those connected individually to the larger body. (5)

3. *See* **sea state**.

4. Waves generated or sustained by winds within their **fetch**; opposed to swell. *See* **fully developed sea**.

sea anemone—Any of numerous **anthozoans** (Actiniaria) whose form, bright colors, and tentacles about the mouth often give them a superficial resemblance to a flower.

sea arch—(or *marine arch, natural arch, marine bridge*). Wave erosion of a cave or tunnel through a **headland** leaving a bridge of rock over the water.

sea arrow—(or *flying squid*). One of a family (Ommastrephidae), but more particularly one of a genus (*Ommastrephes*) of this family of **cephalopods** which are elongated and streamlined and possess terminal fins which unite in a point at the terminus of the body. These species are capable of rapid swimming and can overtake schools of fish on which they prey; they often hurtle out of the water and sail through the air, at times landing on the decks of ships.

sea bar—*See* **belt**.

seabather's eruption—*See* **schistosome dermatitis**.

seabeach—*See* **beach**.

sea bed—*See* **sea floor**.

sea bloom—*See plankton bloom.*

seaboard—A general term for the rather extensive coastal region bordering the sea. (68)

sea bottom—*See sea floor.*

sea breeze—A light wind blowing toward the land caused by unequal heating of land and water masses. (61)

sea butterfly—*See pteropod.*

sea cave—(or *marine cave*). A cave eroded in a **sea cliff** by wave action. It usually is at sea level.

seachannel—A long, narrow, U-shaped or V-shaped shallow depression of the sea floor, usually occurring on a gently sloping **plain** or **fan**. (62)

sea cliff—A cliff situated at the seaward edge of the coast. (61) (*See figure for shore profile.*)

sea clutter—*See sea return.*

sea cow—(or *sirenian*). An aquatic herbivorous mammal of the order Sirenia which includes the dugong, the manatee, and the allegedly extinct Stellar sea cow.

sea cucumber—(or *holothurian*). One of a class (Holothuroidea) of elongate, usually wormlike **echinoderms** which have a flexible body wall and creep over the bottom from shallow water to great depths. They are eaten commonly in the Orient as the trepang or *bêche-de-mer* of the Chinese.

sea fan—Any of a group of fanlike sessile **anthozoans**.

sea feather—1. Any of a group of featherlike sessile **anthozoans**.

2. Any of a group of featherlike sessile **crinoids**.

sea fire—(or *burning of the sea*). A brilliant display of **bioluminescence**; more commonly described from tropical waters.

sea floor—(or *sea bed, sea bottom*). The bottom of the ocean where there is a generally smooth, gentle gradient. In many uses depth is disregarded and the term may be used to designate areas in **basins** or **plains** or on the **continental shelf**.

sea fog—A type of **advection fog** formed when air that has been lying over a warm water surface is transported over a colder water surface, resulting in cooling of the lower layer of air below its dew point. (5)

sea gate—A restricted passage leading to the sea. (68)

sea gooseberry—A luminescent **ctenophore** (*Pleurobrachia pileus*) found in coastal waters. Has the appearance of a transparent gooseberry.

sea grape—A small **ascidian**, particularly of the species *Molgula manhattensis*, which grows in large clusters on piles, rocks, and other underwater objects.

seagrass—1. A member of either of two families (Hydrocharitaceae and Zosteraceae) of usually grasslike marine **spermatophytes**. Seagrasses grow chiefly on sand or mud-sand bottoms and

most abundantly in water less than 30 feet, but some may grow on rock in the **intertidal zone**, and others may range to depths of at least 200 feet. The eelgrass (*Zostera marina*), the turtlegrass (*Thalassia testudinum*), and the manatee-grass (*Syringodium filiforme*) are better known members of these families.

2. Any grasslike marine **alga**.

sea ice—1. Specially, ice formed by the freezing of sea water; opposed, principally to land ice. In brief, it forms first as **frazil** crystals (lolly ice), thickens into **sludge**, and coagulates into **sheet ice, pancake ice, or ice floes** of various shapes and sizes. Thereafter, sea ice may develop into **pack ice** and/or become a form of **pressure ice**.

2. Generally, any ice floating in the sea.

(5)

sea ice shelf—Sea ice floating in the vicinity of its formation and separated from **fast ice**, of which it may have been a part, by a **tide crack**, or a family of such cracks. (68)

seaknoll—*See knoll.*

sea lettuce—One of either of two genera (*Monostroma* and *Ulva*) of membranous **green algae**.

sea level—(or *water level*). The height of the surface of the sea at any time.

sea level datum—*See mean sea level.*

sea lily—*See crinoid.*

sea mat—*See bryozoan.*

sea mist—*See steam fog.*

sea moat—*See moat.*

seamount—An elevation rising 500 fathoms (1,000 meters) or more from the sea floor and of limited extent across the summit. (62)

seamount chain—Several **seamounts** in a line with bases separated by a relatively flat sea floor. (62)

seamount group—Several closely spaced **seamounts** not in a line. (62)

seamount range—Several **seamounts** having connected bases and aligned along a **ridge** or **rise**. (62)

sea mud—A rich saline deposit from **salt marshes** and seashores. (2)

seapeak—*See seamount.*

sea pen—Any of a group of penlike or featherlike sessile **anthozoans**.

sea puss—A dangerous **longshore current**, a **rip current**, caused by return flow, loosely the submerged channel or inlet through a **bar** caused by those currents. (61)

sea reach—The straight section of the lower course of a river between the last bend and the sea. (68)

sea return—(also called *sea clutter*). Radar echoes reflected from the sea. (68)

seascarp—*See escarpment.*

seashore—The **shore** of a sea or ocean. (61)

seashore lake—A body of water isolated from the sea by sediment bars or banks.

sea slick—An area of sea surface, variable in size and markedly different in appearance, with color and/or oiliness; usually caused by **plankton blooms**.

sea slide—A submarine sediment slump or mass movement which may evolve into a turbidity flow. Analogous to a landslide. (2)

sea slug—*See nudibranch.*

sea snake—A reptile of the family Hydrophiidae; a group comprising about 50 species of truly marine forms distantly related to the cobras and possessing similar venom. All are inhabitants of warm coastal waters of the Indian Ocean and western Pacific with one exception, the yellow-bellied sea snake, which is oceanic and ranges entirely across both the Indian and Pacific Oceans in low latitudes.

sea snow—(also called *plankton snow*, *marine snow*). Particles of organic detritus and living forms. The downward drift of these particles and living forms, especially in dense concentrations, appears similar to a snowfall when viewed by underwater investigators.

seasonal current—A current that changes with seasonal winds.

sea spider—(or *pycnogonid*). One of a class (Pycnogonida) of spiderlike benthic **arthropods** which range from shallow water to great depths. The species inhabiting shallow waters range in size from a fraction of an inch to a few inches; the deepwater species may attain a spread of several feet.

sea squirt—*See ascidian.*

sea stack—A tall, columnar rock isolated from the coast by differential wave erosion. (2)

sea star—(or *starfish*). One of a class (Asteroidea) of **echinoderms** having a flat, usually five-armed body. The body wall contains embedded calcareous plates bearing spines or tubercles. Some spines are modified into pincerlike organs, called pedicellariae, which in some tropical species are dangerously venomous to humans.

sea state—(or *state of the sea*). The numerical or written description of ocean surface roughness. For more precise usage sea state may be defined as the average height of the highest one-third of the waves observed in a wave train, referred to a numerical code which covers an increasing range of such heights as indicated by WMO Code 75 table below:

Code	Wave height (feet)
0-----	0
1-----	0-1/2
2-----	1/2-1 2/3
3-----	1 2/3-4
4-----	4-8
5-----	8-13
6-----	13-20
7-----	20-30
8-----	30-45
9-----	Over 45

sea turtle—Any of various large marine turtles belonging to the reptilian order Testudinata and having the feet modified into paddle-like appendages, including the leatherback, hawksbill, loggerhead, green, and Ridley turtles, and being widely distributed in warm seas.

sea urchin—One of a class (Echinoidea) of **echinoderms** in which the body is covered by a hard shell (or **test**) composed of fitted immovable plates; spines articulated at their bases and of various sizes, often large, and sharp are present on the test; members of the class may be spherical (the regular sea urchins), depressed spherical (the cake urchins), discoidal (the sand dollars), or round elongate (the heart urchins). Many species of urchins have venomous spines.

sea valley—*See valley.*

sea wall—A manmade structure of rock or concrete built along a portion of coast to prevent wave erosion of the beach. (2)

sea walnut—A transparent, luminescent **ctenophore** (*Mnemiopsis*). Often seen in large swarms on the surface in coastal waters.

seaward beach—The seaward facing beach of the reef islands. (56) (*See figure for atoll.*)

seaward reef margin—The seaward edge of the **reef flat**, marked in places by an **algal ridge** and cut by **surge channels**, which are the landward extensions of the reef-front grooves. (56) (*See figure for atoll.*)

sea water—The water of the seas, distinguished from **fresh water** by its appreciable **salinity**. The amount of the salinity greatly affects the water's physical characteristics.

The distinction between the usage of salt water and sea water is not very sharply drawn. Commonly, sea water is used as the antithesis of specific types of fresh water, as river water, lake water, rain water, etc., whereas salt water is merely the antithesis of fresh water in general.

seawater batteries—Silver-zinc batteries activated by flow of sea water through them.

seaweed—(or *weed*). Any macroscopic marine **alga** or **seagrass**.

Secchi disc—A white, black, or varicolored disc, 30 centimeters (about 11.7 inches) in diameter, used to measure water **transparency** (clarity). The disc is lowered in the water and the depth (in meters) at which it disappears from sight is averaged with the depth at which it reappears. This average value is used to represent sea water transparency.

second—1. A term used to describe distance or depth; one second refers to about 4,800 feet, or the distance that sound will travel through sea water during one second. Two ships may be said to be 10 seconds apart when their positions are separated by about 48,000 feet.

2. The sixtieth part of a minute of angular measure.

3. The sixtieth part of a minute of time. (35)
- secondary current pattern**—A short-period variation of the **prevailing current pattern**.
- secondary electron**—An **electron** ejected from an atom, molecule, or surface as a result of a collision with a charged particle or **photon**. (70)
- secondary production**—The organic matter produced by herbivores of the **zooplankton** in a given area or volume in a given time. The second **trophic level**.
- secondary tide station**—A place at which tide observations are made over a short period. (68) *See* **subordinate station**.
- secular change**—An increase or decrease of intensity and/or change of direction of the total magnetic field over a period of many years.
- sediment**—Particulate organic and inorganic matter which accumulates in a loose unconsolidated form. It may be chemically precipitated from solution, secreted by organisms, or transported by air, ice, wind, or water and deposited.
- sedimentary basin**—A depression, often marine, in which sediments are deposited. The deposits are usually thickest in the center and thinner toward the edges. (2)
- sedimentary rocks**—Rocks formed by the accumulation of sediment in water (aqueous deposits) or from air (eolian deposits). The sediment may consist of rock fragments or particles of various sizes (conglomerate, sandstone, shale); of the remains or products of animals or plants (certain limestones and coal); of the product of chemical action or of evaporation (salt, gypsum, etc.); or of mixtures of these materials. (2)
- sedimentation**—The process of breakup and separation of particles from the parent rock, their transportation, deposition, and consolidation into another rock.
- sedimentation method**—A technique used in the quantitative estimation and identification of **phytoplankton** organisms. The plankton to be measured is concentrated by settling in glass cylinders and the organisms are counted or identified by using an inverted microscope.
- sedimentation unit**—That thickness of material which are deposited under essentially constant physical conditions. (2)
- sedimentology**—The study of **sedimentary rocks** and the processes by which they were formed. (2)
- segmented worm**—*See* **annelid**.
- seiche**—1. A **standing wave** oscillation of an enclosed or semienclosed water body that continues, pendulum fashion, after the cessation of the originating force, which may have been either seismic, atmospheric, or wave induced.
2. An oscillation of a fluid body in response to a disturbing force having the same frequency as the natural frequency of the fluid system. Tides are now considered to be seiches induced primarily by the periodic forces caused by the sun and moon. (5)
- seine**—A type of net used to catch fish by encirclement, usually by active closure of the two ends but also including closure or pursing of the bottom (**purse seine**).
- seismic activity**—*See* **seismicity**.
- seismicity**—The phenomenon of earth movements.
- seismic profile**—The data resulting from a single series of observations made at one geographic location with a linear arrangement of seismometers. (4)
- seismic profiler**—A continuous deep sea reflection system used to study the structure beneath the ocean floor to depths of 10,000 feet or more. The reflections are recorded on a drum whose rotation is actuated by the initial explosion. (4)
- seismic reflection**—The measurements, and recording in wave form, of the travel time of acoustic energy reflected back to detectors from rock or sediment layers which have different elastic wave velocities.
- seismic sea wave**—*See* **tsunami**.
- seismograph**—An instrument used to measure and record earthquake vibrations and other earth tremors. (5)
- selachian**—*See* **shark**.
- selective filter**—(or *colored filter*). An **optical filter** which changes, by absorption, the spectral distribution of the energy passing through it. (8)
- self noise**—*See* **own ship's noise**.
- semidaily**—*See* **semidiurnal**.
- semidiurnal**—(or *semidaily*). Having a period or cycle of approximately half a **lunar day** (12.42 solar hours). The tides and tidal currents are semidiurnal when two flood and two ebb periods occur each lunar day.
- semidiurnal constituent**—A tidal constituent that has two maximums and two minimums each constituent day; its symbol is usually distinguished by the subscript 2, as M_2 , S_2 , N_2 , etc.
- semidiurnal current**—The type of tidal current having two flood and two ebb periods of nearly the same duration during a tidal day; usually associated with a **semidiurnal tide**.
- semidiurnal tide**—The type of tide having two **high waters** and two **low waters** each tidal day, with small inequalities between successive high and successive low water heights and durations. (*See* figure for **types of tide**.)
- sensible heat**—The portion of energy exchanged between ocean and atmosphere which is utilized in changing the temperature of the medium into which it penetrates.
- sensor**—A technical means, usually electronic, to extend man's natural senses by means of energy emitted or reflected. The energy may be nuclear, electromagnetic, including the visible and invisible portions of the spectrum, chemical, biological, thermal, or mechanical.

sequence of current—The order in which the four tidal current strengths occur daily, with special reference as to whether the stronger flood immediately precedes or follows the stronger ebb. Usually associated with mixed tidal currents having inequalities in speeds and durations.

sequence of tide—The order in which the four tides of a day occur, with special reference as to whether the **higher high water** immediately precedes or follows the **lower low water**. Usually associated with a mixed tide having inequalities in heights and durations. (50)

sergestid—One of a family (Sergestidae) of usually deep pelagic shrimps or prawns.

serial station—(also called *hydrographic station*). An **oceanographic station** consisting of one or more Nansen casts. (5)

serpulid—*See tubeworm.*

sessile—1. Attached directly by base, without stipe or stalk.

2. Permanently attached; not free to move about.

seston—The living and nonliving bodies which swim or float in water.

set—1. (or *current direction*). The direction toward which the current flows. Usually indicated in degrees true or points of the compass.

2. (or *settle*). To attach to a surface, as by the larvae of various marine **invertebrates**.

3. The periodic attachment of many larvae of marine invertebrates, especially **barnacles** and **bivalves**, to a surface.

settle—*See set.*

settling volume—The amount of **plankton** in a container concentrated by gravity and having variable quantities of interstitial water.

shadow zone—A region into which very little sound energy penetrates.

shallow marginal seas—*See shelf seas.*

shallows—An indefinite term applied to expanses of shoal or shallow water.

shallow scattering layer—The population(s) of organisms in water over a **continental shelf** which scatter sound. The organisms usually occur as separate groups or patches and are discontinuous horizontally. The horizontal dimensions of such patches on the echo-sounder record usually are less than the vertical dimensions. *See deep scattering layer, surface scattering layer.*

shallow water—(or *very shallow water*). 1. Commonly, water of such a depth that surface waves are noticeably affected by bottom topography. It is customary to consider water of depths less than half the surface wavelength as shallow water.

2. In hydrodynamics with regard to progressive **gravity waves**, water in which the depth is less than $1/25$ the wavelength.

(61)

shallow water constituent—A short-period harmonic term introduced into the formula of as-

tronomical tide constituents to take account of the change in the form of a tide wave resulting from shallow water conditions. Shallow water constituents include **overtides** and **compound tides**. (50)

shallow water wave—(also called *very shallow water wave*). A progressive **gravity wave** which is in water less than $1/25$ the wavelength in depth. (73)

shard—A curved, spiculelike fragment of volcanic glass. (2)

shark—(or *selachian*). Any of approximately 250 species of fishlike vertebrates belonging to the elasmobranch order Selachii, and including the large plankton-feeding basking whale and sharks, the predacious white, mako, tiger, blue, hammerhead, sand, and gray sharks, and a variety of others such as the cow, frill, horn, thresher, nurse, cat, angel, and dogfish sharks.

shear crack—A crack in sea ice caused by two different, simultaneous forces acting in parallel but opposite directions on adjacent portions of the ice. The sheared parts undergo a displacement parallel to the plane of the crack. (68)

shearing stress—Any of the tangential components of the **stress tensor**. In oceanography, the shearing stress exerted on the sea surface by the wind.

sheet flow—*See laminar flow.*

sheet ice—Ice formed in a smooth thin layer on a water surface by the coagulation of **frazil** or **sludge**. (5)

sheet-type luminescence—1. A display of biological light appearing diffuse or shimmering, often making the sea surface appear milky or greenish in color. This type of display usually is caused by masses of microscopic or tiny organisms. Displays may cover large areas of the sea surface, at times causing a uniform glow from horizon to horizon, or they may appear as irregular patches or wide ribbons of light in an otherwise dark sea. *See bioluminescence.*

2. Called "spilled luminescence" in Russian papers.

shelf—1. This term is not recommended by ACUF for a rock ledge, reef, or sandbank in the sea.

2. Short form for **continental** (or island) **shelf**.

shelf break—*See shelf edge.*

shelf edge—The line along which there is a marked increase of slope at the outer margin of a **continental** (or island) **shelf**. (62)

Note: Conventionally the shelf edge has been taken at 100 fathoms (200 meters).

shelf ice—*See ice shelf.*

shelf seas—(or *shallow marginal seas*). Shallow seas which occupy wide portions of a **continental shelf**. *See also epeiric seas, inland seas, epicontinental seas.*

shell—The hard outer covering of an **invertebrate**; a calcareous, siliceous, bony, horny, or chitinous covering.

shellfish—Any aquatic **invertebrate** with a hard external covering, but more commonly any **crustacean** or **mollusk**, especially the edible commercial species.

shell ice—(also called *cat ice*). Ice, on a body of water, that remains as an unbroken surface when the water level drops so that a cavity is formed between the water surface and the ice. (5)

shingle—Rounded, often flat waterworn rock fragments larger than approximately 16 millimeters.

shingle barchanes—Ridges of **shingle**, with intervening troughs of sand, formed in shallow water at right angles to the beach.

shingle rampart—A ridge of **shingle**, about 3 to 6 feet (1 to 2 meters) high, built by waves on the seaward edge of and parallel to a **reef flat**. (2)

shipboard synoptic system—Electronic shipboard system (hove-to) that collects, records, and prepares for radio transmission the profile of temperature, salinity, and sound velocity with depth.

shipborne expendable bathythermograph (BT)

—An instrument system designed to record water temperature with depth from a ship moving at speeds up to 25 knots in sea states up to 6 (13 to 20 feet) without interference to normal ship routine. It can provide measurements from surface to 1,500 feet with an accuracy of ± 2 percent or 15 feet whichever is greater and a temperature accuracy of $\pm 0.4^\circ\text{F}$ over a range of 28° to 95°F .

ship motion—In perfectly calm water a carefully steered ship moves along a straight course. A point which corresponds to the center of gravity of the ship also moves along this straight line at a constant velocity. In a wave system, however, this point deviates from this simple, straight line motion in six different ways:

1). Heave, the up-and-down motion of this point as it travels along.

2). Surge, the fore-and-aft motion of this point as the ship speeds up and slows down when she encounters waves.

3). Sway, the athwartship motion as the point departs from a straight line path.

4). Roll, the athwartships angular rotation about this point which occurs as the ship heels first to one side and then to the other.

5). Pitch, the fore-and-aft angular rotation about this point which occurs as the bow and stern alternately rise and fall.

6). Yaw, the horizontal angular rotation about this point which occurs as the direction of the ship's keel is deflected from the direction of her course.

The first three motions are translational motions, the last three are rotational motions. In

other words, the first three motions are motions such that the center of gravity actually departs from its straight line motion and the last three motions are motions such that the center of gravity does not depart from its position.

(46)

ship observations—Meteorological and oceanographic data taken for a specific location, observed from a ship underway or at anchor.

ship report—The encoded and transmitted report of a marine weather observation. (5)

ship synoptic code—A synoptic code for communicating marine weather observations. It is a modification of the **International Synoptic Code**. (5)

Ship Visit Report—A navigational report submitted by ship's personnel. In addition to data affecting the safety of navigation, the reports involve such intelligence as marine and celestial phenomena, weather routing, current data, etc.

shipworm—(or *Teredo*). One of a family (*Teredinidae*) of wormlike **bivalves** in which the shells are limited to the head end. **Larvae** penetrate wood, plastics, and other material, and the organisms excavate tunnels (in which they remain for life) as they grow by rasping away the surrounding material with their ridged and toothed shells. Incurrent and excurrent siphons project from the original entrance hole, which is never enlarged. Shipworms are one of the two most destructive groups of **marine borers**.

shoal—1. A submerged **ridge**, **bank**, or **bar** consisting of or covered by unconsolidated sediments (mud, sand, gravel) which is at or near enough to the water surface to constitute a danger to navigation. If composed of rock or coral, it is called a reef. (An offshore hazard to navigation with a least depth of 10 fathoms (20 meters) or less, composed of unconsolidated material.) (62) *See* **reef**.

2. (or *school*). A great number of fish or aquatic animals thronged together or considered as a group, for example, herring shoals.

3. Having little depth; to cause to become shallow. (61)

4. To proceed from a greater to a lesser depth of water. (61)

5. To become shallow gradually. (61)

shoal area—1. An area, dangerous to surface ships, in which there are depths of 10 fathoms, or less, over a bottom which is not rocky.

2. A shallow area.

shoaling—A bottom effect which describes the height of the waves, but not the direction. It can be divided into two parts which occur simultaneously. The one part has to do with the fact that waves become less dispersive close to shore; therefore, since the same energy can be carried by high waves of lesser height, this effect causes a gradual decrease in the wave height. In the other part, the waves slow down,

the crests move closer together, and since the energy between crests remains relatively fixed, the waves can become higher near shore.

These effects are evidenced in the initial decrease in height of the incoming wave, then an increase in height as the wave comes into shore.

shoaling coefficient—The ratio of the height of a wave in water of any depth to its height in deep water, with the effect of refraction eliminated. Sometimes called shoaling factor or **depth factor**. (61)

shoaling effect—The alteration of a wave proceeding from deep water into shallow water. *See shoaling.*

shoaling factor—*See shoaling coefficient.*

shoal patches—Individual and scattered elevations of the bottom, with depths of 10 fathoms or less, but composed of any material except rock or coral.

shoal reefs—**Bank reefs**; also irregular **reef patches** among submerged shoals of calcareous detritus. (2)

shock crack—*See concussion crack.*

Shoran—A precise short-range electronic navigation system which uses the time divergence of pulse-type transmission from two or more fixed stations. (This term is derived from the words "short-range navigation.") (63)

shore—The narrow strip of land in immediate contact with the sea, including the zone between high and low water lines. (*See figure for shore profile.*)

shore clearing—*See shore lead.*

shoreface—The narrow zone seaward from the low tide shoreline permanently covered by water, over which the beach sands and gravels actively oscillate with changing wave conditions. (61) (*See figure for shore profile.*)

shore ice—1. The basic form of **fast ice**. It is a compact ice cover that is attached to the shore and, in shallow water, also grounded. (74)

2. (or *grounded ice*). Sea ice that has been beached by wind, tides, currents, or ice pressure. It is a type of fast ice and may sometimes be **rafted ice**. (5)

shore ice belt—*See ice foot.*

shore lead—A lead between **pack ice** and a narrow fringe of **fast ice**, or between pack ice and the **shore**. (74)

It may be closed by wind or currents so that only a **tide crack** remains. (5)

shoreline—The boundary line between a body of water and the land at high tide (usually **mean high water**). (68) *See coastline.* (*See figure for nearshore current system.*)

shoreline and coastal classification—As suggested by F. P. Shepard the following genetic classification has two principal subdivisions, Primary coasts and Secondary coasts; the former representing coasts and shorelines which are essentially the result of the sea resting against a landmass that owes its topography to a

terrestrial agency, whereas the latter are largely the result of present day marine processes or marine organisms.

I. Primary (Youthful) Shorelines and Coasts

A. Land Erosion Coasts—which includes ria, drowned glacial erosion, and drowned Karst topography.

B. Subaerial Deposition Coasts—which includes river deposition, glacial deposition plains, wind deposition coasts, and landslide coasts.

C. Volcanic Coasts—which includes lava flow coasts, tephra coasts, and volcanic collapse or explosion coasts.

D. Shaped by Diastrophic Movements—which includes fault coasts, fold coasts, and sedimentary extrusions.

II. Secondary Coasts (may or may not have been Primary Coasts before being shaped by the sea)

A. Wave Erosion Coasts.

B. Marine Deposition Coasts—which includes barrier coasts, cusped forelands, beach plains, and mudflats or salt marshes.

C. Coasts Built by Organisms—which includes coral reef, serpulid reef, oyster reef, mangrove, and marsh grass coasts.

(52)

shoreline of emergence—That **shoreline** resulting when the water surface comes to rest against a partially emerged sea floor.

shoreline of submergence—That **shoreline** produced when the water surface comes to rest against a partially submerged land area.

shore polynya—A **polynya** along the coast, formed either by current or wind. (74)

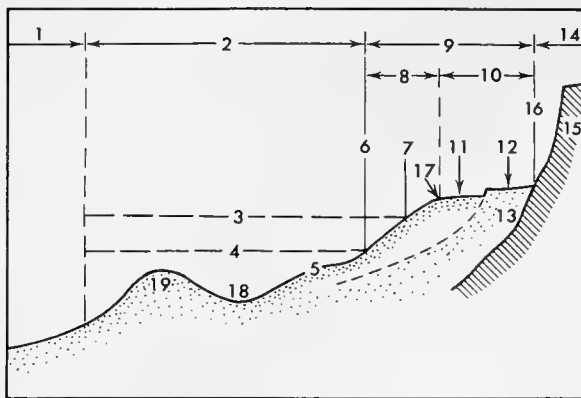
shore profile—The intersection of the ground surface with a vertical plane; may extend from the top of the dune line to the seaward limit of sand movement. (61) *See figure on next page.*

short-crested wave—A wave, the crest length of which is of the same order of magnitude as the **wavelength**. A system of short-crested waves has the appearance of hills being separated by troughs. (73)

short wave—Waves under conditions where the relative depth (water depth/wavelength) is greater than 0.5, and where the phase velocity is independent of water depth, but dependent upon wavelength.

short-wave radiation—In oceanography, a term used loosely to distinguish radiation in the visible and near-visible portions of the electromagnetic spectrum (roughly 0.4 to 1.0 micron in wavelength) from long-wave radiation (**infrared radiation**). (5)

shrimp trawl—A bottom trawl; that is, a bag net with a triangular shaped top and bottom, the open end (base of the triangle) fishes in an oval shape spread laterally by otter boards and ver-



SHORE PROFILE

1. Offshore; 2. Shoreface or Inshore; 3. Mean high water;
4. Mean low water; 5. Step; 6. Low tide shoreline; 7. High tide shoreline;
8. Foreshore or Beach face; 9. Shore or Beach; 10. Backshore or Backbeach;
11. Ordinary or Summer berm; 12. Storm or Winter berm; 13. Beach scarp;
14. Coast; 15. Sea cliff; 16. Coastline; 17. Crest of berm; 18. Trough;
19. Ball or Longshore bar.

(AFTER WIEGEL, 1953)

tically by floats on the head or top rope and by weights on the lead or foot rope. Fish entering the open end are trapped in the apex or "cod" end of the net. Lateral dimensions of the net opening range from about 24 to 100 feet.

shuga—Spongy white ice lumps a few centimeters in diameter (about one inch), formed of **sludge** and sometimes of **anchor ice**, and emerging on the surface.

Siberian anticyclone—See **Siberian high**.

Siberian high—(or *Siberian anticyclone*). An area of high pressure which forms over Siberia in winter, and which is particularly apparent on mean charts of sea level pressure. It is centered near Lake Baikal, where the average sea level pressure exceeds 1,030 millibars from late November to early March.

This anticyclone is enhanced by the surrounding mountains which prevent the cold air from flowing away readily. In the center of the anticyclone the normal clockwise circulation is replaced by **katabatic winds** down the river valleys, but to the east along the Pacific coast there is a belt of very strong northerly winds.

In summer the Siberian high is replaced by a low pressure area. See **monsoon**. (5)

sieve—Wire cloth containers with mesh openings graded increasingly in a fixed ratio. Coarse bottom sediments such as sand are usually analyzed for size by sieving.

sigma limits—The interval about the mean expressed in units of standard deviation. In a normal distribution, 2σ limits on each side of a mean include about 95 percent of the **population**, 3σ limits include 99 percent of the **population**. (22)

sigma-t—(symbol σ_t). A conveniently abbreviated value of the density of a sea water sample of temperature t and salinity S :

$$\sigma_t = (\rho_{(S, t)} - 1) \times 10^3,$$

where $\rho_{(S, t)}$ is the value of the sea water density in cgs units at standard atmospheric pressure. If, for example, $\rho_{(S, t)} = 1.02648$, then $\sigma_t = 26.48$. (5)

sigma-zero—(symbol σ_0). Sigma-t at 0°C.

Knudsen's Tables give values of sigma-zero as a function of **salinity** or **chlorinity**, as well as corrections to be applied to obtain **sigma-t**. (5)

signal—A disturbance which is used to carry information; opposed to **noise**.

signal wave—Any sound wave upon which it is required to make an observation of any kind is known as a signal wave, or more often, simply as a **signal**. (28)

signature—1. The characteristic frequency pattern of the target displayed by detection and classification equipment. (63)

2. The graph of pressure versus time at a point as a ship passes over it. Increased water velocity in the constriction between the ship and the bottom of the water basin causes the pressure variation by the Venturi effect.

significant wave—A statistical term relating to the one-third highest waves of a given group and defined by the average of their heights and periods.

The composition of the higher waves depends upon the extent to which the lower waves are considered. Experience so far indicates that a careful observer who attempts to establish the character of the higher waves will record values which approximately fit the definition.

significant wave height—(or *characteristic wave height*). The average height of the one-third highest waves of a given wave group. Note that the composition of the highest waves depends upon the extent to which the lower waves are considered. In wave record analysis, the average height of the highest one-third of a selected number of waves, this number being determined by dividing the time of record by the significant period. (61)

significant wave period—An arbitrary period generally taken as the period of the one-third highest waves within a given group. Note that the composition of the highest waves depends upon the extent to which the lower waves are considered. In wave record analysis, the average period of the most frequently recurring of the larger well-defined waves in the record under study. (61)

sikussak—An Eskimo name for very old **sea ice**, resembling **glacier ice** trapped in a **fiord**, and having a snow accumulation on its surface which contributes to its formation and perpetuation. (59)

silicate silicon—Ionic form of silicon utilized by various plankters, principally **diatoms** and **radiolarians**. The measurement of silicates in sea water is useful for determining diatom productivity.

siliceous ooze—A fine-grained pelagic sediment containing more than 30 percent siliceous skeletal remains of pelagic plants and animals.

silicoflagellate—Any of a group of microscopic marine **phytoplankton** having siliceous shells with radiating spines; they are inhabitants principally of colder waters.

sill—The low part of the **ridge** or **rise** separating **ocean basins** from one another or from the adjacent **sea floor**. (62)

sill depth—The greatest depth over a **sill**. (62)

sill basin—(or *barred basin*). A submarine **basin** separated from the main basin by a narrow submerged **ridge**. Deep water in the silled basin may be stagnant and **anaerobic**. An example is Fossa de Cariaco, Venezuela. (2)

silt—An unconsolidated sediment whose particles range in size from 0.0039 to 0.0625 millimeter in diameter (between clay and sand sizes). *See phi grade scale*.

simple harmonic wave—An oscillation translating with constant speed and amplitude, and represented mathematically by a trigonometric or complex exponential function. Thus,

$$A \sin \left(\frac{2\pi}{\lambda} \times -vt + \phi \right) \text{ or } e \exp i \left(\frac{2\pi}{\lambda} \times -vt + \phi \right)$$

represents a simple harmonic wave of amplitude A , wavelength λ , frequency ν , and phase angle ϕ .

In ocean wave studies, a simple harmonic progressive wave is an idealized wave characterized by constant speed of propagation and a straight crest of indefinite length. (5)

simple sound source—A source that radiates sound uniformly in all directions under free-field conditions. (6)

single day tide—British terminology for **diurnal tide**. (68)

sinking—1. (or *downwelling*). A downward movement of surface water generally caused by converging currents or when a **water mass** becomes more dense than the surrounding water. *See upwelling*.

2. In atmospheric optics, a refraction phenomenon, the opposite of **looming**, in which an object on or slightly above the geographic horizon apparently sinks below it. Sinking occurs whenever the rate of density with height through the atmosphere is of smaller magnitude than normal or, in extreme cases, where the density actually increases with height. (5)

siphonophore—One of an order (Siphonophora) of medusoid **coelenterates**. Many are luminescent, some are venomous, and some possess a **pneumatophore** (an air-filled float), which imparts a sound scattering capacity to the orga-

nisms. A pneumatophore-bearing species has been observed within the **deep scattering layer**.

sirenian—*See sea cow*.

size of floating ice—The linear extent of individual fragments of ice. In general, ice fragments are angular or circular. The linear dimension used for describing the size of an individual ice fragment is an approximation of the diameter. Size is usually observed either in feet and miles or meters and kilometers, whichever is more convenient or applicable. The terms most generally used to describe ice fragments according to increasing size are in order: **brash ice**, **block**, **small ice floe**, **medium ice floe**, **giant floe**, and **ice field**. (65)

skate barrow—*See sailor's purse*.

skerries—Low, small islands, reefs, and rocks which form a broad belt (*skjærgard*) extending along a coast for hundreds of miles. Skerries rise from a shallow coastal **strandflat**.

skin—The first film or crust of **newly formed ice**, with some degree of hardness. (68)

skin diving—Free diving with or without SCUBA gear.

skjærgard—*See skerries*.

sky map—A pattern on the underside of extensive cloud areas created by the varying amounts of light reflected from the earth's surface. Snow surfaces produce a white glare in the sky (**snow blink**) and ice surfaces a yellowish-white glare (**ice blink**). Bare land and water surfaces reflect little or no light and for this reason the clouds above these surfaces are relatively dark (**land sky**, **water sky**). Generally the same conditions can be observed from an aircraft above the clouds, when the thickness of the cloud layer permits. (65)

slack ice—*See broken ice*.

slack tide—*See slack water*.

slack water—(sometimes called *slack tide*). The interval when the speed of the **tidal current** is very weak or zero; usually refers to the period of reversal between ebb and flood currents. In some places slack water occurs near times of high and low water, whereas in other localities the slack water may occur midway between high and low water. (*See figure for current curve*.)

slant path velocity—The mean velocity along one cycle of a sound ray path.

slant range—The diagonal distance between a point at one position and a point at another position in a vertical plane.

slat-flecked ice—Ice swept clear of snow except for wind ripples saturated with **brine**. (59)

slewing—In ice navigation, the act of forcing a ship through ice by pushing apart adjoining **ice floes**. (59)

slide—*See slump*.

slightly stratified estuary—An **estuary** in which the salinity increases slightly with depth and also increases noticeably along its length from the head to the mouth.

slime—Soft, fine, oozy mud or other substance of similar consistency. (68)

slime film—*See* **primary film**.

slob ice—An accumulation of **sludge**, so dense as to make the passage of small craft impossible. (59)

slope—The degree of inclination to the horizontal. Usually expressed as a ratio, such as 1:25 or 1 on 25, indicating 1 unit rise in 25 units of horizontal distance; or in a decimal fraction (0.04); degrees ($2^{\circ}18'$); or percent (4%). It is sometimes described by such adjectives as: steep, moderate, gentle, mild, or flat. (61)

slope current—*See* **gradient current**.

slope of foreshore—The angle between the tangent to the beach at the **high water line** (or some reference point) and the horizontal. (73)

slough—1. A small muddy marshland or tidal waterway which usually connects other tidal areas.
2. A **tideland** or bottomland creek. (61)

slud—*See* **young ice**.

sludge—1. Spongy whitish ice lumps a few centimeters across. They consist of slush, snow slush, and sometimes of spongy ice lumps formed on the bottom of a shallow sea and emerging at the surface.
2. (also called *slush*, *cream ice*). An accumulation of ice crystals which remain separate or only slightly frozen together. It forms a thin layer and gives the sea surface a grayish or leaden-tinted color. With light winds no ripples appear on the surface. *See* **grease ice**, **ice slush**. (74)

sludge cake—An accumulation of **sludge** hardened into a cake strong enough to bear the weight of a man. (59)

sludge floe—A large **sludge cake**. (59)

sludge lump—An irregular mass of **sludge** shaped by the action of strong winds. (59)

slump—(or *slide*). The slippage or sliding of a mass of unconsolidated sediment down a submarine or subaqueous slope. Slumps occur frequently at the heads or along the sides of submarine **canyons**. The sediment usually moves as a unit mass initially but often becomes a turbidity flow. It may be triggered by any small or large earth shock.

slush—*See* **sludge** (sense 2); **ice slush**.

slush pond—A pool or lake containing slush. (Slush ponds are common in summer on ablation surfaces of glaciers and ice caps.) (59)

small calorie—(abbreviated cal). *See* **calorie**.

small diurnal range—The average difference in height between mean lower high water and mean higher low water, measured over a 19-year period, or its computed equivalent. *See* **diurnal range**. (50)

small field of ice—*See* **small ice field**.

small floe—*See* **small ice floe**.

small ice cake—An **ice cake** less than 2 meters (6.6 feet) across. (74)

small ice field—(or *small field of ice*). 1. An **ice field** 10 to 15 kilometers (5.4 to 8.1 n. miles) across. (74)
2. A Russian term for an ice field between 500 meters and 2 kilometers (1,640 feet to 1.1 n. miles) in width.

small ice floe—1. *See* **ice floe**.
2. A floe of sea ice 30 to 600 feet across. (59) Obsolete.

small ice skylight—*See* **ice skylight**.

small scale—*See* **scale**.

small tropic range—The average difference in height between all **tropic lower high waters** and all **tropic higher low waters** which occur twice monthly when the moon's north and south declinations are greatest. *See* **lunar declination**, **tropic range**.

smoothing—An averaging of data in space or time, designed to compensate for random errors or fluctuations of a scale smaller than that presumed significant to the problem at hand. For example, a thermometer smooths the temperature reading on the scale of its **time constant**. (5)

smooth sea—Sea with waves no higher than ripples or small wavelets. (68)

snail—*See* **gastropod**.

snapper—*See* **clamshell snapper**.

snapping shrimp—(or *pistol shrimp*). Certain species of shrimp belonging to the family Alpheidae, chiefly in the genera *Alpheus* and *Synalpheus*, that are capable of producing sharp cracking sounds by the rapid closure of an enlarged claw. These shrimps form large populations in warm shallow waters on shell, rock, or coral bottoms where their sounds constitute a major component of underwater **background noise**. Shrimp noise ranges in frequency from about 500 to 50,000 cps, with principal components between 2,000 and 20,000 cps.

Snell's law—When a wave (light or sound) travels obliquely from one medium into another, the ratio of the sine of the **angle of incidence** to the sine of the **angle of refraction** is the same as the ratio of the respective wave velocities in these mediums and is a constant for two particular mediums.

snow blink—(also called *snow sky*). A bright, white glare on the underside of clouds, produced by the reflection of light from a snow covered surface. This term is used in polar regions with reference to the **sky map**; snow blink is lighter than **ice blink**, and much lighter than **land sky** or **water sky**. (5)

snow-covered ice—Ice covered with snow. (74)

snow ice—Ice crust on a water surface containing a large proportion of fallen or drifted snow. (59) *See* **ice rind**.

snow sky—*See* **snow blink**.

snow sludge—A soft elastic crust formed on fallen snow on a water surface. (59)

snow slush—A viscous mass formed as a result of a thick snow fall into cooled water. (74)

snow water on the ice—(or *puddle*). Ice whose surface is covered with snow water (that is, an accumulation on the ice of melt water mainly due to snow melting).

sofar—1. An acronym derived from the expression "*sound fixing and ranging*."

2. A position-fixing system by which hyperbolic lines of position are determined by measuring, at shore listening stations, the difference in the time of reception of sound signals produced in a **sound channel** in the sea. (66)

sofar channel—*See sound channel*.

solar constant—The rate at which solar radiation is received outside the earth's atmosphere on a surface normal to the incident radiation, and at the earth's mean distance from the sun. For decades the tentative result was 1.94 or 1.95 gram-calories per square centimeter per minute, however recent studies of the infrared and ultraviolet portions of the solar spectrum suggest a value of about 2.00 gram-calories per square centimeter per minute. (5)

solar declination—The angular distance of the sun expressed north or south of the celestial equator; it is indicated as (+) when north and (−) when south of the equator. Maximum declination is about 23½ degrees north and south of the Equator; maximum north declination occurs about June 21 and maximum south declination about December 21. (50)

solar tide—The tide caused solely by the **tide-producing forces** of the sun. (50)

solid—A state of matter in which the relative motion of the molecules is restricted and they tend to retain a definite fixed position relative to each other, giving rise to crystal structure. A solid may be said to have a definite shape and volume. (27)

solitary wave—A wave consisting of a single elevation (above the water surface), its height not necessarily small compared to the depth, and neither followed nor preceded by another elevation or depression of the water surface. (61)

solstice—One of the two points in the sun's orbit (the ecliptic) farthest from the celestial equator; the instant when the sun's declination is maximum. *See summer solstice, winter solstice*.

solstitial tide—The tide occurring near the times of the **solstices** when the sun reaches maximum north and south declinations; the **tropic range** at these times is greatest.

solubility—The extent to which a substance (solute) mixes with a liquid (solvent) to produce a homogeneous system (**solution**).

solution—The state in which a substance, or solute, is homogeneously mixed with a liquid

called the solvent. Thus, **pure water** is a solvent and **sea water** is a solution of many substances.

solution basin—A shallow depression on a reef or beach rock surface produced by solution of the surface. (2)

Somali Current—*See East Africa Coast Current*.

sonar—1. An acronym derived from the expression "*sound navigation and ranging*." The method or the equipment for determining by underwater sound techniques the presence, location, or nature of objects in the sea. (3)

2. A system for determining distance of an underwater object by measuring the interval of time between transmission of an underwater sonic or ultrasonic signal and return of its echo. (66) *See active sonar, passive sonar*.

sonar background noise—*See background noise*.

sonar projector—*See transducer*.

sonar performance figure—The source level of a surface ship active sonar minus the equivalent plane wave noise in the receiving band.

sonic bearing—(or *acoustic bearing*). A bearing determined by measuring the direction from which a sound wave is coming.

sonic fishes—(or *soniferous fishes*). Those fishes which are capable of producing sounds, usually by means of specialized organs such as the air bladder or pharyngeal teeth. The spectra of fish sounds generally have their limits between 50 and 5,000 cps, with most of the sound energy concentrated between 100 and 800 cps. Air bladder sounds range from about 50 to 1,500 cps, with principal frequencies in the region of 100 to 300 cps; sounds produced by stridulation of hard parts, such as teeth or spines, may have components from 50 to 800 cps or more, but typically show the greatest energy from about 500 to 3,000 cps.

sonic frequency—*See audio frequency*.

sonic layer depth—The depth of the surface layer into which sound rays are trapped by upward **refraction** effects. The sonic layer depth is indicated on a **sound velocity** versus depth trace by the point of near surface maximum sound velocity.

sonic marine animals—(or *soniferous marine animals*). Organisms living in the sea which are capable of producing sounds, either purposeful by means of specialized organs, or incidental to the course of normal activity such as feeding or swimming. These animals include certain invertebrates (principally **crustaceans**), several groups of fishes, and most marine mammals. *See snapping shrimp, sonic fishes, sonic marine mammals*.

sonic marine mammals—(or *soniferous marine mammals*). Those mammals which are capable of producing sounds, including most, perhaps all, of the whales, porpoises, and seals. A great variety of sound has been recorded from **ceta-**

ceans, ranging in frequency from the low 40-cps moans of the fin whale to the echolocation clicks of the bottlenose porpoise, which have high energy between 20,000 and 30,000 cps and may have minor components in the region of 200,000 cps. Recent investigations of underwater sounds emitted by seals and sea lions indicate that several **pinnipeds** produce sharp clicks ranging from about 100 to at least 30,000 cps, with principal frequencies between 2,000 and 12,000 cps.

sonic wave—*See* sound wave.

soniferous fishes—*See* sonic fishes.

soniferous marine animals—*See* sonic marine animals.

soniferous marine mammals—*See* sonic marine mammals.

sonobuoy—A free floating or anchored device that includes a buoy with radio telemetering equipment and a **hydrophone** suspended beneath. Sound signals received at the hydrophone are transmitted to a nearby receiver for analysis.

sonodivers—Untethered, unmanned, submersible vehicles, launched from ships for recording **ambient noises** and supplementary information capable of sampling noise at depths from 100 to 20,000 feet over a frequency range of 10 to 50,000 cps.

sonoprobe—A low frequency echo sounder which generates sound waves and records their reflections from one or more sediment layers beneath the sediment/water interface. (2)
See **subbottom reflection**.

sound—1. The periodic variation in pressure, particle displacement, or particle velocity in an elastic medium. *See* **sound velocity**.

2. A long **arm** of the sea which forms a **channel** between an island and the mainland or a sea and ocean. It is usually wider and longer than a **strait**. (2)

3. To dive suddenly toward deep water, usually from the surface or upper water levels, as a fish or whale when hooked or harpooned, or a submarine attempting to escape detection or attack by enemy craft.

4. To measure or ascertain the depth of water as with sounding lines. (61)

sound absorption—*See* **absorption**.

sound channel—The region in the water column where **sound velocity** first decreases to a minimum value with depth and then increases in value as a result of pressure. Above the minimum value sound rays are bent downward, and below the minimum value sound rays are bent upward; the rays are thus trapped in this channel. Sound traveling in a deep channel can be detected thousands of miles from the sound source.

sound channel axis—The depth at which minimum **sound velocity** occurs.

sound energy density—The sound energy density at a point in a sound field is the sound energy contained in a given infinitesimal part of the medium divided by the volume of that part of the medium. (6)

soundhead—An enclosure containing the transmitting projector and the receiving **hydrophone**.

sounding—1. The measurement of the depth of water beneath a ship.

2. In geophysics, any penetration of the natural environment for scientific observation. (5)

sounding datum—The plane to which soundings are referred. *See* also **chart datum**. (61)

sounding line—*See* **lead line**.

sound intensity—1. At a point the average rate of sound energy transmitted in a specified direction through a unit area normal to this direction at the point considered. (6)

2. In practice, considered as the square of the **sound pressure**.

sound pressure—The instantaneous pressure at a point in a medium in the presence of a **sound wave**, minus the static pressure at that point.

sound pressure level—Twenty times the logarithm to the base 10 of the ratio of the pressure of sound to the reference pressure, in decibels at a specific point. The reference pressure shall be explicitly stated.

sound velocity—The rate of travel at which which sound energy moves through a medium, usually expressed in feet per second.

The velocity of sound in sea water is a function of temperature, salinity, and the changes in pressure associated with changes in depth. An increase in any of these factors tends to increase the velocity. Sound is propagated at a speed of 4,742 feet per second at 32°F, one atmospheric pressure, and a salinity of 35 per mille.

sound wave—(also called *acoustic wave*, *sonic wave*). A mechanical disturbance advancing with finite velocity through an elastic medium and consisting of longitudinal displacements of the ultimate particles of the medium, that is, consisting of compressional and rarefactional displacements parallel to the direction of advance of the disturbance; a **longitudinal wave**. (5)

source level—The sound output of a source as expressed in decibels relative to 1 dyne per square centimeter at a distance of 1 yard from the sound source.

source region—The extensive area of the oceans where a **water mass** acquired its basic characteristics.

South Atlantic Current—An eastward flowing current of the South Atlantic Ocean that is continuous with the northern edge of the **West Wind Drift**. (5)

South Equatorial Current—Any of several ocean currents driven by the southeast trade winds flowing over the tropical oceans of the Southern Hemisphere.

In the Atlantic Ocean it is known as the Atlantic South Equatorial Current and flows westward with its axis through 2°N., 25°W. Part flows northwest along the northeast coast of South America (the Guianas) as the **Guiana Current**. The other part turns below Natal and flows south along the coast of Brazil as the **Brazil Current**.

In the Pacific Ocean, the Pacific South Equatorial Current flows westward between approximately 3°N and 10°S. Much of it turns south in midocean, forming a large anticyclonic whirl. The portion that continues across the ocean divides as it approaches Australia, part moving north toward New Guinea and part turning south along the east coast of Australia as the **East Australia Current**.

In the Indian Ocean, the Indian South Equatorial Current axis is located at about 12°S and as it approaches the east coast of Africa it turns south, joining the **Agulhas Current**. See also **monsoon current**.

South Indian Current—An eastward flowing current of the southern Indian Ocean that is continuous with the northern edge of the **West Wind Drift**.

South Pacific Current—An eastward flowing current of the South Pacific Ocean that is continuous with the northern edge of the **West Wind Drift**. (5)

spark-type luminescence—A display of biological light appearing as innumerable flickering pinpoints of light, particularly conspicuous in the wake of a ship, along the hull line, or in agitated waters. **Crustaceans**, such as **copepods** and **euphausiids**, cause this type of display. See **bioluminescence**.

spat—The spawn or young of bivalve **mollusks**.

species—See **classification of organisms**.

specific acoustic impedance—The ratio of **acoustic pressure** in a medium to the particle velocity of the medium. The meter-kilogram-second unit of specific acoustic impedance is a kilogram per square meter second or rayl. (33)

specific activity—1. The **activity** of a **radioisotope** of an element per unit weight of element present in the sample.

2. The activity per unit mass of a pure **radionuclide**.

3. The activity per unit weight of any sample of radioactive material.

(41)

specific gravity—The ratio of the **density** of a given substance to that of distilled water usually at 4°C and at a pressure of one atmosphere. Since the density of pure water depends on its isotopic composition, unless the isotopic composition of the distilled water can be specified,

the term specific gravity should not be used when the intention is to state a precise value. Values derived from **Knudsen's Tables** are of specific gravity, not density.

specific heat—The heat capacity of a system per unit mass, that is, the ratio of the heat absorbed (or released) by unit mass of the system to the corresponding temperature rise (or fall).

The amount of heat required to raise the temperature of 1 gram of water by 1°C. The specific heat of water is usually measured at constant pressure but may also be measured at constant volume.

The specific heat of water, which for **pure water** at 17.5°C (63.5°F) is 1 calorie per gram, decreases with increasing temperature and salinity. (5, 54)

specific volume—The volume per unit mass of a substance, or the reciprocal of **density**. (5)

In oceanographic practice, specific volume is taken as the reciprocal of **specific gravity**.

specific volume anomaly—(or *anomaly of specific volume*; also called *steric anomaly*; symbol δ). In oceanography, the excess of the actual specific volume of the sea water at any point in the ocean over the specific volume of sea water of salinity 35 per mille and temperature 0°C at the same pressure. The integral of specific volume anomaly with depth is the **dynamic height anomaly**. See **thermosteric anomaly**. (5)

Since oceanographic tables actually list reciprocal density rather than specific volume, the quantity used in oceanography is actually "reciprocal density anomaly." However, a "reciprocal density anomaly" is numerically equal to a specific volume anomaly to as many significant figures as are desirable in oceanographic work.

spectral distribution curve—A curve representing the spectral concentration of a quantity as a function of wavelength (or frequency). (8)

spectrophotometer—A device for the measurement and analysis of both emitted and absorbed **radiant energy**. Appropriate identifications of the composition or the constituents of organic and inorganic matter may be made. Quantitative information derived from a determination of the intensity or density of specific spectral lines may also be measured.

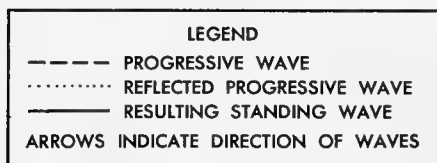
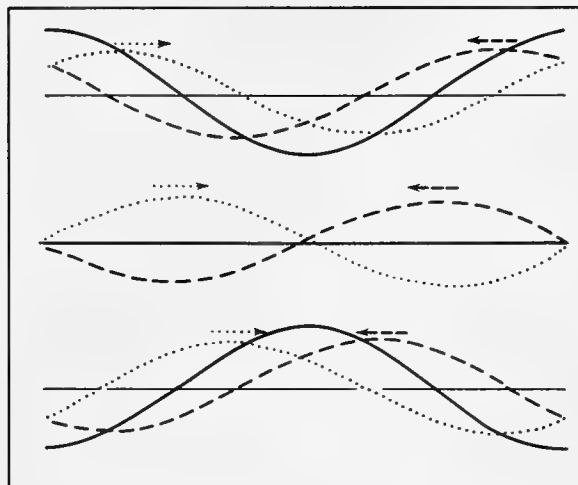
spectrum—A visual display, a photographic record, or a plot of the distribution of the intensity of energy dispersion of a given kind as a function of its wavelength, energy, frequency, momentum, mass, or any related quantity. (70)

spectrum density—The mean-square amplitude of the output of an ideal filter with unity gain responding to the oscillation, per unit bandwidth; that is, the limit for vanishingly small bandwidth of the quotient of the mean-square amplitude divided by the bandwidth.

- spectrum level**—The level of that part of a signal contained within a band one cycle per second wide, centered at the particular frequency. Ordinarily this has significance only for a signal having a continuous distribution of components within the frequency range under consideration. The phrase "spectrum level" cannot be used alone, but must appear in combination with a modifier, as, for example, pressure, velocity, voltage, etc. (3)
- spectrum stripper**—The electronic accessory of a multichannel analyzer which performs **spectrum stripping**.
- spectrum stripping**—The process of subtracting known components of a gamma ray spectra to reveal otherwise obscured spectral components.
- specular reflection**—A mirrorlike or perfect reflection of sound rays from a smooth surface or bottom.
- speed of advance**—(abbreviated SOA). The expected speed to be made good over the earth's surface.
- spermatophyte**—One of a division (Spermatophyta) of plants, most of which possess true stems, leaves, and roots, and all of which produce seeds. Only a small group of seed plants are marine. *See* **seagrass**.
- sperm whale**—Largest of the toothed whales, or odontocetes, attaining a length of about 60 feet. It has a large blunt head and a disproportionately small lower jaw bearing a series of large conical teeth. A single species, *Physeter catodon*, is recognized, occurring in all warm seas. *See* **toothed whale**.
- spherical irradiance**—Limit of the ratio of **radiant flux** onto a spherical surface to the area of the surface, as the radius of the sphere tends toward zero with its center fixed. Unit of measurement is watt per square meter (W/m^2). (8)
- spherical irradiance meter**—A radiant flux meter with spherical collecting surface of effective area A , every elemental area of which is a **cosine collector**. If F is the **radiant flux** recorded by the meter, then the associated spherical irradiance is $E_s = F/A$. (8)
- spherical spreading**—*See* **spreading of sound**.
- spherical wave**—A wave whose wave front surfaces are concentric spheres. Such waves propagate from a point source.
- spicule**—A minute needlelike or multiradiate calcareous or siliceous body in **sponges**, **radiolarians**, primitive **chitons**, and **echinoderms**. They frequently are identified in marine sediment samples.
- Spilhaus-Miller sea sampler**—A **bathythermograph** with attached containers designed to collect sea water samples at predetermined depths. The sample bottles are triggered to close at both ends by the pressure sensing element of the bathythermograph.
- spilling breaker**—*See* **breaker**.
- spiny lobster**—One of a tribe (Palinura) of **crustaceans**, individuals of which are prized as food and are reported to make sounds of considerable magnitude.
- spit**—A small point of land or narrow **shoal** projecting into a body of water from the shore. (2) (*See* figure for **recurved spit**.)
- Spitsbergen Current**—An ocean current flowing northward and westward from a point south of Spitsbergen, and gradually merging with the **East Greenland Current** in the Greenland Sea. The Spitsbergen Current is the continuation of the northwestern branch of the **Norway Current**. (68)
- splashnik**—An expendable **accelerometer** telemetering buoy which provides surface wave data.
- spoil banks**—Submerged accumulations of dumped material dredged from channels or harbors. The region where such material is dumped is called **spoil ground**.
- spoil ground**—An area where dredged material is deposited. *See* **dumping ground**. (68)
- sponge**—One of a phylum (Porifera) of solitary or colonial, sessile animals of simple construction. Sponges are of many sizes and forms and varied in color.
- spongine**—A protein secretion, closely akin to silk, which forms the skeleton of a **fibrous sponge**.
- spouting horn**—Marine caves eroded in coastal rocks which have openings to the air through which water spouts or sprays as waves surge into the cavern beneath.
- spray ice**—Ice formed from blown spray, which may occur along shore, on floating ice, on ships or seaplanes. (59)
- spray ridge**—One of a series of ice formations on an **ice foot**, formed by the freezing of spray blown from the waves by the wind.
- spreading anomaly**—That part of the **propagation anomaly** which may be identified with the geometry of the ray paths. (28)
- spreading of sound**—The phenomenon whereby transmitted **sound intensity** decreases in a constant relation to distance from the sound source. Three laws govern spreading, all relating sound intensity to a ratio of distance from the sound source. These spreading laws are:
- $$I = 1/r \text{ (cylindrical spreading)}$$
- $$I = 1/r^2 \text{ (inverse law or spherical spreading)}$$
- $$I = 1/r^4 \text{ (dipolar spreading), where } I = \text{sound intensity and } r = \text{distance from sound source.}$$
- spring flowering**—*See* **spring maximum**.
- spring high water**—*See* **mean high water springs**.
- spring low water**—*See* **mean low water springs**.
- spring maximum**—(or *spring flowering*). The abundance of marine **phytoplankton** (predominantly **diatoms**) after a winter minimum. The production of phytoplankton is generally the

- highest for the year during this period. This condition occurs most frequently in regions of the higher latitudes which experience some form of vertical mixing.
- spring range**—*See* **mean spring range**.
- spring rise**—*See* **mean spring rise**.
- spring**—*See* **spring tides**.
- spring sludge**—*See* **rotten ice**.
- spring tide**—(or *spring*). Tide of increased range which occurs about every two weeks when the moon is new or full (**syzygy**). (50) (*See* figure for **tide cycle**.)
- spur**—1. A subordinate **elevation, ridge, or rise** projecting outward from a larger feature. (62)
2. A ridge, usually composed of sand or gravel, which extends into the sea from the shore or from a larger submarine elevation. (68)
3. *See* **ram**. (59)
- squeeze**—(or *barotrauma*). A type of injury occurring in divers, usually during descent, which comes about because of inability to equalize pressure between a closed air space, such as the middle ear, and outside water pressure.
- squid**—(or *decapod mollusk*). One of an order (Decapoda) of **cephalopods** in which the body is cigar shaped or globose and bears ten arms, eight of which are of equal length with suckers along the entire length and two of which are longer with suckers only on a broad terminal portion; shell, in most, is embedded in the body or absent. Some species (the **sea arrows**) are among the faster **nekton**, one species (the **giant squid**) is the largest known invertebrate and a food of the sperm whale, and others have been suggested as possible sound scattering components of the **deep scattering layer**.
- Staballoy slide***—A trade name for a gold-plated glass slide used in the mechanical **bathythermograph** to record the temperature versus depth trace.
- stability**—The resistance to overturning or mixing in the water column, resulting from the presence of a positive density gradient.
- stabilizing force**—The ordinary restoring force in an **unstable-type gravimeter**.
- stable gravimeter**—A **gravimeter** having a single weight or a spring such that the sensitivity is proportional to the square of its period.
- stable isotope**—1. An **isotope** of an element which is not radioactive.
2. A mixture of isotopic nonradioactive **nucleides** of composition different from that occurring in nature, as an article of commerce.
3. In common usage, any stable nuclide (not preferred). (41)
- stable polynya**—*See* **polynya**.
- stable-type gravimeter**—A **gravimeter** which uses a high order of optical and/or mechanical magnification so that a change in position of a weight or associated property is measured directly.
- stagnant glacier**—An inactive **glacier**. (65)
- stalked barnacle**—(or *goose barnacle, gooseneck barnacle*). A **barnacle** whose body is differentiated into the body proper, which usually is covered by a two-valved shell, and a stalk at the base, by which the animal is attached to a firm surface. Many are pelagic or deep living, and some are attached to free-floating objects, floating seaweed, hulls of ships, and whales.
- stamuhka**—A Russian word for **sea ice** stranded on a shoal or shallows.
- stand**—*See* **stand of tide**.
- standard depth**—A depth below the sea surface at which water properties should be measured and reported, either directly or by interpolation, according to the proposal by the *International Association of Physical Oceanography* in 1936. The accepted depths (in meters) are: 0, 10, 20, 30, 50, 75, 100, 150, 200, 250, 300, 400, 500, 600, 800, 1000, 1200, 1500, 2000, 2500, 3000, 4000, 5000, 6000, 7000, 8000, 9000, 10000, to which NODC has added 125, 700, 900, 1100, 1300, 1400, and 1750.
- standard deviation**—(symbol σ). The positive square root of the variance σ^2 . This is a measure of the scatter or spread in a series of observations. (5)
- standard displacement**—The surface displacement of a submarine, exclusive of the water in nonwatertight structure, when fully manned, engaged, and equipped for sea duty, including all armament and ammunition, equipment, provisions for crews, miscellaneous stores, and implements of every description that are intended to be carried in war but excluding fuel, lubricating oil, fresh water, or ballast water of any kind. This definition was established by the 1930 *London Treaty for the Limitation of Armaments*. (64)
- standard port**—British term for **reference station**.
- standard sea water**—*See* **normal water**.
- standard station**—*See* **reference station**.
- standard temperature and pressure**—(abbreviated S.T.P.; also called *normal temperature and pressure*). A phrase used in physics to indicate a temperature of 0°C and a pressure of one standard atmosphere. (5)
- standing crop**—*See* **biomass**.
- standing floe**—1. A separate **ice floe** standing vertically or inclined and enclosed by rather smooth ice. (74)
2. *See* **ropak**.
- standing oscillation**—*See* **standing wave**.
- standing stock**—*See* **biomass**.
- standing wave**—(or *stationary wave, standing oscillation*). A type of wave in which the surface of the water oscillates vertically between fixed points, called **nodes**, without progression. The points of maximum vertical rise and fall are called **antinodes** or **loops**. At the nodes, the underlying water particles exhibit no vertical

motion but maximum horizontal motion. At the antinodes the underlying water particles have no horizontal motion and maximum vertical motion. They may be the result of two equal progressive wave trains traveling through each other in opposite directions. (61)



FORMATION OF A STANDING WAVE BY REFLECTION OF A PROGRESSIVE WAVE

(AFTER KING, 1902)

stand of tide—(or *stand*, *tidal stand*). The interval at high or low water when there is no appreciable change in the height of the tide; its duration will depend on the range of the tide, being longer when the tide range is small and shorter when the tide range is large. Where a **double tide** occurs, the stand may last for several hours even with a large range of tide.

starfish—*See sea star.*

state of sea—*See sea state.*

static instability—*See instability.*

station—1. In oceanography, the geographic location at which any set of oceanographic observations was taken; also, the observations recorded at the location. The appropriate verbal phrase is "occupy a station."

2. In science generally, a permanent or temporary location where scientific observations and measurements are made.

3. *See also serial station, ocean station.*
(5)

stationary field—A natural field of force as a gravimetric or magnetic field.

stationary wave—*See standing wave.*

stationary wave theory—A theory which assumes that the basic tide motion in the open ocean consists of a system of **standing wave** oscillations; **progressive waves** are of secondary importance except where the tide advances into tributary waters.

station data—Data collected by an oceanographic ship while taking a **station**. Station data usually consists of identifying information, weather data, and water temperature, salinity, and chemical composition at specified depths.

statistical oceanography—The study of the oceanic environment by use of statistical methods uninfluenced by physical theories.

statistical prediction—Prediction of the future state of the ocean environment by use of observed variables which show correlation with unobserved and predictive variables.

steadiness—*See persistence.*

steam fog—(or *sea smoke*; also called *arctic sea smoke*, *arctic smoke*, *frost smoke*, *water smoke*, *sea mist*, *steam mist*). **Fog** formed when water vapor is added to air which is much colder than the vapor's source; most commonly, when very cold air drifts across relatively warm water.

No matter what the nature of the vapor source (warm water, industrial combustion, exhaust, exhaled breath), its **equilibrium vapor pressure** is greater than that which corresponds to the colder air; thus, the water vapor, upon becoming mixed with and cooled by the cold air, rapidly condenses. It should be noted that although **advection** of air is necessary to produce steam fog, it differs greatly from an **advection fog**, in the usual sense, which is caused by warm, moist air moving over a cold surface.

Steam fog is commonly observed over lakes and streams on cold autumn mornings, as well as in polar regions. It is sometimes confused with **ice fog**, but its particles are entirely liquid. At temperatures below -20°F , these may freeze into droxtals (ice crystals) and create a type of ice fog which may be known as frost smoke. (5)

steam mist—*See steam fog.*

Stefan-Boltzmann law—(or *Stefan's law*).

One of the **radiation** laws which states that the amount of energy radiated per unit time from a unit surface area of an ideal black body is proportional to the fourth power of the absolute temperature of the black body. (5)

Stefan's law—*See Stefan-Boltzmann law.*

stenohaline—Capable of existence only within a narrow range of **salinity**, as certain marine organisms.

stenothermic—Tolerant of only a very narrow range of temperature.

(58)

step—The nearly horizontal section which more or less divides the **beach** from the **shoreface**. (*See figure for shore profile.*)

stereographic projection—A perspective, con-formal, azimuthal map projection in which points on the surface of a sphere are conceived as projected by radial lines from any point on the surface to a plane tangent to the antipode of the point of the projection. Circles project as circles except for great circles through the point of tangency which project as straight lines. (68)

steric anomaly—*See specific volume anomaly.*

steric level—The mean dynamic depth (or height) for the month minus the annual mean dynamic depth to the same isobaric reference level.

still water level—The level that the sea surface would assume in the absence of wind waves; not to be confused with **mean sea level** or half-tide level. (5) (*See figures for wave and surf zone.*)

stingray—*See ray, venomous marine animals.*

stipe—The basal, stemlike part of the thallus of an alga beneath an erect blade. (13)

Stokes law—An expression of the relation between the size of spherical particles and their settling velocity in a fluid. The law is used in determining the proportion and size distribution of silt and clay in sediment samples.

stolonate bryozoan—*See erect bryozoan.*

stone—A general term for rock fragments and rock ranging from pebbles and gravels to boulders or large rock masses.

stone reef—Offshore bars converted into solid rock reefs by the calcium carbonate cementation of sand grains in the upper 10 to 15 feet of the reef. (2)

stones—Detached particles of rock usually smaller than 256 millimeters in diameter.

stopped—The condition of a ship without power; contrasted with **hove-to.**

stop trim—The condition of **trim** when net buoyancy is zero whereby a stationary submarine can maintain its depth.

storis—The Scandinavian name for the pack of heavy **ice floes** which drifts from the Arctic Ocean along the east coast of Greenland, around Kap Farvel, and northward along the west coast of Greenland where it melts.

storm ice foot—An **ice foot** produced by the breaking of a heavy sea or the freezing of wind driven spray. (68)

storm surge—(or *storm tide, storm wave, tidal wave*). A rise above normal water level on the open coast due only to the action of wind stress on the water surface. Storm surge resulting from a **hurricane** or other intense storm also includes the rise in level due to atmospheric pressure reduction as well as that due to wind stress. A storm surge is more severe when it occurs in conjunction with a high tide.

storm tide—1. *See storm surge.*

2. The height of a storm surge (or **hurricane wave**) above the astronomically predicted level of the sea.

(5)

storm track—The path followed by a center of low atmospheric pressure. (5)

storm wave—1. A wind-generated sea surface wave of great height.

2. *See storm surge.*

3. *See hurricane wave.*

(5)

strain crack—(also called *tension crack*). A **crack in sea ice** caused by stretching of the ice beyond its elastic limit, usually due to motion of underlying water. (68)

strain gauge—*See dynamometer.*

strait—A narrow sea **channel** which separates two landmasses.

strand—The portion of the **seashore** between high and low water line. (2)

stranded ice—*See shore ice.*

stranded ice foot—An **ice foot** formed by the stranding of **ice floes** or small **icebergs** along a shore. It may be built up by freezing spray or breaking seas. (68)

stranded pressure ridge—A large **pressure ridge** formed when ice is forced against the shore.

strandflat—A low, broad coastal flat, slightly submerged, supporting thousands of low small islands, reefs, and rocks. It may extend for hundreds of miles along a coast.

strath—A broad elongated **depression** with relatively steep walls located on a **continental shelf**. The longitudinal profile of the floor is gently undulating, with the greatest depths often being found in the inshore portion. (62)

stratulate—Having numerous thin layers, either of sedimentary deposition from suspension as by wave motion, or of deposition from solution. (48)

stratification—The state of a fluid that consists of two or more horizontal layers arranged according to their density, the lightest layer being on top and the heaviest at the bottom.

stratigraphy—The branch of geology which treats of the formation, composition, sequence, and correlation of layered or bedded rocks. (2)

stratosphere—From an imperfect analogy with the atmosphere, a term applied by some oceanographers to the nearly uniform masses of cold deep and **bottom water** of middle and low latitudes. This layer is separated from the **troposphere** by the **thermocline**. (54)

stratum—A single sedimentary bed or layer of generally homogenous rock, independent of thickness. *See bed.*

stream—Not to be confused with current. *See strip.*

stream current—A narrow, deep, and fast-moving current as opposed to a relatively wide and weak **drift current**; for example, the **Gulf Stream**, the **Kuroshio**, and the **Cromwell Undercurrent**.

streamline flow—*See* **laminar flow**.

strength of current—1. The greatest speed of the **tidal current**; usually referenced in knots and in hours before or after low and high water. (*See* figure for **current ellipse**.)

2. For **nontidal currents**, the average of the highest speeds observed, usually determined from the highest 10 percent of the observations.

strength of ebb—(also called *ebb strength*). The **ebb current** at the time of maximum speed.

strength of ebb interval—The time interval between the transit (upper or lower) of the moon and the next maximum **ebb current** at a place. Usually shortened to **ebb interval**. (68)

strength of flood—(also called *flood strength*). The **flood current** at the time of maximum speed.

strength of flood interval—The time interval between the transit (upper or lower) of the moon and the next maximum **flood current** at a place. Usually shortened to **flood interval**. (68)

stress tensor—The complete set of stress components in a medium, which are written as a tensor τ_{ij} . It has nine components, one for each of the coordinate faces of an imaginary fluid element upon which the stress acts ($j=x, y, z$) and for each direction in which the stress is directed ($i=x, y, z$). (5)

stridulatory sound—The noise produced by hard skeletal parts of an animal rubbing together or vibrating as the rasping of **pharyngeal teeth** in certain fishes or the rattle of the spiny lobster's antennae against a toothed ridge on the **carapace**.

string—*See* **strip**.

strip—(or *ice stream, ice strip, stream string*). A long narrow area of **pack ice**, more limited than a **belt**, bounded by **open water** or land. Strips are usually about one kilometer (3,281 feet) or less in width, and are composed of small fragments detached from the main mass of ice run together under the influence of wind, swell, or current. (74)

S₂ constituent—The principal solar **semidiurnal constituent** of the theoretical **tide-producing forces**. (*See* figure for **partial tide**.)

Subarctic Current—An eastward flowing ocean current which lies north of the **North Pacific Current**. It originates from part of the **Aleutian Current** and from outflow of water from the Bering Sea. As it approaches the coast of North America it divides to join the northward-flowing **Alaska Current**, and the southward-flowing **California Current**.

subbottom reflection—The return of sound energy from a discontinuity in material below the sea bottom surface.

subclass—*See* **classification of organisms**.

subcoastal plains—Submerged **plains** of a **continental shelf**. (2)

subkingdom—*See* **classification of organisms**.

sublimation—The transition of the solid phase of certain substances into the gaseous and vice versa without passing through the usual liquid phase. Water possesses this property; thus, ice can change directly to water vapor or water vapor to ice. Strictly speaking, the word sublimation means the evaporation of ice and its immediate recondensation elsewhere, but it is also used to denote the single process of the condensation of water vapor into ice. (65)

sublittoral—That benthic region extending from **mean low water** to a depth of about 100 fathoms (200 meters), or the edge of a **continental shelf**. (2) (*See* figure for **classification of marine environments**.)

submarine alluvial fan—This term is not recommended by the ACUF for a fan composed of sedimentary deposits. *See* **fan**.

submarine best depth—The optimum depth for a submarine to operate to avoid detection.

submarine bulge—*See* **fan**.

submarine canyon—*See* **canyon**.

submarine delta—*See* **fan**.

submarine geology—*See* **geological oceanography**.

submarine geomorphology—The branch of geology that deals with the features of the **sea floor**, their form, origin, and development, and the changes they are undergoing.

submarine isthmus—A submarine **elevation** joining two land regions and separating two **basins** by a depth less than that of the basins. (68)

submarine peninsula—An elevated portion of the submarine relief resembling a peninsula. The opposite is **sac**. (68) *See* **peninsula**.

submarine pit—*See* **submarine well**.

submarine valley—*See* **valley**.

submarine well—A cavity on the sea bottom; also called a submarine pit. (68)

submerged breakwater—A **breakwater** with its top below the **still water level**. When this structure is struck by a wave part of the wave energy is reflected seaward. The remaining energy is largely dissipated in a **breaker**, transmitted shoreward as a multiple crest system, or transmitted shoreward as a simple wave system.

suborder—*See* **classification of organisms**.

subordinate station—1. One of the places for which tide or tidal current predictions are determined by applying a correction to the predictions of a **reference station**. (68)

2. A tide or tidal current station at which a short series of observations has been made, which are reduced by comparison with simultaneous observations at a reference station. (68)

3. Called secondary port in British terminology. (68)

4. *See* **tide station**.

subphylum—*See classification of organisms.*

subsequent penetration—The depth to which a mine sinks into the bottom after the initial impact.

subsurface current—A current usually flowing below the **thermocline**, generally at slower speeds and frequently in a different direction from the currents near the surface.

subtropical anticyclone—*See subtropical high.*

Subtropical Convergence—(or *Subtropical Convergence zone, Subtropical Convergence line*). The zone of converging currents generally located in midlatitudes. It is fairly well defined in the Southern Hemisphere where it appears as an earth-girding region within which the surface temperature increases equatorward.

Subtropical Convergence line—*See Subtropical Convergence.*

Subtropical Convergence zone—*See Subtropical Convergence.*

subtropical high—(or *subtropical anticyclone, oceanic anticyclone, oceanic high*). One of the semipermanent highs of the subtropical high pressure belt. They lie over oceans, and are best developed in the summer season. *See Azores high, Bermuda high, Pacific high.* (5)

sugar berg—*See sugar iceberg.*

sugar iceberg—(or *sugar berg*). An iceberg composed of the more porous type of **glacier ice**. Such ice is formed at very low temperatures, is loosely constructed, and falls apart easily. (65)

sugarloaf sea—*See intersecting waves.*

summer minimum—The scarcity of **phytoplankton** (generally **diatoms**) noted after the abundance in the spring. Grazing by **zooplankton** and depletion of essential nutrients are the main factors in reducing the phytoplankton population.

summer solstice—For either hemisphere, the **solstice** at which the sun is above that hemisphere. In northern latitudes, this occurs approximately on 21 June. (5)

sun zenith distance—The angle between the zenith and the sun's disk. (8)

superfamily—*See classification of organisms.*

superoceanic deep—*See hadal.*

supralittoral—(or *supratidal*). The shore zone immediately above high tide level, commonly the zone kept more or less moist by waves and spray. (2) (*See figure for classification of marine environments.*)

supratidal—*See supralittoral.*

surf—1. Collective term for **breakers**. (73)

2. The wave activity in the area between the **shoreline** and the outermost limit of breakers. (61)

surface anomalies—Irregularities at the earth's surface, in the weathering zone, or in near surface beds which interfere with geophysical measurements.

surface corrections—Corrections of geophysical measurements for **surface anomalies** and ground elevations.

surface current—A general term meaning that part of a directly observed movement of water which, in nearshore areas, does not extend more than 3 to 10 feet (1 to 3 meters) below the surface; in deep, or open ocean areas, surface currents generally are considered to extend from the surface to depths of about 33 feet (10 meters).

When surface currents are computed by theoretical methods, the volume of water in the mixed layer (above the **thermocline**) from the surface to depths of about 165 to 495 feet (50 to 150 meters), generally is referred to as surface current.

surface density—The density of the surface material within the range of elevation differences of the gravitational survey. Both the **Bouguer correction** and the **terrain corrections** depend on the density of the surface materials.

surface duct—A zone immediately below the sea surface where sound rays are refracted toward the surface and then reflected. They are refracted because the **sound velocity** at some depth near the surface is greater than at the surface.

The rays alternately are refracted and reflected along the duct to considerable distances from the sound source.

surface energy—*See surface tension.*

surface free energy—*See surface tension.*

surface of discontinuity—*See interface.*

surface of no motion—*See layer of no motion.*

surface path—(or *direct path, near surface path*). Sound paths which go no deeper than 1,000 feet from the surface.

surface probe—A **thermistor** that is towed along the surface to record a continuous sea surface temperature.

surface reflection—The return of sound rays to depth after striking the sea surface.

surface reverberation—*See reverberation.*

surface scattering layer—The population(s) of organisms in the surface layers of the ocean which scatter sound. The organisms may occur in a uniform layer extending from the surface to a depth as great as 100 fathoms. On the echo-sounder record, several layers or patches of discrete scatterers may be conspicuous within the uniform layer. *See deep scattering layer, shallow scattering layer.*

surface temperature—1. In oceanography, the temperature of the layer of sea water nearest the atmosphere. It is generally determined either as **bucket temperature** or **injection temperature**.

2. In meteorology, the temperature of the air near the surface of the earth, almost invariably

determined by a thermometer in an instrument shelter.

(5)

surface tension—(also called *surface energy, surface free energy, capillary forces, interfacial tension*). A phenomenon peculiar to the surface of liquids, caused by a strong attraction towards the interior of the liquid acting on the liquid molecules in or near the surface in such a way to reduce the surface area. An actual tension results and is usually expressed in dyne per centimeter or erg per square centimeter.

(5)

surface water—*See mixed layer.*

surface wave—A progressive **gravity wave** in which the disturbance (that is, the particle movement in the fluid mass as well as the surface movement) is confined to the upper limits of a body of water. Strictly speaking this term applies to those progressive gravity waves whose celerity depends only upon the wavelength (73)

surf beat—Irregular oscillations of the nearshore water level, with periods of the order of several minutes. (61) *See beating.*

surf zone—The area between the outermost **breaker** and the limit of wave **uprush**. (61)

surge—1. The name applied to wave motion with a period intermediate between that of the ordinary wind wave and that of the tide, from about $\frac{1}{2}$ to 60 minutes. It is of low height, usually less than 0.3 foot. (61)

2. Horizontal oscillation of water with comparative short period accompanying a **seiche**.

(73) *See storm surge.*

3. *See ship motion.*

surge channel—A transverse **channel** cutting the outer edge of an **organic reef** in which the water level fluctuates with wave or tidal action. (2)

surging breaker—*See breaker.*

surveillance—The systematic observation of air, surface, or subsurface areas by visual, electronic, photographic, or other means.

suspended load—*See load.*

suspension current—*See turbidity current.*

sverdrup—A unit of volume transport equal to one million cubic meters (35.313 million cubic feet) per second. (45)

Swallow float—A tubular buoy, usually made of aluminum, that can be adjusted to remain at a selected density level to drift with the motion of that **water mass**. The float is tracked by shipboard listening devices and current velocities can be determined.

swash—(or *uprush, run-up*). 1. The rush of water up onto the beach following the breaking of a wave.

2. A narrow channel or sound within a sandbank, or between a sandbank and the shore. (68)

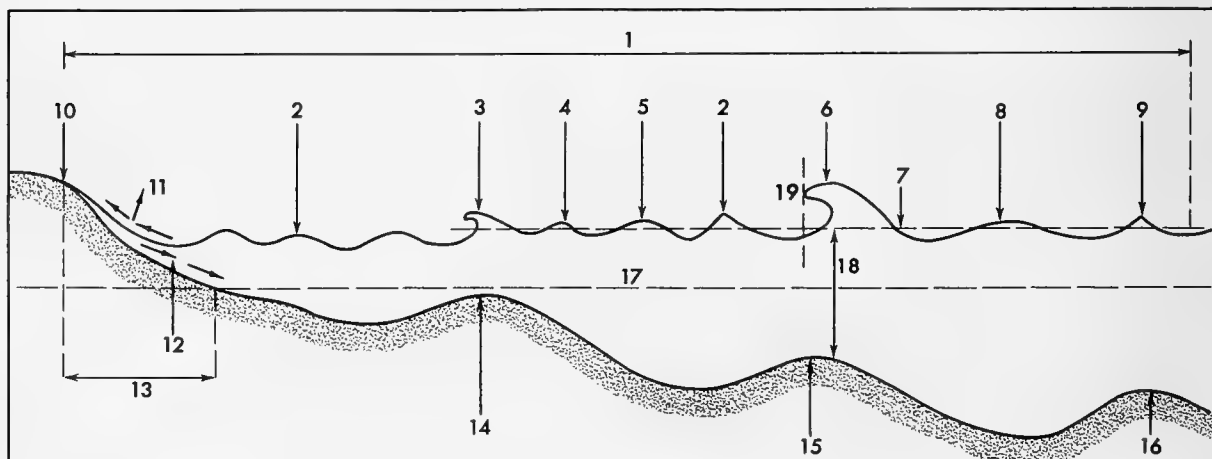
3. Also a **bar** over which the sea washes. (68)

swash channel—1. On the open shore, a **channel** cut by flowing water in its return to the parent body (that is, a rip channel).

2. A secondary channel passing through or shoreward of an inlet or river bar. (*See figure for bars.*)

(61)

swash mark—The thin wavy line of fine sand, mica scales, bits of seaweed, etc., left by the **uprush** when it recedes from its upward limit of movement on the **beach face**. (61)



SCHEMATIC DIAGRAM OF WAVES IN THE BREAKER ZONE

1. Surf or Breaker zone; 2. Translatory waves; 3. Inner line of breakers; 4. Peaked up wave; 5. Reformed oscillatory wave;

6. Outerline of breakers; 7. Still water level; 8. Waves flatten again; 9. Waves break up but do not break on this bar at high

tide; 10. Limit of uprush; 11. Uprush; 12. Backrush; 13. Beach face; 14. Inner bar; 15. Outer bar (inner bar at Low tide); 16. Deep bar (outer bar at low tide); 17. Mean lower low water (MLLW); 18. Breaker depth ≈ 1.3 height

19. Plunge point

(NBS, TR-4, 1954)

sway—*See* **ship motion**.

swell—1. Ocean waves which have traveled out of their generating area. Swell characteristically exhibits a more regular and longer period and has flatter crests than waves within their **fetch**. (5)

2. *See* **rise**.

swept area—An area determined to be clear of navigational danger.

swim bladder—*See* **air bladder**.

swimmer's itch—*See* **schistosome dermatitis**.

symbiosis—A relationship between two species in which one or both species are benefitted and neither is harmed. Some authorities restrict the meaning of symbiosis to those interrelationships between certain plants and animals. *See* **commensalism**, **mutualism**, **inquilinism**.

synchronous resonant wave—One wave whose

period is equal to the natural period of the water basin, or the period of roll of a ship.

syncline—A fold or arch of rock in which the strata dip inward toward the plane of the axis. *See* **anticline**.

synoptic chart—Any chart or map on which data and analyses are presented that describe the state of the marine environment over an area at a given moment in time.

synoptic oceanography—The study of the physical spatial field of parameters through analysis of simultaneous observations from many platforms. The regular repetition of a pattern of simultaneous observations.

syzygy—The two points in the moon's orbit when the moon is in **conjunction** or **opposition** to the sun relative to the earth; time of new or full moon in the cycle of phases. (*See* figure for **tide cycle**.)

T

table iceberg—*See* **tabular iceberg**.

tableknoll—A **knoll** with a comparatively smooth, flat top. (62)

tablemount—A **seamount** having a comparatively smooth, flat top. (62)

table reef—A small isolated **reef**, with or without islands, which has no **lagoon**. (2)

tabular iceberg—(or *barrier iceberg*, *table iceberg*). A flat-topped **iceberg** showing horizontal firn-snow layers, usually calved from an ice-shelf formation. (74)

Newly formed tabular icebergs have nearly vertical sides and flat tops. In the antarctic where they are most numerous, tabular icebergs may be tens of miles wide, up to 100 miles long, and as much as 1,000 feet thick with about 100 feet exposed above the sea surface. In the arctic, the large icebergs of this type are called **ice islands**, but they are considerably smaller than the largest of the antarctic variety. (5)

tail wind—*See* **crosswind**, **following wind**.

talus—1. A slope.

2. (also called *scree*). The debris at the foot of a cliff or slope, particularly that accumulated as a result of gravitational roll or slide. (68)

tangential stresses—The components of the **stress tensor** which are tangential to the faces of the fluid element. (5)

tangue—Very fine calcareous silt and clay derived from banks of **coquina** limestone and which is deposited in estuaries and along the coast of the Bay of Biscay. (2)

tape gage—A **tide gage** which consists essentially of a float attached to a tape and counterpoise. (50)

target strength—A measure of the reflecting power of the target. The ratio, in decibels, of the reradiated sound (target echo) measured one yard from the target to the sound incident on the target.

taut-wire mooring—A mooring arrangement in which a submerged float provides the upward force necessary to maintain the system in a fixed position with reference to the sea bottom. Taut-wire moors may be single, double, or multipoint according to design requirements of the system and the speed and variability of the ambient currents.

tectonics—The study of origin and development of the broad structural features of the earth.

telemetry—The study and technique involved in measuring a quantity or quantities in place, transmitting this value to a station, and there interpreting, indicating, or recording the quantities.

telescoped ice—*See* **rafted ice**.

telluric current—(or *earth current*). Natural electric currents that flow on or near the earth's surface in large sheets. Methods have been developed for using these currents to make resistivity surveys.

temperature—In general, the degree of hotness or coldness as measured on some definite temperature scale by means of any of various types of thermometers. (5)

temperature inversion—In oceanography, a layer in which temperature increases with depth.

temperature-salinity diagram—(or *T-S diagram*, *T-S curve*, *T-S relation*). The plot of temperature versus salinity data of a water column. The result is a diagram which identifies the **water masses** within the column, the column's stability, and indicates the σ_t value, and allows an estimate of the accuracy of the temperature and salinity measurements.

temperature scale—(or *thermometric scale*). A graduated scale for measuring the temperature of matter, usually based on the freezing and boiling points of pure water at standard atmospheric pressure. The temperature scales most commonly used are the Celsius (centigrade) scale, the Kelvin (or absolute) scale, and the Fahrenheit scale.

temporary anchorage—*See* **anchorage**.

tension crack—*See* **strain crack**, **shear crack**.

tented ice—**Pressure ice** in which two **ice floes** have been pushed into the air, leaving an air space underneath. (5)

tent fish—*See* **Alexander's acres**.

tenting—The vertical displacement upward of ice under pressure to form a flatsided arch with a cavity beneath. *See* **bending**, **rafting**. (68)

tephra—A collective term for all elastic volcanic materials which during an eruption are ejected from a crater or from some other type of vent and transported through the air, including volcanic dust, ash, cinders, lapilli, scoria, pumice, bombs, and blocks. (2)

Teredo—A genus of molluscan borers. Also the common name of the animal. *See* **shipworm**.

terrace—A bench-like structure bordering an undersea feature. (62)

terrain correction—(or *topographic correction*).

A correction applied to observed values obtained in geophysical surveys in order to remove the effect of variations to the observations due to the topography in the vicinity of the sites of observation.

terrestrial magnetism—*See geomagnetism.*

terrestrial radiation—(also called *erradiation*, *earth radiation*). The total **infrared radiation** emitted from the earth's surface including the seas and oceans; to be carefully distinguished from **effective terrestrial radiation**, atmospheric radiation, and **insolation**. (5)

terrigenous sediments—Deposits consisting of debris derived from the erosion of land areas and usually deposited in the shallow parts of the sea.

test—The hard covering or supporting structure of many **invertebrates**, it may be enclosed within an outer layer of living tissue; a **shell**. (2)

test board—*See fouling panel.*

test panel—*See fouling panel.*

test plate—*See fouling panel.*

Texas Tower—A fixed tower mounted offshore on the **continental shelf** or a **shoal** to provide oceanographic and meteorological observations.

thalassic rocks—Strata formed in deep, still water far from land, generally composed of very fine grains. (48)

thallatogenic—The vertical movement of the **sea floor**. (2)

thallophyte—One of an artificial grouping (Thallophyta) of simple plants lacking true stems, leaves, and roots and generally having one-celled sex organs. The algae, fungi, and bacteria are included in this group.

thalweg—The line connecting the deepest points of the channel of a sea valley or submarine canyon.

thawing holes in the ice—Ice pocked with open holes, usually circular. These holes represent a further stage of development of snow waters by ice melting. (74)

theoretical gravity—The value of **gravity** calculated for a particular latitude according to an accepted formula such as the 1924 *International Formula of Gravity*.

thermal—Pertaining to temperature or heat. (5)

thermal capacity—*See heat capacity.*

thermal conductivity—(also called *heat conductivity*, *coefficient of thermal conduction*, *coefficient of heat conduction*). The time rate of transfer of heat by **conduction**, through unit thickness, across unit area for unit difference of temperature. It is measured as calories per second per square centimeter for a thickness of one centimeter and a difference of temperature of 1°C. (27)

thermal energy—*See heat.*

thermal equator—*See oceanographic equator.*

thermal expansion—That property of a substance which causes it to change its volume with changes in temperature.

thermal layer—*See thermocline.*

thermal noise—A very low level **noise** produced by molecular movements in the sea.

thermal structure—The temperature variation with depth in sea water.

thermal wake—A temperature change produced on the sea surface by passage of a submerged submarine; although small, it can sometimes be detected with special sensors.

thermistor—A thermally sensitive resistor employing a semiconductor material (usually metallic oxides) with a large negative resistance-temperature coefficient. The response characteristics of thermistors are generally dependent upon ambient conditions, especially temperature, and the nature and purity of the semiconductor material. (34)

thermistor bolometer—A device which is very sensitive to temperature changes resulting from absorption of long wave **infrared radiation**.

thermistor chain—An instrument-carrying chain (up to 1,200 feet long) generally towed astern to get continuous temperature recordings from upper water layers at sea. (35)

thermocline—A vertical negative temperature gradient in some layer of a body of water, which is appreciable greater than the gradients above and below it; also a layer in which such a gradient occurs. The principal thermoclines in the ocean are either seasonal, due to heating of the surface water in summer, or permanent. (5)

thermodynamics—The science that treats of the mechanical action or relations of heat.

thermogram—The record of a **thermograph**. (5)

thermograph—A self-recording thermometer. The thermometric element is most commonly either a bimetal strip or a **Bourdon tube**. (5)

In oceanography, the two most commonly used thermographs are the Geodyne* (Bourdon) and Braincon* (mercury thermometer, radioactive source, and film).

thermohaline—Pertaining to both temperature and salinity acting together; for example, **thermohaline circulation**.

thermohaline circulation—Vertical circulation induced by surface cooling, which causes convective overturning and consequent mixing.

thermohaline convection—Vertical movement of water observed when sea water, because of its decreasing temperature or increasing salinity, becomes heavier than the water underneath it and a disturbed vertical equilibrium results. (25)

thermometer—An instrument for measuring temperature by utilizing the variation of the physical properties of substances according to their thermal states. (5)

- thermometer frame**—A frame designed to hold 2, 3, and in some cases 4 **reversing thermometers**. It can be quickly attached to or removed from a **Nansen bottle**. The frame consists of tubes arranged for reading the thermometers and perforations to permit water circulation around the mercury reservoir.
- thermometer reader C viewer**—A 6-X lense mounted in a tube for ease and increased accuracy in reading **reversing thermometer** temperatures.
- thermometric conductivity**—(also called *thermal diffusivity, heat conductivity*). The ratio of the **thermal conductivity** of a substance to the product of its specific heat and its density. For a fluid, c is the specific heat at constant pressure. The thermometric conductivity determines the rate of heating due to a given temperature distribution. (5)
- thermometric depth**—The depth, in meters, at which paired protected and unprotected thermometers attached to a **Nansen bottle** are reversed. The difference between the corrected readings of the 2 thermometers represents the effect of the **hydrostatic pressure** at the depth of reversal. This depth may then be determined by formula or form a **depth anomaly (ΔZ) graph**. Depths obtained by this means are of greatest value when a **wire angle** occurs.
- thermometric scale**—See **temperature scale**.
- thermonuclear reaction**—A nuclear reaction in which the energy necessary for the reaction is provided by colliding particles that have kinetic energy by virtue of their thermal agitation. Such reactions occur at appreciable rates only for temperatures of millions of degrees and higher, the rate increasing, enormously with the temperature. The energy of most stars is believed to be derived from exothermic thermonuclear reactions. (70)
- thermoprobe**—A **transducer** used to measure temperature *in situ* of ocean bottom sediments at depths beneath the bottom. Such measurements when combined with heat conductivity information provide a measurement of heat flow through the ocean bottom. (4)
- thermosteric anomaly**—The **specific volume anomaly** (steric anomaly) that the sea water at any point would attain if the sea water were brought isothermally to a pressure of one standard atmosphere. In other words, thermosteric anomaly is the specific volume anomaly calculated for the given salinity and temperature but for a standard pressure. (5)
- thick winter ice**—**Winter ice** more than 30 centimeters (12 inches) thick. (74)
- thorium series**—The series of **nuclides** resulting from the decays of Th^{232} . (41)
- thorofare**—Deep channels in the lagoon marshes behind barriers and spits.
- threshold depth**—See **sill depth**.
- thurm**—A ragged, rocky headland swept by the sea. (2)
- tickle**—Any narrow passage connecting two large bodies of water. In the Gulf of St. Lawrence it is restricted to an **inlet** between the sea and a **lagoon**. (2)
- tidal basin**—A basin affected by tides, particularly one in which water can be kept at a desired level by means of a gate. (68)
- tidal bore**—See **bore**.
- tidal component**—See **partial tide**.
- tidal constants**—Tidal relations that remain essentially the same for any particular locality. Tidal constants are classed as harmonic and non-harmonic, the **harmonic constants** consisting of the amplitudes and epochs, and the **nonharmonic constants** including those values determined directly from observations, such as tidal ranges and intervals. (68)
- tidal constituent**—See **constituent, partial tide**.
- tidal correction**—A correction applied to gravitational observations to remove the effect of earth tides on gravimetric observations. The value of gravity at any point varies in a cyclical manner during the course of a day due to the changing positions of the sun and the moon relative to the area being investigated. The tidal correction is commonly included in the drift correction and may be determined by a series of observations at a fixed base station.
- tidal crack**—See **tide crack**.
- tidal current**—(sometimes called *tidal stream*). The alternating horizontal movement of water associated with the rise and fall of the **tide** caused by the astronomical **tide-producing forces**.
- In relatively open locations, the direction of tidal currents rotates continuously through 360 degrees diurnally or semidiurnally. In coastal regions, the nature of tidal currents will be determined by local topography as well. See **flood current, ebb current, reversing current, rotary current**. (5)
- tidal current chart**—A chart showing, by arrows and numbers, the average direction and speed of **tidal currents** at a particular part of the current cycle. A number of such charts, one for each hour of the current cycle, usually are published together. A **current diagram** is a graph showing average speeds of flood and ebb currents throughout the current cycle for a considerable part of a tidal waterway. (68)
- tidal current curve**—See **current curve**.
- tidal current cycle**—The period which includes a **flood** and an **ebb** from one **high water** to the next succeeding high water. The duration of a semidiurnal tide approximates 12.42 hours; that of a diurnal tide approximates 24.84 hours. See **tide curve, tide cycle**.
- tidal current diagram**—See **current diagram**.
- tidal cycle**—See **tide cycle**.
- tidal datum**—See **chart datum**.

tidal datum plane—*See* chart datum.

tidal day—*See* lunar day.

tidal delta—Sand bars or shoals formed in the entrance of inlets by reversing tidal currents. (2)

tidal difference—The difference in time or height of a high or low water between a **subordinate station** and a **reference station**. The difference is applied to the prediction at the reference station to obtain the time or height of the tide at a subordinate station. These differences are available in tide tables.

tidal epoch—*See* epoch.

tidal flat—A marsh or sandy or muddy coastal flatland which is covered and uncovered by the rise and fall of the tide. (2)

tidal glacier—(or *tidewater glacier*). A glacier whose terminus is in **tidewater**. (59)

tidal inlet—*See* inlet.

tidal movement—The movement which includes both the vertical rise and fall of the tide, and the horizontal flow of the **tidal currents**. This movement is associated with the astronomical **tide-producing forces** of the moon and sun acting upon the rotating earth.

tidal outlet—*See* inlet.

tidal platform ice foot—An ice foot between high and low water levels, produced by the rise and fall of the tide. (68)

tidal pool—A pool of water remaining on a beach or reef after recession of the tide. (73)

tidal prediction—*See* tide prediction.

tidal pressure ridge—A pressure ridge in sea ice caused by forces exerted on the ice by the tide. (59)

tidal prism—The difference between the **mean high water volume** and the **mean low water volume** of an estuary.

tidal prism method—A theoretical procedure for determining the **flushing time** of a harbor or estuary. The method assumes that the contaminant is initially distributed uniformly throughout the harbor or estuary, and that during each **tide cycle** a volume of water and contained contaminant equal to the **tidal prism** is removed from the harbor and replaced by a new volume of sea water which mixes completely and uniformly with the water present in the estuary at low water. Therefore, the amount of con-

taminating material removed on each tidal cycle may be expressed as a percentage of the contaminant in the harbor during the previous tidal cycle:

$$\frac{\text{tidal prism volume}}{\text{high water volume of harbor}} \times (100) = \text{percent of contaminant removed from harbor.}$$

tidal range—*See* tide range.

tidal rise—*See* rise of the tide.

tidal scour—The erosion of the bottom by **tidal currents** with formation of deep channels and holes. (2)

tidal stand—*See* stand of tide.

tidal stream—*See* tidal current.

tidal water—*See* tidewater.

tidal wave—1. The wave motion of the tides.

2. In popular usage, any unusually high (and therefore destructive) water level along a shore. It usually refers to either a **storm surge** or **tsunami**.

(5)

tide—The periodic rising and falling of the earth's oceans and atmosphere. It results from the **tide-producing forces** of the moon and sun acting upon the rotating earth. This disturbance actually propagates as a wave through the atmosphere and through the surface layer of the oceans.

Atmospheric tides are always so designated, whereas the term "tide" alone applies to the water level. Sometimes, the periodic horizontal movements of the water along coast lines is also called "tide," but it is more correct to designate the latter as **tidal current**, reserving the name tide for the periodic vertical movements.

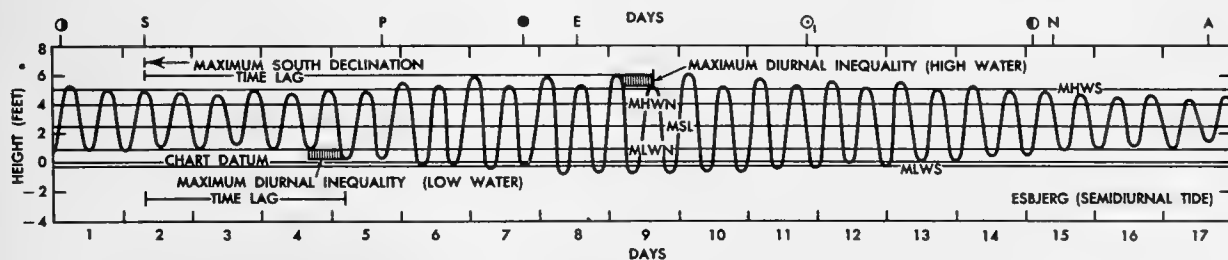
tide amplitude—One-half of the difference in height between consecutive **high water** and **low water**; hence, half of the tide range. (5)

tide bulge—*See* tide wave.

tide crack—1. A crack formed between **shore ice** and the **ice foot** as a result of changing sea level. (74)

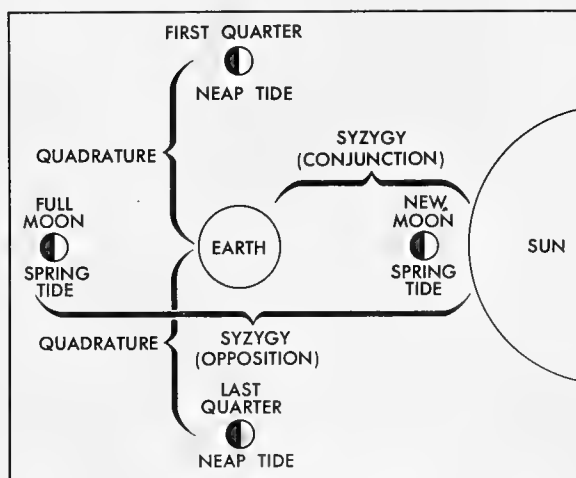
2. A crack between the moving sea ice and the unmoving ice foot. It may widen to form a **shore lead**. *See* crack. (5)

tide curve—A graphic presentation of the rise and fall of tide; time (in hours or days) is represented by the abscissa and height by the ordinate. *See* marigram.



TYPICAL TIDE CURVE

tide cycle—A period which includes a complete set of tide conditions or characteristics, such as a tidal day, a lunar month, or the **Metonic cycle**. See **tidal current cycle**. (68)



TIDE CYCLE

tide gage—A device for measuring the height of **tide**. It may be simply a graduated staff in a sheltered location where visual observations can be made at any desired time; or it may consist of an elaborate recording instrument (sometimes called **marigraph**) making a continuous graphic record of tide height against time. Such an instrument is usually actuated by a float in a pipe communicating with the sea through a small hole which filters out shorter waves.

See **automatic tide gage, box gage, pressure gage, tape gage, tide staff**. (5)

tidehead—The inland limit of water affected by a **tide**. (68)

tide indicator—A form of **tide gage** designed for the purpose of clearly indicating the height and time of the tide measured from a predetermined plane of reference.

tideland—Land which is under water at high tide and uncovered at low tide. **Tideland, beach, strand, and seashore** have nearly the same meanings. **Tideland** refers to the land sometimes covered by **tidewater**. (68)

tidemark—1. A high water mark left by tidal water.

2. The highest point reached by a high tide.

3. A mark placed to indicate the highest point reached by a high tide, or occasionally, any specified state of **tide**.

(68)

tide pole—See **tide staff**.

tide-predicting machine—An instrument that computes, sometimes for years in advance, the times and heights of high and low waters at a **reference station** by mechanically summing the harmonic constituents of which the tide is composed.

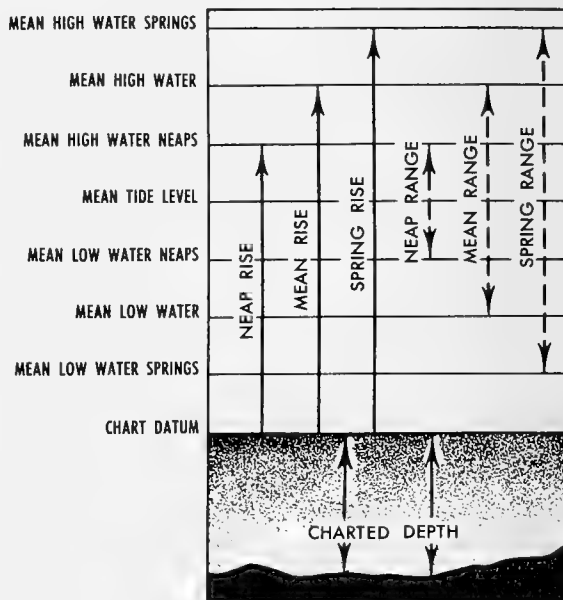
tide prediction—Predetermined time and height of **high** or **low water** at a **reference station**. May be computed years in advance by mechanically summing the harmonic constituents of which the **tide** is composed. Used to compile **tide tables**.

tide-producing force(s)—The slight local difference between the gravitational attraction of two astronomical bodies and the centrifugal force that holds them apart. These forces are exactly equal and opposite at the center of gravity of either of the bodies, but, since gravitational attraction is inversely proportional to the square of the distance, it varies from point to point on the surface of the bodies. Therefore, gravitational attraction predominates at the surface point nearest to the other body, while centrifugal “repulsion” predominates at the surface point farthest from the other body. Hence there are two regions where **tide-producing forces** are at a maximum, and normally there are two tides each lunar day and solar day. (5)

tide race—A very rapid **tidal current** in a narrow channel or passage.

tide range—The difference in height between consecutive **high** and **low waters**. Where the type of tide is diurnal the mean range is the same as the diurnal range.

See **diurnal range, great diurnal range, mean range, apogean range, perigean range, great tropic range, small tropic range, mean tropic range**.



TIDE RANGES FROM CHART DATUM

tide rip—A misnomer for **rips**.

tide rise—See **rise** (sense 1).

tide staff—(also called *tide pole*). A **tide gage** consisting of a vertical graduated staff from

which the height of the **tide** at any time can be read directly. (50)

tide station—A place where tide observations are obtained. It is a **primary tide station** when continuous observations are available for a sufficient number of years to determine the characteristic tide features for the locality. A secondary tide station is operated during a short period of time to obtain data for a specific purpose. (50) See **secondary tide station, reference station**.

tide tables—Tables which give daily predictions, usually a year in advance, of the times and heights of the **tide**. These predictions are usually supplemented by tidal differences and constants by means of which additional predictions can be obtained for numerous other places. (50) See **tide prediction, tidal difference**.

tidewater—(or *tidal water*). Water affected by **tides** or sometimes that part of it which covers the **tideland**. The term is sometimes used broadly to designate the seaboard. (68)

tidewater glacier—See **tidal glacier**.

tide wave—(or *tide bulge*). A long-period wave associated with the **tide-producing forces** of the moon and sun; identified with the rising and falling of the tide. (50) See **tide, tidal movement, stand of tide**.

tideway—A **channel** through which a **tidal current** flows. (68)

tilted iceberg—A **tabular iceberg** that has become unbalanced, so that the flat, level top is inclined. (68)

time—Time is measured by the rotation of the earth with respect to some point in the celestial sphere and may be designated as sidereal, solar, or lunar, according to whether the measurement is taken in reference to the vernal equinox, the sun, or the moon. Solar time may be Apparent or Mean, according to whether the reference is to the actual sun or the mean sun. Mean solar time may be local or standard according to whether it is based upon the transit of the sun over the local meridian or a selected meridian adopted as a standard over a considerable area. Greenwich time is standard time based upon the meridian of Greenwich, England. In Civil time the day commences at midnight, while in Astronomical time as used prior to 1925 the beginning of the day was reckoned from the noon of the civil day of the same date. The name Universal Time is now applied to the Greenwich Civil Time. On 1 January 1953, the term Greenwich Mean Time replaced the term Greenwich Civil Time in the United States. (73)

time constant—(also called *lag coefficient*). Generally, the time required for an instrument to indicate a given percentage of the final reading resulting from an input signal; the **relaxation time** of an instrument. In the case of instruments such as thermometers, whose response to

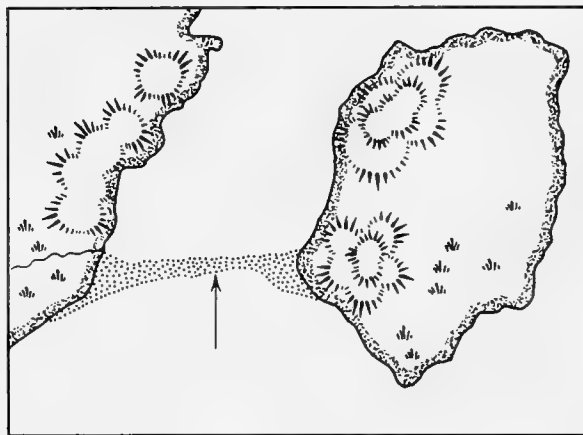
step changes in an applied signal is exponential in character, the time constant is equal to the time required for the instrument to indicate 63.2 percent of the total change, that is, when the transient error is reduced to $1/e$ of the original signal change. (5)

time series—Values of a variable during a finite time period.

tintinnid—Any of a suborder (Tintinnoinea) of microscopic planktonic **Protozoa** which possess a tubular or vase-shaped outer shell. Several species are luminescent.

titration—A chemical method for determining the concentration of a substance in solution. This concentration is established in terms of the smallest amount of the substance required to bring about a given effect in reaction with another known solution or substance. The most common titration is that for **chlorinity**.

tombolo—A bar or spit connecting or "tying" an island to the mainland or to another island. (2)



TOMBOLO

(68; IR-4, 1954)

tongue—1. A projection of the **ice edge** up to several kilometers in length. It is caused by winds or currents. (74)

2. A narrow peninsula formed by a glacier and a steep, narrow cliff of ice rising high above glacial névé is called an **ice tongue**. An extension of a glacier into the sea is called a **glacier tongue**, and, if the end is afloat, an **ice tongue afloat**. (68)

3. An **inlet**. (68)

4. A narrow, rapid current. (68)

5. Protrusion of water into a region of different temperature. A tongue is cold when it extends into an area of warmer water, or warm when it extends into an area of colder water.

Tongue of the Ocean—(abbreviated TOTO). A steep-sided, deepwater embayment approximately 100 nautical miles long, 20 nautical miles wide, and one nautical mile deep, connected to the Atlantic Ocean by Northeast Providence Chan-

- nel and Northwest Providence Channel and trends southeast into the Great Bahama Bank, terminating in a circular **cul-de-sac**. (11)
- toothed cetacean**—*See* **toothed whale**.
- toothed whale**—(or *odontocete*, *toothed cetacean*). A member of the cetacean suborder Odontoceti, which comprises the dolphins, porpoises, killer whales, beaked whales, and sperm whales.
- tooth shell**—(or *tusk shell*, *scaphopod*). One of a class (Scaphopoda) of benthic marine mollusks having tubular, tapering, slightly curved shells, open at both ends; the body has no distinct head but possesses a foot.
- topographic correction**—*See* **terrain correction**.
- topography**—The configuration of a surface including its relief. In oceanography the term is applied to a surface such as the sea bottom or a surface of given characteristics within the water mass.
- torsion crack**—A crack in sea ice, produced by twisting of the ice beyond its elastic limit. (68)
- tosca**—Applied in Argentina to a white calcareous marl. In Colombia it is synonymous with volcanic tufa. (48)
- total internal reflection**—In wave refraction theory, a term analogous to the phenomenon of the total internal reflection of light at a 45–45–90 prism. It occurs at a special type of **caustic**. (73)
- total magnetic intensity**—The vector resultant of the intensity of the horizontal and vertical components of the earth's magnetic field at a specified point.
- total phosphorus**—Includes both the soluble phosphorus (phosphate) and the organic phosphorus contained in the plankton organisms and other organic material in the water. (71)
- total scattering coefficient**—*See* **scattering coefficient**.
- tow**—(or *haul*). A single haul of a net.
- trace**—1. (sometimes called *profile*). A line drawn on a graph which shows the variation of an oceanographic element such as temperature and salinity usually with depth.
2. The indication of the recorded depth on an **echogram**.
- tracer**—A foreign substance mixed with (or attached to a given substance) to enable the distribution or location of the latter to be determined subsequently. A radioactive tracer is a physical or chemical tracer having **radioactivity** as its distinctive property. An **isotopic tracer** is a **radionuclide** used as a chemical tracer for the element with which it is isotopic. (41)
- tracer studies**—A technique for studying the role of an element, a group of elements, or a compound in a biological, chemical, or physical process. In this technique an **isotopic tracer** is employed to follow the course of the bulk material through the process. (41)
- traction**—*See* **load**.
- traction load**—*See* **load**.
- trade winds**—The wind system, occupying most of the tropics, which blows from the **subtropical highs** toward the equatorial trough; a major component of the general circulation of the atmosphere. The winds are northeasterly in the Northern Hemisphere and southeasterly in the Southern Hemisphere. *See* **antitrades**. (5)
- traffic noise**—The general disturbance caused by ships not associated with a specific ship or, more significant, which has no definite directional distribution relative to a given observation point and which shows little change in intensity with change in position.
(28)
- training wall**—*See* **jetty**.
- transducer**—A device that converts electrical energy to sound energy, or the converse. When sound energy received through the water is converted to electrical energy, the device is termed a hydrophone; conversely, when electrical energy is converted to sound energy and transmitted through the water, the device is termed a sonar projector or echo sounder.
- transducer loss**—The ratio of the available power of the source to the power that the **transducer** delivers to the load under specified operating conditions. (6)
- transgressive reef**—One of a series of reefs or **bioherms** developed close to and parallel to the shore, by a net movement of the sea over the land. (2)
- transient thermocline**—A small decrease in vertical temperature observed above the **thermocline**. It is a short-term phenomenon associated primarily with diurnal heating and wind mixing.
- transit**—The passage of the moon over the local meridian; it is designated as upper transit when it crosses the observers meridian and as lower transit when it crosses the same meridian but 180 degrees from the observer's location. When specified, transit may be referred to the Greenwich meridian.
- transitional water wave**—A progressive **gravity wave** in water whose depth is less than $\frac{1}{2}$ but more than $\frac{1}{25}$ the wavelength. Often called a **shallow water wave**. (73)
- transition zone**—The water area between two opposing currents manifested by **eddies**, **upwelling**, **rips**, and similar turbulent conditions occurring either vertically or horizontally; or a zone between two water masses of differing physical characteristics such as temperature and/or salinity.
- transmission anomaly**—The difference (in **decibels**) between the total **transmission loss** in intensity and the reduction in intensity due to an assumed inverse square divergence.
- transmission gain**—Whenever the transmission factor is a number greater than unity, as it is in the case of an amplifier, the **transmission loss** would have a negative sign. In such cases the

- logarithm of the reciprocal of the transmission factor is written with a positive sign and designated as a transmission gain. (28)
- transmission level**—The energy at any point in an energy transmission system is the rate of flow of that energy as expressed in terms of (1) a specified reference rate of flow and of (2) the **transmission loss** by which the actual rate of flow must be reduced to equal the reference rate. (28)
- transmission loss**—The energy lost in the transmission of sound from one point to another; the loss usually is expressed in **decibels**. In **passive sonar** the loss is one way, whereas in **active sonar** it is two way (travel from projector and return of echo).
- transmittance**—The ratio of the transmitted **radiant flux** to the incident radiant flux (in either **irradiance** or **radiance** form). (8)
- transparency**—That property of water to transmit light of different wavelengths. Transparency sometimes is measured in percent of radiation that penetrates a distance of one meter; sometimes it is expressed as the average depth at which a **Secchi disc** disappears and reappears.
- transponder**—An automated receiver/transmitter for transmitting signals when triggered by an interrogating signal.
- transport**—1. The process by which a substance or quantity is carried past a fixed point, or across a fixed plane. In oceanography and meteorology, such quantities are: heat, momentum, mass, dissolved impurities, suspended particles, etc. (5)
2. *See flux.*
- tranverse bars**—Slightly submerged sand ridges which extend at right angles to the **shoreline**. (2)
- transverse cylindrical orthomorphic projection**—*See transverse Mercator projection.*
- transverse Mercator projection**—(also called *transverse cylindrical orthomorphic projection, inverse Mercator projection, inverse cylindrical orthomorphic projection*). A conformal cylindrical map projection in which points on the surface of a sphere or spheroid, such as the earth, are conceived as developed by Mercator principles on a cylinder tangent along a meridian. This projection is particularly useful for charts of polar regions and for those extending a relatively short distance from the tangent meridian. It is frequently used for star charts. (68)
- transverse wave**—(also called *distortional wave*). A wave in which the direction of propagation of the wave is normal to the displacements of the medium, for example, a vibrating string. The **gravity wave** in which fluid parcels move in circular orbits is an example of a mixed transverse-longitudinal wave. (5)
- traumatic air embolism**—*See air embolism.*
- travel time**—The time necessary for waves to travel a given distance from the generating area.
- trawl**—1. A bag- or funnel-shaped net to catch bottom fish by dragging along the bottom.
2. A large research net designed on bottom trawl principles to catch large **zooplankton** and fishes by towing in intermediate depths.
- treibeis**—*See pack ice.*
- trench**—A long, narrow and deep depression of the sea floor, with relatively steep sides. (62)
See foredeep, hadal.
- triangulation**—The measurement of a series of angles between points on the surface of the earth, for the purpose of establishing relative positions of the points in surveying. (68)
- Tridacna**—*See giant clam.*
- trim**—1. The attitude of a submerged submarine with respect to neutral buoyancy and fore-and-aft balance.
2. In a more restrictive sense, the adjustment of submarine buoyancy.
3. The relation of the draft of a ship at the bow and stern. (68)
- tripton**—(or *abioseston*). Collectively, all of the dead suspended particulate matter in aquatic habitats. (44)
- Tritium**—(abbreviated 3H or T). The hydrogen **isotope** having one proton and two neutrons in the nucleus (mass number 3). (70)
- trochoidal wave**—A progressive oscillatory wave whose form is that of a prolate cycloid or trochoid. It is approximated by waves of small amplitudes. (61)
- trochophore**—(or *trochosphere*). The free-swimming pelagic larval stage of some **annelids** and **mollusks**.
- trochosphere**—*See trochophore.*
- trophic level**—A successive stage of nourishment as represented by links of the food chain. Primary producers (**phytoplankton**) constitute the first trophic level, herbivorous **zooplankton** the second trophic level, and carnivorous organisms the third trophic level.
- tropical air**—A type of air whose characteristics are developed over low latitudes. Maritime tropical air (mT), the principal type, is produced over the tropical and subtropical seas. It is very warm and humid, and is frequently carried poleward on the western flanks of the **sub-tropical highs**. Continental tropical air (cT) is produced over subtropical arid regions, and is hot and very dry. (5)
- tropical cyclone**—The general term for a cyclone that originates over the tropical oceans. At maturity, the tropical cyclone is one of the most intense and feared storms of the world; winds exceeding 175 knots (200 mph) have been measured, and its rains are torrential. *See hurricane.* (5)
- tropic currents**—Tidal currents occurring twice monthly when the effect of the moon's maximum declination is greatest. Greatest diurnal inequalities between speeds and durations of successive

- flood and successive ebb currents occur at this time.
- tropic higher high water**—(abbreviated TcHHW). The mean higher high water of **tropic tides**. (68)
- tropic higher high water interval**—(abbreviated TcHHWI). The lunitidal interval pertaining to the mean higher high waters at the time of **tropic tides**. (68) *See lunitidal interval*.
- tropic higher low water**—(abbreviated TcHLW). The mean higher low water of **tropic tides**. (68)
- tropic high water inequality**—(abbreviated HWQ). The average difference between the heights of the two high waters of the tidal day at the time of **tropic tides**. *See diurnal inequality*. (68)
- tropic inequalities**—**Tropic high water inequality** is the average difference between the two high waters at the times of **tropic tides**. **Tropic low water inequality** is the average difference between the two low waters at the times of **tropic tides**. The terms are applicable only when the type of tide is semidiurnal or mixed.
- tropic intervals**—**Tropic higher high water interval** is the lunitidal interval of the higher high waters at the time of the **tropic tides**. **Tropic lower low water interval** is the lunitidal interval of the lower low waters at the time of the **tropic tides**. *See lunitidal interval*.
- tropic lower high water**—(abbreviated TcLHW). The mean lower high water of **tropic tides**. (68)
- tropic lower low water**—(abbreviated TcLLW). The mean lower low water of **tropic tides**. (68)
- tropic lower low water interval**—(abbreviated TcLLWI). The lunitidal interval pertaining to the mean lower low waters at the time of **tropic tides**. (68) *See lunitidal interval*.
- tropic low water inequality**—(abbreviated LWQ). The average difference between the heights of the two low waters of the tidal day at the time of **tropic tides**. *See diurnal inequality*. (68)
- tropic range**—Contracted form of **great tropic range**.
- tropic tide**—The tide that occurs twice monthly when the effect of the moon's maximum declination north or south of the Equator is greatest. *See tropic currents*.
- tropic velocity**—The speed of the greater flood or greater ebb tidal currents at the time of **tropic tides**. (68)
- troposphere**—From an analogy with the atmosphere, the term applied by some oceanographers to the upper layer of the oceans in middle and low latitudes. This layer is characterized by relatively high temperatures and strong currents, and is generally bounded by the top of the **thermocline**. (54) *See stratosphere*.
- trough**—1. A long depression of the sea floor normally wider and shallower than a **trench**. (62)
2. *See wave trough*.
- try net**—A small **shrimp trawl** 12 to 24 feet wide designed for exploration of shrimp grounds. This net is frequently used for biological sampling of benthic fishes.
- T-S curve**—*See temperature-salinity diagram*.
- T-S diagram**—*See temperature-salinity diagram*.
- T-S relation**—*See temperature-salinity diagram*.
- tsunami**—(or *tunami*, *tidal wave*, *seismic sea wave*). A long-period sea wave produced by a submarine earthquake or volcanic eruption. It may travel unnoticed across the ocean for thousands of miles from its point of origin and builds up to great heights over shoal water.
- Tsushima Current**—That part of the **Kuroshio** flowing northeastward through Korea Strait and along the Japanese coast in the Sea of Japan; it sets strongly eastward through Tsugaru Strait at speeds to 7 knots.
- T-3**—(also called *Fletcher's ice island*, *Drift Station Bravo*). A drifting **ice island** of the Arctic Ocean, probably formed by the **calving** of **shelf ice** from Ward Hunt Island in the Canadian Archipelago. T-3 is short for Target-3, so named because it was first observed by radar from aircraft in July 1950. (T-1, originally called Target-X, was first seen on radar in August 1946.) T-3 has been occupied intermittently as a scientific **drift station** since 1952, first by the U. S. Air Force, and since February 1962 by the Arctic Research Laboratory of Point Barrow, Alaska. During the IGY, it was known as Drift Station Bravo. It is also known as Fletcher's ice island after Colonel Joseph O. Fletcher, its first station leader.
- tubeworm**—Any **polychaete**, chiefly the serpulids or sabellids, that builds a calcareous or leathery tube on a submerged surface. Tubeworms are notable **fouling organisms**.
- tufa**—A chemical sedimentary rock composed of calcium carbonate or silica, precipitated from percolating ground water or from a spring.
- tuff**—Cemented consolidated **volcanic ash**.
- tunami**—*See tsunami*.
- tunic**—The outer cuticular covering of **tunicates**. (47)
- tunicate(s)**—One of a subphylum (Tunicata or Urochordata) of globular or cylindrical, often saclike animals, many of which are covered by a tough flexible **tunic**. Many are **sessile**, others are pelagic, and some are strongly luminescent. *See ascidian, pyrosome, salp*.
- turbidite**—**Turbidity current** deposits characterized by both vertically and horizontally graded bedding.
- turbidity**—Reduced water clarity resulting from the presence of suspended matter. Water is considered turbid when its load of suspended matter

is visibly conspicuous, but all waters contain some suspended matter and therefore are turbid.

turbidity current—(or *density current, mud flow, suspension current*). A highly turbid, relatively dense current carrying large quantities of clay, silt, and sand in suspension which flows down a submarine slope through less dense sea water.

turbulence—A state of fluid flow in which the instantaneous velocities exhibit irregular and apparently random fluctuations, so that in practice only statistical properties can be recognized and subjected to analysis. These fluctuations often constitute major deformations of the flow and are capable of transporting momentum, energy, and suspended matter at rates far in excess of the rate of transport by molecular diffusion and conduction in a nonturbulent or laminar flow. (5)

turbulent diffusion—*See eddy diffusion.*

turbulent flow—A flow characterized by irregular, random velocity fluctuations.

turn of the tide—*See change of tide.*

turnover rate—Usually, the **net primary production** per unit primary standing crop (**phytoplankton**) under natural light conditions, or more specifically, the production divided by the standing stock (**biomass**).

turret ice—*See ropak.*

turtlegrass—*See seagrass.*

tusk shell—*See tooth shell.*

two-year ice—A Russian term for **young polar ice**.

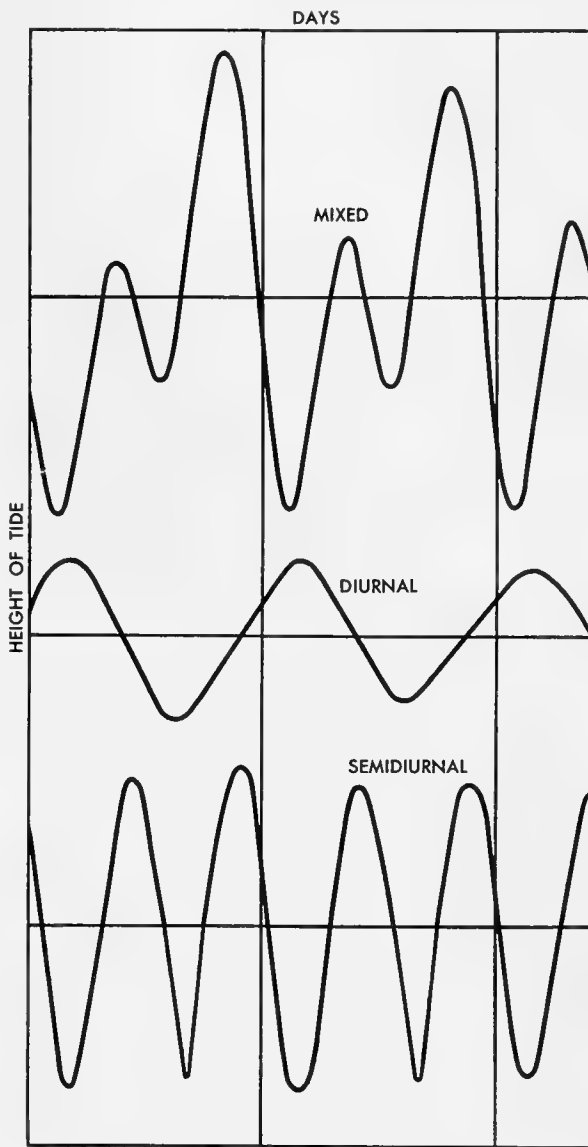
tychoplankton—**Plankton** consisting of animals and plants which have temporarily migrated or have been carried into the plankton from their normal benthic habitat.

Tyler standard grade scale—A scale for sizing particles based on the square root of 2 used as specifications for sieve mesh. Alternate class limits closely approximate the class limits on the **Udden grade scale**, and the intermediate limits are the geometric means of the Udden scale values: 0.50, 0.71, 1.00, 1.41, 2.00. (2)

Tyndall flowers—Small water-filled cavities, often of basically hexagonal shape, which appear in the interior of ice masses upon which light is falling. Their formation results from the melting ice by radiative absorption at points of defect in the ice lattice. (5)

type of tide—The characteristic feature of the **tide** (tidal current) determined from the combination of its diurnal and semidiurnal com-

ponents. Tides are classified as semidiurnal, mixed, and diurnal, but there are no sharply defined limits separating the groups.



TYPES OF TIDE CURVES

typhon—*See typhoon.*

typhoon—(also spelled typhon). A severe **tropical cyclone** in the western Pacific. (5)

U

- Udden grade scale**—A grade scale for particle size, with 1 millimeter as the reference point and involving the fixed ratio 2 or $\frac{1}{2}$, depending on whether the scale is increasing or decreasing, as $\frac{1}{4}$, $\frac{1}{2}$, 1, 2, 4. (5)
- ultraplankton**—**Plankton** smaller than 5 microns; includes bacteria and smaller flagellate forms.
- ultrasonics**—The technology of sound at frequencies above the audio range; that is, above 20,000 cycles per second. (3)
- ultraviolet radiation**—**Electromagnetic radiation** of shorter wavelength than visible radiation but longer than X-rays; roughly, radiation in the wavelength interval from 10 to 4,000 **angstroms**. (5)
- umbrella**—(or *bell*). The gelatinous body of a jellyfish, usually bearing prominent tentacles. It may be bell-, dome-, bowl-, or saucer-shaped according to species.
- unbroken ice**—**Sea ice** which has not been disturbed since its formation. It is usually **fast ice**, although a single smooth **ice floe** could be said to be unbroken ice.
- unconformity iceberg**—An **iceberg** consisting of more than one kind of ice, such as blue water-formed ice and **névé**. Such an iceberg often contains many crevasses and silt bands. (68)
- unconsolidated sediments**—*See* **sediment**.
- uncovers**—(or *dries*). An area of a **reef** or other projection from the bottom of a body of water which periodically extends above and below the surface. (30)
- unda**—The part of the ocean floor which lies in the zone of wave action, in which the bottom sediments are repeatedly stirred and reworked; the topographic expression is termed undaform, and the rock unit is termed undathem.
- undaform**—*See* **unda**.
- undathem**—*See* **unda**.
- undercurrent**—A water current flowing beneath a **surface current** at a different speed or in a different direction. (5)
- underflow**—*See* **bottom flow**.
- undermelting**—The melting from below of any floating ice. (5)
- undersea satellite**—A basketball-size device containing a gauge (to measure tides), a seismometer, and a transmitter.
- undertow**—1. A seaward flow near the bottom of a sloping beach.
2. The subsurface return by gravity flow of the water carried up on shore by waves or breakers. *See* **rip current**. (50)
- underwater gradient**—*See* **slope, gradient**.
- underwater ice**—*See* **anchor ice, frazil ice**.
- underwater sound**—*See* **sound**.
- underway**—The condition in which a ship is making headway against the seas; as opposed to **hove-to**.
- undulation**—A continuously propagated motion to and fro, in any fluid or elastic medium, with no permanent translation of the particles themselves.
- uniform flow**—Any current in which neither convergence nor divergence is present.
- unilateral transducer**—A **transducer** that cannot be actuated at its outputs by waves in such a manner as to supply related waves at its inputs. (69)
- unprotected thermometer**—A reversing thermometer (for sea water temperature) which is not protected against hydrostatic pressure. The mercury bulb is therefore squeezed, and the amount of mercury broken off on reversal is a function both of temperature and hydrostatic pressure.
- When compared with the simultaneous reading of a **protected thermometer**, which is affected by temperature only, the unprotected thermometer reading can be converted to pressure, and then, by applying the mean density of the water, to depth. (5)
- unstable polynya**—*See* **polynya**.
- unstable-type gravimeter**—A **gravity meter** which utilizes a moving system which approaches a point of instability such that small changes in gravity produce relatively large motions of the system.
- upcoast**—In United States usage, the coastal direction generally trending toward the north. (2)
- updrift**—The direction opposite that of the predominant movement of **littoral** materials. (61)
- uplifted reef**—A **coral reef** exposed above water level. (2)
- upper transit**—*See* **transit**.
- uprush**—The rush of water up onto the beach following the breaking of a wave. *See* **swash, run-up**. (61) (*See* figure for **surf zone**.)
- upstream**—Generally, in the direction from which a fluid is flowing; the opposite of **downstream**. (5)

upward irradiance—The **radiant flux** incident on an infinitesimal element of the lower face (180 to 360 degrees) of a horizontal surface containing the point being considered, divided by the area of that element. Unit of measurement is watt per square meter (W/m^2). (8)

upwelling—The process by which water rises from a lower to a higher depth, usually as a result of **divergence** and offshore currents. *See* **sinking**.

Upwelling is most prominent where persistent wind blows parallel to a coastline so that the resultant **wind-driven current** sets away from the coast. *See* **Ekman spiral**. It constitutes a dis-

tinct climatogenetic influence by bringing colder water to the surface. Over the open ocean, upwelling occurs wherever the wind circulation is cyclonic, but is appreciable only in areas where that circulation is relatively permanent. It is also observable when the southern trade winds cross the Equator.

The upwelled water, besides being cooler, is richer in plant nutrients, so that regions of upwelling are generally also regions of rich fisheries. (5)

uranium series—The series of **nuclides** resulting from the decay of U^{238} . (41)

V

vacuum filtration—A method of extracting **phytoplankton** and bacteria from a water sample.

See **Millepore* filter**.

valence electron—An electron which is gained, lost, or shared in a chemical reaction. (70)

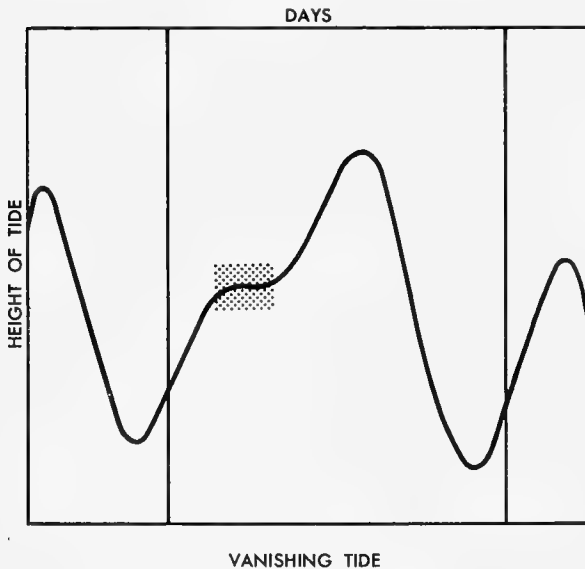
valley—A relatively shallow, wide depression with gentle slopes, the bottom of which grades continuously downward. The term is used for features that do not have canyonlike characteristics in any significant part of their extent. (62)

valley iceberg—(also called *drydock iceberg*). An **iceberg** eroded in such a way that a large U-shaped slot, which may be awash, extends through its surface separating pinnacles or slabs. (59)

valve—1. One of the pieces forming the shell of a **diatom**.

2. Any of the pieces forming the shell of certain **invertebrates**, such as the **mollusks** and **barnacles**.

vanishing tide—When a high and low water “melt” together into a period of several hours with a nearly constant water level, the tide is in the diurnal category but is known as a vanishing tide.



vapor—Any substance existing in the gaseous state at a temperature lower than that of its **critical point**; that is, a gas cool enough to be liquified if sufficient pressure were applied to it.

If any vapor is cooled sufficiently, say at con-

stant pressure, it ultimately reaches a state of saturation such that further removal of heat is accompanied by condensation to the liquid phase. (5)

vaporization—*See* **evaporation**.

vapor pressure—(or *vapor tension*). The pressure exerted by the molecules of a given **vapor**. For a pure, confined vapor, it is that vapor's pressure on the walls of its containing vessel; and for a vapor mixed with other vapors or gases, it is that vapor's contribution to the total pressure (that is, its partial pressure).

In the atmosphere, vapor pressure is used almost exclusively to denote the partial pressure of water vapor. Care must be exercised in interpreting the term's meaning as used in other branches of science. (5)

vapor tension—*See* **vapor pressure**.

variability of waves—1. The variation of heights and periods between individual waves within a **wave train**. (Wave trains are not composed of waves of equal height and period, but rather of waves with heights and periods which vary in a statistical manner.)

2. The variation in direction of propagation of waves leaving the generating area.

3. The variation in height along the coast, usually called “variation along the wave.”

(61)

variable—A quantity that may assume a number of values. (22)

variable depth sonar—(abbreviated VDS). A shipborne sonar system whereby the **transducer** can be lowered below the thermal layer.

variance—A measure of variability denoted by σ^2 and defined as the mean-square deviation from the mean, that is, the mean of the squares of the differences between individual values of the variable and its mean value.

variation—1. The range within which values of a **variable** lie, as in the diurnal or annual variation.

2. *See* **declination**.

(5)

varve—A sedimentary deposit, bed, or lamination deposited in one season. It is usually distinguished by color or composition and used as an index to changes in the depositional environment.

vast ice floe—*See* **ice floe**.

vector mean—*See* **resultant current**.

veering—1. According to general international usage, a change in wind direction in a clockwise sense (for example, south to southwest to west) in either hemisphere of the earth; the opposite of **backing**.

2. According to widespread usage among United States meteorologists, a change in wind direction in a clockwise sense in the Northern Hemisphere, counterclockwise in the Southern Hemisphere; the opposite of **backing**.

(5)

vein—A narrow **lead** or **lane** in **pack ice**. (59)

veliger—The planktonic larval second stage of many **gastropods**.

velocity discontinuity—An abrupt change of the rate of propagation of seismic waves within the earth, as at an interface. (35)

velocity hydrophone—A **hydrophone** in which the electric output substantially corresponds to the instantaneous particle velocity in the impressed sound wave. (69)

velocity of sound—*See* **sound velocity**.

vener—A thin layer of sediment covering a rocky surface.

venomous marine animal—Any of various organisms living in the sea that are capable of injecting venom into other organisms, either to capture prey or in self-defense. This capability is developed to the highest degree in some of the jellyfishes, sea urchins, marine snails of the genus *Conus*, stingrays, catfishes, scorpionfishes, and sea snakes.

ventral—Pertaining to or situated on the lower or abdominal surface; opposite of **dorsal**. (26)

vertex velocity—The velocity at which a sound ray becomes horizontal (**grazing angle** equals zero).

vertical haul—(or *vertical tow*). The lifting of an open **plankton net** from a certain depth to the surface while the ship or other platform is on station. *See* **horizontal haul**, **oblique haul**.

vertical intensity—The magnetic intensity of the vertical component of the earth's magnetic field, reckoned positive if downward, negative if upward.

vertically mixed estuary—An **estuary** in which the salinity is homogeneous with depth but increases along its length from the head to the mouth.

vertical tow—*See* **vertical haul**.

very close drift ice—*See* **very close pack ice**.

very close pack ice—**Sea ice** whose concentration is practically 10-tenths (8-eighths) with little if any **open water**. (74)

very open drift ice—*See* **very open pack ice**.

very open pack ice—**Sea ice** whose concentration ranges between 1- and 3-tenths (1- to 2-eighths). (74)

very shallow water—Water of depths less than $\frac{1}{25}$ the wavelength of surface waves.

very shallow water wave—*See* **shallow water wave**.

vesicle—*See* **pneumatocyst**.

vigia—A rock or shoal in the sea, whose existence or position is doubtful; also a warning note to this effect on a nautical chart. (68)

viscosity—(or *internal friction*). That molecular property of a fluid which enables it to support **tangential stresses** for a finite time and thus to resist deformation. (5)

viscous damping—The dissipation of energy that occurs when a particle in a vibrating system is resisted by a force whose magnitude is a constant independent of displacement and velocity, and whose direction is opposite to the direction of the velocity of the particle. (6)

viscous stress—The resistive force of the water; it is proportional to the speed of the current but acts opposite to its direction of flow.

V_o —The volume of mercury below the 0°C mark determined at 0°C in the reversed main thermometer. Expressed in degrees Celsius. V_o is found on the deep sea reversing thermometer card. (67)

voe—An inlet, bay, or creek. (2)

void ratio—The ratio of intergranular voids to the volume of solid material in a sediment. (2)

volcanic ash—Uncemented pyroclastic material consisting of fragments mostly under 4 millimeters in diameter. Coarse ash is $\frac{1}{4}$ to 4 millimeters in grain size; fine ash is below $\frac{1}{4}$ millimeter. A constituent of some marine sediments. (2)

volcanic blocks—Essential, accessory, or accidental volcanic **ejecta**, usually angular and larger than 32 millimeters in diameter, erupted in a solid state. (2)

volcanic bombs—Fragments or lava up to several feet long thrown out of a volcano in a liquid, semifluid, or plastic state and solidified in flight or soon after landing.

volcanic breccia—A rock composed predominantly of angular volcanic fragments greater than 2 millimeters in size set in a subordinate matrix of any composition and texture, or with no matrix; or composed of fragments other than volcanic set in a volcanic matrix. (17)

volcanic cinders—*See* **scoria**.

volcanic cone—A conical hill or mountain with a crater or cup-shaped hollow at the summit constructed of ash, scoria, lava, and other volcanic materials discharged through the summit crater. (*See* figure for **compound volcano**.)

volcanic ejecta—*See* **tephra**.

volcanic eruption—The emission or ejection of volcanic material at the earth's surface from a crater or from a fissure. (2)

volcanic harbor—A bay formed by the flooding of a volcanic crater through a gap in the rim.

volume reverberation—*See* **reverberation**.

volume scattering function—*See* **scattering function**.

volume transport—The volume of moving water measured between two points of reference and expressed in cubic meters per second. It is determined by measuring the cross-sectional areal limits of the current and multiplying this figure by the current speed.

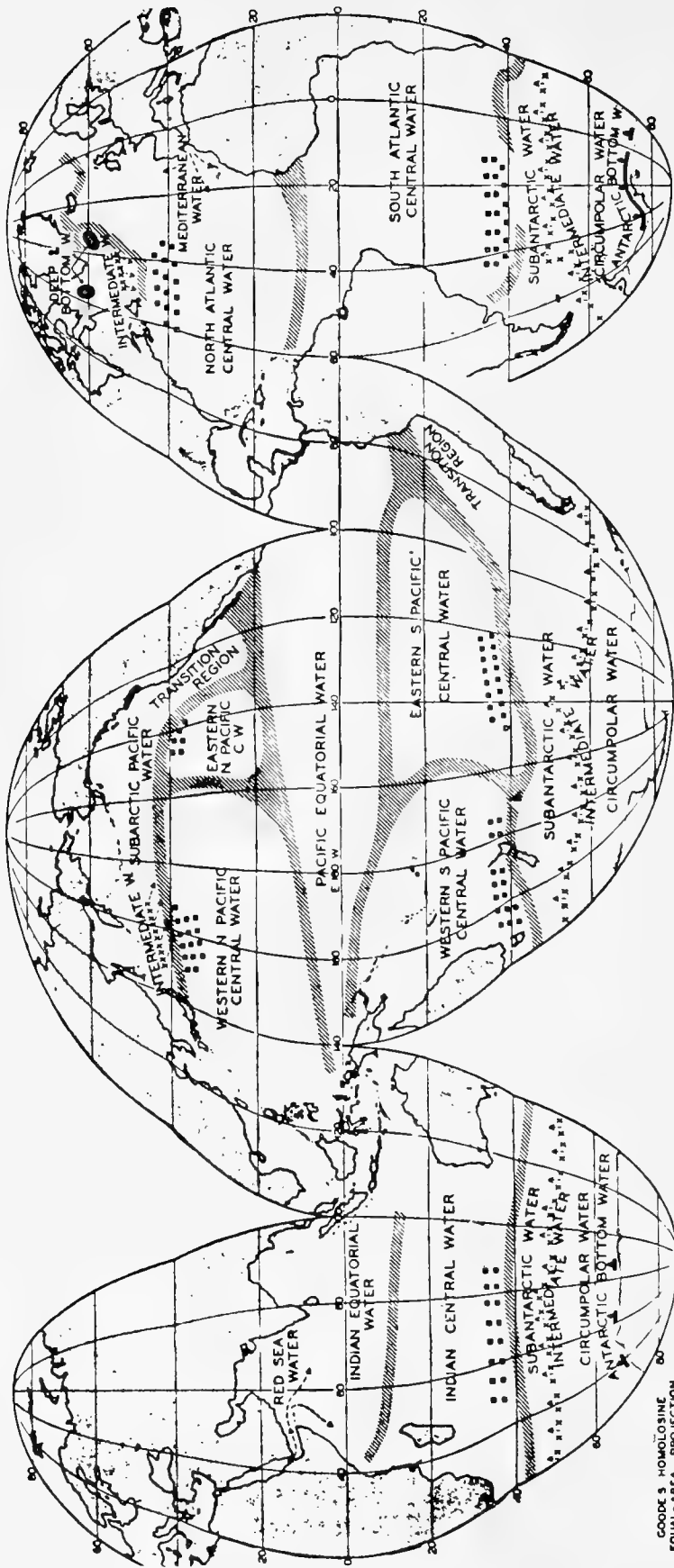
volume velocity—The rate of alternating flow of the medium through a specified surface due to a sound wave. (6)

von Arx current meter—A type of current measuring device using electromagnetic induction to determine speed and, in some models, direction of deep sea currents. This meter provides continuous recordings of current by transmitting, through a connecting cable, signals to a deck unit that registers speed, direction, and instrument depth.

vulgar establishment—*See* establishment of the port.

W

- wake**—The region of turbulence immediately to the rear of a solid body in motion relative to a fluid. (5)
- warm pool**—A body of warm water entirely surrounded by cold water.
- wash and strain ice foot**—An ice foot formed from ice casts and slush and attached to a shelving beach, between the high and low water lines. High waves and spray may cause it to build up above the high water line. (68)
- washovers**—(or *wave delta*). Small **deltas** build on the lagoon side of a **bar** separating the lagoon from the open sea. Storm waves breaking over the bar deposit sediment on the lagoon side in the form of **deltas**. (2)
- water**—*See* **fresh water, normal water, pure water, sea water.**
- water color**—The apparent color of the surface layers of the sea caused by the reflection of certain components of the visible light spectrum coupled with the effects of dissolved material, concentration of **plankton**, detritus, or other matter. Color of oceanic water varies from deep blue to yellow and is expressed by number values which are a variation of the Forel scale. Plankton concentrations may cause a temporary appearance of red, green, white, or other colors. *See* **Forel scale.**
- water content**—A ratio; 100 multiplied by the weight of water in a bottom sediment sample divided by the weight of the dried sample, expressed as a percentage.
- water exchange**—The volume and rate of water replacement in a specific location controlled by such factors as tides, winds, river discharge, and currents.
- water flea**—(or *cladoceran*). One of a suborder (Cladocera) of small **crustaceans** that swim in a jerky or jumpy manner. Although abundant in some shallow water environments, they are not among the more abundant marine **plankton**.
- water-laid rope**—*See* **cable-laid rope.**
- water level**—*See* **sea level.**
- water line**—A juncture of land and sea. This line fluctuates, changing with the tide or other fluctuations in the water level. Where waves are present on the beach, this line is also known as the limit of **backrush**. (Approximately the intersection of the land with the **still water level**.) (61) *See* **shoreline, coastline.**
- water mass**—A body of water usually identified by its T-S curve or chemical content, and normally consisting of a mixture of two or more **water types**. (*See* **temperature-salinity diagram**.)
- The terms water mass and water type have been used loosely and interchangeably in oceanographic literature.
- The major recognized water masses of the oceans are shown in the figures on the following pages. (32)
- water opening**—*See* **opening.**
- water pocket**—A **water mass** of limited size, frequently in the form of a pocket, and having properties different from those of the surrounding water. Water pockets are often located at a meandering boundary where they usually are partly or completely cut off from the original main body of water. (25)
- water sample**—A portion of water brought up from a certain depth to determine its composition.
- water sky**—The dark appearance of the underside of a cloud layer due to the reflection of a surface of open water surrounded or bounded by ice. The area of open water may be beyond the range of visibility. (74)
- This term is used, largely in polar regions, with reference to the **sky map**; water sky is darker than **land sky**, and much darker than **ice blink** or **snow blink**. (5)
- water smoke**—*See* **steam fog.**
- waterspout**—Usually, a tornado occurring over water; rarely, a lesser whirlwind over water, comparable in intensity to a dust devil over land.
- Waterspouts are most common over tropical and subtropical waters. (5)
- water tagging**—The process of introducing foreign substances (tracers) into the ocean to detect the movement of its waters by subsequent measurement of the location and distribution of the introduced substance. *See* **tracer.**
- water transparency**—*See* **transparency.**
- water type**—Sea water of a specified temperature and salinity, and hence defined by a single point on a **temperature-salinity diagram**. (5)
- watt**—A unit of power equal to one **Joule** per second or 10^7 **ergs** per second. (5)
- wattenschlick**—Tidal or intertidal mud. (2)
- wave**—1. A disturbance which moves through or over the surface of the medium (here, the ocean),



APPROXIMATE BOUNDARIES OF THE UPPER WATER MASSES OF THE OCEAN

(SVERDRUP ET AL., 1946)

SURFACE WATER MASSES:

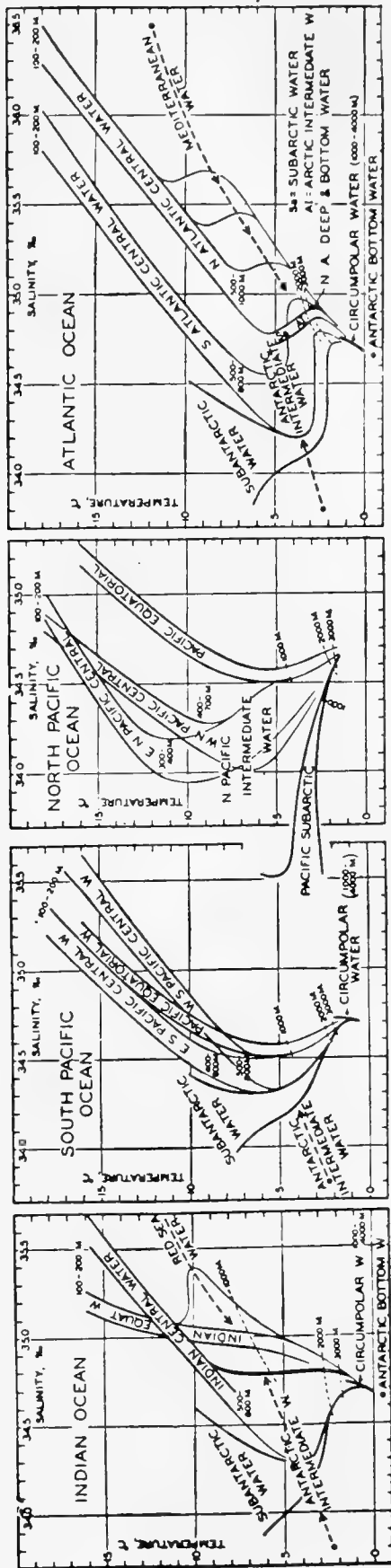
- ANTARCTIC SURFACE WATER
- ARCTIC SURFACE WATER
- NORTH ATLANTIC CENTRAL WATER
- SOUTH ATLANTIC CENTRAL WATER
- SUBANTARCTIC WATER—ALL OCEANS
- SUBARCTIC PACIFIC WATER
- WESTERN NORTH PACIFIC CENTRAL WATER
- EASTERN NORTH PACIFIC CENTRAL WATER
- PACIFIC EQUATORIAL WATER
- WESTERN SOUTH PACIFIC CENTRAL WATER
- EASTERN SOUTH PACIFIC WATER
- INDIAN EQUATORIAL WATER
- INDIAN CENTRAL WATER

SURFACE AND DEEP WATER:

- ANTARCTIC CIRCUMPOLAR WATER—ALL SOUTHERN OCEAN

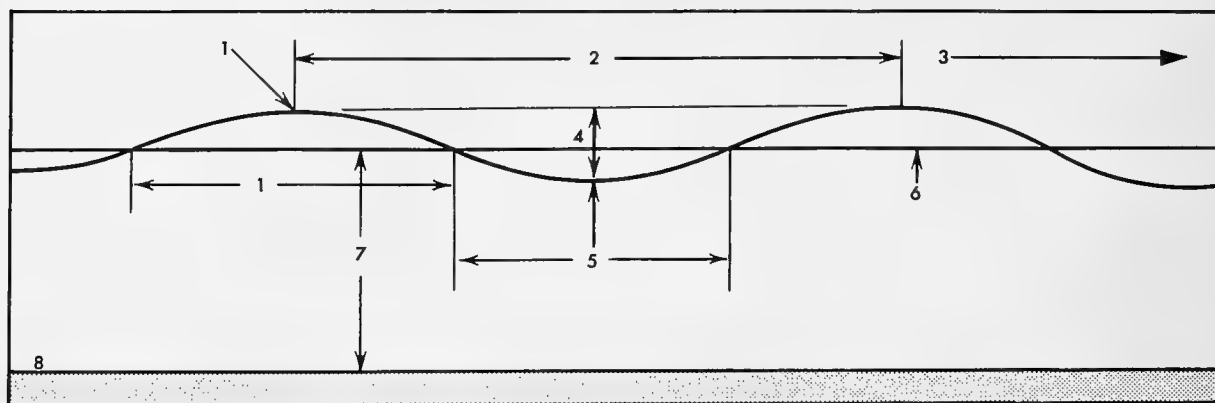
DEEP WATER MASSES:

- ANTARCTIC INTERMEDIATE WATER
- INTERMEDIATE WATER—NORTH ATLANTIC
- INTERMEDIATE WATER—NORTH PACIFIC
- MEDITERRANEAN WATER
- NORTH ATLANTIC DEEP AND BOTTOM WATER
- PACIFIC DEEP WATER
- ARCTIC DEEP WATER
- ANTARCTIC BOTTOM WATER



TEMPERATURE-SALINITY RELATIONS OF THE PRINCIPAL WATER MASSES OF THE OCEANS

HYDROG. (I. A.) 11, 1951



WAVE CHARACTERISTICS

1. Wave crest; 2. Wave length; 3. Direction of wave travel; 4. Height;
5. Wave trough; 6. Still water level; 7. Depth; 8. Ocean bottom

(WEGEL, 1953)

with speed dependent upon the properties of the medium.

2. A ridge, deformation, or undulation of the surface of a liquid.

wave age—The state of development of a wind-generated sea surface wave, conveniently expressed by the ratio of wave speed to wind speed. Wind speed is usually measured at about 25 feet (8 meters) above **still water level**. (5)

wave base—The depth at which wave action ceases to stir the sediments. (2)

wave celerity—The magnitude of wave speed.

wave crest—The highest part of a wave. Also that part of the wave above **still water level**. (61) (See figure for **wave**.)

wave crest length—(or *crest width*). The length of a wave along its **crest**. (61) (See figure for **wave**.)

wave decay—The change which waves undergo after they leave a generating area (**fetch**) and pass through a calm, or region of lighter or opposing winds. In the process of decay, the **significant wave height** decreases and the significant wavelength increases. (61)

wave deltas—See **washovers**.

wave direction—The direction from which a wave approaches. (61) (See figure for **wave**.)

wave filter—See **filter**.

wave forecasting—The theoretical determination of future wave characteristics, usually from observed or predicted meteorological phenomena. (61)

wave front—The leading side of a wave. (68) (See figure for **refraction diagram**.)

wave generation—1. The creation of waves by natural or mechanical means.

2. In wave forecasting the growth of waves caused by a wind blowing over a water surface for a certain period of time. The area involved is called the generating area or **fetch**.

(61)

wave group—A series of waves in which the wave direction, wavelength, and wave height vary only slightly. (61)

wave height—The vertical distance between a **wave crest** and the preceding **wave trough**. See also **significant wave height**. (61) (See figure for **wave**.)

wave height coefficient—The ratio of the **wave height** at a selected point in shallow water to the deepwater wave height. The **refraction coefficient** multiplied by the shoaling factor. (61)

wave hindcasting—The calculation from historic synoptic wind charts of the wave characteristics that probably occurred at some past time. (61)

wave interference—The phenomenon which results when waves of the same or nearly the same frequency are superposed. It is characterized by a spatial or temporal distribution of amplitude of some specified characteristic differing from that of the individual superposed waves. (6)

wavelength—1. The distance between corresponding points of two successive periodic waves in the direction of propagation, for which the oscillation has the same phase. Unit of measurement is meters.

Note: The wavelength of monochromatic radiant energy depends on the refractive index of the medium. Unless otherwise stated, values of wavelengths are those in air. (8)

2. The horizontal distance between points on two successive waves measured perpendicularly to the **wave crest**. (See figure for **wave**.) (61)

wavelength of sound—The distance between corresponding points of adjacent sound waves; measurement is determined by the ratio of speed to frequency.

wave level—The position of the sea surface above or below a reference plane at any specific time in the **tide cycle**.

wave meter—An instrument used to measure and record **wave heights**.

wave of translation—A wave in which the water particles are permanently displaced to a significant degree in the direction of wave travel. (61) (See figure for **surf zone**.)

wave period—The time, in seconds, required for a **wave crest** to traverse a distance equal to one wavelength. (73)

wave pole—(also called *wave staff*). A device for measuring sea surface waves. It consists of a weighted pole below which a disk is suspended at a depth sufficiently deep for the wave motion associated with **deepwater waves** to be negligible. The pole will then remain nearly steady as if anchored to the bottom, and wave height and period can be ascertained by observing or recording the length of the pole that extends above the surface. See **wave recorder**. (5)

wave ray—(or *orthogonal*). A line drawn everywhere perpendicular to the **wave crests** on a refraction diagram. (See figure for **refraction diagram**.)

wave recorder—An instrument for recording ocean waves. Most wave recorders are designed for recording **wind waves**, that is, waves of

periods up to about 25 seconds, but some are designed to record waves of longer periods such as **tsunamis**, **seiches**, or **tides**. See **tide gage**.

(5)

wave refraction—1. The process by which the direction of a train of waves moving in shallow water at an angle to the contours is changed. The part of the **wave train** advancing in shallower water moves more slowly than that part still advancing in deeper water, causing the **wave crests** to bend toward alignment with the underwater contours.

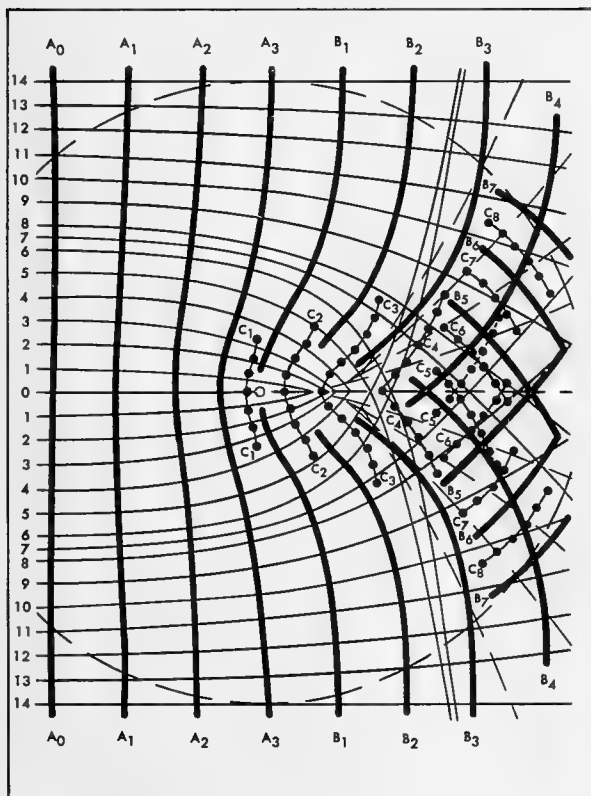
2. The bending of wave crests by currents. (61)

wave signature—The graph of pressure versus time at a point as a wave passes over it.

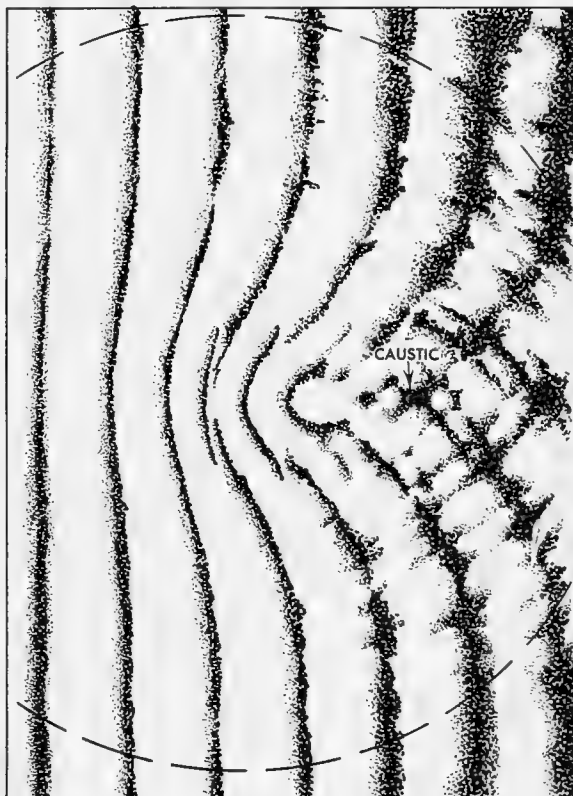
wave spectrum—1. In ocean wave studies, a graph showing the distribution of wave heights with respect to frequency in a wave record. (5)

2. A concept used to describe by mathematical function the distribution of wave energy (square of wave height) with frequency (1/period). The square of the wave height is related to the potential energy of the sea surface so that the spectrum can also be called the energy spectrum.

wave staff—See **wave pole**.



ACTUAL WAVE CREST-ORTHOGONAL PATTERN FOR WAVES PASSING OVER A CLOCK GLASS



SHADOWGRAPH FOR WAVES OF MODERATE LENGTH PASSING OVER A CLOCK GLASS

WAVE REFRACTION—CAUSTIC

(AFTER WIEGEL, 1953)

wave steepness—The ratio of the **wave height** to **wavelength**. (73)

wave-straightened coast—A straight cliffed coast which results from wave erosion of homogeneous coastal rocks; along a contact between weak and resistant layers forming a hogback coast; or along a fault with more resistant rocks shoreward forming a fault-line coast. It has a wave-cut beach at the base of the sea cliffs and hanging valleys along the coast.

wave train—A series of waves moving in the same direction.

wave trough—The lowest part of a wave form between successive **wave crests**. Also that part of a wave below **still water level**. (61) (*See figure for wave.*)

wave velocity—1. The speed at which the individual wave form advances. (73)

2. A vector quantity that specifies the speed and direction with which a sound wave travels through a medium. (6)

weathered—Descriptive of ice or rock that has been destroyed or partially destroyed by thermal, chemical, and mechanical processes.

weathered ice—Hummocked polar ice subjected to weathering which has given the **hummocks** and **pressure ridges** a rounded form. If the weathering continues, the surface may become more or less level. (74)

weathered iceberg—An **iceberg** which is irregular in shape, due to an advanced stage of **ablation**. It may have overturned. If the weathering produces spires or pinnacles, a pinnacled, pyramidal, or irregular iceberg results; if it produces a large U-shaped slot extending through the iceberg, a valley or drydock iceberg results; and if it produces a large opening at the water line, extending through the iceberg, an arched iceberg results. (68)

weather patrol ship—*See ocean station vessel.*

weather routing—*See optimum ship routing.*

weather ship—*See ocean station vessel.*

weed—*See seaweed.*

weight crack—*See hinge crack.*

Wentworth grade scale—A logarithmic grade scale for size classification of sediment particles, starting at 1 millimeter and using the ratio of $\frac{1}{2}$ in one direction (and 2 in the other), providing diameter limits to the size classes of 1, $\frac{1}{2}$, $\frac{1}{4}$, etc., and 1, 2, 4, etc. This was adopted by Wentworth from Udden's scale with slight modification of grade terms and limits. (2) *See phi grade scale.*

West Australia Current—The complex current flowing along the west coast of Australia. It flows northward and is stronger during November, December, and January; it is weakest and tends to be variable in May, June, and July. It curves toward the west to join the **South Equatorial Current**.

West Greenland Current—The current flowing northward along the west coast of Greenland

into Davis Strait. It is formed by water of the **East Greenland** and **Irminger Currents**. Part of the West Greenland Current turns to the left when approaching the Davis Strait and joins the **Labrador Current** flowing southward; the other part continues into Baffin Bay.

West Ice—1. The drifting ice of Baffin Bay.

2. To Norwegians, the drifting ice off the east coast of Greenland.

(59)

West Wind Drift—(sometimes called *Antarctic Circumpolar Current*). The ocean current with the largest volume transport (approximately 110×10^6 cubic centimeters per second); it flows from west to east around the Antarctic continent and is formed partly by the strong westerly wind in this region and partly by density differences.

wet density—The ratio of the weight of the solid particles of a bottom sediment and the contained moisture to its total volume.

wet weight—Quantitative measure of wet plankton; the living weight. Although commonly used, this measurement may lead to erroneous results unless all extraneous water is removed by blotting or draining.

whale—A cetacean. *See baleen whale, toothed whale.*

whalebone—*See baleen.*

whalebone whale—*See baleen whale.*

whirlpool—Water moving rapidly in a circular path; an eddy or vortex of water. *See eddy, gyre.*

whitecap—On the crest of a wave, the white froth caused by wind. (61)

whitefish—1. Any of a family Coregonidae of predominantly fresh-water fishes.

2. A menhaden, young bluefish, or whiting.

3. (chiefly British). Any of several commercial fishes, such as cod, halibut, and sole, with white nonoily flesh.

4. The beluga or white whale.

white ice—A Russian term for **sea ice** of 30 to 70 centimeters (12.0 to 27.5 inches) in thickness.

white noise—**Noise** whose spectrum density (or spectrum level) is substantially independent of frequency over a specified range. (6)

whiteout—(also called *milky weather*). An atmospheric optical phenomenon of the polar regions in which the observer appears to be engulfed in a uniformly white glow. Neither shadows, horizon, nor clouds are discernible; sense of depth and orientation is lost; only very dark, nearby objects can be seen.

Whiteout occurs over an unbroken snow cover and beneath a uniformly overcast sky, when, with the aid of the **snow blink** effect, the light from the sky is about equal to that from the snow surface. Blowing snow may be an additional cause.

This phenomenon is experienced in the air as well as on the ground. (5)

white water—1. Frothy water as in **whitecaps** or **breakers**.

2. Light-colored water over a **shoal**.
(68)

Wien's law—One of the radiation laws which states that the wavelength of maximum radiation intensity for a black body is inversely proportional to the absolute temperature of the radiating black body. (5)

wind chill—That part of the total cooling of a body caused by air motion. (5)

wind-chill factor—*See* **wind-chill index**.

wind-chill index—(also called *wind-chill factor*). The cooling effect of any combination of temperature and wind, expressed as the loss of body heat in kilogram calories per hour per square meter of skin surface. The wind-chill index is based on the cooling rate of a nude body in the shade; it is only an approximation because of individual body variations in shape, size, and metabolic rate. (5)

wind chop—*See* **chop**.

wind direction—The direction from which the wind blows. (68)

wind drift—1. *See* **drift current, wind-driven current**.

2. That portion of the total vector drift of sea ice from which the effects of the current have been subtracted.

wind-driven current—(sometimes called *wind drift, drift current*). A current formed by the force of the wind. Theoretically, currents produced by the wind will set to the right of the direction of the wind in the Northern Hemisphere and to the left in the Southern Hemisphere. *See* **Ekman spiral**.

wind mixing—Mechanical stirring of water due to motion, induced by the surface wind. Similar to **mechanical mixing**.

window—An unfrozen portion of a river, which remains unfrozen all or part of the winter because of a strong current or a local inflow of warm water. (59)

wind rose—1. A diagram showing the relative frequency of winds blowing from different directions. It may also show average speed or frequency of occurrence of various speeds from different directions.

2. A diagram showing the average relation between winds from different directions and the occurrence of other meteorological phenomena, such as rain. (68)

wind set-up—1. The vertical rise in the **still water level** on the leeward side of a body of water caused by wind stresses on the surface of the water.

2. The difference in still water levels on the windward and the leeward sides of a body of water caused by wind stresses on the surface of the water.

3. Synonymous with wind tide. Wind tide is usually reserved for use on the ocean and large

bodies of water. Wind set-up is usually reserved for use on reservoirs and smaller bodies of water. *See* **meteorological tide**.

(61)

wind stress—The force, per unit area, of the wind acting on the water surface to produce waves and currents; its magnitude depends on the wind speed, air density, and roughness of the water surface.

wind tide—*See* **wind set-up, meteorological tide**.

windward—The direction from which the wind is blowing. (61)

wind wave—A wave resulting from the action of wind on a water surface. While the wind is acting on it, it is a **sea**, thereafter, a **swell**. *See* **fetch**. (5)

winged headland—A **seacliff** with two bays or spits, one on either side. (2)

Winkler method—A chemical method for estimating the dissolved oxygen in sea water. In this method manganous hydroxide is allowed to react with the oxygen of the sample to produce a manganese compound which in the presence of acid potassium iodide liberates an equivalent quantity of iodine that can be titrated with standard sodium thiosulphate.

winnow—In regard to current action, to sort selectively and carry off fine sediment grains from a heterogeneous sediment deposit, leaving the coarse grains.

winter drift ice—**Drift ice** composed exclusively of **winter ice**.

winter fast ice—1. **Fast ice** in fiords, gulfs, and straits, mainly formed by growth from the shore, but also by cementing of **pack ice**. Winter fast ice rises and falls according to the tide. (74)

2. Fast ice made up of **winter ice**.

winter ice—1. Generally unbroken level ice of less than one winter's growth. It is between 15 centimeters and 2 meters (6.0 inches to 6.6 feet) thick. *See* **medium winter ice, thick winter ice**.

2. Sea ice more than eight inches thick and less than one year old; the stage which follows **young ice**.

winter solstice—For either hemisphere, the solstice at which the sun is above the opposite hemisphere. In northern latitudes, the time of this occurrence is approximately 22 December. (5) *See* **solstice**.

wiping—*See* **flashing**.

wire angle—The angle measured between the oceanographic wire and the vertical.

wire angle indicator—A device used to measure the angle of the oceanographic wire from the vertical. It consists of a protractor with a weighted plumb arm. The indicator is suspended from the wire at two points and the plumb arm points to the **wire angle**.

WMO Code—An international nomenclature adopted by the World Meteorological Organization for use by all reporting nations.

WORKING

working—In sea ice navigation, making headway through an ice pack by boring, breaking, and slewing. (59)

worm tube—A tube, usually of calcium carbonate or particles of mud or sand, built on a submerged surface by a **polychaete** worm.

wrack—The British term for **rockweeds**.

X

xanthophyll—A plant pigment. *See nonastacin carotenoid.*

X-rays—**Electromagnetic radiation** of wavelengths less than about 100 Å (**angstroms**), produced: (1) when electrons striking a target lose kinetic energy in passing through the strong electric fields surrounding the target nuclei; (2)

by the transitions of atoms from K, L, . . . energy states to lower energy states. In nuclear reactions it is customary to refer to photons originating in the nucleus as gamma rays, and to those originating in the extranuclear part of the atom as X-rays. These rays are sometimes called Roentgen rays after their discoverer, W. C. Roentgen. (41)

Y

yaw—*See ship motion.*

yaw angle—*See angle of yaw.*

young ice—1. Newly formed level ice generally in the transition stage of development from **ice rind** or **pancake ice** to **winter ice**. It is 5 to 15 centimeters (2 to 6 inches) in thickness. (74)

2. Formerly newly formed level ice between 2 and 8 inches thick.

young polar ice—(also called *two-year ice*).

Polar ice that has survived its first summer of melting and has passed on to its second year of growth. At the end of its second winter, young

polar ice may become thicker than 2 meters (6.5 feet). It differs from one-year ice in that a greater portion shows above the water surface and any **hummocks** present show more weathering. (74)

young shore ice—The primary stage of formation of **shore ice**. It is of local formation and usually consists of **ice rind** or thin **young ice** usually some 10 meters (32.8 feet.) wide, but sometimes as wide as 100 to 200 meters (328 to 656 feet). (74)

yowling—*See ice yowling.*

Z

Z/L graph—A graph used to determine *in situ* depths of oceanographic observations by the thermometric depth versus wire depth ratio method.

ZoBell bottle—A sterile bottle constructed to collect sea water samples at a desired depth for bacteriological analysis. Multiple sampling can be accomplished in a manner similar to an **oceanographic cast**.

zoea—An early larval form of certain decapod **crustaceans**. (26) *See* **decapod**.

zonal flow—Currents or winds moving east or west along a latitude. (32)

zone time—The local mean time of a reference or zone meridian whose time is kept throughout a designated zone. The zone meridian is usually

the nearest meridian whose longitude is exactly divisible by 15 degrees.

zoogene—The environment and deposits characterized by abundant lime-secreting organisms, such as **reefs**. (2)

zooplankton—The animal forms of **plankton**. They include various crustaceans, such as copepods and euphausiids, jellyfishes, certain protozoans, worms, mollusks, and the eggs and larvae of benthic and nektonic animals. They are the principal consumers of the **phytoplankton** and, in turn, are the principal food for a large number of squids, fishes, and baleen whales.

zooplankton equivalent—*See* **plankton equivalent**.

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APPENDIX A

Abbreviations and Acronyms

- A**—1. Absolute temperature scale; same as Kelvin temperature scale.
2. (or \AA) Angstrom.
- AA**—Approximate absolute temperature scale.
- ACIM**—*Axis-Crossing Interval Meter* (Sonar signal analyzer Q-4X).
- ADA**—British *Action Data Automation System*.
- ADF**—*Automatic Direction Finding*.
- ADP**—*Automatic Data Processing*.
- AGM**—(*Auxiliary General Missile*) Designation for U.S. Navy missile range instrumentation ships.
- AGOR**—(*Auxiliary General Oceanographic Research*) Designation for U.S. Navy oceanographic research ships.
- AGS**—(*Auxiliary General Survey*) Designation for U.S. Navy hydrographic survey ships.
- AGSC**—*Auxiliary General Survey Coastal*. Designation for U.S. Navy small coastal hydrographic survey ships.
- AGSS**—(*Auxiliary General Submarine*) An experimental deep-diving submarine.
- AMOS**—*Acoustic Meteorological Oceanographic Survey*.
- AMR**—*Atlantic Missile Range*.
- AN/AQS-10**—A variable depth sonar (VDS) presently in use in the fleet.
- AN/ASQ-12**—A helicopter sonar.
- AN/BOR-2B**—A cylindrical or conformal passive array of submarine hydrophones.
- AN/BQN-3**—A submarine secure depth sounder.
- AN/BR-28**—A cylindrical or conformal passive array of submarine hydrophones.
- ANIP**—*Army-Navy Instrumentation Program*.
- AN/SQQ-14**—A mine location and classification sonar.
- AN/SQS-20**—A scanning sonar.
- AN/SQS-23**—A sonar presently in use by surface ships.
- AN/SQS-26**—A new, large, high-powered, low-frequency sonar.
- AN/UQC-1**—An underwater telephone.
- AOS**—*Amphibious Objective Studies*.
- AOU**—*Apparent Oxygen Utilization*.
- ARLIS**—An abbreviation for *Arctic Research Laboratory Ice Station*, ARLIS is a term used to designate remote scientific stations established on the Arctic Ocean by the Arctic Research Laboratory of Barrow, Alaska.
- ART**—*Airborne Radiation Thermometer*.
- ASDIC**—(*Anti-Submarine Development Investigation Committee*) British echo-ranging equipment.
- ASODDS**—*ASWEPS Submarine Oceanographic Digital Data System*.
- ASSESS**—(*Analytical Studies of Surface Effects of Submerged Submarines*) A submarine detection method not dependent on acoustic phenomena.
- ASW**—*Antisubmarine Warfare*.
- ASWEPS**—(*Antisubmarine Warfare Environmental Prediction System*) A research effort to develop methods of forecasting changes in the oceanographic environment.
- AUTEC**—A project to develop and install the *Atlantic Underwater Test and Evaluation Center* which is located in the Tongue of the Ocean with installations ashore on Andros Island in the Bahamas.
- BC**—*Bathyconductograph*.
- BC chart**—*Bottom Contour chart*.
- Bev**—Billion-electron-volts.
- BOD**—*Biological Oxygen Demand*.
- BPF**—*Bottom Pressure Fluctuation*.
- BT**—*Bathythermograph*.
- B.T.U., Btu**—*British Thermal Unit*.
- c**—curie.
- C**—*Celsius* temperature scale; formerly centigrade temperature scale.
- cal**—Calorie; small calorie.
- Cal**—Large calorie; kilogram-calorie.
- CANLANTNAV**—Consecutively numbered radio message originated by the Canadian Navy, Halifax, Nova Scotia, to disseminate urgent information affecting navigation in the northwest portion of the North Atlantic Ocean.
- CANPACNAV**—Consecutively numbered radio message originated by the Canadian Navy, Victoria, B.C., to disseminate urgent information affecting navigation in the water off the Canadian Pacific coast.
- CBASF**—*Current Bibliography for Aquatic Sciences and Fisheries*. (UN Food & Agriculture Organization)
- CGC**—*Coast Guard Cutter*.
- CGOU**—*Coast Guard Oceanographic Unit*.
- cgs**—*Centimeter-gram-second*.
- Cl**—Chlorinity.

- CLIMAT SHIP**—Monthly means reported by ocean weather ships (WMO Code FM 72B).
- CLIMAT TEMP SHIP**—Report of monthly aerological means from an ocean weather ship (WMO Code FM 76C).
- CMR**—Common Mode Rejection.
- Conshelf Two**—Continental Shelf Station Number *Two*.
- CRT**—Cathode ray tube.
- DAPAC**—Abbreviation of *Danger Areas Pacific*, a U.S. Naval Oceanographic Office publication containing routing instructions for areas in Pacific and Far East waters declared dangerous because of mines.
- db**—Decibel.
- DDI**—Depth Deviation Indicator.
- DHQ**—Mean diurnal high water inequality.
- DLQ**—Mean diurnal low water inequality.
- DRAI**—Dead Reckoning Analog Indicator.
- DRT**—Dead Reckoning Tracer. A device for continually recording track of own ship (as well as other ships).
- DRV**—Deep Research Vehicle.
- DSL**—Deep Scattering Layer.
- DSSP**—Deep Submergence Systems Program.
- DSSRG**—Deep Submergence Systems Research Group.
- DTG**—Date-Time-Group.
- DUMS**—Deep Unmanned Submersibles. A jet propelled submersible designed to follow a prescribed underwater path for collecting oceanographic information or for mapping sea bottoms.
- DUNC**—Deep Underwater Nuclear Counter. An ultrasensitive radiation measuring device for analyzing the sea's naturally occurring radioactive sources.
- EASTROPIC**—Eastern Tropical Pacific (Program).
- ECM**—Electronic Counter Measures.
- EER**—Explosive Echo Ranging.
- EQUALANT**—Equatorial Atlantic Survey.
- EQUAPAC**—Equatorial Pacific Survey.
- ESG**—Electrically Suspended Gyroscope.
- ev**—Electron-volt.
- F**—Fahrenheit temperature scale.
- FLIP**—(Floating Instrument Platform) Similar in design to SPAR, and used as a base for oceanographic research, FLIP is manned and can drift with currents.
- FLOOD**—(Fleet Observation of Oceanographic Data) A program of the U.S. Naval Oceanographic Office to place oceanographic instruments aboard ships of the regular fleet.
- FM**—Frequency Modulation.
- FORD**—Floating Ocean Research and Development (Station).
- FRV**—Fisheries Research Vessel.
- GCT**—Greenwich Civil Time.
- GEBCO**—General Bathymetric Chart of the Oceans.
- GEK**—Geomagnetic Electrokinetograph.
- GEM**—Ground Effect Machine.
- GEON**—(Gyro Erected Optical Navigation) A system of celestial navigation.
- GMT**—Greenwich Mean Time.
- GTS**—Guinean Trawling Survey.
- HHW**—Higher high water.
- HHWI**—Higher high water interval.
- HIRAN**—High Precision Shoran.
- HLW**—Higher low water.
- HLWI**—Higher low water interval.
- HODS**—Hydrographic-Oceanographic Data Sheets.
- HUK**—Hunter-Killer naval force or unit. An ASW force.
- HW**—High water.
- HWF&C**—High water full and change.
- HWI**—High water interval.
- HWLI**—High water lunital interval.
- HWN**—High water neaps.
- HWOST**—High water of ordinary spring tides.
- HWQ**—Tropic high water inequality.
- HWS**—High water springs.
- HYDRA**—A project to evaluate the impact of radiation produced by the detonation of underwater nuclear explosions.
- HYDROLANT**—Consecutively numbered radio message originated by the U.S. Naval Oceanographic Office, Washington, D.C., to disseminate urgent information affecting navigation in the Atlantic Ocean area. See **NAVEAM**.
- HYDROPAC**—A consecutively numbered radio message originated by the U.S. Naval Branch Oceanographic Office, Honolulu, Hawaii, to disseminate urgent information affecting navigation in the Pacific Ocean area.
- HYPSES**—(Hydrographic Precision Scanning Echo Sounder) An improved instrument for conducting bathymetric surveys in deep oceanic areas.
- IAC**—Weather analysis (WMO Code FM 45C).
- IAC FLEET**—Weather analysis in abbreviated form (WMO Code FM 46C).
- ICE**—Prefix for ice group in a weather report.
- ICECON**—Controlled ice information in time of war or emergency.
- IFF**—Identification Friend or Foe.
- IGY**—(International Geophysical Year) By international agreement, a period during which greatly increased observation of worldwide geophysical phenomena is undertaken through the co-operative effort of participating nations. July 1957–December 1958 was the first such year; however, precedent was set by the International Polar Years of 1882 and 1932.
- IHD**—International Hydrological Decade.
- IIOE**—(International Indian Ocean Expedition) An international effort to increase the knowledge of the Indian Ocean. This project is current at this writing.
- ILW**—International low water.
- IOSN**—Indian Ocean Standard Net.
- IR**—Infrared radiation.
- ITcal**—International Table calorie.

- Kcal; kg-cal**—*Kilogram-calorie*.
Kev—*Kilo-electron-volts*.
km—*Kilometer*.
LD—*Layer depth*.
LHW—*Lower high water*.
LHWI—*Lower high water interval*.
LLW—*Lower low water*.
LLWI—*Lower low water interval*.
LOCO—*Long cores*.
Loran—*Long range navigation*. (Low frequency)
LS—*Light Ship*.
LW—*Low water*.
LWI—*Low water interval*.
LWOST—*Low water of ordinary spring tides*.
LWQ—*Tropic low water inequality*.
MAD—(*Magnetic Anomaly Detector*) Gear used to detect local changes in the earth's magnetic field caused by a submerged submarine.
MAFOR—*Weather forecast for shipping* (WMO Code FM 61C).
MAGNET—*Worldwide Airborne Magnetic Survey* (by the U.S. Naval Oceanographic Office).
MAMOS—*Marine Automatic Meteorological Oceanographic Station*.
MARID—*Ship reports of the sea surface temperature* (UK only).
MAWEC—*Military Aircraft Weather Code*.
mc—*Millicurie*.
Mev—*Million-electron-volts*.
MHHW—*Mean higher high water*.
MHW—*Mean high water*.
MHWN—*Mean high water neaps*.
MHWS—*Mean high water springs*.
 μc —*Microcurie*.
 $\mu\mu\text{c}$ —*Micro-microcurie*.
MILS—*Missile Impact Location Survey*.
MLLW—*Mean lower low water*.
MLR—*Marine Life Resources* (Program).
MLW—*Mean low water*.
MLWN—*Mean low water neaps*.
MLWS—*Mean low water springs*.
Mn—*Mean range*.
MOHO—*Mohorovičić Discontinuity*.
MOHOLE—*Mohorovičić Hole* (Project).
MONAB—*Mobile Noise Analysis Barge*.
MRI—*Mean rise interval*.
MSL—*Mean sea level*.
MTL—*Mean tide level*.
MWL—*Mean water level*.
NACLI—*Report of monthly means for North Atlantic Ocean* (WMO Code FM 73).
NAVEAM—*A consecutively numbered radio message originated by United Kingdom authorities to disseminate urgent information affecting navigation in North European and Mediterranean waters*. See **HYDROLANT**, **HYDROPAC**.
NEPAN TIROS—*Cloud data obtained by satellite photography*.
NIS—*National Intelligence Survey*.
NOMAD—(*Navy Oceanographic and Meteorological Automatic Device*) A platform designed to monitor and report weather and oceanographic data automatically.
NORPAC—*Northern Pacific* (Project).
NORWESTLANT—*Northwest Atlantic* (Project).
Np—*Neap range*.
NP-1—*North Pole-1*; a Russian drift station.
N.T.P.—*Normal temperature and pressure*.
OMEGA—*A long-range navigation system, giving worldwide coverage with six to ten transmitter (ground) stations, with an accuracy of 1 to 3 n. miles*.
OOP—*Oceanographic Observations of the Pacific*.
OS—*Ocean Station*.
OSV—*Ocean Station Vessel*.
OTDHC—*Oceanographic Technical Data Handling Committee*.
PDR—1. (*Periscope Depth Range*) The maximum range at which active sonar echo ranging contact can be made with a submarine operating at periscope depth.
 2. (*Precision Depth Recorder*) A device for recording a sonic depth trace.
PGR—*Precision Graphic Recorder*.
PILOT SHIP—*Upper wind report from ship* (WMO Code FM 33C).
PMR—*Pacific Missile Range*.
Pn—*Perigean range*.
PPI—(*Plan Position Indicator*) The usual means of presentation of sonar and/or radar signals.
PUFFS—*Passive Underwater Fire Control Sonar Feasibility Study*.
PVC—*Polyvinyl corer*.
r—*Roentgen*.
rad—*Radiation absorbed dose*.
RADIAC—(*Radioactivity Detection Indication and Computation*) A term devised to designate various types of radiological measuring instruments or equivalent.
RBE—*Relative Biological Effectiveness*.
rem—*Roentgen equivalent man*.
REMPAC—(*Reflectivity Measurements Pacific*) Twelve-kc normal incident bottom reflectivity measurements. Using either towed or hull mounted transducer.
rep—*Roentgen equivalent physical*.
RF—*Radio Frequency*.
RUM—(*Remote Underwater Manipulator*) A device built to study the ocean bottom (down to 20,000 feet) for prolonged periods. It is equipped with a mechanical arm and hand and television cameras.
R/V—*Research Vessel*.
SAU—(*Search/Attack Unit*) Part of an ASW task group.
SBT—*Submarine bathythermograph*.
SCOMO—*Satellite Collection of Meteorological Observations*.

- SCUBA**—(*Self-Contained Underwater Breathing Apparatus*) Refers to several types of breathing apparatus by means of which a diver carries his breathing medium with him and thus is independent of surface conditions.
- Sg**—Spring range.
- SHIP**—Surface weather report from ship (WMO Code FM 23C or FM 22C).
- shoran**—*Short range navigation* (electronic positioning system).
- SHRED**—Ship report in abbreviated form (WMO Code FM 23C).
- SINS**—*Ships Internal Navigation System*.
- sofar**—*Sound fixing and ranging*.
- SOMACO chart**—*Sonar Magnetic Contour chart*.
- sonar**—*Sound navigation and ranging*.
- SNAP**—*Systems for Nuclear Auxiliary Power*.
- SOOP**—*Submarine Oceanographic Observation Program*.
- SOA**—*Speed of advance*.
- SPAR**—(*Seagoing Platform for Acoustic Research*) A 350-foot long tube (16-foot diameter) partially submerged in a vertical position used as a stable unmanned platform for conducting acoustic research. *See* **FLIP**.
- SPESH**—Special weather report from a ship (WMO Code FM 26B).
- SPRC**—(*Self-Propelled Robot Craft*) A craft capable of making detailed data recordings for long distances in a horizontal plane along the ocean's deeper levels.
- SST**—*Sea surface temperature*.
- STOR**—*Scripps Tuna Oceanographic Research*.
- S.T.P.**—*Standard temperature and pressure*.
- STU**—*Submersible Test Unit*.
- SVTP**—*Sound Velocity, Temperature, and Pressure unit*.
- SWM**—(*Shipboard Wave Meter*) An instrument to record the wave situation at sea.
- SYNCOM**—*Synchronous Communications Satellite*.
- SYNOP**—Surface weather report from a land station (WMO Code FM 11C).
- TcHHW**—*Tropic higher high water*.
- TcHHWI**—*Tropic higher high water interval*.
- TcHLW**—*Tropic higher low water*.
- TcLHW**—*Tropic lower high water*.
- TcLLW**—*Tropic lower low water*.
- TcLLWI**—*Tropic lower low water interval*.
- TEMP SHIP**—Upper level pressure, temperature, humidity (possibly wind report) from a ship (WMO Code FM 36C).
- TENOC**—(*Ten Year Program in Oceanography*) The basic planning document for U.S. Navy oceanography.
- TOTO**—*Tongue Of The Ocean*.
- T-S**—*Temperature-salinity*.
- T-3**—Fletcher's ice island, Drift Station Bravo.
- UDT**—*Underwater Demolition Team*.
- UHF**—*Ultra High Frequency*.
- UMP**—*Upper Mantle Project*.
- UNIS**—*Underwater Television and Inspection System*.
- USW**—*Undersea Warfare*.
- UTS**—(*Underwater Telephone System*) A durable sonar system enabling surface ships or submarine to communicate with one another via sound waves.
- VAMP**—*Visual-Acoustic-Magnetic Pressure*.
- VDS**—*Variable Depth Sonar*.
- VHF**—*Very High Frequency*.
- VLF**—*Very Low Frequency*.
- WATEN**—Wave tendency report (WMO Code FM 11C and FM 16A).
- WAVES**—Actual height of waves when height is over $9\frac{3}{4}$ meters in reports from ships and coastal stations.
- WBAN**—(*Weather Bureau, Air Force, and Navy*) Term used to denote observational instructions or forms that are common to the three principal meteorological agencies in the United States.
- WECON**—Controlled weather information in time of war or emergency.
- WMO**—*World Meteorological Organization*.

APPENDIX B

LIST OF OCEANOGRAPHIC INSTITUTIONS, AGENCIES, ACTIVITIES, AND GROUPS

- AAAS**—American Association for the Advancement of Science, Washington, D.C.
- AANII**—Arctic and Antarctic Research Institute, Leningrad, U.S.S.R.
- ACES**—Antisubmarine Composite Engineering Squadron. (Proposed Navy-Civilian ASW squadron to pursue ASW development.)
- ACMRR**—Advisory Committee on Marine Resources Research, Secretariat, Fisheries Biology Branch (FAO), Rome, Italy.
- ACS**—American Chemical Society, Washington, D.C.
- ACSM**—American Congress of Surveying and Mapping, Washington, D.C.
- ADAC**—Acoustic Data Analysis Center.
- AEC**—Atomic Energy Commission, Germantown, Maryland.
- AES**—Atlantic Estuarine Society.
- AFAC**—American Fisheries Advisory Committee.
- AFS**—American Fisheries Society, Washington, D.C.
- AGI**—American Geological Institute, Washington, D.C.
- AGU**—American Geophysical Union, Washington, D.C.
- AIBS**—American Institute of Biological Sciences, Washington, D.C.
- AID**—Agency for International Development, Washington, D.C.
- AINA**—Arctic Institute of North America, Washington, D.C.
- AIOP**—Association Internationale d'Océanographie Physique. *See IAPO.*
- ALS**—American Littoral Society, Sandy Hook Marine Laboratory, Highlands, New Jersey.
- AMS**—1. American Meteorological Society, Boston, Massachusetts.
2. Army Map Service, Washington, D.C.
- AMSOC**—American Miscellaneous Society, Washington, D.C.
- ANARE**—Australian National Antarctic Research Expeditions, Melbourne, Victoria, Australia.
- ANZAAS**—Australian and New Zealand Association for the Advancement of Science.
- AOG**—Atlantic Oceanographic Group, Bedford Institute of Oceanography, Dartmouth, Nova Scotia, Canada.
- APL**—1. Applied Physics Laboratory, Johns Hopkins University, Baltimore, Maryland.
2. Applied Physics Laboratory, University of Washington, Seattle, Washington.
- ARL**—Arctic Research Laboratory, University of Alaska, Point Barrow, Alaska.
- ARPA**—Advanced Research Projects Agency, Washington, D.C.
- ASA**—American Shellfish Association.
- ASAB**—Association for Study of Animal Behaviour.
- ASDEFORLANT**—Antisubmarine Defense Force, Atlantic Fleet, U.S. Naval Base, Norfolk, Virginia.
- ASII**—American Science Information Institute, Detroit, Michigan.
- ASIRC**—Aquatic Sciences Information Retrieval Center, University of Rhode Island, Kingston, Rhode Island.
- ASLO**—American Society of Limnology and Oceanography.
- ASMFC**—Atlantic States Marine Fisheries Committee.
- ASP**—American Society of Photogrammetry, Washington, D.C.
- ASTM**—American Society for Testing Materials, Philadelphia, Pennsylvania.
- ATLANTNIRO**—Atlantic Scientific Research Institute of Fishing Economy and Oceanography, Kaliningrad, U.S.S.R.
- AUTEC**—Atlantic Underwater Test and Evaluation Center, Andros Island, Bahamas, B.W.I.
- AZCHERNIRO**—Azov and Black Sea Research Institute of Marine Fisheries and Oceanography, Kerch, U.S.S.R.
- BALTNIRO**—The Baltic Research Institute of Marine Fisheries and Oceanography, Kaliningrad, U.S.S.R.
- BCE**—Bureau of Commercial Fisheries, U.S. Department of Interior, Washington, D.C.
- BCSO(NA)**—British Commonwealth Scientific Office (North America), Washington, D.C.
- BEB**—Beach Erosion Board. *See CERC.*

Note: Locations of organizations are given only where readily available; some organizations have no permanent location.

- BIWS**—Bureau of International Whaling Statistics, Sandefjord, Norway.
- BM**—Bureau of Mines, U.S. Department of the Interior, Washington, D.C.
- BMI**—Battelle Memorial Institute, Columbus, Ohio
- BNCOR**—British National Committee for Oceanic Research, c/o Royal Society, Burlington House, Piccadilly, London, England.
- BSFW**—Bureau of Sport Fisheries and Wildlife, U.S. Department of the Interior, Fish and Wildlife Service, Washington, D.C.
- BUDOCKS**—Bureau of Yards and Docks, U.S. Navy, Washington, D.C.
- BUMINES**—Bureau of Mines, U.S. Department of the Interior, Washington, D.C.
- BUSHIPS**—Bureau of Ships, U.S. Navy, Washington, D.C.
- BUWEPS**—Bureau of Naval Weapons, U.S. Navy, Washington, D.C.
- CAAS**—Ceylon Association for the Advancement of Science, Colombo, Ceylon.
- CALCOFI**—*See* CCOFI.
- CBI**—Chesapeake Bay Institute, Johns Hopkins University, Baltimore, Maryland.
- CBO**—Conference of Baltic Oceanographers.
- CCIR**—International Radio Consultative Committee, Geneva, Switzerland.
- CCO**—Coordinating Committee on Oceanography.
- CCOFI**—California Cooperative Oceanic Fisheries Investigations, La Jolla, California.
- CCOR**—Co-ordinating Committee for Oceanographic Research, Science Co-operation Division, CSIR, Pretoria, Republic of South Africa.
- CCTA**—Commission for Technical Co-operation in Africa South of the Sahara, Commission for Scientific Council for Africa, Lagos, Nigeria.
- CERBOM**—Centre d'Études et de Recherches de Biologie et d'Océanographie Médicale, Nice, France.
- CERC**—Coastal Engineering Research Center (formerly Beach Erosion Board), U.S. Army, Washington, D.C.
- CERN**—European Organization for Nuclear Research, Geneva, Switzerland.
- CERS**—Centre d'Études et de Recherches Scientifiques, Biarritz, France.
- CFRS**—Central Fisheries Research Station, Pusan, Korea.
- CHS**—Canadian Hydrographic Service, Ottawa, Ontario, Canada.
- CIA**—Central Intelligence Agency, Washington, D.C.
- CIESM**—Commission Internationale pour l'Exploration Scientifique de la Méditerranée, Monte Carlo, Monaco.
- CIG**—Comité International de Géophysique, Paris, France.
- CIOMS**—Council for International Organizations of Medical Sciences. *See* IUGG.
- CIPASH**—Committee on International Programs in Atmospheric Sciences and Hydrology of the NAS/NRC, Washington, D.C.
- CLAO**—Consejo Latino-Americano de Oceanografía, Montevideo, Uruguay.
- CLARC**—Consejo Latino-Americano de Radiación Cosmica, Universidad Major de San Andrés, LaPaz, Bolivia.
- CMAe**—Commission de Météorologie Aéronautique. *See* WMO.
- CMAS**—Confédération Mondiale des Activités Subaquatiques (World Underwater Federation), Paris, France.
- CMM**—Commission on Maritime Meteorology.
- CNCOR**—Chinese National Committee on Oceanic Research, College of Science, National Taiwan University, Taipei, Taiwan.
- CNFRO**—Comité National Français de Recherche Océanique, Paris, France.
- CNMRO**—Comité National Malgache de Recherche Océanique, Centre d'Océanographie et des Pêches de Nosy Bé, Nosy Bé, Malagasy Republic.
- CNO**—Chief of Naval Operations, U.S. Navy, Washington, D.C.
- CNPIO**—Comissão Nacional Portuguesa para Investigação Oceanográfica, Instituto Hidrográfico, Lisbon, Portugal.
- CNR**—Consiglio Nazionale delle Ricerche, Italy.
- CNRS**—Centre National de la Recherche Scientifique, Paris, France.
- CODC**—Canadian Oceanographic Data Centre, Ottawa, Ontario, Canada.
- COEC**—Comité Central d'Océanographie et d'Étude des Côtes, Paris, France.
- COFI**—*See* CCOFI.
- COMASWFORLANT**—Commander Antisubmarine Warfare Force, Atlantic Fleet, U.S. Naval Base, Norfolk, Virginia.
- COMASWFORPAC**—Commander Antisubmarine Warfare Force, U.S. Pacific Fleet. Pearl Harbor, Honolulu, Hawaii. (Also referred to as ASDEFORPAC).
- COMEXO**—Comité d'Exploitation des Océans, Paris, France.
- COMOPTEVFOR**—Commander Operational Test and Evaluation Force, U.S. Naval Base, Norfolk, Virginia.
- COSPAR**—Committee on Space Research (Scientific Committee of ICSU), s'Gravenhage, Netherlands.
- CPR**—Committee on Polar Research of NAS/NRC, Washington, D.C.
- CREO**—Centre de Recherches et d'Études Océanographiques, Paris, France.
- CRREL**—Cold Regions Research and Engineering Laboratory (formerly SIPRE), Hanover, New Hampshire.
- CSAGI**—Comité Spécial de l'Année Géophysique Internationale (Special Committee of the ICSU).

- CSI**—Coastal Studies Institute, Louisiana State University, Baton Rouge, Louisiana.
- CSIR**—1. Council of Scientific and Industrial Research, Pretoria, Republic of South Africa.
2. Council of Scientific and Industrial Research, New Delhi, India.
- CSIRO**—Commonwealth Scientific and Industrial Research Organization, Cronulla, Sydney, Australia.
- CTCA**—*See* CCTA.
- CUW**—Committee on Undersea Warfare.
- DDC**—Defense Documentation Center, Washington, D.C.
- DHI**—Deutsches Hydrographisches Institut, Hamburg, West Germany.
- DIA**—Defense Intelligence Agency, Washington, D.C.
- DMTS**—Department of Mines and Technical Surveys, Ottawa, Ontario, Canada.
- DNHA**—Departamento de Navegación Hidrográfía de la Armada, Valparaíso, Chile.
- DOD**—Department of Defense, Washington, D.C.
- DOO**—Director, Office of Oceanography (UNESCO), Paris, France.
- DOR**—Division of Oceanographic Research, Department of Mines and Technical Surveys, Ottawa, Ontario, Canada.
- DOT**—Department of Transport, Ottawa, Ontario, Canada.
- DRB**—Defence Research Board, Pacific Naval Laboratory, Esquimalt, British Columbia, Canada.
- DTMB**—David Taylor Model Basin, U.S. Navy, Washington, D.C.
- DVNIGMI**—Far Eastern Scientific Hydrometeorological Institute, Vladivostok, U.S.S.R.
- DWK**—Deutsche Wissenschaftliche Kommission für Meeresforschung, Hamburg, West Germany.
- EAEG**—European Association of Exploration Geophysicists, s'Gravenhage, Netherlands.
- ECA**—Economic Commission for Africa, Addis Ababa, Ethiopia.
- ECAFE**—Economic Commission for Asia and the Far East, Bangkok, Thailand.
- ECE**—Economic Commission for Europe (United Nations), Paris, France.
- ECLA**—Economic Commission for Latin America, Santiago, Chile.
- ECOSOC**—Economic and Social Council of United Nations, New York, New York.
- EPOC**—Eastern Pacific Oceanic Conference.
- ERDL**—Engineer Research and Development Laboratories, U.S. Army, Fort Belvoir, Virginia.
- ESSA**—Environmental Science Services Administration, U.S. Department of Commerce, Washington, D.C.
- ETAP**—Expanded Technical Assistance Programme, United Nations, New York, New York.
- FAC/SPC**—Fisheries Advisory Committee of the South Pacific Commission.
- FAGS**—Federation of Astronomical and Geophysical Services (ICSU), Paris, France.
- FAO**—Food and Agriculture Organization of the United Nations, Rome, Italy.
- FCST**—Federal Council for Science and Technology, Washington, D.C.
- FID**—Fédération Internationale de Documentation, s'Gravenhage, Netherlands.
- FRBC**—Fisheries Research Board of Canada, St. Andrews, New Brunswick, Canada.
- FTC**—Fisheries Technical Committee, Federal Fisheries Service, Lagos, Nigeria.
- FWS**—*See* USFWS.
- GCFI**—Gulf and Caribbean Fisheries Institute, Coral Gables, Florida.
- GCRL**—Gulf Coast Research Laboratory, Ocean Springs, Mississippi.
- GFCM**—General Fisheries Council for the Mediterranean (FAO), Rome, Italy.
- GGI**—State Hydrological Institute, Leningrad, U.S.S.R.
- GIMRADA**—Geodesy, Intelligence and Mapping Research and Development Agency, U.S. Army Engineers, Fort Belvoir, Virginia.
- GNCOR**—German National Committee for Oceanic Research, Institut für Meereskunde, Kiel, West Germany.
- GOIN**—State Institute of Oceanography, Moscow, U.S.S.R.
- GRB**—Geophysical Research Board, National Research Council, Washington, D.C.
- GRD**—Geophysics Research Directorate, Air Force Cambridge Research Center, Bedford, Massachusetts.
- GS**—Glaciological Society, Cambridge, England.
- GUSMP**—Main Administration of the Northern Sea Route, Moscow, U.S.S.R.
- HBRI**—Hydrobiological Research Institute, Istanbul, Turkey.
- HEW**—U.S. Department of Health, Education, and Welfare, Washington, D.C.
- HO**—Hydrographic Office. In the U.S., now officially designated U.S. Naval Oceanographic Office.
- IAA**—Instituto Antártico Argentino, Buenos Aires, Argentina.
- IAB**—Abstracting Board (ICSU), Paris, France.
- IAC**—International Advisory Committee on Research in the Natural Sciences (UNESCO), Paris, France.
- IACOMS**—International Advisory Committee on Marine Sciences (UNESCO), Paris France.
- IAEA**—International Atomic Energy Agency, Vienna, Austria.
- IAF**—International Astronautical Federation, Baden, Switzerland.

- IAG**—International Association of Geodesy (IUGG), Paris, France.
- IAGA**—International Association of Geomagnetism and Aeronomy (IUGG), Tortosa, Spain.
- IAGS**—Inter-American Geodetic Survey, Pan American Union, Washington, D.C.
- IAHR**—International Association for Hydraulic Research, Delft, Netherlands.
- IAL**—International Association of Theoretical and Applied Limnology, Westmoreland, England.
- IAMAP**—International Association of Meteorology and Atmospheric Physics, Toronto, Ontario, Canada.
- IANEC**—Inter-American Nuclear Energy Commission, Pan American Union, Washington, D.C.
- IAPO**—International Association of Physical Oceanography (IUGG), Göteborg, Sweden.
- IAS**—International Association of Sedimentology, La Jolla, California.
- IASH**—International Association of Scientific Hydrology (IUGG), Gentbrugge, Belgium.
- IASPEI**—International Association for Seismology and Physics of the Earth's Interior (IUGG), Strasbourg, France.
- IATA**—International Air Transport Association, Montreal, Quebec, Canada.
- IATTC**—*See* ITTC.
- IAU**—International Astronomical Union, Hailsham, Sussex, England.
- IAV**—International Association of Volcanology (IUGG), U.S. Geological Survey, Washington, D.C.
- IBP**—International Biological Programme (ICSU), Rome, Italy.
- ICES**—International Council for the Exploration of the Sea, Charlottenlund, Denmark.
- ICG**—International Coordination Group for ICITA, Washington, D.C.
- ICITA**—International Cooperative Investigations of the Tropical Atlantic (UNESCO), Paris, France.
- ICMI**—International Commission for Mathematical Instruction. *See* IMU.
- ICNAF**—International Commission for the Northwest Atlantic Fisheries, Halifax, Nova Scotia, Canada.
- ICO**—1. Interagency Committee on Oceanography, Washington, D.C.
2. International Commission for Optics, London, England.
- ICOL**—Italian Commission for Oceanography and Limnology, Rome, Italy.
- ICOR**—Intergovernmental Conference on Oceanic Research. *See* IOC.
- ICSEMS**—International Commission for the Scientific Exploration of the Mediterranean Sea, Paris, France.
- ICSU**—International Council of Scientific Unions, Rome, Italy.
- IEEE**—Institute of Electrical and Electronic Engineers, New York, New York.
- IFIPS**—International Federation of Information Processing Societies, Zurich, Switzerland.
- IFM**—1. Institut für Meereskunde, Universität Hamburg, Hamburg, West Germany.
2. Institut für Meereskunde, Universität Kiel, Kiel, West Germany.
- IFORS**—International Federation of Operational Research Societies, London, England.
- IFR**—Institute of Fisheries Research, University of North Carolina, Morehead City, North Carolina.
- IGC**—International Geological Congress, Copenhagen, Denmark.
- IGPP**—Institute of Geophysics and Planetary Physics (SIO), La Jolla, California.
- IGU**—International Geographical Union, Zurich, Switzerland.
- IHB**—International Hydrographic Bureau, Monte Carlo, Monaco.
- IIOE**—International Indian Ocean Expedition. *See* IOC.
- IIP**—International Ice Patrol, U.S. Coast Guard, Washington, D.C.
- ILTS**—Institute of Low Temperature Science, Sapporo, Japan.
- IM**—Instytut Morski, Gdansk, Poland.
- IMCO**—Intergovernmental Maritime Consultative Organisation, London, England.
- IMS**—1. Institute of Marine Science, University of Alaska, College, Alaska.
2. Institute of Marine Science, University of Texas, Port Aransas, Texas.
3. Institute of Marine Science, University of Miami, Coral Gables, Florida.
- IMU**—International Mathematical Union, Bombay, India.
- INCOR**—1. Israeli National Committee for Oceanic Research, Jerusalem, Israel.
2. Indian National Committee on Oceanic Research, Council of Scientific and Industrial Research, New Delhi, India.
- INCP**—Italian National Committee for Productivity, Rome, Italy.
- INPFC**—International North Pacific Fisheries Commission, University of British Columbia, Vancouver, British Columbia, Canada.
- INQUA**—Association Internationale pour l'Étude du Quaternaire, Torun, Poland.
- IOAN**—Institute of Oceanology (Academy of Sciences), Moscow, U.S.S.R.
- IOBC**—Indian Ocean Biological Center, Cochin, India.
- IOC**—Intergovernmental Oceanographic Commission (UNESCO), Paris, France.
- IOF**—International Oceanographic Foundation, Miami, Florida.
- IOUBC**—Institute of Oceanography, University of British Columbia, Vancouver, British Columbia, Canada.

- IPFC**—Indo-Pacific Fisheries Council, Bangkok, Thailand.
- IPHC**—International Pacific Halibut Commission, Seattle, Washington.
- IPMM**—Institut des Pêches Maritimes du Maroc, Casablanca, Morocco.
- IPSF**—International Pacific Salmon Fisheries Commission, Vancouver, British Columbia, Canada.
- IRE**—Institute of Radio Engineers. *See* **IEEE**.
- ISA**—Instrument Society of America, Pittsburgh, Pennsylvania.
- ISBB**—International Society of Bioclimatology and Biometeorology, Leiden, Netherlands.
- ISO**—International Organization for Standardization, Geneva, Switzerland.
- ISTPM**—Institut Scientifique et Technique des Pêches Maritimes, Paris, France.
- ITIC**—International Tsunami Information Center, Honolulu, Hawaii.
- ITTC**—Inter-American Tropical Tuna Commission, Scripps Institution of Oceanography, La Jolla, California.
- ITU**—International Telecommunication Union, Geneva, Switzerland.
- IUB**—International Union of Biochemistry, London, England.
- IUBS**—International Union of Biological Sciences, University of California, Davis, California.
- IUCN**—International Union for the Conservation of Nature and Natural Resources, Brussels, Belgium.
- IUCr**—International Union of Crystallography, Groningen, Netherlands.
- IUGG**—International Union of Geodesy and Geophysics, Paris, France.
- IUGS**—International Union of Geological Sciences, Hellerup, Denmark.
- IUHPS**—International Union of the History and Philosophy of Science, Paris, France.
- IUPAC**—International Union of Pure and Applied Chemistry, Basel, Switzerland.
- IUPAP**—International Union of Pure and Applied Physics, Paris, France.
- IUPS**—International Union of Physiological Sciences, University of Rochester, Rochester, New York.
- IUTAM**—International Union of Theoretical and Applied Mechanics, Châtillon-sous-Bagneux, France.
- IUWDS**—International Ursigram and World Days Service (UNESCO), Utrecht, Netherlands.
- IWC**—International Whaling Commission, London, England.
- JCAM**—Joint Commission on Atomic Masses.
- JCAR**—Joint Commission on Applied Radioactivity (IUPAC), Gif-sur-Yvette, France.
- JMA**—Japan Meteorological Agency, Tokyo, Japan.
- KASPNIRO**—Caspian Institute of Marine Fisheries and Oceanography, Astrakhan, U.S.S.R.
- KNMI**—Koninklijk Nederlands, Meteorologisch Instituut, De Bilt, Netherlands.
- LASIL**—Land-and-Sea Interaction Laboratory (USC&GS), Norfolk, Virginia.
- LGO**—Lamont Geological Observatory, Columbia University, Palisades, New York.
- MAMBO**—Mediterranean Association for Marine Biology and Oceanology, Valletta, Malta.
- MARAD**—U.S. Maritime Administration, Washington, D.C.
- MARINOSTAT**—Hopkins Marine Station, Pacific Grove, California.
- MBA**—Marine Biological Association, Plymouth, England.
- MBL**—Marine Biological Laboratory, Woods Hole, Massachusetts.
- MDL**—*See* **USNMDL**.
- MESCO**—Middle East Science Cooperation Office, Cairo, Egypt.
- MIL-E-CON**—Military Electronic Conference (Sponsored by **IRE**).
- MIR**—Morski Instytut Rybacki, Gdynia, Poland.
- MLRG**—Marine Life Research Group, Scripps Institution of Oceanography, La Jolla, California.
- MO**—Meteorological Office, Bracknell, England.
- MOHOLE**—Mohorovičić Discontinuity Hole, NAS/NRC, Washington, D.C.
- MPL**—Marine Physics Laboratory, Scripps Institution of Oceanography, San Diego, California.
- MRI**—Meteorological Research Institute, Tokyo, Japan.
- MSA**—Maritime Safety Agency, Tokyo, Japan.
- MSC**—Marine Science Center, Lehigh University, Bethlehem, Pennsylvania.
- MSTS**—Military Sea Transport Service, U.S. Navy, Washington, D.C.
- MTS**—Marine Technology Society, Washington, D.C.
- NADC**—Naval Air Development Center, U.S. Navy, Johnsville, Pennsylvania.
- NAEC**—Naval Air Engineering Center, U.S. Navy, Philadelphia, Pennsylvania.
- NAS**—National Academy of Sciences, Washington, D.C.
- NASA**—National Aeronautics and Space Administration, Washington, D.C.
- NASCAS**—Committee on Atmospheric Sciences (NAS/NRC), Washington, D.C.
- NASCO**—National Academy of Sciences, Committee on Oceanography, Washington, D.C.
- NASL**—Naval Applied Science Laboratory, U.S. Navy, Brooklyn, New York.
- NAS/NRC**—National Academy of Sciences/National Research Council, Washington, D.C.
- NAVOCEANO**—U.S. Naval Oceanographic Office, Washington, D.C.

- NBS**—U.S. National Bureau of Standards, Washington, D.C.
- NCAR**—National Center for Atmospheric Research, Boulder, Colorado.
- NCEL**—Naval Civil Engineering Laboratory, U.S. Navy (**BuDocks**), Port Hueneme, California.
- NCGG**—National Committee for Geodesy and Geophysics, Karachi, Pakistan.
- NCMR**—Netherlands Committee for Marine Research, Den Helder, Netherlands.
- NCOR**—National Committee for Oceanographic Research, Karachi, Pakistan.
- NEAFC**—North East Atlantic Fisheries Commission (Replaces **PCIFC**), London, England.
- NEES**—Naval Engineering Experimental Station, U.S. Navy, Annapolis, Maryland.
- NEL**—Navy Electronics Laboratory, U.S. Navy, San Diego, California.
- NIO**—National Institute of Oceanography, Wormley, Godalming, Surrey, England.
- NIRS**—National Institute of Radiological Sciences, Chiba, Japan.
- NMDL**—*See* **USNMDL**.
- NMEL**—Navy Marine Engineering Laboratory, U.S. Navy, Annapolis, Maryland.
- NML**—Narragansett Marine Laboratory, University of Rhode Island, Kingston, Rhode Island.
- NODC**—National Oceanographic Data Center, U.S. Naval Oceanographic Office, Washington, D.C.
- NOL**—Naval Ordnance Laboratory, U.S. Navy, White Oak, Maryland.
- NOL CORONA**—Naval Ordnance Laboratory, U.S. Navy, Corona, California.
- NOO**—*See* **NAVOCEANO**.
- NOTS**—Naval Ordnance Test Station, U.S. Navy, China Lake, California.
- NPFSC**—North Pacific Fur Seal Commission, U.S. Department of the Interior, Washington, D.C.
- NPI**—Norwegian Polar Institute, Bergen, Norway.
- NRC**—National Research Council, Washington, D.C.
- NRDL**—Navy Radiological Defense Laboratory, U.S. Navy, San Francisco, California.
- NRL**—Naval Research Laboratory, U.S. Navy, Washington, D.C.
- NSF**—National Science Foundation, Washington, D.C.
- NSIA**—National Security Industrial Association, Washington, D.C.
- NTU**—National Taiwan University, Taipei, Taiwan.
- NUOS**—Naval Underwater Ordnance Station, U.S. Navy, Newport, Rhode Island.
- NUSL**—*See* **USNUSL**.
- NWL**—Naval Weapons Laboratory, U.S. Navy, Dahlgren, Virginia.
- NWRC**—National Weather Records Center, Asheville, North Carolina.
- NWS**—Navy Weather Service, U.S. Navy, Washington, D.C.
- NZNCOR**—New Zealand National Committee on Oceanic Research, Dominion Museum, Wellington, New Zealand.
- NZOI**—New Zealand Oceanographic Institute, Wellington, New Zealand.
- OACI**—Organisation de l'Aviation Civile Internationale, Montreal, Quebec, Canada.
- OASN**—Office of the Assistant Secretary of the Navy, U.S. Navy, Washington, D.C.
- OCDE**—Organisation de Coopération et de Développement Économiques, Paris, France.
- OECD**—*See* **OCDE**.
- OFRS**—Office Français de Recherche Sous-Marine, Marseilles, France.
- OIA**—Oceanic Industries Association, Washington, D.C.
- OIC**—Oceanographic Instrumentation Center, U.S. Naval Oceanographic Office, Washington, D.C.
- OISA**—Office of International Scientific Affairs, U.S. Department of State, Washington, D.C.
- OMM**—*See* **WMO**.
- ONI**—Office of Naval Intelligence, U.S. Navy, Washington, D.C.
- ONR**—Office of Naval Research, U.S. Navy, Washington, D.C.
- O/O**—Office of Oceanography (**UNESCO**), Paris, France.
- ORD**—Oceanic Research Division (**SIO**), La Jolla, California.
- ORI**—Ocean Research Institute, University of Tokyo, Tokyo, Japan.
- ORL**—Ordnance Research Laboratory, Pennsylvania State University, State College, Pennsylvania.
- ORSA**—Operations Research Society of America, Baltimore, Maryland.
- ORSOM**—*See* **ORSTOM**.
- ORSTOM**—Office de la Recherche Scientifique et Technique d'Outre-Mer, Bondy, France.
- OSAP**—Ocean Surveys Advisory Panel (**ICO**), Washington, D.C.
- OSE**—Ocean Science and Engineering, Inc., Washington, D.C.
- OSI**—Ocean Systems, Incorporated, Washington, D.C.
- OST**—Office of Science and Technology, Washington, D.C.
- OSTAC**—Ocean Science and Technology Advisory Committee (**NSIA**), Washington, D.C.
- OSW**—Office of Saline Water, U.S. Department of the Interior, Washington, D.C.
- PAIGH**—Pan American Institute of Geography and History, Mexico City, Mexico.
- PAN**—Polaska Akademia Nauk, Warsaw, Poland.
- PBS**—Pacific Biological Station, Nanaimo, British Columbia, Canada.

- PCIFC**—Permanent Commission of the International Fisheries Convention (Replaced by **NEAFC**), London, England.
- PHS**—U.S. Public Health Service, Washington, D.C.
- PIHM**—Panstwowy Instytut Hydrologiczno-Meteorologiczny, Gdynia, Poland.
- PINRO**—Polar Research Institute for Marine Fisheries and Oceanography, Murmansk, U.S.S.R.
- PIOSA**—Pan-Indian Ocean Science Association, Tejgaon Dacca, East Pakistan.
- PIPICO**—Panel on International Programs of the **ICO**, Washington, D.C.
- PMR**—Pacific Missile Range, U.S. Navy, Point Mugu, California.
- PNL**—Pacific Naval Laboratory, Esquimalt, British Columbia, Canada.
- POFI**—Pacific Oceanographic Fisheries Investigation, Honolulu, Hawaii.
- POG**—Pacific Oceanographic Group, Nanaimo, British Columbia, Canada.
- PSA**—Pacific Science Association, Honolulu, Hawaii.
- PSAC**—President's Science Advisory Council, Washington, D.C.
- PSC**—Pacific Science Council, Honolulu, Hawaii.
- RCN**—Royal Canadian Navy, Ottawa, Ontario, Canada.
- RESA**—Scientific Research Society of America, New Haven, Connecticut.
- RFCWA**—Regional Fisheries Commission for West Africa, Accra, Ghana.
- SACFCO**—Standing Advisory Committee on Fisheries of the Caribbean Organization, Hato Rey, Puerto Rico.
- SACI**—South Atlantic Cooperative Investigations.
- SACLANTCEN**—Supreme Allied Command for the Atlantic Center (ASW Research Center), La Spezia, Italy.
- SAIL**—Sea-Air Interaction Laboratory, U.S. Weather Bureau, Washington, D.C.
- SANAE**—South African National Antarctic Expeditions, Capetown, South Africa.
- SANCAR**—South African National Council for Antarctic Research, Capetown, South Africa.
- SCANDOC**—Scandinavian Documentation Center, Washington, D.C.
- SCAR**—Special Committee for Antarctic Research (**ICSU**), Cambridge, England.
- SCG**—Scientific Committee for Inter-Union Cooperation in Geophysics.
- SCIBP**—Sectional Committee of the International Biological Programme.
- SCOR**—1. Scientific Committee on Oceanic Research, Hamburg, West Germany; Blindern, Norway; Karachi, Pakistan; Sopot-molo, Poland.
2. Special Committee for Oceanographic Research (**UN**), New York, New York.
- SEAS**—Committee for the Scientific Exploration of the Atlantic Shelf.
- SEASCO**—South East Asia Science Co-operation Office, New Delhi, India.
- SHN**—Servicio de Hidrografia Naval, Buenos Aires, Argentina.
- SI**—Smithsonian Institution, Washington, D.C.
- SIE**—Science Information Exchange (**SI**), Washington, D.C.
- SIO**—Scripps Institution of Oceanography, La Jolla, California.
- SIPRE**—Snow, Ice, and Permafrost Research Establishment. *See* **CRREL**.
- SMBA**—Scottish Marine Biological Association, Edinburgh, Scotland.
- SNEMSA**—Southern New England Marine Sciences Association, Kingston, Rhode Island.
- SOGETRAM**—Société Générale de Travaux Maritimes at Fluviaux.
- SPRI**—Scott Polar Research Institute, Cambridge, England.
- SWAFAC**—Southwest Atlantic Fisheries Advisory Commission.
- TINRO**—Pacific Research Institute of Fisheries and Oceanography, Vladivostok, U.S.S.R.
- TWZO**—Trade Wind Zone Oceanography (**BCF**), Honolulu, Hawaii.
- UDML**—University of Delaware Marine Laboratories, Newark, Delaware.
- UN**—The United Nations, New York, New York.
- UNESCO**—United Nations Educational, Scientific, and Cultural Organization, Paris, France.
- UNSF**—United Nations Special Fund, Paris, France.
- URSI**—Union Radio Scientifique Internationale, Brussels, Belgium.
- USAID**—U.S. Agency for International Development, Washington, D.C.
- USARP**—U.S. Antarctic Research Program, Washington, D.C.
- USCG**—U.S. Coast Guard, Washington, D.C.
- USC&GS**—U.S. Coast and Geodetic Survey, U.S. Department of Commerce, Washington, D.C.
- USFWS**—U.S. Fish and Wildlife Service, U.S. Department of the Interior, Washington, D.C.
- USGS**—U.S. Geological Survey, U.S. Department of the Interior, Washington, D.C.
- USMA**—U.S. Maritime Administration, Washington, D.C.
- USN**—U.S. Navy, Washington, D.C.
- USNA**—U.S. Naval Academy, Annapolis, Maryland.
- USNMDL**—U.S. Navy Mine Defense Laboratory, Panama City, Florida.
- USNHO**—U.S. Navy Hydrographic Office (now U.S. Naval Oceanographic Office), Washington, D.C.

USNUSL—U.S. Navy Underwater Sound Laboratory, Fort Trumbull, New London, Connecticut.

USWB—U.S. Weather Bureau, U.S. Department of Commerce, Washington, D.C.

VIMS—Virginia Institute of Marine Science, Gloucester Point, Virginia.

VNIRO—All-Union Research Institute of Marine Fisheries and Oceanography, Moscow, U.S.S.R.

WDC—World Data Center (WDC-A, Washington, D.C.), (WDC-B, Moscow, U.S.S.R.).

WHO—World Health Organization of the United Nations, Geneva, Switzerland.

WHOI—Woods Hole, Oceanographic Institution, Woods Hole, Massachusetts.

WMO—World Meteorological Organization of the United Nations, Geneva, Switzerland.

