DOCUMENT RESUME

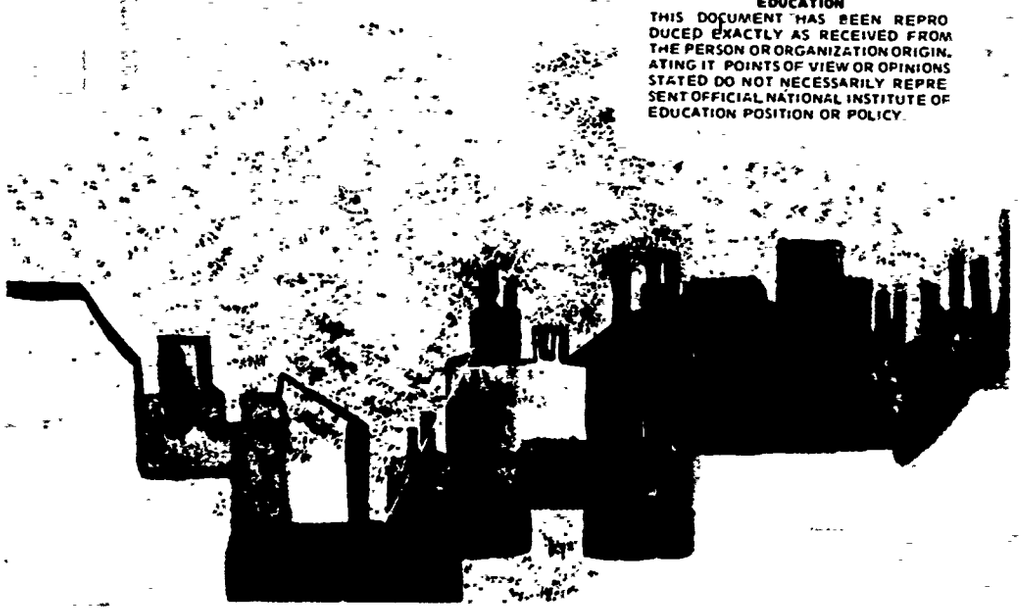
ED 077 692 SE 016 131

AUTHOR	Huschke, Ralph E., Ed.
TITLE	Glossary of Terms Frequently Used in Air Pollution.
INSTITUTION	American Meteorological Society, Boston, Mass.
PUB DATE	68
NOTE	41p.; 1972 Reprint
AVAILABLE FROM	American Meteorological Society, 45 Beacon Street, Boston, Massachusetts 02108 (Pub. Gap-100, $2.00)
EDRS PRICE	MF-$0.65 HC-$3.29
DESCRIPTORS	*Air Pollution Control; *Definitions; Earth Science; *Environment; Environmental Influences; *Glossaries; *Meteorology; Reference Materials; Space Sciences; Word Lists

ABSTRACT

Compiled in this glossary are 275 terms related to air pollution and meteorology. Definitions are designed to be understandable by the non-scientist yet sufficiently technical to satisfy professional requirements. Many terms are extracted from the "Glossary of Meteorology" published by the American Meteorological Society. (BL)

GLOSSARY OF TERMS FREQUENTLY USED IN AIR POLLUTION



AMERICAN METEOROLOGICAL SOCIETY, 45 Beacon St., Boston, Mass. 02108

GLOSSARY OF METEOROLOGY

edited by
RALPH E. HUSCHKE

PRICE: $18.00
(638 pages)

The most extensive compilation of the atmospheric sciences' terminology in existence.

The GLOSSARY OF METEOROLOGY contains 7347 entries defining 7200 words and phrases stemming from meteorology, hydrology, oceanography, geomagnetism, and astrophysics. It has received universal acclaim as being one of the most significant reference works in its field.

Every definition is understandable by the non-scientist yet sufficiently technical to satisfy professional requirements. Working scientists, students, and those laymen with just an interest in the atmosphere will find the Glossary to be a valuable reference.

Whether for acquaintanceship with an unfamiliar term or for the "basic" definition presented in the first sentence or two, the reader will find the Glossary more than adequate. For the professional, all technical information including pertinent mathematics is included. For a technical library, the volume is an invaluable reference to a broad segment of current technical terminology related to atmospheric physics and research in the space environment.

AMERICAN METEOROLOGICAL SOCIETY, 45 BEACON ST., BOSTON, MASS. 02108

PROGRAM

SEMINAR FOR SCIENCE WRITERS

ON

GLOBAL AIR POLLUTION

Sponsored by the American Meteorological Society
and
The National Association of Science Writers
Supported by the National Science Foundation
Jack Tar Hotel
San Francisco, California

30 January 1968

INTRODUCTION

Prof. Louis J. Battan, President, American Meteorological Society

CHAIRMAN

Dr. Vincent J. Schaefer, Director, Atmospheric Sciences Research Center, State University of New York at Albany, Albany, New York - "You are a Cloud Seeder."

PARTICIPANTS

Dr. James P. Lodge, Jr., Program Scientist, National Center for Atmospheric Research, Boulder, Colorado - "The Population of the United States is 39 Billion."

Dr. John R. Goldsmith, M.D., Chief, Environmental Hazards Evaluation, California State Department of Public Health, Berkeley, California - "The Hazards of Second-Hand Air."

Prof. Reid A. Bryson, Director for the Center of Climatic Research, University of Wisconsin, Madison, Wisconsin - "Dust Everywhere."

Prof. A. J. Haagen-Smit, Department of Biology, California Institute of Technology, Pasadena, California - "Is There Hope for Los Angeles?"

ACKNOWLEDGMENTS

The first seminar for science writers sponsored by the American Meteorological Society and the National Association of Science Writers is scheduled for January 30, 1968 in San Francisco. The objective of this seminar is to provide science writers with basic and up-to-date information on the subject of Global Air Pollution. Arrangements were made by Dr. Kenneth C. Spengler, Executive Director of the American Meteorological Society and Miss Evelyn Mazur, Assistant to the Executive Director. Acknowledgment is made to the National Science Foundation for financial support.

We are indebted to Mr. Ralph E. Huschke, RAND Corporation for compiling the Glossary of Terms Frequently Used in Air Pollution and to Dr. Louis J. Battan, The University of Arizona and Dr. Reid A. Bryson, University of Wisconsin for their assistance. Many terms appearing in this glossary were extracted from the Glossary of Meteorology, edited by Ralph E. Huschke and published by the American Meteorological Society.

INTRODUCTION

Although man has been polluting the atmosphere since he discovered how to make fire, it is only in recent years that we have begun to realize the seriousness of the problem. As population and industry have grown, the quantities of undesirable particles and gases added to the atmosphere have multiplied at an alarming rate. The natural processes of atmospheric cleansing have not succeeded in removing pollutants fast enough. As a result there are increasing amounts of contaminants in the earth's atmosphere.

The air pollution problem is being attacked on many fronts. Scientists and engineers are investigating the sources of pollutants, their types, the reactions occurring in the atmosphere, the diffusion of gases and particles and the effects of contaminants on materials, vegetation, animals and humans.

Meteorologists are particularly concerned with what happens to pollutants after they get into the atmosphere. We know reasonably well how to explain and predict the behavior of smoke coming out of a single smoke stack or even a number of stacks. We still have much to learn about the behavior of atmospheric pollutants over large city complexes such as the one between Washington and Boston. As you would expect, the very interesting question of world-wide pollution is still the subject of speculation. Some interesting observations have been made and some far-reaching theories have been advanced.

It has been alleged that the importance of air pollution has been exaggerated, that we are unnecessarily concerned about the consequences. It cannot be denied that occasionally the problem has been represented in overly dramatic terms calculated to frighten the public. On the other hand, there is no question that polluted air is costing vast sums of money by damaging and destroying man's property and possessions. More importantly, we are paying the infinitely higher costs measured in terms of sickness and sometimes death.

There is little doubt that on the average the atmosphere is becoming more contaminated, the quality of the air is degrading, the sewer in the sky is filling. It is essential that we reverse the trend. This can only be done by restricting the quantities of smoke and other pollutants, particularly in those places and at those times when the atmosphere is incapable of dispersing them rapidly.

Louis J. Battan
University of Arizona

ABSOLUTE STABILITY – The state of a column of air in the atmosphere when its lapse rate of temperature is less than the saturation-adiabatic lapse rate. An air parcel displaced upward by any adiabatic process would then be more dense than its environment and would tend to sink back to its level of origin.

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.

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

ABSORPTION BAND – A range of wavelengths (or frequencies) in the electromagnetic spectrum within which radiant energy is absorbed by a substance.

ABSORPTION COEFFICIENT – A measure of the amount of normally incident radiant energy absorbed through a unit distance or by a unit mass of absorbing medium.

ABSORPTION LINE – A minute "range" of wavelength (or frequency) in the electromagnetic spectrum within which radiant energy is absorbed by the medium through which it is passing. Each line is associated with a particular mode of vibration or rotation induced in an absorbing molecule by the incident radiation.

The absorption bands of a polyatomic gas are actually closely spaced groups of absorption lines.

ABSORPTION SPECTRUM – The array of absorption lines and absorption bands which results from the passage of radiant energy from a continuous source through a selectively absorbing medium cooler than the source.

ABSORPTIVITY – (Also called absorption factor; infrequently called absorptive power.) 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. The absorption may occur either at the surface of (as with an opaque body) or in transit through the substance.

ACCRETION – The growth of a particle by the external addition of matter. In cloud physics, it is the growth of a precipitation particle by the collision of a frozen particle with a supercooled liquid droplet which freezes upon contact.

ACTINIC – Pertaining to electromagnetic radiation capable of initiating photochemical reactions, as in photography or the fading of pigments. Because of the particularly strong action of ultraviolet radiation on photochemical processes, the term has come to be almost synonymous with ultraviolet, as in "actinic rays."

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.

ADSORPTION – The adhesion of a thin film of liquid or gas to a solid substance.

ADVECTION – The process of transport of an atmospheric property solely by the mass motion (velocity field) of the atmosphere; also, the rate of change of the value of the advected property at a given point.

Often, particularly in synoptic meteorology, advection refers only to the horizontal or isobaric components of motion, that is, the wind field as shown on a synoptic chart.

Regarding the general distinction (in meteorology) between advection and convection, the former describes the predominantly horizontal, large-scale motions of the atmosphere while convection describes the predominantly vertical, locally induced motions.

AEROSOL – A colloidal system in which the dispersed phase is composed of either solid or liquid particles, and in which the dispersion medium is some gas, usually air.

There is no clear-cut upper limit to the size of particles comprising the dispersed phase in an aerosol, but as in all other colloidal systems, it is rather commonly set at 1 micron. Haze, most smokes, and some fogs and clouds may thus be regarded as aerosols. However, it is not good usage to apply the term to ordinary clouds whose drops are so large as to rule out the usual concept of colloidal stability. It is also poor usage to apply the term to the dispersed particles alone; an aerosol is a system of dispersed phase and dispersing medium taken together.

AGGLOMERATION – The growth of a particle by collision with and assimilation of other particles. Ordinarily, the connotation is that all particles are solid.

AGGLUTINATION – The adhesion of solid particles together or to a solid surface.

AIR – The mixture of gases comprising the earth's atmosphere. Since the composition of the atmosphere is slightly variable with respect to certain components, the term "pure air" has no precise meaning, but it is commonly used to imply freedom from non-gaseous suspensoids (dust, hydrometeors) and also freedom from such gaseous contaminants as industrial effluents.

By far the most important gas found in air, from the meteorological viewpoint, is water vapor.

(continued)

The per cent by volume of those gases found in relatively constant amount in dry air is very nearly as follows:

nitrogen (N_2)	78.084 percent
oxygen (O_2)	20.946
argon (A)	0.934
carbon dioxide (CO_2)	0.033
neon (Ne)	0.0018
helium (He)	0.000524
methane (CH_4)	0.0002
krypton (Kr)	0.000114
hydrogen (H_2)	0.00005
nitrous oxide (N_2O)	0.00005
Xenon (Xe)	0.0000087

In addition to the above constituents there are many variable constituents. Chief of these is water vapor, which may vary from zero to volume percentages close to four per cent. Ozone, sulfur dioxide, ammonia, carbon monoxide, and other trace gases occur in small and varying amounts.

AIR CONDITIONING – (Sometimes called climatization.) The artificial control of humidity, temperature, "purity," and motion of the air within buildings and other enclosed spaces; also the operation of equipment for such controls. The objective may be to secure either maximum human comfort or the best environment for a given industrial operation.

AIR CURRENT – Very generally, any moving stream of air; it has no particular technical connotation.

AIRLIGHT – Light scattered into the eyes of an observer by atmospheric suspensoids (and, to a slight extent, by air molecules) lying in the observers cone of vision. It is the principal cause of the "glare" experienced in a hazy or polluted atmosphere.

AIR MASS – 1. 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.

2. Same as optical air mass.

AIR POLLUTION – The general term alluding to the undesirable addition to the atmosphere of substances (gases and liquids and solid particles) either that are foreign to the "natural" atmosphere or in quantities exceeding their natural concentrations.

AIR QUALITY – The composition of air with respect to quantities of pollutants therein; used most frequently in connection with "standards" of maximum acceptable pollutant concentrations.

AMBIENT AIR – Literally, the air moving around us; the air of the surrounding environment. It is used, generally, in opposition to closed, controlled environments of any kind.

AMMONIA – (Chemical formula: NH_3) A colorless gas with a sharp, irritating odor, having a density about six-tenths that of air at the same temperature and pressure.

Trace quantities of ammonia enter the atmosphere as a result of natural decay processes and from industrial pollution. Its high solubility in water should decrease its chances of remaining in the atmosphere under rainy conditions.

ANEMOMETER – The general name for instruments designed to measure the speed (or force) of the wind.

ANGSTROM – (Abbreviated A, 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} cm or 10^{-4} microns.

The wavelength of visible light ranges from about 4000 to 7000 angstroms; whereas x-ray wavelengths and atomic diameters are of the order of a few angstroms. The unit is named in honor of the nineteenth century Swedish spectroscopist, A. J. Ångstrom.

ANTICYCLONE – A large-scale atmospheric circulation system in which (in the northern hemisphere) the winds rotate clockwise. Because this is almost invariably accompanied by relatively high atmospheric pressure, the terms "anticyclone" and "high" are commonly used interchangeably.

Three characteristics of anticyclones are critical to air pollution. (1) Winds near an anticyclone center are very light. (2) The general outflow of air from an anticyclone causes the air aloft to subside and produce a widespread subsidence inversion, which traps pollutants at low levels. (3) An anticyclone is relatively cloud free, and the resulting sunshine induces photochemical smog.

ASH FALL – The gravitational settling of the fly ash through the atmosphere; also, the ash that has thus settled.

ATTENUATION – In physics, any process in which the flux density (or 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 (mainly by absorption and scattering). It should not be applied to the divergence of flux due to distance alone, as described by the inverse-square law.

In meteorological optics, the attenuation of light is customarily termed extinction. (The latter is sometimes used with regard to any electromagnetic radiation.)

ATTENUATION COEFFICIENT – A measure of the space rate of diminution, or attenuation, of any transmitted electromagnetic radiation.

BACKGROUND LEVEL – In air pollution studies, the concentration of a pollutant that would exist in the absence of the particular source under study; a "standard" against which the contribution of the particular source can be compared.

BASIN – With respect to air pollution, a geographical area where surrounding elevated terrain can, at least under some atmospheric conditions, impede the flow of air into and out of the area.

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.

BISHOP'S RING – A faint, broad, reddish-brown corona occasionally seen in dust clouds, especially those which result from violent volcanic eruptions. The angular radius of this ring's inner edge is about 20° and its angular width is about 10°, the exact dimensions being controlled by the particle-size of the dust layer.

It is named after Rev. S. Bishop of Honolulu, who first described the phenomenon.

BIVANE – A bi-directional wind vane; a sensitive wind vane used in turbulence studies to obtain a record of the horizontal and vertical components of the wind. The instrument consists of two lightweight airfoil sections mounted orthogonally on the end of a counter-balanced rod which is free to rotate in the horizontal and vertical planes. The positions of the rod may be recorded by electrical techniques.

BLACK BODY – A hypothetical "body" which absorbs all of the electromagnetic radiation striking it; that is, one which neither reflects nor transmits any of the incident radiation.

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.

BOUNDARY LAYER – In meteorology, a general term for the layer of air adjacent to the earth's surface. Several kinds of boundary layers (or the upper limits thereof) can be defined according to different physical or dynamical characteristics.

Unless otherwise specified in air pollution contexts, the concept of the planetary boundary layer should be assumed.

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.

BURN OFF – With reference to fog or low stratus cloud layers, to dissipate by daytime heating from the sun.

CALM – The absence of apparent motion of the air. In weather observing practice, the wind is reported as "calm" if its speed is less than one mile per hour (or one knot).

CARBON DIOXIDE – (Chemical formula: CO_2) A heavy, colorless gas that enters the atmosphere as the result of efficient natural and artificial combustion processes; the fourth most abundant constituent of dry air.

There is substantial evidence that the amount of CO_2 in the atmosphere has increased by 10 percent, from about 300 ppm to 330 ppm, in the last half century, and that this increase has come about by the increased burning of carbonaceous fuels. Because of its strong absorption of infrared radiation, CO_2 has important influence on the atmosphere's radiation balance and, therefore, on the static stability of the atmosphere. The effects of increasing amounts of atmospheric CO_2 are, as yet, unknown; but it is worth noting that many present-day efforts to control pollution have the net effect of increasing the CO_2 output while decreasing the emission of other pollutants.

CARBON MONOXIDE – (Chemical formula: CO) A colorless, odorless, and very toxic gas, found in trace quantities in the natural atmosphere, but also produced by the incomplete combustion of carbonaceous fuels.

CASCADE IMPACTOR – A low-speed impaction device for use in sampling both solid and liquid atmospheric suspensoids. The simple impactor consists of four pairs of jets and sampling plates working in series and designed in such a manner that each sampling plate collects particles of predominantly one size range.

CIRCULATION – The flow or motion of a fluid in or through a given area or volume. This is the most general term applied to atmospheric motions on all scales.

CIRCULATION PATTERN – The general geometric configuration of atmospheric circulation at a given time and region.

CLEAN AIR – A political term alluding to the chemical and optical condition of the atmosphere back in the good old days.

CLEAR – 1. After United States weather observing practice, the state of the sky when it is cloudless or when the sky cover is less than 0.1 (to the nearest tenth).

2. In popular usage, the condition of the atmosphere when it is very transparent (as opposed to hazy, foggy, etc.) and accompanied by negligible cloudiness. In weather forecast terminology, the maximum cloudiness considered is about 0.2.

COAGULATION – Generally, any process that converts numerous small particles into a smaller number of larger particles.

COALESCENCE – The merging of two liquid particles into a single particle.

COLLECTION EFFICIENCY – In general, the fraction of all particles initially moving on a collision course with a given impactor which actually do collide with and remain adhered to that impactor.

COLLOID – See colloidal system.

COLLOIDAL DISPERSION – Same as colloidal system.

COLLOIDAL SUSPENSION – Same as colloidal system. See also suspension.

COLLOIDAL SYSTEM – (Also called colloidal dispersion, colloidal suspension.) An intimate mixture of two substances one of which, called the dispersed phase (or colloid) is uniformly distributed in a finely divided state through the second substance, called the dispersion medium (or dispersing medium). The dispersion medium may be a gas, a liquid or a solid and the dispersed phase may also be any of these, with the exception that one does not speak of a colloidal system of one gas in another.

A system of liquid or solid particles colloidally dispersed in a gas is called an aerosol.

COMBUSTION NUCLEUS – A condensation nucleus formed as a result of industrial or natural combustion processes.

The chemical nature of such nuclei may vary almost as much as can the nature of reactants in industrial combustion processes, but because of the prevalence of sulfur impurities in many coals, sulfur dioxide (SO_2) and sulfur trioxide (SO_3) are perhaps the most important of the substances acting as combustion nuclei. Both of these oxides are hygroscopic and hence can serve to nucleate atmospheric condensation processes. The role of the ammonium ion (NH_4^+) which is formed in some combustion processes is probably of almost equal importance to that of the sulfite (SO_3^{-2}) and sulfate (SO_4^{-3}) ions.

COMPOUND – X An unknown nitrogen compound presumed to be formed as a result of the consumption of nitrogen dioxide in the photooxidation system of photochemical smog. It is sought in order to try to explain not only the consumption of nitrogen, but also certain smog effects not attributable to known constituents; and, ideally, its absorption spectrum must be consistent with the spectra observed in real smogs.

The compound PAN (peroxyacetal nitrate) appears to have most of the characteristics demanded of Compound – X.

CONCENTRATION – General term for the amount of a substance contained in a unit area or volume, or relative to the amount of medium within which the substance is contained.

In air pollution, the concentration of particulates is expressed either as number of particles per unit volume of air or as weight of particles per unit volume of air. Gaseous pollutant concentrations are usually expressed as the ratio of the weight of the pollutant to the total weight of air-pollutant mixture.

CONDENSATION – The physical process by which a vapor becomes a liquid or solid; the opposite of evaporation. In meteorological usage, this term is applied only to the transformation from vapor to liquid; any process in which a solid forms directly from its vapor is termed sublimation, as is the reverse process.

CONDENSATION NUCLEUS – A particle, either liquid or solid, upon which condensation of water vapor begins in the atmosphere.

CONDENSATION TRAIL – (Or contrail; also called vapor trail.) A cloud-like streamer frequently observed to form behind aircraft flying in clear, cold, humid air.

CONTAMINANT – Same as pollutant.

CONTRAIL Same as condensation trail.

CONVECTION – 1. 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.

2. As specialized in meteorology, atmospheric motions that are predominantly vertical, resulting in vertical transport and mixing of atmospheric properties; distinguished from advection.

Because the most striking meteorological results of convective motion occur in conjunction with the rising current of air (strong updrafts, convective clouds, etc.), convection often is used to imply only upward vertical motion, and in this sense it is opposed to subsidence.

CONVECTIVE STABILITY – (Or convectional stability) Same as static stability.

CORRASION – (Or wind corrosion.) The abrasive action of wind-borne material, especially sand, dust, and ice crystals; a form of weathering.

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.

Of great significance is the corrosion due to the combined effects of atmospheric temperature, humidity, and suspended impurities; for example, the rusting of iron, the direct effects upon a surface wetted by acid rain water, or, indirectly, the rotting of wood caused by the action of fungi or fungi of bacteria in the soil and in enclosed spaces.

CURRENT – See air current.

CYCLONE – 1. A large-scale atmospheric circulation system in which (in the northern hemisphere) the winds rotate counter clockwise. Because this is almost invariably accompanied by relatively low atmospheric pressure, the terms "cyclone" and "low" are commonly used interchangeably. Cyclones typically are associated with stormy weather and unstable air, and therefore serve to ameliorate air pollution.

2. A device for removing particulates from a moving stream of gas by centrifugal force.

DEPOSITION – The settling to earth of particulates previously suspended in the atmosphere.

DEW POINT – (Or dew-point temperature.) The temperature to which a given parcel of air must be cooled at constant pressure and constant water-vapor content in order for saturation to occur. When this temperature is below 0°C, it is sometimes called the frost point.

DEW-POINT SPREAD – (Commonly contracted spread; also called dew-point deficit, dew-point depression.) The difference in degrees between the air temperature and the dew point.

DIFFUSE SKY RADIATION – (Or skylight; also called diffuse skylight, sky radiation.) Radiation reaching the earth's surface after having been scattered from the direct solar beam by molecules or suspensoids in the atmosphere. Of the total light removed from the direct solar beam by scattering in the atmosphere (approximately 25 percent of the incident radiation), about two-thirds ultimately reaches the earth as diffuse sky radiation.

DIFFUSION – In meteorology, the exchange of fluid parcels (and hence the transport of conservative properties) between regions in space, in the apparently random motions of a scale too small to be treated by the equations of motion.

In meteorology, the diffusion of momentum (viscosity), vorticity, water vapor, heat (conduction), and gaseous components of the atmospheric mixture, have been studied extensively. The atmospheric motions diffusing these properties may in many cases be of much larger scale than the molecular, the exchanging parcels being called eddies, and the diffusion equation extended by analogy to turbulent diffusion. It is this latter approach that is used in diffusion studies relating to air pollution.

DIFFUSIVITY – A measure of the rate of diffusion of a fluid property.

DISPERSED PHASE – See colloidal system.

DISPERSING MEDIUM – See colloidal system.

DISPERSION – 1. In air pollution terminology, loosely applied to the removal (by whatever means) of pollutants from the atmosphere over a given area; or, the distribution of a given quantity of pollutant throughout an increasing volume of atmosphere.

2. See colloidal system.

DOWNWASH The transport of pollutants downward to the earth's surface by a descending current of air.

DRY AIR – 1. In atmospheric thermodynamics and chemistry, air that contains no water vapor.

2. Generally, air with low relative humidity.

DUST – Solid materials suspended in the atmosphere in the form of small irregular particules, many of which are microscopic in size. It imparts a tannish or greyish hue to distant objects. The sun's disk is pale or colorless or has a yellowish tinge at all periods of the day.

Dust cannot be a stable component of the atmosphere because it must eventually fall back to the earth's surface when winds and turbulence become

(continued)

too weak to bear it aloft. Dust is due to many natural and artificial sources: volcanic eruptions, salt spray from the seas, blowing solid particles, plant pollen and bacteria, smoke and ashes of forest fires and industrial combustion processes, etc.

DUST COUNTER – (Also called Kern counter, nucleus counter.) General term for an instrument which measures the size and number of dust particles in the atmosphere.

DUST FALL – The gravitational settling of dust through the atmosphere; also, the dust that has thus settled.

DUST HORIZON – The top of a dust layer which is confined by a low-level temperature inversion and has the appearance of the horizon when viewed from above against the sky. In such instances the true horizon is usually obscured by the dust layer.

Similarly defined are fog horizon, haze horizon, smog horizon, and smoke horizon.

DUST LOADING – (Or particulate loading.) Engineering term for the concentration of dust (or other particulates) in the atmosphere.

DUSTSTORM – (Or dust storm; also called duster, black blizzard.) An unusual, frequently severe weather condition characterized by strong winds and dust-filled air over an extensive area. Prerequisite to a dust storm is a period of drought over an area of normally arable land, thus providing the very fine particles of dust which distinguish it from the more common sandstorm of desert regions.

EDDY – 1. By analogy with a molecule, a "glob" of fluid within the fluid mass that has a certain integrity and life history of its own; the activities of the bulk fluid being the net result of the motion of the eddies.

The concept is applied with varying results to phenomena ranging from the momentary spasms of the wind to storms and anticyclones.

2. Any circulation drawing its energy from a flow of much larger scale, and brought about by pressure irregularities as in the lee of a solid obstacle.

EDDY DIFFUSION – Same as turbulent diffusion.

EDDY DIFFUSIVITY – (Also called coefficient of eddy diffusion, eddy diffusion coefficient.) The exchange coefficient for the diffusion of a conservative property by eddies in a turbulent flow.

See also diffusivity.

EDDY FLUX – (Or turbulent 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.

EFFLUENT – The mixture of substances, gases and liquids and suspended matter, discharged into the atmosphere (or ground, river, ocean) as the result of a given process. The presumption has been that nature provides for adequate dispersal of the effluent.

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.

EMISSION – 1. With respect to radiation, the generation and sending out of radiant energy.

2. With respect to air pollution, the release of pollutants into the atmosphere.

EMISSIONS – In air pollution, a general term usually applied to combustion waste products at their source.

ENTRAINMENT – In meteorology, the mixing of environmental air into a preexisting organized air current so that the environmental air becomes part of the current.

EVAPORATION – (Also called vaporization.) The physical process by which a liquid or solid is transformed to the gaseous state; the opposite of condensation. In meteorology evaporation usually is restricted in use to the change of water from liquid to gas, while sublimation is used for the change from solid to gas as well as from gas to solid.

EXCHANGE COEFFICIENTS – (Also called austausch coefficients, eddy coefficients, interchange coefficients.) Coefficients of eddy flux (e.g., of momentum, heat, water vapor, etc.) in turbulent flow, defined in analogy to those of the kinetic theory of gases (see eddy).

EXTINCTION – The attenuation of light; that is, the reduction in illuminance of a parallel beam of light as the light passes through a medium wherein absorption and scattering occur.

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.

EYE IRRIATION – One effect of photochemical smog that is sufficiently general and qualitatively measurable that it is used as an index of smog severity.

FALLOUT – 1. The descent to the ground of dust and other airbourne debris, usually referring to debris resulting from an explosion, and especially applied to radioactive debris from an atomic or thermonuclear explosion.

2. In air pollution terminology, sometimes used for the settling out of very fine particles as opposed to larger particles of ash.

FLY ASH – Ash particles, frequently in the form of small, irregular flakes, that escape into the atmosphere and quite rapidly settle to the ground.

FLUX – (Also called transport.) The rate of flow of some quantity, often used in reference to the flow of some form of energy.

FLUX DENSITY – The flux (rate of flow) of any quantity, usually a form of energy, through a unit area of specified surface.

FOG – A hydrometeor consisting 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 miles). (Compare mist.) Fog differs from cloud only in that the base of fog is at the earth's surface while clouds are above the surface. When composed of ice crystals, it is termed ice fog.

Fog is easily distinguished from haze by its appreciable dampness and grey color. Mist may be considered as intermediate between for and haze; its particles are microscopic in size, it is less damp than fog, and does not restrict visibility to the same extent. There is no distinct line, however, between any of these categories.

FREE ATMOSPHERE – (Sometimes called free air.) That portion of the earth's atmosphere, above the planetary boundary layer, in which the effect of the earth's surface friction on the air motion is negligible, and in which the air is usually treated (dynamically) as an ideal fluid. The base of the free atmosphere is usually taken as the geostrophic wind level.

FREE RADICAL – An organic compound whose structure is disturbed so that there is at least one unpaired electron. All free radicals are highly energetic and reactive, and in photochemical smog, their role is as a transfer agent for oxygen molecules.

FRESH AIR – A relative term, having no technical connotation, alluding to air that is generally stimulating and refreshing and implying adequate ventilation.

FRICTION LAYER – Same as planetary boundary layer.

FRONT – 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.

FRONTAL PASSAGE – (Sometimes abbreviated fropa.) The passage of a front over a point on the earth's surface.

FUME – In air pollution terminology, very fine particulates, predominantly less than one micron in diameter.

FUMIGATION – 1. The phenomenon in which pollutants, that had remained aloft in stratified, stable air, are brought rapidly to ground level when the air destabilizes.

2. In pollution-effects experiments: subjection to a test gas or gaseous mixture.

GLARE – Any hindrance to vision caused by scattering or reflection of light into an observer's line of sight.

Glare due to scattering of light by dust particles deposited on the windshield of an automobile, for example, is noticeable only when the driver is looking into the sun, since particles as large as most dusts scatter predominantly in the forward direction. Smaller atmospheric suspensoids, however, produce the more azimuthally uniform glare known as air-light which has an effect on visibility that is almost independent of the relative positions of sun and object viewed.

GREENHOUSE EFFECT – The heating effect exerted by the atmosphere upon the earth by virtue of the fact that the atmosphere (mainly its water vapor, carbon dioxide, ozone, and suspended particles) absorbs and re-emits radiation that otherwise would escape to space.

GROUND INVERSION – Same as surface inversion.

HALF-LIFE – The time required for a system decaying at an exponential rate (such as an element in radioactive disintegration) to be reduced to one-half its initial size or intensity.

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.

Many haze formations are caused by the presence of an abundance of condensation nuclei which may grow in size, due to a variety of causes, and become mist, fog, or cloud. Distinction is sometimes drawn between dry haze and damp haze, largely on the basis of differences in optical effects produced by the smaller particles (dry haze) and the larger particles (damp haze) which develop from slow condensation upon the hygroscopic haze particles. Dry haze particles, with diameters of the order of 0.1 micron, are small enough to scatter shorter wavelengths of light preferentially, though not according to the inverse

fourth-power law of Rayleigh scattering. Such haze particles produce a bluish color when the haze is viewed against a dark background, for dispersion allows only the slightly bluish scattered light to reach the eye. The same type of haze, when viewed against a light background, appears as a yellowish veil, for here the principal effect is the removal of the bluer components from the light originating in the distant light-colored background. Haze may be distinguished by this same effect from mist, which yields only a gray obscuration, since in mist the particle sizes are too large to yield appreciable differential scattering of various wavelengths.

HAZE HORIZON – See dust horizon.

HAZE LAYER – A layer of haze in the atmosphere, usually bounded at the top (haze line) by a temperature inversion and frequently extending downward to the ground.

Necessary for the existence of this phenomenon are, of course, a source of haze particles, and a relatively stable stratification of temperature in the atmosphere either within or immediately above the haze layer. A haze layer may vary in extent from the type developed locally over an urban area at night, to a layer covering thousands of square miles as within an old and stable air mass.

HEAT ISLAND – Same as thermal island.

HIGH – 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.

HUMIDITY – 1. Generally, some measure of the water-vapor content of air.
2. Popularly, same as relative humidity.

HYDROCARBONS – A group of compounds that consist solely of the elements carbon and hydrogen. A variety of hydrocarbons exist in gasoline vapors, natural gas, and exhaust products. In photochemical smog, they react with atomic oxygen and ozone to form new reactive compounds.

HYDROGEN – (Symbol: H. Chemical formula: H_2.) A colorless and odorless, highly combustible gaseous element; the lightest and apparently most abundant chemical element in the universe. As a pure gas, however, it is found only in trace quantities in our atmosphere.

HYDROGEN SULFIDE – (Chemical formula: H_2S.) A colorless, flammable, dangerously poisonous gas having an offensive (rotten egg) odor, deriving as an air pollutant mainly from inadequately controlled petroleum refineries.

HYDROMETEOR – Any product of condensation or sublimation of atmospheric water vapor, whether formed in the free atmosphere or at the earth's surface; also, any water particles blown by the wind from the earth's surface.

HYDROSTATIC STABILITY – Same as static stability.

HYGROSCOPIC – Pertaining to a marked ability to accelerate the condensation of water vapor.

In meteorology, this term is applied principally to those condensation nuclei composed of salts which yield aqueous solutions of a very low equilibrium vapor pressure compared with that of pure water at the same temperature. Condensation on hygroscopic nuclei may begin at a relative humidity much lower than 100 per cent (about 75 per cent for sodium chloride); while on so-called non-hygroscopic nuclei, which merely furnish sufficiently large (by molecular standards) wettable surfaces, relative humidities of nearly 100 per cent are required. "Damp haze" is formed of hygroscopic particles in the process of slow growth in relatively dry air.

IMPACTOR – (Or impactometer.) A general term for instruments which sample atmospheric suspensoids by impaction. In general, the instrument consists of a housing which constrains the air to flow past a sensitized sampling plate.

INFRARED RADIATION – (Abbreviated IR; also called long-wave radiation.) Electromagnetic radiation lying in the wavelength interval from about 0.8 microns to an indefinite upper boundary sometimes arbitrarily set at 1000 microns (0.01 cm). 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.

Whereas visible radiation is generated primarily by intra-atomic processes, infrared radiation is generated almost wholly by larger-scale intramolecular processes, chiefly molecular rotations and internal vibrations of many types. Electrically symmetric molecules, such as the nitrogen and oxygen molecules which comprise most of the earth's atmosphere, are not capable of absorbing or emitting infrared radiation, but several of the triatomic gases, such as water vapor, carbon dioxide, and ozone are infrared-active and play important roles in the propagation of infrared radiation in the atmosphere.

INSOLATION – (Contracted from incoming solar radiation.) In general, solar radiation received at the earth's surface.

INVERSION – In meteorology, a departure from the usual decrease or increase with altitude of the value of an atmospheric property; also, the layer through which this departure occurs (the "inversion layer"), or the lowest altitude at which the departure is found (the "base of the inversion"). This term almost always means a temperature inversion.

INVERSION BASE – In standard practice, the lowest height in the atmosphere at which the temperature ceases to decrease with altitude; the bottom or base of an inversion layer.

INVERSION LAYER – A layer in the atmosphere through which the temperature remains constant or increases with altitude.

KONIMETER – (Also spelled conimeter.) An instrument for determining the dust content of a sample of air. One form of the instrument consists of a tapered metal tube through which a sample of air is drawn and allowed to impinge upon glass slide covered with a viscous substance. The particles caught are counted and measured with the aid of a microscope.

LAND BREEZE – A coastal breeze blowing from land to sea, caused by the temperature difference when the sea surface is warmer than the adjacent land. Therefore, it usually blows by night and alternates with a sea breeze, which blows in the opposite direction by day.

LAPSE RATE – The decrease of an atmospheric variable with height, the variable being temperature, unless otherwise specified.

LINE SOURCE – See source.

LITHOMETEOR – The general term for dry atmospheric suspensoids, including dust, haze, smoke and sand.

LOADING – See dust loading.

LOCAL CIRCULATION – In general, the detailed nature of atmospheric circulation in a given region, particularly as it is effected by physical peculiarities of the region. The distribution of urban air pollutants is largely a function of local circulation.

LONG-WAVE RADIATION – In meteorology, same as infrared radiation.

LOW – (Sometimes called depression.) In meteorology, elliptical for "area of low pressure," referring to a minimum of atmospheric pressure in two dimensions (closed isobars) on a constant-height chart or a minimum of height (closed contours) on a constant-pressure chart.

Since a low is, on a synoptic chart, always associated with cyclonic circulation, the term is used interchangeably with cyclone.

MAC – Abbreviation for "maximum acceptable concentration", with reference to air quality standards.

MARINE LAYER – Name applied to the moist sub-inversion layer of the atmosphere along the California coast.

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.

MESOMETEOROLOGY – The study of meso-scale atmospheric phenomena.

MESO-SCALE – In meteorology: having characteristic spatial dimensions somewhere between 1 and 100 miles, usually implying between 5 and 50 miles. Meso-scale phenomena thus include the bulk of air-pollution phenomena in addition to land and sea breezes, mountain winds, squalls and thunderstorms, etc.

METEOROLOGICAL RANGE – (Also called standard visibility, standard visual range.) An empirically consistent measure of the visual range of a target; a concept developed to eliminate from consideration the threshold contrast and adaptation luminance, both of which vary from observer to observer. It is a function only of the extinction coefficient of the atmosphere at the time and place in question.

METEOROLOGY – The study dealing with the phenomena of the atmosphere. This includes not only the physics, chemistry, and dynamics of the atmosphere, but is extended to include many of the direct effects of the atmosphere upon the earth's surface, the oceans, and life in general. The goals often ascribed to meteorology are the complete understanding, accurate prediction, and artificial control of atmospheric phenomena.

MICROMETEOROLOGY – The study of micro-scale atmospheric phenomena.

MICRON – 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.

MICRO-SCALE – In meteorology, having characteristic spatial dimensions of about one mile and less. Typical micro-scale phenomena include the diffusion of effluents, the effects of structures on air flow, the retention of moisture by crops, etc.

MIST – According to international definition: a hydrometeor consisting of an aggregate of microscopic and more-or-less hygroscopic water droplets suspended in the atmosphere. It produces, generally, a thin, greyish veil over the landscape. It reduces visibility to a lesser extent than fog. The relative humidity Mist is intermediate in all respects between haze (particularly "damp haze") and fog.

MIXED LAYER – In air pollution terminology, the layer of air usually a sub-inversion layer, within which pollutants are mixed by turbulence and diffusion.

MIXING DEPTH – Same as mixing height.

MIXING HEIGHT – (Or mixing depth.) The thickness of the atmospheric layer, measured from the surface upward, through which pollutants are presumed to mix by virtue of convection caused by daytime heating at the surface. The designation of a mixing height implies the existence of an inversion, in which case the mixing height is also the height of the inversion base.

NEPHELOMETER – General name for instruments which measure, at more than one angle, the scattering function of particles suspended in a medium. Information obtained from such instruments may be used to determine the size of the suspended particles and the visual range through the medium.

NITRIC OXIDE – (Chemical formula: NO.) A colorless gas that enters the atmosphere as a pollutant mainly via the exhaust of automobile engines. Its principal effect in smog is to combine with oxygen to form nitrogen dioxide (NO_2). NO_2 is then photodissociated to produce NO and atomic oxygen, the first main step in the complex production of photochemical smog.

NITROGEN – (Symbol N.) A colorless, tasteless, odorless gaseous element. It is the most abundant constituent of the atmosphere, amounting to 78.09 per cent by volume of dry air.

Nitrogen enters the atmosphere from volcanoes and from the decay of organic matter. It is removed from the atmosphere by certain natural nitrogen-fixing bacteria for use in plant life processes; all a part of a complex nitrogen cycle.

Free nitrogen is very inactive, but once combined (by bacterial fixation, high pressure, high temperature, etc.) it takes part in many transformations.

NITROGEN DIOXIDE – (Chemical formula: NO_2.) A reddish-brown gas that exists in photochemical smog as a secondary pollutant, having formed from the combination of nitric oxide (NO) and oxygen (O_2). It also photodissociates into the latter two components, the first step in the highly complex chain of reactions that constitutes photochemical smog.

The rate of production of NO_2 is greatly enhanced by the presence of hydrocarbons.

NUCLEATION – Any process by which the phase change of a substance to a more condensed state (condensation, sublimation, freezing) is initiated at certain loci (see nucleus) within the less condensed state.

NUCLEUS – In physical meteorology, a particle of any nature upon which, or the locus at which, molecules of water or ice accumulate as a result of a phase change to a more condensed state; an agent of nucleation.

OBSCURATION – (Also called obscured sky cover.) In United States weather observing practice, the designation for the sky cover when the sky is completely hidden by surface-based obscuring phenomena.

OBSCURING PHENOMENON – (Also called obscuration.) In United States weather observing practice, any atmospheric phenomenon (this does not include clouds) which restricts the vertical visibility or slant visibility, that is, which obscures a portion of the sky from the point of observation. Potentially, all hydrometeors and lithometeors may be obscuring phenomena.

OBSTRUCTION TO VISION – In United States weather observing practice, one of a class of atmospheric phenomena, other than the weather class of phenomena, which may reduce horizontal visibility at the earth's surface.

OLEFINS – A class of unsaturated (lacking in hydrogen) hydrocarbons of the general formula C_nH_{2n}. They are chemically very reactive and are presumed to take an active part in the production of free radicals, aldehydes, etc. in photochemical smog.

There is considerable experimental evidence that gaseous mixtures containing olefins produce eye irritation. aerosols, plant damage, and ozone.

OPTICAL AIR MASS – (Originally called, simply, air mass.) A measure of the length of the path through the atmosphere to sea level traversed by light rays from a celestial body, expressed as a multiple of the path length for a light source at the zenith.

OXIDANT – Generally, any oxidizing agent, that is, a substance that acquires electrons in a chemical reaction. Ozone (O_3) and atomic oxygen(O) are extremely effective oxidants.

As a measured constituent of polluted air, the oxidant level is a function of the reagent used for the measurement. Maximum measured values are on the order of one part per million. The most common reagent used is potassium iodide (KI), which practically excludes the detection of O_2 as a oxidant.

OXIDATION – Any chemical change in which the oxidation state (positive valence) of an element is increased. Formerly, its meaning was restricted to the combination of oxygen with other substances.

OXYGEN – (Symbol: O. Chemical formula: O_2.) In its free form, a colorless, tasteless, and odorless gaseous element; the second most abundant gas in the earth's atmosphere and a prerequisite of virtually all forms of animal life.

Except in local areas of photochemical smog, oxygen occurs primarily in molecular form (O_2) up to an altitude of about 20 kilometers.

OZONE – (Chemical formula: O_3) An unstable, blueish colored gas with a pungent odor. It is a much more effective oxidizing agent than O_2 (ordinary molecular oxygen).

Quite apart from its natural production in the upper atmosphere, ozone is an important component of photochemical smog where the required oxygen atoms (to combine with O_2) are made available through the photodissociation of nitrogen dioxide.

OZONE LAYER – 1. Same as ozonosphere.

2. Generally, any layer in the atmosphere in which there is a maximum of ozone concentration.

OZONOSPHERE – (Also called ozone layer.) The general stratum of the upper atmosphere in which there is an appreciable ozone concentration and in which ozone plays an important part in the radiative balance of the atmosphere. This region lies roughly between 10 and 50 km, with maximum ozone concentration at about 20 to 25 km. The ozonosphere is produced and maintained by processes that are entirely independent of air pollution.

PAN – See Compound-X.

PARTIAL PRESSURE – The pressure exerted by a single component of a gaseous mixture.

PARTICULATE LOADING – See dust loading.

PARTICULATES – Any liquid or solid particles suspended in or falling through the atmosphere.

As pollutants, particulates are particularly obnoxious in that they reduce visibility and create filth. They are produced primarily as the result of incomplete combustion (ash, soot). Some combustion products act as effective condensation nuclei, and droplets of various solutions are formed as a secondary process, some of which, notably sulfuric acid, are highly corrosive.

PHOTOCHEMICAL REACTION – A chemical reaction which involves either the absorption or emission of radiation. It most commonly refers to reactions promoted by the absorption of sunlight.

In photochemical smog, reactions of this type produce the main secondary contaminants and are responsible for much of the observed diurnal variation in contaminant levels and effects.

PHOTOCHEMICAL SMOG – The type of smog typical of the Los Angeles basin but becoming more and more prevalent elsewhere. In general, it is any smog wherein secondary pollutants are produced by photochemical reactions.

The common photochemical smog of today has the following typical characteristics. Essential ingredients are the ultraviolet portion of sunlight, nitrogen dioxide (NO_2) and certain carbon compounds (notably hydrocarbons). NO_2 is the primary absorber of the sunlight, releasing highly energetic oxygen atoms. The carbon compounds react with the oxygen atoms (and with the ozone produced by the latter), forming new reactive compounds which, in turn, react with molecular oxygen and nitrogen oxides to create a great variety of additional compounds. The entire process is so complex and variable, and occurs at such small concentrations, that a majority of the secondary and tertiary reactions remain a matter for conjecture.

PHOTODISSOCIATION – The dissociation (splitting) of a molecule by the absorption of a photon. The resulting components may be ionized in the process (photoionization).

PHOTOMETRY – The study of the measurement of the intensity of light (luminous intensity). Photometry is a restricted area within the much more general science of radiometry, in that only visible radiation as it affects reception by the eye is considered.

PHOTOOXIDATION – An oxidation reaction promoted by the absorption of radiation.

PLANE SOURCE – See source.

PLANETARY BOUNDARY LAYER – (Also called friction layer, atmospheric boundary layer.) That layer of the atmosphere from the earth's surface to the geostrophic wind level including, therefore, the surface boundary layer and the Ekman layer. Above this layer lies the free atmosphere.

PLUME – The volume of air space containing any of the substance emitted from a point source. For practical purposes, the limits of a plume have to be arbitrarily defined according to some minimum concentration of the substance.

POINT SOURCE – See source.

POLLUTANT – (Or contaminant.) With respect to the atmosphere, any substance within it that is foreign to the "natural" atmosphere or that exceeds its "natural" concentration in the atmosphere. The universal connotation is that a pollutant is potentially deleterious.

Air pollutants are categorized in several ways: according to their phase (gaseous or particulate, liquid or solid); their source (industrial, automotive, agricultural, etc.): and whether they enter directly from a source (primary) or form through chemical reactions in the atmosphere (secondary).

PPHM – Parts per hundred million.

PPM – Parts per million.

PRECIPITATION – 1. Any of all of the forms of water particles, whether liquid or solid, that fall from the atmosphere and reach the ground. It is a major class of hydrometeor, but is distinguished from cloud, fog, dew, rime, frost, etc. in that it must "fall"; and is distinguished from cloud and virga in that it must reach the ground. Precipitation includes drizzle, rain, snow, snow pellets, snow grains, ice crystals, ice pellets, and hail.

2. In general, the process of removing one or more components of a compound, mixture, or colloidal system by causing it to fallout in the form of a more condensed phase than the initial compound or mixture, or, in the case of a colloidal system or suspension, by inducing the suspended particles to separate from the medium.

PRESSURE GRADIENT – (Also, in meteorology, called barometric 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.

PRESSURE PATTERN – (Sometimes called baric topography.) In meteorology, the general geometric characteristics of atmospheric pressure distribution as revealed by isobars on a constant-height chart; usually applied to cyclonic-scale features of a surface chart.

PRESSURE SYSTEM – An individual cyclonic-scale feature of atmospheric circulation, commonly used to denote either a cyclone or anticyclone.

PRIMARY POLLUTANT – An air pollutant having the same form as when it was emitted at its source.

PREVAILING VISIBILITY – In United States weather observing practice, the greatest horizontal visibility which is equalled or surpassed throughout half of the horizon circle; it need not be a continuous half. In the case of rapidly varying conditions, it is the average of the prevailing visibility while the observation is being taken.

PREVAILING WIND DIRECTION – (Or prevailing wind.) The wind direction most frequently observed during a given period. The periods most frequently used are the observational day, month, season, and year.

RADIATION – 1. The process by which electromagnetic radiation is propagated through free space by virtue of joint undulatory variations in the electric and magnetic fields in space. This concept is to be distinguished from conduction and convection.

2. Same as electromagnetic radiation.

RADIATIONAL COOLING – In meteorology, the cooling of the earth's surface and adjacent air, accomplished (mainly at night) whenever the earth's surface suffers a net loss of heat due to terrestrial radiation.

RADIATION FOG – A major type of fog, produced over a land area when radiational cooling reduces the air temperature to or below its dew point. Thus, a strict radiation for is a nighttime occurrence, although it may begin to form by evening twilight and often does not dissipate until after sunrise.

Factors favoring the formation of radiation fog are (a) a shallow surface layer of relatively moist air beneath a dry layer and clear skies, and (b) light surface winds.

RADIOACTIVE FALLOUT – The eventual descent to the earth's surface of radioactive matter placed in the atmosphere by an atomic or thermonuclear explosion.

RADIOMETRY – The science of measurement of radiant energy, especially of radiant energy in that portion of the total electromagnetic spectrum lying in and adjacent to the visible region.

RADIOSONDE – A balloon-borne instrument for the simultaneous measurement and transmission of meteorological data. The instrument consists of transducers for the measurement of pressure, temperature, and humidity; a modulator for the conversion of the output of the transducers to a quantity which controls a property of the radio frequency signal; a selector switch which determines the sequence in which the parameters are to be transmitted; and a transmitter which generators the radio-frequency carrier.

RELATIVE HUMIDITY – (Popularly called humidity.) The (dimensionless) ratio of the actual vapor pressure of the air to the saturation vapor pressure. The corresponding ratios of specific humidity or of mixing ratio give approximations of sufficient accuracy for many purposes in meteorology. The relative humidity is usually expressed in per cent, and can be computed from psychrometric data.

RIDGE – (Sometimes called wedge.) In meteorology, an elongated area of relatively high atmospheric pressure, almost always associated with and most clearly identified as an area of maximum anticyclonic curvature of wind flow. The locus of this maximum curvature is called the ridge line.

SALT HAZE – A haze created by the presence of finely divided particles of sea salt in the air, usually derived from the evaporation of sea spray.

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. In meteorology, the concept of saturation is applied, almost exclusively, to water vapor as a constituent of the atmosphere.

SCATTERING – (Also called scatter.) The process by which small particles suspended in a medium of a different index of refraction diffuse a portion of the incident radiation in all directions. In scattering no energy transformation results, only a change in the spatial distribution of the radiation. Along with absorption, scattering is a major cause of the attenuation of radiation by the atmosphere.

SCATTERING COEFFICIENT – (Also called total scattering coefficient.) A measure of the attenuation due to scattering of radiation as it traverses a medium containing scattering particles.

SCAVENGING – 1. Same as washout.

2. Chemically, the addition of a chemical to a mixture in order to remove an unwanted constituent or convert it to an acceptable form.

SEA BREEZE – A coastal local wind that blows from sea to land, caused by the temperature difference when the sea surface is colder than the adjacent land. Therefore, it usually blows on relatively calm, sunny, summer davs; and alternates with the oppositely directed, usually weaker, nighttime land breeze. As the sea breeze regime progresses, the wind develops a component parallel to the coast, owing to the coriolis deflection.

SECONDARY POLLUTANT – An air pollutant that has undergone a chemical change since have been first emitted into the atmosphere; or a pollutant created by reactions involving primary pollutants.

SINK – See source.

SMAZE – (Rare.) A combination of smoke and haze; or, a very light smoke condition that resembles haze.

SMOG – As originally coined in 1905 by Des Voeux: a natural fog contaminated by industrial pollutants, a misture of smoke and fog. Today, it is the common term applied to problematical, largely urban, air pollution, with or without the "natural" fog; however, some visible manisfestation is almost always implied.

Smogs are consituted in great variety, but a major dichotomy exists between the "photochemical smogs" of nitrogen oxides and hydrocarbons emitted mainly by automobile engines and, on the other hand, the sulfur-laden smogs produced by the large-scale combustion of fuel oil and coal. Both types contain carbon monoxide, carbon dioxide, and a variety of particulates.

SMOG HORIZON – See dust horizon.

SMOKE – Foreign particulate matter in the atmosphere resulting from combustion process; a type of lithometeor.

When smoke is present, the disk of the sun at sunrise and sunset appears very red, and during the daytime has a reddish tinge. Smoke that has come a great distance from its source, such as from forest fires, usually has a light grayish or bluish color and is evenly distributed in the upper air.

SMOKE HORIZON – See dust horizon.

SOLAR RADIATION – The total electromagnetic radiation emitted by the sun.

To a first approximation, the sun radiates as a black body at a temperature of about 5700°K; hence about 99.9 per cent of its energy output falls within the wavelength interval from 0.15 microns to 4.0 microns, with peak intensity near 0.47 microns. About one-half of the total energy in the solar beam is contained within the visible spectrum from 0.4 to 0.7 microns, and most of the other half lies in the near infrared, a small additional portion lying in the ultraviolet.

SOOT – Fine particles of carbon produced by the incomplete combustion of carbonaceous fuels.

SOUNDING – In meteorology, same as upper-air observation. However, a common connotation is that of a single complete radiosonde observation.

SOURCE – A point, line, area, or volume at which mass or energy is added to a system, either instantaneously or continuously. Conversely, at a "sink," mass or energy is removed.

Examples of sources in the context of air pollution are as follows: a smokestack is a "point source"; a freeway or aircraft trajectory is a "line source"; an entire city is a "plane source."

SPECTROPHOTOMETER – A photometer which measures the intensity of radiation as a function of the frequency (or wavelength) of the radiation.

STABILITY – See static stability.

STABILITY INDEX – An indication of the local static stability of a layer of air.

STABLE – Pertaining to the atmosphere or an atmospheric layer in the condition of static stability, that is, an atmosphere whose temperature lapse rate and moisture distribution is such as to suppress the vertical exchange of air.

STAGNATION – With respect to air pollution, the persistence of a given volume of stable air over a region, permitting an abnormal buildup of pollutants from sources within the region.

STATIC STABILITY – (Also called hydrostatic stability, vertical stability, convective or convectional stability.) The state of the atmosphere when it is stable relative to vertical displacements. Such an atmosphere tends to remain stratified, in that any air that is displaced vertically is subjected to a buoyant force that tends to restore it to its original level.

Static stability is determined primarily by the temperature lapse rate; an inversion layer is an extreme example of a statically stable layer.

STRATIFIED FLUID – A fluid having density variation along the axis of gravity, usually implying upward decrease of density, i.e., a stratification characterized by static stability.

STREAMLINE – In hydrodynamics, a line whose tangent at any point in a moving fluid is parallel to the instantaneous velocity (direction of flow) of the fluid at that point (compare trajectory).

A two-dimensional wind-vector field may be completely specified by streamlines (showing direction) and isotachs (showing speed).

SUB-INVERSION LAYER – Any layer of the atmosphere lying beneath a temperature inversion, usually referring to the layer from the ground upward to the base of a low-level inversion.

SUBLIMATION – The transition of a substance from the solid phase directly to the vapor phase, or vice versa, without passing through an intermediate liquid phase

In physical and chemical literature, it is customary to regard as sublimation only the transition from solid to vapor, but meteorologists do not make this distinction.

SUBSIDENCE – A descending motion of air in the atmosphere, usually with the implication that the condition extends over a rather broad area.

SUBSIDENCE INVERSION – A temperature inversion produced by the adiabatic warming of a layer of subsiding air. This inversion is enchanced by vertical mixing in the air layer below the inversion.

SULFURIC ACID – (Chemical formula: H_2SO_4.) A strongly corrosive, dense oily liquid. Some sulfuric acid is emitted directly into the atmosphere by burning of sulfur-containing fuels, but it may also form by the reaction of sulfur oxides with atmospheric water.

SULFUR DIOXIDE – (Chemical formula: SO_2) A colorless, extremely irritating gas or liquid; forms sulfurous acid (H_2SO_3) in combination with water. It enters the atmosphere as a pollutant mainly as a result of burning high-sulfur-content fuel oils and coal.

Irradiated SO_2 is a very effective producer of aerosols, a quality which is greatly enhanced by the presence of atmospheric water vapor.

SUNSHINE – Direct radiation from the sun, as opposed to the shading of a location by clouds or by other obstructions.

Because of variations in atmospheric turbidity (alone and in conjunction with the optical air mass), and because of the variable optical thickness of clouds, the distinction between sunshine and lack of sunshine is an arbitrary one that is largely dependent upon the type of sunshine recorder in use or upon the quality of subjective estimates.

SUPERIOR AIR – An exceptionally dry mass of air formed by subsidence and usually found aloft but occasionally reaching the earth's surface during extreme subsidence processes.

It is often found above tropical maritime air, bounded by the trade-wind inversion.

SUPERSATURATION – 1. In meteorology, the condition existing in a given portion of the atmosphere (or other space) when the relative humidity is greater than 100 per cent, that is, when it contains more water vapor than is needed to produce saturation with respect to a plane surface of pure water or pure ice.

2. In physical chemistry, the condition existing in a solution when it contains more solute than is needed to cause saturation. Thermodynamically, this type of supersaturation is closely allied to supersaturation of a vapor since the solute cannot crystallize out in solutions free from impurities or seed crystals of the solute.

SURFACE BOUNDARY LAYER – (Also called surface layer, friction layer, atmospheric boundary layer, ground layer.) That thin layer of air adjacent to earth's surface, extending up to the so-called anemometer level (the base of the Ekman layer). Within this layer the wind distribution is determined largely by the vertical temperature gradient and the nature and contours of the underlying surface; and shearing stresses are approximately constant.

SURFACE INVERSION – (Or ground inversion.) A temperature inversion based at the earth's surface; that is, an increase of temperature with height beginning at the ground level.

This condition is due primarily to greater radiative loss of heat at and near the surface than at levels above. Thus, surface inversions are common over land prior to sunrise and in winter over high-latitude continental interiors.

SUSPENSION – In physical chemistry, a system composed of one substance (suspended phase, suspensoid) dispersed throughout another substance (suspending phase) in a moderately finely divided state, but not so finely divided as to acquire the stability of a colloidal system. Given sufficient time, a suspension will, by definition, separate itself by gravitational action into two visibly distinct portions, whereas a colloidal system, by definition, is stable.

Dust in the atmosphere is an example of a suspension of a solid in a gas.

SYNOPTIC – In general, pertaining to or affording an overall view.

In meteorology, this term has become somewhat specialized in referring to the use of meteorological data obtained simultaneously over a wide area for the purpose of presenting a comprehensive and nearly instantaneous picture of the state of the atmosphere. Thus, to a meteorologist, "synoptic," takes on the additional connotation of simultaneity.

TELEPHOTOMETER – A photometer that measures the received intensity of a distant light source. When specifically used to measure the transmissivity of the intervening atmosphere (or other medium), it is usually termed a transmissometer.

TEMPERATURE INVERSION – A layer in which temperature increases with altitude.

The principal characteristic of an inversion layer is its marked static stability, so that very little turbulent exchange can occur within it. Strong wind shears often occur across inversion layers, and abrupt changes in concentrations of atmospheric particulates and atmospheric water vapor may be encountered on ascending through the inversion.

When, in meteorological literature and discussion, an "inversion" is mentioned, a temperature inversion is usually meant.

TEMPERATURE LAPSE RATE – The rate at which air temperature decreases with height in the atmosphere.

TERMINAL FALL VELOCITY – (Or terminal velocity.) The particular falling speed, for any given object moving through a fluid medium of specified physical properties, at which the drag forces and buoyant forces exerted by the fluid on the object just equal the gravitational force acting on the object; after which it falls at constant speed, unless it moves into air layers of different physical properties. In the atmosphere, the latter effect is so gradual that objects such as raindrops, which attain terminal velocity at great heights above the surface, may be regarded as continuously adjusting their speeds to remain at all times essentially in the terminal fall condition.

THERMAL ISLAND – (Also called heat island.) An area, generally around the center of urban buildup, where the average temperature is higher than that of the surroundings.

THERMAL POLLUTION – The emission of high-temperature waste products into the environment.

To date, this is an important problem only in some contexts of water pollution where very large quantities of industrial coolant are injected into streams, estuaries and coastal waters.

THERMAL RADIATION – The electromagnetic radiation emitted by any substance as the result of the thermal excitation of its molecules.

TRACER – An easily detectable substance injected into the atmosphere for the purpose of subsequent measurement and reconstruction of its history (trajectory, diffusion,. etc.)

TRAJECTORY – (or path.) A curve in space tracing the points successively occupied by a particle in motion. At any given instant the velocity vector of the particle is tangent to the trajectory. In steady-state flow, the trajectories and streamlines of the fluid parcels are identical.

TRANSMISSIVITY – (Also called transmittance, transmittancy.) A measure of the amount of radiation propagated through a given medium; defined as the ratio of transmitted radiation to the total radiation incident upon the medium.

TRANSMISSOMETER – (Or telephotometer; also called transmittance meter, hazemeter.) An instrument for measuring the extinction coefficient of the atmosphere and for the determination of visual range.

TRANSPORT – 1. Same as flux.

2. The process by which a substance or quantity is carried past a fixed point, or across a fixed plane. In meteorology and oceanography, such quantities are: heat, momentum, mass, dissolved impurities, suspended particles, etc.

TROUGH – In meteorology, an elongated area of relatively low atmospheric pressure; the opposite of a ridge. The axis of a trough is the trough line.

TURBIDITY – In meteorology, any condition of the atmosphere which reduces its transparency to radiation, especially to visible radiation.

Ordinarily, this is applied to a cloud-free portion of the atmosphere that owes its turbidity to air molecules and suspensoids such as smoke, dust, and haze, and to scintillation effects.

TURBULENCE – 1. 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. The situation is, in fact, analogous to that accepted unreservedly in the field of molecular physics...." (Sutton, O. G., Atmospheric Turbulence, 1955, p. 9.) 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 the molecular processes of diffusion and conduction in a non-turbulent or laminar flow.

The satisfactory treatment of this phenomenon in the atmosphere is perhaps the outstanding unsolved problem of theoretical meteorology.

> "The wind bloweth where it listeth, and thou hearest the sound thereof, but canst not tell whence it cometh, and whither it goeth:"...
>
> John 3:8

TURBULENT DIFFUSION – (Or eddy diffusion.) The diffusion of a conservative property by eddies in a turbulent flow.

ULTRAVIOLET RADIATION – (Abbreviated UV.) Electromagnetic radiation of shorter wavelength than visible radiation but longer than x-rays; roughly, radiation in the wavelength interval from 10 to 4000 angstroms. (continued)

Such radiation has marked actinic and bacteriacidal action, and produces fluorescence in a number of substances. Ultraviolet radiation from the sun is responsible for many complex photochemical reactions characteristic of the upper atmosphere; e.g., the formation of the ozone layer through ultraviolet dissociation of oxygen molecules followed by recombination to form ozone. This portion of the solar spectrum accounts, however, for only about 4 or 5 per cent of the total energy transmitted in the solar beam; and almost all of this small portion is absorbed or reflected by the upper atmosphere, chiefly by oxygen molecules.

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 liquefied if sufficient pressure were applied to it.

If any vapor is cooled sufficiently, say at constant pressure, it ultimately reaches a state of saturation such that further removal of heat is accompanied by condensation to the liquid phase. Except for states quite close to that of saturation, vapors exhibit the general properties of all gases. Quantitatively, however, vapors exhibit measurable departures from perfect-gas laws even in states well removed from that of saturation.

VAPOR PRESSURE – (Also called 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 (i.e., its partial pressure).

In meteorology, vapor pressure is used almost exclusively to denote the the partial pressure of water vapor in the atmosphere. Care must be exercised in interpreting the term's meaning as used in other branches of science.

VAPOR TRAIL – Same as condensation trail.

VENTILATION – With respect to air pollution, any process that serves to dilute pollutants through the atmosphere by thorough mixing or to move polluted air out of areas of potentially high concentration.

VERTICAL STABILITY – Same as static stability.

VISIBILITY – 1. In United States weather observing practice, the greatest distance in a given direction at which it is just possible to see and identify with the unaided eye (a) in the daytime, a prominent dark object against the sky at the horizon, and (b) at night, a known, preferably unfocused, moderately intense light source. After visibilities have been determined around the entire horizon circle, they are resolved into a single value of prevailing visibility for reporting purposes.

VISIBILITY METER – The general term for instruments used to make direct measurements of visual range in the atmosphere or of the physical characteristic of the atmosphere which determine the visual range. Visibility meters may be classified according to the quantities that they measure. Telephotometers and transmissometers measure the transmissivity or, alternatively the extinction coefficient of the atmosphere. Nephelometers measure the scattering function of the atmospheric suspensoids. A third category of visibility meters makes use of an artificial "haze" of variable density which is used to obscure a marker at a fixed distance from the meter.

VISIBLE RADIATION – Electromagnetic radiation lying within the wavelength interval to which the human eye is sensitive, the spectral interval from approximately 0.4 to 0.7 microns (4000 to 7000 angstroms). This portion of the electromagnetic spectrum is bounded on the short-wavelength end by ultraviolet radiation, and on the long-wavelength end by infrared radiation.

VISUAL RANGE – (Or daytime visual range.) The distance, under daylight conditions, at which the apparent contrast between a specified type of target and its background becomes just equal to the threshold contrast of an observer; to be distinguished from the night visual range. The visual range is a function of the atmospheric extinction coefficient, the albedo and visual angle of the target, and the observer's threshold contrast at the moment of observation. Only in the so-called meteorological range does one have a visibility figure dependent only upon the extinction coefficient.

WASHOUT – The sweeping out of airborne particulates by rain or snow.

WATER VAPOR – (Also called aqueous vapor, moisture.) Water substance in vapor form; one of the most important of all constituents of the atmosphere. Its amount varies widely in space and time due to the great variety of both "sources" of evaporation and "sinks" of condensation that provide active motivation to the hydrologic cycle. Approximately half of all of the atmospheric water vapor is found below 2 km altitude, and only a minute fraction of the total occurs above the tropopause. Water vapor is important not only as the raw material for cloud and rain, but also as a vehicle for the transport of energy (latent heat) and as a regulator of planetary temperatures via the greenhouse effect. The amount of water vapor present in a given air sample may be measured in a number of different ways, involving, such concepts as the absolute humidity, mixing ratio, dew point, relative humidity, specific humidity, and vapor pressure.

WEATHERING – The mechanical, chemical, or biological action of the atmosphere, hydrometeors, and suspended impurities on the form, color, or constitution of exposed material; to be distinguished from erosion. (continued)

Mechanical weathering results from the disintegrating action of high temperature, large changes of temperature, frost, or the impact of wind-borne sand or water (e.g. frost action, corrosion, etc.). Chemical weathering is due to the chemical action of atmospheric constituents, especially acid impurities, in a moist atmosphere or in rain water (e.g. corrosion, oxidation, etc.). Biological agencies are mainly fungi which attack organic material (e.g. rotting, mildew, etc.).

WIND – Air in motion relative to the surface of the earth. Since vertical components of atmospheric motion are relatively small especially near the surface of the earth, meteorologists use the term to denote almost exclusively the horizontal component. Vertical winds are always identified as such.

WIND VANE – An instrument used to indicate wind direction.

SUGGESTED READING

P. L. Magill, F. R. Holden, and C. Ackley, eds., Air Pollution Handbook, New York: McGraw-Hill Book Co. (1956).

A. C. Stern, ed., Air Pollution, Vols. I and II. New York: Academic Press 1962), 2nd revised edition (1968).

C. E. Junge, Air Chemistry and Radioactivity. New York: Academic Press (1963).

W. L. Faith, Air Pollution Control. New York: John Wiley & Sons (1959).

D. E. Carr, The Breath of Life, W. W. Norton & Company (1965).

L. J. Battan, The Unclean Sky. New York: Anchor Books, Doubleday & Co., Inc. (1966).

Restoring the Quality of Our Environment, Report of the Environmental Pollution Panel, President's Advisory Committee, The White House, Washington, D. C. (Nov. 1965).

Proceedings of the Third National Conference on Air Pollution, Public Health Service Pub. No. 1649. Washington, D. C., Government Printing Office (Dec. (1966).

PUBLICATIONS OF THE AMERICAN METEOROLOGICAL SOCIETY

Bulletin of the American Meteorological Society
Journal of the Atmospheric Sciences
Journal of Applied Meteorology
Weatherwise
Meteorological and Geoastrophysical Abstracts
Meteorological Monographs
Historical Monographs

About the AMERICAN METEOROLOGICAL SOCIETY...

The American Meteorological Society, serving meteorology, the science of the atmosphere, was founded in 1919 for the development and dissemination of knowledge of meteorology in all its phases and applications and the advancement of its professional ideals.

With membership at various professional and sub professional levels, the Society provides representation and communication media to all individuals and groups concerned, directly or indirectly, with meteorology.

Activities

MEMBERSHIP

- Corporation
- Fellow
- Professional
- Student
- Associate
- Honorary

SCIENTIFIC DEVELOPMENT

- Publications
- International Cooperation
- Meetings and Conferences
- Local Chapters
- Abstracting Service
- Translation Service
- Statements to the Public
- Scientific Committees

PROFESSIONAL DEVELOPMENT

- Employment Service
- Professional Directory
- National Register
- Certified Consulting Meteorologists
- Seal of Approval for Television and Radio

EDUCATIONAL DEVELOPMENT

- Visiting Scientist Program — Universities
- Career Guidance Literature
- Popular Monographs
- Films
- Undergraduate Awards and Scholarship

SCIENTIFIC RECOGNITION

- Awards
- Medals
- Citations