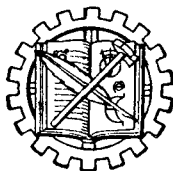


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PREFACE

The publication of a new encyclopedia of chemical terms may well merit, or even require, a few words of explanation. Many such works have been issued in the past to summarize the salient information needed by the readers of their time. This new volume has been prepared with the objective of meeting, with equal effectiveness, the needs of all who are concerned with chemistry today—chemists and non-chemists, teachers and students, those who are interested in pure or applied chemistry, in chemical research, engineering or technology.

In keeping with the present trend, this book places equal emphasis upon the facts of chemistry and the principles which have been developed to explain and correlate them. The organic substances are discussed in comprehensive entries for each type of compound. In the entries for the individual elements, their inorganic and representative organometallic compounds have generally been discussed by periodic groups, and in accordance with present-day concepts of molecular structure and reaction mechanism. Furthermore, those basic concepts are themselves the subject of entries which explain their background and meaning. Such entries deal, for example, with valence bond theory, molecular orbital theory, crystal (and ligand) field theory, conformation and configuration, pi-bonding and other fundamental topics.

In addition to these entries on theoretical topics, there are, of course, many entries on the more descriptive topics. These include the articles on the tests and testing methods, processes and operations, and the chemical reactions, including those known best by the names of the chemists to whom they have been accredited. The various standards for the nomenclature of compounds which have been issued by international and national organizations are given in full, including organic nomenclature, inorganic nomenclature and systems of nomenclature for alkaloids, carbo-

hydrates, steroids, vitamins, boron compounds, and other adopted or recommended systems.

The entries on the terms in physical chemistry provide explanations as well as definitions. Rather than being limited to a uniform size, they have been made long enough to clarify the topic under discussion. Thus, the major entries in heat and thermodynamics are relatively long, as are those in spectroscopy, nuclear structure, electron properties and other subjects which play so important a part in present-day chemical science. Moreover, the basic physical concepts and mathematical relationships that underlie so much of physical and structural chemistry—terms which are used so frequently in discussing the purely chemical topics—have also been covered by the necessary entries.

To make the information in this book readily available, a standard system of referencing has been followed. The key words occurring in an entry which are discussed elsewhere in the book are printed in boldface type. These references make available the necessary background and related information.

The last part of this book consists of four multilingual indices—French-English, German-English, Russian-English and Spanish-English. They have been devised for use in reading the foreign literature, and in finding the corresponding English entry in the main part of this book.

It is the hope of those who have worked on this book that it may prove truly useful to the professional chemists, as well as to all those interested in chemical science. Whether this Encyclopedia will continue to fulfill this hope depends in a large part on the willingness of our readers to criticize our work and to suggest additional improvements. With such aid, future issues of this Encyclopedia may achieve the highest standard of usefulness.

THE EDITORS

CONTRIBUTING EDITORS

- | | |
|--|---|
| A. F. CLIFFORD
<i>Purdue University</i> | S. Z. LEWIN
<i>New York University</i> |
| N. CORNGOLD
<i>Brookhaven National Laboratory</i>
<i>Upton, Long Island, New York</i> | J. C. MAY
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| L. HERZBERG
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<i>Ottawa, Ontario, Canada</i> | G. M. MURPHY
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<i>Bryn Mawr College</i> | C. H. PAGE
<i>National Bureau of Standards</i>
<i>Washington, D. C.</i> |
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<i>Euratom-CEA</i>
<i>Fontenay aux Roses, Seine, France</i> |
| | A. D. YOFFE
<i>Cambridge University</i> |

TRANSLATORS

French

R. A. BINAGHI
N.Y.U. Medical Center

German

G. KRUSE
Scripta Technica, Inc.

Russian

J. BLANSHEI
Princeton University

Spanish

JAIME BLUM
Columbia University

A

A. Former symbol for the element **argon** (A), which is now Ar. Symbol for the **Angstrom unit** (A). Symbol for **van der Waals constant** (a). Symbol for **acceleration** (A or a). Symbol for **activity** (a). Symbol for **specific rotation** [a]. Symbol for **accommodation coefficient** (a). Symbol for **refracting angle of a prism** (A). Symbol for **amplitude** (A). Symbol for **area** (A). Symbol for **atomic weight** (A). Symbol for **Helmholtz function**, or maximum isothermal work function: per atom or molecule, a or a_m , per mole, a , A , or A_M , per unit mass, a , total value A . A factor in **Richardson equation** A . Symbol for **width of slit** (transparent portion) a . See also **alpha**.

ABBE THEORY. A relationship derived for the limiting width of an object visible under the microscope, which is expressed as directly proportional to the wavelength of the light, and inversely proportional to the **aperture**.

ABDERHALDEN REACTION. A serum test used in medical diagnosis, especially in pregnancy.

ABDERHALDEN-SCHMIDT REAGENT. A solution of 0.1 g ninhydrin in 300 ml water, used in testing for adrenalin, for proteins and for hydrolysis products derived from proteins. A blue color, obtained on warming a solution of the substance with a small quantity of the reagent, is given by these compounds.

ABEGG RULE. If the maximum positive **valence** exhibited by an element be numerically added to its maximum negative valence, there appears to be a tendency for the sum to equal 8. This tendency is exhibited especially by the elements of the 4th, 5th, 6th, and 7th groups.

ABEL-PENSKY APPARATUS. A closed apparatus used in determining the flash point of liquids. (See also **Pensky-Martens Apparatus**.)

ABEL REAGENT. A solution of chromic acid (10% CrO_3) used as an etching reagent in metallography.

ABERRATION, OPTICAL. The failure of an optical system to form an image of a point

as a point, of a straight line as a straight line, and of an angle as an equal angle. (See **spherical aberration**, **astigmatism**, **coma**, **curvature of field**, **distortion** (of the image), and **chromatic aberration**.)

ABNEY COLORIMETER. See **colorimeter**, **Abney**.

ABNEY MOUNTING. A method for mounting a **grating**, plateholder and slit on a **Rowland circle** and moving only the slit to observe different parts of the spectrum.

ABRAHAMSON REAGENT. A reagent prepared by mixing a solution of 11.1 g sodium tungstate dihydrate and 5 g sodium citrate in 700 ml water; with a solution of 13.6 g sodium hydrogen sulfate in 200 ml water. It is made up to 1 l, and is used to precipitate proteins from blood.

ABRASION. Erosion or grinding by friction, or shearing action.

ABRASIVE. A material used for wearing away a surface by friction, as in polishing. Sandpaper, steel wool, emery, and pumice are abrasives.

ABRASTOL TEST (VICARIO). Add syrupy phosphoric acid and formaldehyde to the sample to be tested. A green fluorescence develops if abrastol is present.

ABSCISSA. The horizontal **coordinate** of a point in a two-dimensional system, commonly rectangular Cartesian, and usually designated by x . Together with the **ordinate** it locates the position of the point in a plane.

ABSOLUTE. Independent or unlimited, as an absolute condition, or completely pure or unadulterated, as a perfume base or alcohol.

ABSOLUTE ACTIVITY. A quantity defined by the equation

$$\lambda = \exp\left(\frac{\mu}{kT}\right)$$

where k is the Boltzmann constant, T , the absolute temperature and μ , the **thermal potential**. In systems undergoing chemical reactions, this formula takes the following form:

$$\lambda_i = \exp\left(\frac{\mu_i}{kT}\right),$$

where λ_i is the absolute activity of component i , and μ_i is the chemical potential of component i .

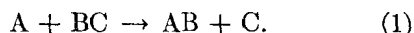
ABSOLUTE HUMIDITY. (1) (Also called vapor concentration, vapor density.) In a system of moist air, the ratio of the mass of **water vapor** present to the volume occupied by the mixture; that is, the density of the water vapor component.

Absolute humidity is usually expressed in grams of water vapor per cubic meter or, in engineering practice, in grains per cubic foot. (Cf. **mixing ratio**, **specific humidity**, **relative humidity**, **dew point**.)

(2) As occasionally used in air conditioning practice, the number of grains of water vapor per pound of moist air, which is dimensionally identical with the **specific humidity**.

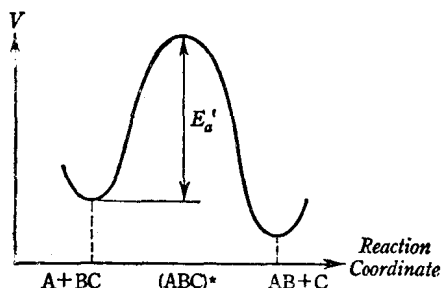
ABSOLUTE REACTION RATE THEORY. A reformulation of the **collision theory of chemical kinetics** due to Wigner, Eyring and others makes possible the expression of the rate constant in a more general form. Similar considerations may be applied to a great many other rate processes (see **Eyring theory of transport processes**). Because the purpose of this theory is to calculate the rate in terms of molecular quantities alone, it is often called the absolute reaction rate theory.

Consider the reaction



To simplify the discussion, assume that A, B and C always remain in a straight line. The course of the reaction may then be followed by noting the values of the two interatomic distances r_{AB} and r_{BC} . At the beginning of the reaction r_{AB} is large and r_{BC} is small while at the end of the reaction r_{AB} is small and r_{BC} is large.

Let us introduce the potential energy surface. The representative point of the system



Potential energy along the reaction coordinate.

moves on this surface along the so-called *reaction coordinate*. The potential energy along the reaction coordinate is represented schematically in the figure. The maximum of the curve corresponds to a situation where three atoms are very close to one another. Moreover this point is a *maximum* along the reaction coordinate but a *minimum* for the direction normal to the reaction coordinate. Indeed the most probable path is the path involving the minimum potential energy in going from the initial to the final state.

Therefore the point considered corresponds to a *saddle point* of the energy surface. It is called the **activated complex**.

One may now assume that the reaction rate is the product of the following three factors: (1) the average number of activated complexes; (2) the characteristic frequency of the activated complex (that is, the inverse of its lifetime); (3) the *transmission coefficient*, K , which is the probability that a chemical reaction takes place after the system has reached the activated state.

Moreover the number of activated complexes is calculated by the equilibrium assumption. (See **equilibrium theory in chemical kinetics**.)

Using this description of the reaction process one derives the following expression for the reaction constant

$$k = K \frac{\phi_r(T)}{\phi_A(T)\phi_{BC}(T)} \frac{kT}{h} \exp\left(-\frac{E^{\ddagger}}{kT}\right). \quad (2)$$

Here the ϕ terms are the **partition functions** $f(T, V)$, the volume factor being removed

$$f = V\phi. \quad (3)$$

ϕ_r corresponds to the activated complex, the degree of freedom associated with the reaction coordinate being removed; k is **Boltzmann's constant**, h is **Planck's constant**, E^{\ddagger} is the energy associated with the activated complex, or **activation energy** of the reaction.

This expression may also be written in the thermodynamic form

$$\begin{aligned} k &= K \frac{kT}{h} \exp\left(-\frac{\Delta G^{\ddagger}}{kT}\right) \\ &= K \frac{kT}{h} \exp\left[-(\Delta H^{\ddagger} - T\Delta S^{\ddagger})/kT\right] \end{aligned} \quad (4)$$

where ΔG^{\ddagger} is a suitable **free energy** of activation and ΔH^{\ddagger} , ΔS^{\ddagger} the corresponding **enthalpy** and **entropy** of activation.

ABSOLUTE TEMPERATURE SCALE. See **temperature scale, absolute**.

ABSOLUTE UNITS. Any set of units defined in terms of fundamental (arbitrary) units of mass, length, and time by connecting physical equations. Compare **international units**. (Cgs electrostatic, cgs electromagnetic, and MKSA units are absolute units.)

ABSOLUTE VISCOSITY. (Also called dynamic viscosity.) The property of a fluid which determines the shearing stresses which arise in it during motion. In pure shear flow, the shearing stress τ is proportional to the transverse velocity gradient du/dy ,

$$\tau = \mu \frac{du}{dy} \text{ (Newton's law of fluid friction)}$$

where μ is the absolute viscosity. In a general field of flow, u_1, u_2, u_3 , of a homogeneous, Newtonian, incompressible fluid, the shearing stresses are proportional to the respective rates of change of strain (Stokes' law). The symmetric stress tensor t_{ij} is assumed to be a linear function of the rate of strain tensor e_{ij} . Taking into account that in a fluid at rest the stress is an isotropic tensor, we put

$$t_{ij} = -p\delta_{ij} + \lambda\delta_{ij}e_{kk} + 2\mu e_{ij}$$

where δ_{ij} is the Kronecker delta. Since $t_{ij} = 0$ for $e_{ij} = 0$, we have $t_{ii} = -3p$ and $3\lambda + 2\mu = 0$. Consequently

$$t_{ij} = -p\delta_{ij} - \frac{2}{3}\mu\delta_{ij}e_{kk} + 2\mu e_{ij}$$

when p is now the hydrostatic pressure. The scalar μ is defined as the absolute viscosity. It is a function of the thermodynamic state of the fluid and is independent of the velocity field.

The ratio

$$\nu = \frac{\mu}{\rho}$$

of absolute viscosity to density is called *kinematic viscosity*.

ABSOLUTE ZERO. The temperature at which a system would undergo a reversible **isothermal** process without transfer of heat. This is the temperature at which the volume of an ideal gas would become zero. The value calculated from the limiting value of the coefficient of expansion of various real gases is -273.16°C .

ABSORBANCE. The logarithm to the base 10 of the reciprocal of the **transmittance**. Generally, pure solvent is the reference material. $A = \log_{10}(1/T)$. See **Beer's law**.

ABSORBANCY. The common logarithm of the reciprocal of the **transmittancy**.

ABSORBED DOSE, DETERMINATION OF. The International Commission on Radiological Units recommended in 1956 that absorbed dose be estimated from the **ionization** in a gas filled cavity at the place of interest in the material irradiated. The energy, E_m , in ergs absorbed per gram of material, is related to the ionization per gram of the gas, J_m , by the equation $E_m = J_m W s_m$ where W is the average energy expended by the ionizing particles per **ion pair** formed and s_m is the ratio of the mass **stopping power** of the medium to that of the cavity gas for these ionizing particles. The absorbed dose in **rads**, D , is then $D = 0.01E_m$ rad. For **x-** and **gamma-radiation** of 20 kev or greater, W can be taken as 34 ev (or 5.4×10^{-11} erg).

ABSORBED DOSE, INTEGRAL. The integration of the energy absorbed throughout a given region of interest. The unit is the **gram-rad**.

ABSORBENT. A substance, material, or solution able to imbibe, or "attract into its mass," or trap liquids or gases, commonly to remove them from a given medium or region.

ABSORBER. In general, a medium, substance or functional part that takes up matter or energy. Specifically a body of material introduced between a source of radiation and a detector to (1) determine the energy or nature of the radiation; (2) to shield the detector from the radiation; or (3) to transmit selectively one or more components of the radiation, so that the radiation undergoes a change in its energy spectrum. Such an absorber may function through a combination of processes of true **absorption**, **scattering** and **slowing-down**.

ABSORPTANCE. The ratio of the **radiant flux** absorbed in a body of material to the radiant flux incident upon it. Commonly, the material is in the form of a parallel-sided plate and the radiation in the form of a parallel beam incident normally on the surface of the plate. Properly, transmission measurements should be corrected for reflection and scattering losses to determine the absorptance. The absorptance may be measured for any radiation, for visible light (optical absorptance) or as a function of the wavelength of the radiation (spectral absorptance).

ABSORPTIOMETER. (1) A graduated tube, closed at one end, used for the analysis of gases, performed by introducing an absorbing agent and noting the decrease in volume at constant pressure of the contents of the

tube. Often incorrectly termed an eudiometer. (2) A device equipped with a simple dispersing system or with filters by which a determination may be made of the concentration of substances by their absorption of nearly monochromatic radiation at a selected wavelength. Note that this is the third meaning given under **colorimeter**.

ABSORPTION. (1) The process whereby the total number of particles emerging from a body of matter is reduced relative to the number entering, as a result of interaction of the particles with the body. (2) The process whereby the kinetic energy of a particle is reduced while traversing a body of matter. This loss of kinetic energy of corpuscular radiation is also referred to as moderation, slowing, or stopping. (3) The process whereby some or all of the energy of sound waves or **electromagnetic radiations** is transferred to the substance on which they are incident or which they traverse. (4) The process of "attraction into the mass" of one substance by another so that the absorbed substance disappears physically.

ABSORPTION APPARATUS. Certain forms of apparatus used especially in gas analysis by means of which a portion of the sample under examination is absorbed and its quantity subsequently determined.

ABSORPTION BAND. A region of the absorption spectrum in which the **absorptivity** passes through a maximum or inflection.

ABSORPTION CELL. A transparent vessel used to hold liquids for the determination of their absorption spectra.

ABSORPTION COEFFICIENT. (1) For the absorption of one substance or phase in another, as in the absorption of a gas in a liquid, the absorption coefficient is the volume of gas dissolved by a specified volume of solvent; thus a widely-used coefficient is the quantity α in the expression $\alpha = V_0/Vp$, where V_0 is the volume of gas reduced to standard conditions, V is the volume of liquid and p is the partial pressure of the gas. (2) In the case of sound, the absorption coefficient (which is also called the acoustical absorptivity) is defined as the fraction of the incident sound energy absorbed by a surface or medium, the surface being considered part of an infinite area. (3) In the most general use of the term absorption coefficient, applied to electromagnetic radiation and atomic and sub-atomic particles, it is a measure of the rate of decrease in intensity of a beam of photons or particles in its passage through a particular

substance. One complication in the statement of the absorption coefficient arises from the cause of the decrease in intensity. When light, x-rays, or other electromagnetic radiation enters a body of matter, it experiences in general two types of attenuation. Part of it is subjected to **scattering**, being reflected in all directions, while another portion is absorbed by being converted into other forms of energy. The scattered radiation may still be effective in the same ways as the original, but the absorbed portion ceases to exist as radiation or is re-emitted as secondary radiation. Strictly therefore, we have to distinguish the true absorption coefficient from the *scattering coefficient*; but for practical purposes it is sometimes convenient to add them together as the total attenuation or *extinction coefficient*.

Accurate measurements upon radiation which has traversed various thicknesses of matter has established that any infinitely-thin layer perpendicular to the direction of propagation cuts down the flux density by a fraction of its value proportional to the thickness of the layer, whence by integration (when permissible) the flux density after having penetrated the medium to a distance x is

$$I = I_0 e^{-ax};$$

in which I_0 is the flux density just after entrance into the medium (i.e., for $x = 0$). (See the **Bouguer law**.) For true absorption, the constant a is the absorption coefficient. For scattering, which obeys the same law, a is the scattering coefficient. And for the total attenuation, including both, it is the *extinction coefficient*, which is the sum of the absorption and the scattering coefficients.

The absorption coefficient may be computed for total radiation which enters the absorbing material, for the visible luminous radiation or as a function of wavelength, being in that case, the *spectral absorption coefficient*. The absorption coefficient divided by the density of the absorbing medium is called the *mass absorption coefficient*. (See **absorption coefficient, mass** and other terms following.)

ABSORPTION COEFFICIENT, ATOMIC.

The atomic absorption coefficient of an element is the fractional decrease in intensity, per number of atoms per unit area; it is equal to the linear absorption coefficient (see **absorption coefficient, linear**) divided by the number of atoms per unit volume, or to the mass absorption coefficient (see **absorption coefficient, mass**) divided by the number of atoms per unit mass. If the medium consists of only one nuclide, the atomic absorption

coefficient μ_t is equivalent to the total **cross section** for the radiation in question.

ABSORPTION COEFFICIENT, LINEAR.

The linear **absorption coefficient** μ_l is the fractional decrease in intensity per unit distance traversed, or $\mu_l = -dI/I dx$, where I is the intensity of the beam and x is the distance traversed.

ABSORPTION COEFFICIENT, MASS. The mass **absorption coefficient** μ_m is the fractional decrease in intensity per unit surface density. For a substance of density ρ , μ_m is equal to μ_l/ρ , and hence is independent of the density.

ABSORPTION CURVE. The graphical relationship between thickness of absorbing material and intensity of transmitted radiation.

ABSORPTION DISCONTINUITY. The discontinuities of the **absorption coefficient** κ_ν (in terms of frequency) or α_λ (using the wavelength notation), of a medium, correspond to spectral absorption lines and are often associated with anomalies in other frequency (wavelength) dependent properties of the medium, e.g., the refractive index.

ABSORPTION EDGE. The wavelength corresponding to an abrupt discontinuity in the intensity of an absorption spectrum, notably an x-ray absorption spectrum, which gives the appearance of a sharp edge in the photograph of such a spectrum.

ABSORPTION, EXPONENTIAL. See **absorption coefficient**.

ABSORPTION FACTOR. In any absorbing system, especially in the case of absorption of **radiation**, the ratio of the total unabsorbed radiation to the total incident radiation, or to the total radiation transmitted in the absence of the absorbing substance. Cf. **absorptivity**.

ABSORPTION INDEX. In traversing perpendicularly a thin layer of absorbing material of thickness d , the amplitude of vibration of light of wavelength λ decreases in the ratio

$$1:e^{-2\pi\kappa_\lambda^d}$$

where κ is the absorption index. In consequence, the ratio of the intensities of the emerging and incident light is given by

$$I_1/I_0 = e^{-4\pi\kappa_\lambda^d}$$

For an absorbing layer of thickness λ this ratio becomes

$$I_1/I_0 = e^{-4\pi\kappa}$$

The **absorption coefficient** " a " is given by

$$I_1/I_0 = e^{-ad}$$

hence

$$a = 4\pi\kappa/\lambda.$$

ABSORPTION LIMIT. See **absorption discontinuity**.

ABSORPTION OF GASES. The solution of gases in liquids is termed absorption. Such solutions obey the laws of **Dalton** and **Henry** unless the dissolved gas reacts with the **solvent** or forms a **constant-boiling mixture** with it.

ABSORPTION PAPER. A specially-prepared filter paper used in fat determination.

ABSORPTION, SELECTIVE. Absorption which varies in amount with wavelength.

ABSORPTION SPECTRUM. See **spectrum, absorption**.

ABSORPTION TUBE. An apparatus for the absorption of gases, totally or selectively.

ABSORPTION VALUE. See **iodine value**.

ABSORPTIVE POWER (OPTICAL). That part of the radiation of a given wavelength which is absorbed by a body. When radiation falls on a surface, a portion A_λ of it is absorbed, a portion R_λ is reflected and a portion Z_λ is transmitted, so that

$$A_\lambda + R_\lambda + Z_\lambda = 1,$$

where A_λ is the absorptive power or absorptivity, R_λ is the reflecting power or reflectivity, Z_λ is the transmitting power or transmissivity at wavelength λ . Sometimes the adjective "monochromatic" is added to the above terms to emphasize that they relate to a definite wavelength.

ABSORPTIVITY. Absorptive power, optical.

ABSORPTIVITY, MOLAR. The **absorptive power** expressed in units of liter/(mole cm); the concentration is in moles per liter and the cell length in centimeters.

ABSTRACTION. Removal of an atom of hydrogen or other element from a molecule by a **free radical** with formation of a free radical from the original molecule.

ABUNDANCE OF ELEMENTS. The percentage distribution of the **elements** in the earth or the earth's crust. Tables have been prepared showing separately this distribution of the elements in the solid portion of the earth (commonly in the crust), in the liquid portion of the earth (i.e., oceans, seas, etc.),

and in the gaseous portion of the earth (i.e., the atmosphere).

ABUNDANCE RATIO. The proportions of the various **isotopes** making up a particular specimen of an **element**.

ABVOLT. The cgs **electromagnetic unit of potential difference** and **electromotive force**. It is the potential difference that must exist between two points in order that one erg of work be done when one abcoulomb of charge is moved from one point to the other. One abvolt is 10^{-8} volt.

Ac. Symbol for the element **actinium**. The prefix *ac-* is used as an abbreviation for **alicyclic**. Abbreviation for **acetyl**, **acyl** or, less commonly, **acetate**.

A-C. **Alternating current**.

ACCELERATING CHAMBER. Any evacuated envelope in which charged particles are accelerated.

ACCELERATION. The time rate of change of **velocity**. Like velocity, acceleration is a **vector** quantity, requiring the specification of both a magnitude and a direction. The defining equation is

$$\mathbf{a} = \frac{d\mathbf{v}}{dt}$$

where \mathbf{v} is the instantaneous velocity and t the time. Acceleration may be indicative of a change in speed, of a change in the direction of a velocity of constant magnitude, or of a combination of the two. The quantity just defined is strictly speaking the *instantaneous acceleration*. (Cf. **acceleration, average**.)

ACCELERATION, ANGULAR. Angular acceleration is the time rate of change of the angular velocity, expressed by the vector derivative $d\boldsymbol{\omega}/dt$. Only in case the direction of the axis remains unchanged can the angular velocity and angular acceleration be treated as scalars. The effect of torque applied to a body free to rotate about an axis is to give it angular acceleration, and the opposition offered by the body to this process gives rise to the concept of **moment of inertia**.

ACCELERATION, AVERAGE. If the instantaneous velocity of a particle is \mathbf{v}_1 at a given instant and \mathbf{v}_2 at a time Δt later, the average acceleration during the time Δt is defined as:

$$\mathbf{a}_{av} = \frac{\mathbf{v}_2 - \mathbf{v}_1}{\Delta t}$$

ACCELERATION, CHEMICAL. The rate of change of the velocity of a chemical reaction. When the acceleration is positive the reaction is increasing in velocity; when negative, the reaction is diminishing in velocity.

ACCELERATION, CORIOLIS. See **coriolis acceleration**.

ACCELERATION OF GRAVITY. The ratio of the weight of a material particle to its mass at any specific point in an approximately uniform gravitational **field**. This is the **acceleration** with which a body would fall in the absence of all other disturbing forces, such as those due to friction.

Specifically, the acceleration with which a body falls *in vacuo* at a given point on or near a given point on the earth's surface. This acceleration, frequently denoted by g , varies by less than one percent over the entire surface of the earth. Its "average value" has been defined by the International Commission of Weights and Measures as 9.80665 M/S^2 or 32.174 ft/S^2 . Its value at the poles is 9.8321 M/S^2 and at the equator 9.7799 M/S^2 .

ACCELERATION, TANGENTIAL. The component of acceleration along the path of motion is called the tangential acceleration. Its magnitude is dv/dt , the time rate of change of the **speed** along the path.

ACCELERATOR. In general, any agent which increases the speed of a chemical **reaction**, but the term is used today in a more restricted sense. It is applied, for example, to materials used in the rubber industry to increase the speed of **vulcanization** and to improve the quality of the product; to substances used to increase the effectiveness of catalysts, which are better known as **promoters** (q.v.); and to substances used to increase the speed of a penetrant, which are better known as **introfiers** (q.v.).

A particle accelerator, an apparatus which gives charged particles high speeds and imparts large amounts of energy. See **betatron**, **cyclotron**, **synchrotron**, etc.

ACCEPTOR. A substance whose **rate of reaction** with another substance is accelerated by the occurrence of a reaction in which the second substance is involved. An electron acceptor. (See discussion of **electron donor**.)

ACCEPTOR ENERGY LEVEL. An **acceptor impurity** atom in a crystal is equivalent to an excess negative charge, since its **atomic core** is insufficiently charged to neutralize its share of the **covalent bonding** electrons. Consequently, it can attract a positive charge, such

as a **hole** in the electron distribution, forming bound states which lie just above the top of the **valence band**. The promotion of an electron to one of these levels frees a hole for conduction, as in a p-type semiconductor (see **semiconductor**, **p-type**).

ACCEPTOR IMPURITY. An **impurity**, in a **semiconductor**, which may induce hole conduction. Such an impurity is capable of accepting an electron from the **valence band**, forming an **acceptor energy level**.

ACCESSORY FACTOR. See **vitamin**.

ACCOMMODATION COEFFICIENT. A quantity defined by the equation:

$$a = \frac{T_3 - T_1}{T_2 - T_1}$$

where T_1 is the temperature of gas molecules striking a surface which is at temperature T_2 , and T_3 is the temperature of the gas molecules as they leave the surface, a is the accommodation coefficient. It is, therefore, a measure of the extent to which the gas molecules leaving the surface are in thermal equilibrium with it.

ACCOMMODATION, OCULAR. Accommodation of the eye for objects at different distances is brought about by changes in the tension of the ciliary muscles which control the shape of the crystalline lens of the eye.

ACCUMULATION COEFFICIENT. A term sometimes used specifically to denote the rate of increase in the concentration of **adsorbed** molecules upon a surface, in relation to the concentration of that molecular species in the phase in contact with the surface.

ACCUMULATOR. See **cell**, **secondary**.

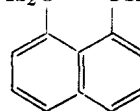
ACCURACY. The quality of correctness or freedom from error. Distinguished from precision as in the examples: (a) "... this procedure measures the precision (reproducibility) of the test, not its accuracy (closeness to the true value)." (b) A four-place table correctly computed is more accurate but less precise than a six-place table containing errors. (c) The accuracy of an instrument is a number or quantity which defines its limit of error. (See also **precision**.) The actual error in measurement can seldom be determined, but its magnitude may usually be estimated.

ACCURACY IN MEASUREMENT. The degree of correctness with which a method of measuring yields the "true" value of a measured quantity. It is usually expressed in terms of error, the units being those of the

measured quantity or the ratio (or percent) of the error to the full scale value or to the actual value.

ACE-. A word fragment derived from **acetic**, as used in acenaphthene.

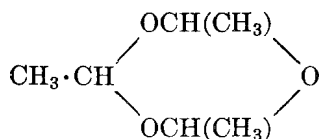
ACENAPHTHENYL. The radical $C_{12}H_9-$, derived from acenaphthene, H_2C-CH_2 .



ACET-. Prefix denoting the presence of the radical $CH_3C\equiv$.

ACETAL(S). Organic dialkyl ethers of the general formula $RCH(OR')(OR'')$ (*gem*-diethers). They are formed by the reaction of aldehydes with alcohols in the presence of small amounts of acids or certain inorganic salts. They are stable toward alkali, are volatile and insoluble in water but are hydrolyzed into aldehydes and alcohols by the action of acids. The last reaction is often used as a source of aldehydes.

ACETALDEHYDE. Acetaldehyde, CH_3CHO , the product of the controlled oxidation of ethanol, reacts (1) with ammoniacal silver nitrate ("Tollen's solution"), to form metallic silver, either as a black precipitate or as an adherent mirror film on glass, (2) with alkaline cupric solution ("Fehling's solution") to form cuprous oxide, red to yellow precipitate, (3) with rosaniline (fuchsine, magenta), which has been decolorized by sulfurous acid ("Schiff's solution"), with restoration of the pink color of rosaniline, (4) with sodium hydroxide, upon warming, with separation of a yellow to brown resin of unpleasant odor (this reaction is given by aldehydes immediately following acetaldehyde in the series, but not by formaldehyde, furfuraldehyde or benzaldehyde, (5) with anhydrous ammonia, to form aldehyde-ammonia ($CH_3 \cdot CHOH \cdot NH_2$), white solid, (6) with concentrated sulfuric acid, with evolution of heat to form paraldehyde (C_2H_4O)₃ or



colorless liquid, slightly soluble in water, (7) with acids, below $0^\circ C$., to form metaldehyde (C_2H_4O)₄ white solid, (8) with dilute hydrochloric acid or dilute sodium hydroxide, to form aldol ($CH_3 \cdot CHOH \cdot CH_2 \cdot CHO$) slowly, (9)

with phosphorus pentachloride, to form ethylidene chloride ($\text{CH}_3 \cdot \text{CHCl}_2$), colorless liquid, (10) with ethyl alcohol and dry hydrogen chloride to form acetal, 1,1-diethoxyethane ($\text{CH}_3 \cdot \text{CH}(\text{OC}_2\text{H}_5)_2$), colorless liquid, (11) with hydrocyanic acid to form acetaldehyde cyanohydrin ($\text{CH}_3 \cdot \text{CHOH} \cdot \text{CN}$), readily converted into alpha-hydroxypropionic (lactic) acid ($\text{CH}_3 \cdot \text{CHOH} \cdot \text{COOH}$), (12) with sodium hydrogen sulfite to form acetaldehyde sodium bisulfite ($\text{CH}_3 \cdot \text{CHOH} \cdot \text{SO}_3\text{Na}$), white solid, from which acetaldehyde is readily recoverable by treatment with sodium carbonate solution, (13) with hydroxylamine hydrochloride forms acetaldoxime ($\text{CH}_3 \cdot \text{CH} \cdot \text{NOH}$), white solid, (14) with phenylhydrazine, to form acetaldehyde phenylhydrazone ($\text{CH}_3 \cdot \text{CH} \cdot \text{N} \cdot \text{NH} \cdot \text{C}_6\text{H}_5$), white solid, (15) with magnesium methyl iodide in anhydrous ether ("Grignard's solution") to yield, after reaction with water, isopropyl alcohol ($(\text{CH}_3)_2\text{CHOH}$), a secondary alcohol, (16) with semicarbazide to form acetaldehyde semicarbazone ($\text{CH}_3 \cdot \text{CH} \cdot \text{N} \cdot \text{NH} \cdot \text{CO} \cdot \text{NH}_2$), white solid, (17) with chlorine to form trichloroacetaldehyde ("chloral") ($\text{CCl}_3 \cdot \text{CHO}$), (18) with hydrogen sulfide to form thioacetaldehyde ($\text{CH}_3 \cdot \text{CHS}$ or $(\text{CH}_3 \cdot \text{CHS})_3$).

ACETAL TEST (GRODZKI). Acetal is detected, in its acidified (with hydrochloric acid) aqueous solution, by a precipitate of iodoform formed on addition of sodium hydroxide solution and iodine solution.

ACETAMIDO. The radical CH_3CONH —.

ACETANILIDE. The compound $\text{C}_6\text{H}_5\text{NH}_2 \cdot \text{COCH}_3$, usually prepared by reaction of aniline and acetic acid.

ACETANILIDE TEST (BARRAL). Phosphomolybdic acid gives a light yellow precipitate with acetanilid which, unlike that given by acetophenetidin, dissolves on warming.

ACETANILIDE TEST (VITALI). A trace of acetanilid treated with a few drops of chlorinated lime solution and a crystal of phenol, produces a blue color. Acetanilid added to a solution of potassium chlorate in sulfuric acid produces a red mixture, which changes to yellow when diluted with water and blood-red when heated. On adding a trace of acetanilid to a solution of potassium nitrite in hydrochloric acid, a yellow color is produced which on heating changes to green and finally to blue.

ACETATE. An ester or salt of acetic acid containing the radical CH_3COO —.

ACETATE PROCESS. A process for the preparation of a synthetic fiber from cotton linters, wood pulp, and other sources of cellulose. The material is acetylated, dissolved in acetone, and forced through spinnerets into a coagulating solution.

ACETENYL. See ethynyl.

ACETIC. Related to acetic acid, CH_3COOH .

ACETIC ACID AND ACETATES. Acetic acid ($\text{H} \cdot \text{C}_2\text{H}_3\text{O}_2$ or $\text{CH}_3 \cdot \text{COOH}$) is a colorless liquid, melting point 16.6°C , boiling point 118°C , miscible with water, alcohol, or ether in all proportions. Acetic acid solution reacts with alkalis and metals to form acetates, e.g., sodium acetate, calcium acetate; similarly, with some oxides, e.g., lead acetate; with carbonates, e.g., sodium acetate, calcium acetate, magnesium acetate; with some sulfides, e.g., zinc acetate, manganese acetate. Ferric acetate solution, upon boiling, yields red precipitate of basic ferric acetate. Acetic acid solution attacks many metals, liberating hydrogen and forming acetate, e.g., magnesium, zinc, iron. Acetic acid is an important organic substance, with alcohols forming esters (acetates); with phosphorus trichloride forming acetyl chloride ($\text{CH}_3 \cdot \text{CO} \cdot \text{Cl}$), which is an important reagent for transfer of the acetyl (CH_3CO —) group; on dehydration forming acetic anhydride, also an acetylating reagent; forming acetone and calcium carbonate when passed over lime and a catalyzer (barium carbonate) or when calcium acetate is heated; forming methane (and sodium carbonate) when sodium acetate is heated with sodium hydroxide; forming ethane and CO_2 upon electrolysis of sodium acetate (Kolbe synthesis); forming cacodyl oxide, $[(\text{CH}_3)_2\text{As}]_2\text{O}$ upon heating a mixture of potassium acetate and As_2O_3 ; forming mono-, di-, trichloroacetic (or bromoacetic) acids by reaction with chlorine (or bromine) from which hydroxy- and amino-, aldehydic-, and dibasic acids, respectively, may be made; forming acetamide when ammonium acetate is distilled. Acetic acid dissolves sulfur and phosphorus and is an important solvent for organic substances.

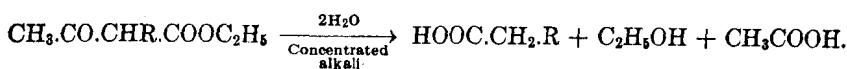
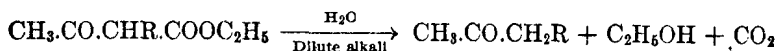
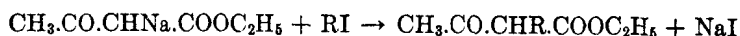
ACETIC ACID (AND FORMIC ACID) TEST (BONNES). Distil the sample with sulfuric acid. Neutralize with calcium carbonate, evaporate and distil the residue over a flame, into a little water. Then treat this solution with (1) fuchsin-bisulfate which gives a rose color if formic acid was present, (2) alkaline sodium nitrocyanoferate(III) solution, which gives a yellow color becoming red, if acetic acid was present.

ACETIC ACID TEST (FEIGL-ZAPPERT-VASQUEZ). Acetic acid is detected by evaporating 1 or 2 drops of solution with a little calcium carbonate, heating the residue in a microdistilling flask, and exposing to the vapors a paper moistened with an alkaline solution of *o*-nitrophenol. An indigo color indicates the presence of acetic acid.

ACETIFIER. Equipment used for the production of acetic acid, commonly by accelerated oxidation of fermented organic materials.

ACETIMETER. An instrument for acetimetry.

ACETIMETRY. The process of determining the acetic acid strength of a solution.



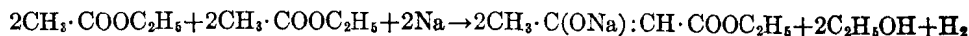
ACETIMIDO. The radical $\text{CH}_3\text{C}(\text{:NH})$ —.

ACETO-. Prefix denoting the presence of the radical CH_3CO —.

ACETOACETIC. Related to acetoacetic acid, $\text{CH}_3\cdot\text{CO}\cdot\text{CH}_2\cdot\text{COOH}$.

ACETOACETIC ACID TEST (DENIGES). A solution of acetoacetic acid gives a ruby-red color with sodium nitrocyanoferate(III) solution.

ACETOACETIC ESTER CONDENSATION. A class of reactions occasioned by the dehydrating power of metallic sodium or sodium ethoxide on the ethyl esters of monobasic aliphatic acids and a few other esters. It is best known in the formation of acetoacetic ester:



The actual course of the reaction is complex. By the action of acids the sodium may be eliminated from the first product of the reaction and the free ester obtained. This may exist in the tautomeric enol and keto forms. On boiling the ester with acids or alkalies it will split in two ways, the circumstances determining the nature of the main product. Thus, if moderately strong acid or weak al-

kali is employed, acetone is formed with very little acetic acid (ketone splitting). In the presence of strong alkalies however, very little acetone and much acetic acid result (acid splitting). Derivatives of acetoacetic ester may be decomposed in the same fashion, and this fact is responsible for the great utility of this condensation in organic synthesis. See also **acetoacetic ester synthesis**; and **Claisen condensation**.

ACETOACETIC ESTER SYNTHESIS. The substitution in the active methylene group of acetoacetic ester by reactive halides. Usually the sodium salt of the ester is used, and the condensation is followed by decarboxylation with dilute alkali, or deacylation with concentrated alkali.

ACETOLYSIS. (1) A decomposition reaction in which one of the reacting substances breaks up so as to yield an acetyl radical. Symbolically, a reaction of the type $\text{AB} + \text{CAc} = \text{AAc} + \text{CB}$, in which A, B, and C are various radicals, and Ac is the acetyl group, CH_3CO —. (2) **Hydrolysis** accompanied by **acetylation**, as in the treatment of cellulose with acetic acid and acetic anhydride to form octa-acetyl cellobiose. (3) **Solvolysis** by acetic acid.

ACETOMETER. Apparatus used in acetimetry.

ACETONE. Acetone $(\text{CH}_3)_2\text{CO}$, produced by heating calcium acetate, by oxidation of isopropyl alcohol or by fermentation of sugars, reacts (1) with phosphorus pentachloride to

yield acetone chloride $((\text{CH}_3)_2\text{CCl}_2)$, (2) with hydrogen chloride dry to yield both mesityl oxide $(\text{CH}_3\text{COCH:C}(\text{CH}_3)_2)$, liquid, and phorone $((\text{CH}_3)_2\text{C:CHCOCH:C}(\text{CH}_3)_2)$, yellow solid, (3) with concentrated sulfuric acid to yield mesitylene $(\text{C}_6\text{H}_3(\text{CH}_3)_3)$ (1,3,5), (4) with ammonia to yield acetone amines, e.g., diacetoneamine $(\text{C}_6\text{H}_{13}\text{NO})$, (5) with hydrogen cyanide to yield acetone cyanohydrin

((CH₃)₂C(OH)·CN), readily converted into an aldehydic acid ((CH₃)₂CHOH·COOH), (6) with sodium hydrogen sulfite to form acetone sodium bisulfite, (CH₃)₂C(OH)·SO₃Na, (7) with hydroxylamine to yield acetoxime, ((CH₃)₂C:NOH), solid, (8) with phenylhydrazine to yield acetonephenylhydrazone ((CH₃)₂C:NNHC₆H₅·H₂O), solid, (9) with semicarbazide, forms acetonesemicarbazone ((CH₃)₂C:NNHCONH₂) solid, (10) with methyl magnesium iodide in anhydrous ether ("Grignard's solution") to yield, after reaction with water, trimethylcarbinol ((CH₃)₃COH), a tertiary alcohol, (11) with ethyl thioalcohol and dry hydrogen chloride to yield mercaptol ((CH₃)₂C(SC₂H₅)₂), (12) with hypochlorite, hypobromite, or hypoiodite solution to yield chloroform (CHCl₃), bromoform (CHBr₃) or iodoform (CHI₃), respectively, (13) with most reducing agents to form isopropyl alcohol ((CH₃)₂CHOH), a secondary alcohol, but with sodium amalgam to form pinacol ((CH₃)₂COH·COH(CH₃)₂), (14) with sodium dichromate and sulfuric acid to form acetic acid (CH₃COOH).

ACETONE NUMBER. The weight of a substance insoluble in acetone (CH₃—CO—CH₃), useful in estimating the degree of **polymerization** and certain other properties of organic materials.

ACETONE TEST (BAEYER-DREWSON). Add some *o*-nitrobenzaldehyde to the solution to be tested and heat the mixture to boiling, then add a few drops of sodium hydroxide or potassium hydroxide solution. If acetone is present, a blue color is produced. A number of modifications of this test have been developed.

ACETONE TEST (BAEYER-VILLIGER). While chilling with ice, add 10 ml concentrated sulfuric acid to 3 ml 3% hydrogen peroxide. When 1 drop of acetone is added to 1 ml of this ice-cold reagent, an immediate crystalline precipitate of acetone peroxide is produced.

ACETONE TEST (FRITSCH). Acetone is detected by a fuchsin-red color appearing when a solution containing it is heated with an equal volume of a 5% solution of rhamnose in concentrated hydrochloric acid.

ACETONITRIOLIC. Related to acetonitriolic acid, CH₃(NO₂)C=NOH.

ACETONYL. The radical CH₃COCH₂—.

ACETONYLIDENE. The radical



ACETOPHENETIDINE TEST (ALCOCK-WILKIN). On heating 0.01 g acetophenetidine with 5 ml concentrated sulfuric acid a brown color is obtained, which turns to red upon addition of water and ammonia.

ACETOPHENETIDINE TEST (AUTENRIETH-HINSBERG). The formation of the mononitroderivative on boiling acetophenetidine crystals with 10–12% nitric acid. The nitro derivative crystallizes from water in needles having a melting point of 103°C.

ACETOPHENETIDINE TESTS (BARRAL). When acetophenetidine crystals are heated with bromine water, they are colored rose-red, the supernatant liquid becoming yellow-orange. A brown precipitate appears on cooling. Million reagent produces first a yellow and then a red color in the hot solution.

ACETOXY. The radical CH₃COO—.

ACETYL. The radical CH₃CO—.

ACETYLACETONE. The compound CH₃COCH₂COCH₃ formed by action of AlCl₃ on acetyl chloride or of Na on ethyl acetate and acetone.

ACETYLACETONE REAGENT. A solution of 0.5 g acetylacetone in 100 g alcohol or water, used as a test reagent for ferric iron. An orange-red color, best obtained in slightly acid solution, indicates the presence of ferric iron.

ACETYLAMINO. The radical CH₃CONH—.

ACETYLATION OR ACETYLIZATION. A reaction or process whereby an **acetyl** radical, CH₃CO—, is introduced into an organic compound. Reagents often used for acetylation are acetic anhydride, acetyl chloride, acetic acid, etc.

ACETYLBENZOIC. Related to acetylbenzoic acid, CH₃·CO·C₆H₄·COOH.

ACETYLENE. Acetylene, ethyne (C₂H₂ or CH≡CH), the first member of the **acetylene series**, is a colorless gas, which is almost odorless when pure (the odor usually associated with acetylene is due to impurities of H₂S and PH₃), moderately poisonous, boiling point –84°C, density, 1.17 grams per liter at 0°C and 760 mm (specific gravity 0.91, air equal to 1.00), slightly soluble in water or alcohol, very soluble in acetone (300 volumes of acetylene in 1 volume acetone at 12 atmospheres pressure), burns when ignited in air with a luminous sooty flame, forms an explosive mixture with air over a wide range (about

3% to 80% acetylene), explosive when compressed to 2 or more atmospheres, of high fuel value (1455 B.T.U. per cubic foot). Acetylene reacts (1) with chlorine, to form acetylene tetrachloride ($C_2H_2Cl_4$ or $CHCl_2 \cdot CHCl_2$) or acetylene dichloride ($C_2H_2Cl_2$ or $CHCl:CHCl$), (2) with bromine, to form acetylene tetrabromide ($C_2H_2Br_4$ or $CHBr_2 \cdot CHBr_2$) or acetylene dibromide ($C_2H_2Br_2$ or $CHBr:CHBr$), (3) with hydrogen chloride (bromide, iodide), to form vinyl chloride ($CH_2:CHCl$) (monobromide, monoiodide) and 1,1-dichloroethane, ethylidene chloride ($CH_3 \cdot CHCl_2$) (dibromide, diiodide), (4) with water in the presence of a catalyst, e.g., mercuric sulfate, to form acetaldehyde ($CH_3 \cdot CHO$), (5) with hydrogen, heated in the presence of a catalyst, e.g., finely divided nickel, to form either ethylene (C_2H_4) or ethane (C_2H_6), (6) with metals such as copper or nickel, when moist, also lead or zinc, when moist and unpurified. Tin is not attacked. Sodium yields, upon heating, the compounds C_2HNa and C_2Na_2 . (7) With ammoniacal copper(I) (or silver) salt solution to form copper(I) (or silver) acetylide (C_2Cu_2), dark red precipitate, explosive when dry, and yielding acetylene upon treatment with acid, (8) with mercury(II) chloride solution to form trichloromercuric acetaldehyde ($C(HgCl)_3 \cdot CHO$), precipitate, which with hydrochloric acid yields acetaldehyde plus mercury(II) chloride, (9) with sodium in liquid ammonia yields NaC_2H , which upon pyrolysis gives Na_2C_2 and C_2H_2 , (10) under pressure with a catalyst gives benzene (Reppe).

ACETYLENE SERIES, ALKYNES. A series of unsaturated hydrocarbons having the general formula C_nH_{2n-2} , and containing a triple bond between two carbon atoms, as $-C \equiv C-$. The name of the series is that of the simplest member, **acetylene** ($HC \equiv CH$). The members of this series are also designated by changing the "yl" termination of the alcohol radicals of like carbon content to "yne"; e.g., acetylene, C_2H_2 , is thus named ethyne; propylene, C_3H_4 , is named propyne; butylene, or crotonylene, C_4H_6 , is named butyne, etc. Their chemical properties resemble those of acetylene. (See also **hydrocarbons**.)

ACETYLENE TEST (CHAVASTELON). Acetylene combines with silver nitrate in alcoholic or aqueous solution to give the addition product acetylene-silver.

ACETYLENE TEST (DENIGÈS). An aqueous solution of 50 g ammonium chloride, 25 g cupric sulfate, 0.5 ml hydrochloric acid is diluted with water to a volume of 250 ml of

solution. In testing, 4–5 ml of this solution are boiled with 0.3 g copper turnings until colorless. The colorless liquid is diluted with 1 ml water and cooled with ice. Paper moistened with it turns red if acetylene is present.

ACETYLFORMIC. Pyruvic.

ACETYL GROUP TEST (DEL BOCA-REMAZZANO). Add to 1–2 ml of the solution to be tested, 4–5 drops 5% lanthanum nitrate solution, then enough 0.02 *N* iodine to color the solution light brown, and then ammonia by drops until a faint turbidity appears. A blue or violet color or precipitate indicates the presence of the acetyl group.

ACETYLIDE. The anion $C_2^{=}$ or HC_2^{-} , or a compound containing one of these anions.

ACETYL NUMBER OR VALUE. A constant determined in oil and fat analysis, by treating the sample with acetic anhydride, saponifying the product, and titrating the acetic acid obtained, with potassium hydroxide. Specifically, the number of milligrams of potassium hydroxide required to neutralize the acetic acid liberated by saponification from 1 g oil, fat, or wax acetylated with acetic anhydride.

ACETYLSALICYLIC. Related to acetylsalicylic acid, $CH_3COO \cdot C_6H_4COOH$.

ACHROMAT. A compound **lens** corrected so as to have the same focal length for two or more different wavelengths. Commonly the **F-** and **C-lines** are the chosen wavelengths.

ACHROMATIC. Free from **hue** (see **achromatic color**). Transmitting light without showing its constituent colors, or separating it into them. In the accepted colorimetric sense: for primary light sources, the color of the **equi-energy spectrum** ($x = y = z = \frac{1}{3}$) is taken as achromatic; for surface colors the light source serving as illuminant is taken as achromatic. On this basis, an ideal white surface is always defined as achromatic whatever may be the color of the light.

In optical design: an optical system is achromatic if it is approximately corrected for chromatic aberration in the sense that the focal length is the same for two distinct wavelengths.

ACHROMATIC COLOR. Devoid of **hue**. Such a color is often called grey.

ACHROMATIC COMBINATION. If reversed crown and flint prisms are made of such angle that the angles of **dispersion** between any two different wavelengths of light

are alike but reversed in direction, then these two colors will not be separated and all colors lying between them will be separated little if any from each other. By using three kinds of glass it is possible to bring three colors together. When the dispersions balance, the **deviations** will in general not balance. This same principle is used in making achromatic lenses. Achromatic prisms have a maximum of deviation and a minimum of dispersion while an **Amici prism** disperses the light with a minimum of deviation.

ACHROMATIC LIGHT, SPECIFIED.

Light of the same chromaticity as that having an equi-energy spectrum. The colorimetric standard illuminants *A*, *B* and *C*, the spectral energy distributions of which were specified by the C.I.E. in 1931, with various scientific applications in view:

Standard A. Incandescent electric lamp of color temperature 2854°K.

Standard B. Standard A combined with a specified liquid filter, to give a light of color temperature approximately 4800°K.

Standard C. Standard A combined with a specified liquid filter to give a light of color temperature approximately 6500°K.

Any other specified white light.

ACHROMATIC LOCUS. Chromaticities which may be acceptable reference standards under circumstances of common occurrence are represented in a **chromaticity diagram** by points in a region which may be called the "achromatic locus." Any point within the achromatic locus, chosen as a reference point, may be called an "**achromatic point**." Such points have also been called "white points." However, the term "white point" is best used to specify the intersection of the various achromatic loci obtained under different conditions of adaptation.

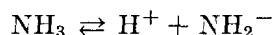
ACHROMATIC POINT. The point on a **chromaticity diagram** that represents an achromatic stimulus.

by its failure to produce a blue color with iodine. This period is used as a measure of enzymatic activity, with a standard starch solution, commonly 1%, in water.

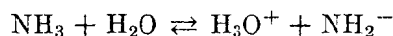
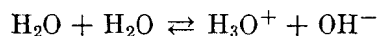
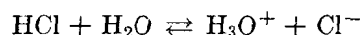
ACI- A prefix used to indicate the acid form, as aci-acetoacetic ester.

ACICULAR. Shaped like a needle.

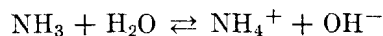
ACID(S) AND BASES. In the definitions of Lowry and Brønsted, an acid is a proton donor; a base, a proton acceptor. For example, HCl, H₂O and NH₃ are acids in the reactions:



Note that this definition is different in at least two respects that are major from the older definition of an acid as a substance dissociating to give H⁺ in water. The Lowry-Brønsted theory states that for every acid there be a "conjugate" base, and vice versa. Thus, in the examples cited above, Cl⁻, OH⁻ and NH₂⁻ are the conjugate bases of HCl, H₂O and NH₃. Furthermore, since the equations given above should more properly be written

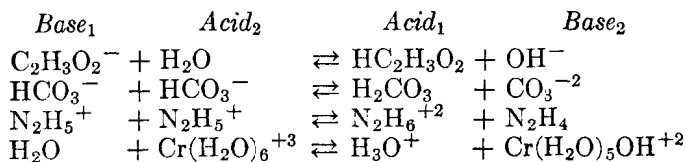


it can be seen that every acid-base reaction involving transfer of a proton will involve two conjugate acid-base pairs, e.g., in the last equation NH₃ and H₃O⁺ are the acids and NH₂⁻ and H₂O the respective conjugate bases. On the other hand, in the reaction



H₂O and NH₄⁺ are the acids and NH₃ and OH⁻ the bases.

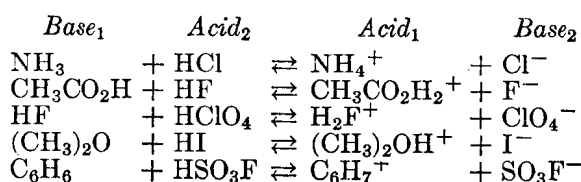
In other reactions, e.g.,



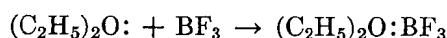
ACHROMIC. Free from color.

ACHROMIC PERIOD. The time required for complete **fermentation** of starch, as shown

the conjugate acids and bases are as indicated. The theory is not limited to the aqueous solution; for example, the following reactions can be considered in exactly the same light:



Acids may be classified according to their charge or lack of it. Thus, in the reactions cited above, there are "molecular" acids and bases, such as HCl, H₂CO₃, HClO₄, etc., and N₂H₄, (CH₃)₂O, C₆H₆, etc., and also cationic acids and bases, such as H₃O⁺, N₂H₅⁺, N₂H₆²⁺, NH₄⁺, (CH₃)₂OH⁺, etc., as well as anionic acids and bases, such as HCO₃⁻, Cl⁻, NH₂⁻, CO₃²⁻, etc. In a more general definition, Lewis calls a base any substance with a free pair of electrons which it is capable of sharing with an electron pair acceptor, which is called an acid. For example, in the reaction:



The ethyl ether molecule is called a base, the boron trifluoride, an acid. The complex is called a Lewis salt, or addition compound.

Acids are classified as monobasic, dibasic, tribasic, polybasic, etc., according to the number (one, two, three, many, etc.) of hydrogen atoms, replaceable by bases, contained in a molecule. They are further classified as (1) organic when the molecule contains carbon; (1a) carboxylic, when the proton donor is a —COOH group; (2) normal, if they are derived from phosphorus or arsenic, and contain three hydroxyl groups; (3) ortho, meta, or para, according to the location of the carboxyl group in relation to another substituent in a cyclic compound or (4) ortho, meta, or pyro, according to their composition.

ACID, ALICYCLIC. Alicyclic acid.

ACID AMIDE. Any organic compound containing the formamyl group —CONH₂. The general formula is RCONH₂, in which R is an organic radical in all cases except that of the simplest acid amide, formamide, HCONH₂.

ACID ANHYDRIDE. A compound derived from an acid by the elimination of one or more molecules of water from one or more molecules of the acid. The corresponding acids may commonly be regenerated from them by the addition of water, the process being often accompanied by an evolution of heat. In the early periods of chemical theory, the acid anhydrides were regarded as the true acids; e.g., SO₃ was considered the formula of sulfuric acid.

ACID CAPACITY. The neutralizing power of a base expressed as the number of hydroxyl ions available per molecule.

ACID(S), CARBOXYLIC. Carboxylic acids (containing carboxyl group —COOH) are of wide variety as to constitution, physical properties, methods of preparation, and uses well illustrated by reference to some of the particular acids, such as formic, acetic, stearic, oleic, benzoic. Several hydroxy acids (containing hydroxyl group, —OH, and carboxyl group, —COOH) are found in important natural materials. Such acids are tartaric, citric, malic and lactic. The ionization constants of some organic acids arranged in decreasing acidic strength are:

<i>Acid</i>	<i>Ionization Constant of Acid</i>
Trifluoroacetic....	1.8
Trichloroacetic....	6.3×10^{-1}
Dichloroacetic....	5.5×10^{-2}
Oxalic.....	3.8×10^{-2}
Malonic.....	1.6×10^{-3}
Chloroacetic.....	1.4×10^{-3}
Phthalic.....	1×10^{-3}
Tartaric.....	1.2×10^{-3}
Salicylic.....	1.1×10^{-3}
Citric.....	8.5×10^{-4}
Malic.....	4×10^{-4}
Formic.....	2.1×10^{-4}
Carbonic.....	1.5×10^{-4}
Lactic.....	1×10^{-4}
Benzoic.....	6.6×10^{-5}
Succinic.....	6.8×10^{-5}
Acetic.....	1.86×10^{-5}

The usually cited constant of 4.2×10^{-7} for carbonic acid is actually for the reaction $\text{CO}_2(\text{aq}) + \text{H}_2\text{O} \rightleftharpoons \text{H}^+ + \text{HCO}_3^-$.

ACID CHLORIDE. A compound containing the radical —COCl.

ACID DYE OR STAIN. Dyes or stains of an acidic nature, or those which require an acid to set them. This term "acid stain" is often applied to water-soluble stains.

ACID EGG. An egg-shaped vessel of fitted heavy construction with appropriate piping