ination has been made to show that it will assist greatly in unraveling the intricacies of the life history of this species from the point of view of morphological changes and their relation to temperature variation. One fact, indeed, is clearly apparent and that is this: the reproductive season begins at 15° C. or very close to it and extends only to 20° C. or closely in its neighborhood. The vegetative processes preceding anthesis and maturing of seed have also fairly narrow, but different, temperature relations, as do also those succeeding the maturing of seed. The active period of growth and reproduction seems to be normally included within an interval of 10° C., *i. e.,* from 10° C. to 20°. During the colder as well as during the warmer periods of the year, according to the particular zone, normal or invaded, *Zostera marina* L. enters into a state of quiescence, total or nearly so, but revives when the proper temperature for vegetative activity of one sort or the other comes again. The material now in my hands as the result of this cooperation seems ample for clearing up these points, and a more detailed report is in preparation.

There seems to be no dependence on a particular period of illumination in the case of the various stages of growth and reproduction —in other words, no photo-periodism in the sense of Garner and Allard. This negation stands out very clearly.

William Albert Setchell

University of California,
August 23, 1922

THE AMERICAN CHEMICAL SOCIETY

DIVISION OF PHYSICAL AND INORGANIC CHEMISTRY

S. E. Sheppard, *chairman*
Robert E. Wilson, *secretary*

Experimental studies of the radiation hypothesis: Farrington Daniels. The decomposition of nitrogen pentoxide is a favorable reaction for testing deductions from the radiation hypothesis, since it is a unimolecular, gas phase reaction which takes place at room temperature. The influence of the temperature of the walls of the containing vessel and their optical nature have been investigated. Nitrogen dioxide is an important factor in determining its velocity. The influence of various solvents has been studied. The effect of visible and infra red light has been investigated. Experiments have been carried out to determine whether the vessel walls can supply sufficient energy to cause the reaction. A search has been made for the emission of light predicted on the basis of the radiation hypothesis.

Some deductions from statistical mechanics: W. H. Rodebush. Marcelin derived an equation for the temperature coefficient of the rate of a chemical reaction which agreed with the empirical Arrhenius equation. Tolman has shown that this derivation was incorrect. A rigorous derivation of a similar equation is given. By combining this equation with the assumptions of the quantum theory a physical basis is obtained for the empirical equation of Dushman, which has been shown to have considerable validity. The equation contains a constant which is characteristic for the molecule involved so that complete validity of the Dushman equation for all different kinds of molecules could not be expected.

The "creepage" corona, a new type of silent discharge: F. O. Anderegg and H. E. Bowers. The effect of a dielectric material in an electric field has been studied by C. W. Rice *(Proc. Am. Inst. Elec. Eng.,* 1917). K. B. McEachron has found that glass rods may increase the yield of ozone *(Purdue Univ. Eng. Expt. Sta. Bull. 7).* A study of their results shows that the action of the dielectric material in the "creepage" discharge is probably partly catalytic. Experiments have been made with a variety of dielectric materials including fragments of ordinary glass, quartz glass and of earthenware, with and without beeswax impregnation; also blue and white flint and of hematite. The effect of these materials upon air and upon carbon monoxide subjected to a silent discharge has been studied under a variety of conditions. Preliminary results are given, strongly supporting the contention that catalytic action and ionic activation are superimposed in this type of discharge.

The effect of container walls on chemical reactions in the corona: F. O. Anderegg and K. B. McEachron. In the effort to trace out the causes which contribute to the common lack of reproducibility in results, in the study of chemical reactions in the corona discharge, experiments have been extended over a considerable period of time. The surface of metallic electrodes is disintegrated so that "polarization" and variation in chemical action may result. If a dielectric material is placed between the electrodes, the variable effects of internal and surface changes of the dielectric may be superimposed upon the discharge, the result being variable yields. Some of the products of the reactions in the discharge are liable to be absorbed on the walls, the amount absorbed depending upon the condition of the walls. Under certain conditions complete inhibition of the usual reactions results.

A comparative study of the absorption spectra of phenylazophenol derivatives in the visible region of the spectrum: C. S. Adams, C. E. Boord and Alpheus W. Smith. This paper is a continuation of the work previously published by Smith and Boord. The present study includes fifty-seven azoderivatives, fourteen of which have not been previously described. Alkali salt causes a displacement of the absorption band toward the red end of the spectrum, the degree of displacement varying with the solvent medium. Substitution causes displacement toward the longer wave lengths, the order for substitution in the phenyl nucleus being, in ascending scale, para meta ortho and in the phenol nucleus being ortho meta. The nitrophenyl derivatives form an exception to this rule. Weighting of the molecule by substituents follows Nietzki's rule. This is particularly true of the methyl derivatives. For the halogens Cl Br I, symmetry of the molecule seems to have a marked effect upon the absorption. Restoration of the symmetry of azobenzene by substitution of the same group in both para positions produces a marked hypso-chromic effect.

The potentials of silver: Silver halide—halide electrodes in light. Part I: S. E. Sheppard and Felix A. Elliott. Single potentials of an illuminated electrode were measured by the potentiometer compensation method, in a cell composed according to the system:

Light Ag, AgBr, x KBr aq	KBr aq sat.	Dark x KBr, AgBr:Ag or 0.1 N HBr, H_2, Pt

Hence an illuminated electrode could be coupled with an identical unilluminated electrode, or with a standard hydrogen electrode. The following factors in the preparation have to be controlled to secure reproducibility: (1) preparation of the silver surface; (2) halogenizing the electrode; (3) "ripening" the halogenized surface, and aging. With electrodes thus prepared it was found that the potentials, at an illumination of 16 C. M., were reduced as the concentration of bromide was increased, and also by increased bromination in preparing. With constant intensity of light the electrodes rapidly attained a maximum potential, which then fell off (solarization). Repeated intermittent exposure and darkening, up to 160 minutes, showed no noticeable fatigue.

Oxidation potentials of permanganates with other manganese compounds: D. J. Brown and S. B. Aronson.

Energy changes in the reduction of quinones: J. B. Conant and L. F. Fieser. The free energy, total energy and latent heat of reduction of a number of derivatives of benzoquinone, naphthoquinone and anthraquinone have been determined by measuring the oxidation-reduction potential and its temperature coefficient. The free and total energy changes are very different for different types of quinones. The latent heat of reduction is approximately the same for all the quinones measured. A method has been developed for measuring the potential in alcoholic solutions and applied to a number of substances too insoluble to be measured in aqueous solution. The potential of a given quinone is somewhat greater in alcoholic than in aqueous solution but essentially constant in 50, 75 and 95 per cent. alcohol. The potentials in two different solvents are related by an equation involving the solubilities of the oxidized and reduced compounds.

The effect of substitution on the free energy of reduction. I. Benzoquinone derivatives: Victor K. La Mer and Lillian E. Baker. The reproducibility and validity of the electro-metric titration method of measuring oxidation-reduction potentials has been established as less than ±0.2 Mv., when precautions are taken or corrections made for errors, such as removal of H^+ during the reaction, dissolved oxygen, variation in contact potential, etc. (see below). A ground glass stopper makes an excellent junction for titration work, reproducible to ±0.05 Mv. for dilute HCl against saturated KCl. Measurements on homologous quinones in acid solutions where the activity ratio quinone hydroquinone is unity show that halogen substitution raises, while alkyl substitution lowers the value of Π_o, the normal potential of reduction in the order Cl $>$ Br $>$ None $>$ Methyl $>$ dimethyl $>$ methyl, isopropyl $>$ m dimethoxy $>$ phenylene (napthoquinone).

Electrometric Oxidation—reduction titrations of pure compounds and mixtures: Lillian E. Baker and Victor K. La Mer. Calculation and experiment show that complex formation (quinhydrone) in the case of nine substituted quinone-hydroquinone systems, is not sufficient to cause any perceptible drift in the values of Π_o at least in acid solution when the latter is determined over a wide range of concentrations by the method of Clark, the concentration of the quinone substances varying between .001 to .003 M. Impurities whose potentials approximate that of the system under examination so closely as to evade detection by differential titration cause pronounced drifts, the extent of which depends upon the amount of impurity present as well as whether the impurity has the higher or lower potential.

Electrometric titrations of silicic acid: William Stericker. Silicic acid was titrated with sodium hydroxide in order to determine what salts it formed. The sol was prepared from recrystallized sodium metasilicate and was carefully purified by dialysis. The pure sol gelled readily. There was no indication of the presence of hydrogen ions or of the formation of any salts. The titration of a sodium silicate solution indicated that this may have been due to polymerization of the acid. Although the first results would indicate that sodium silicate is completely hydrolyzed in dilute solution, titrations with phenolphthalein indicator show this is not so.

Synthesis of urea with the enzyme urease: Edward Mack and Donald S. Villars. The reversible action of enzymes has been already shown in several cases, but has never been demonstrated for urease. In the present paper, it is proved beyond any doubt that the equilibrium in the reaction $(NH_2)_2CO + 2H_2O \rightleftarrows (NH_4)_2CO_3$ can be approached from the $(NH_4)_2CO_3$ side, and that the presence of urease hastens very decidedly the attainment of equilibrium. Previous failure to detect the effect was due to (1) starting with too dilute a solution of $(NH_4)_2CO_3$ and (2) not waiting a long enough time for the action, which even in the presence of urease is slow.

The action of urease in the decomposition of urea: Edward Mack and Donald S. Villars. From the work of E. A. Werner and others it seems probable that urea in its reaction with water to form ammonium carbonate takes two courses: (1) it forms ammonium cynanate as an intermediate product, which is itself changed to ammonium carbonate; and (2) it forms ammonium carbamate, which is hydrolyzed to carbonate. By a process of elimination, it has been possible, in the present paper, to show that it is the transformation of urea into ammonium carbamate which is catalyzed by the presence of the enzyme. Process (1) is not affected by urease. It proceeds at its normal rate in the presence of the enzyme.

The acceleration of the hydrolysis of mustard gas by alkaline colloidal solutions: Robert E. Wilson and Everett W. Fuller. A careful series of experiments was carried out to determine the mechanism by which alkaline colloidal solutions, such as those of sulfonated corn oil, so greatly accelerate the removal of mustard gas from contaminated clothing. It was found that these accelerating solutions do not increase the solubility of the mustard gas in the aqueous phase nor the specific rate of hydrolysis, but that in solutions of proper alkalinity they act as carriers of mustard gas. The acid produced by the hydrolysis precipitates out tiny oil globules in the aqueous film adjacent to the liquid mustard gas, and these globules rapidly dissolve unhydrolyzed mustard gas, and are then swept up into the alkaline portion of the solution and redissolved, thus permitting rapid hydrolysis of the mustard gas which they carry. Part of the acceleration is also due to the fact that these colloidal solutions keep the mustard gas spread out in a thin film on the cloth, instead of causing it to draw up into globules, as happens in the presence of solutions of higher interfacial tension.

Hydrogen ion concentration and photochemical reaction velocity: G. S. Forbes and J. C. Woodhouse. The speed of photochemical oxidation of quinine by CrO_3 in unvaried concentrations is nearly constant from $0.5NH_2SO_4$ at least to $2.5NH_2SO_4$. Below 0.5N, the order of reaction with respect to hydrogen ion N_H increases. At 0.01N (the lowest concentration practicable) it is about 1 and is rapidly increasing, presumably toward 2 the value of N_H in the dark. Previously $N_{cr\,o_3}$ had been shown, as small concentrations were reached, to increase from 0 to 1, its value in the dark. The conclusion follows that the oxidation is a reaction stage separate from a preceding stage of photochemical sensitization, and slow with respect to it only at low concentrations. Such relations are doubtless more common than suspected.

The inhibition of the photochemical decomposition of hydrogen peroxide solutions: Wm. T. Anderson, Jr., and Hugh S. Taylor. (1) The inhibitory effects of 25 typical organic compounds on the photochemical decomposition of hydrogen peroxide solutions have been studied in four definite spectral regions of the ultra-violet; (2) The inhibition by such agents has been associated with the absorptive capacity of the organic compounds for ultra-violet light. A striking correlation between these factors has been obtained in the case of benzene, several esters, acids, amides, ketones and alkaloids. The retarding action of amines and alcohols requires an explanation based on other causes than adsorption of light; (3) It has been shown that the inhibitors act more efficiently when in the peroxide solutions than when in a screening solution of similar thickness and concentration.

The reduction of copper oxide by carbon monoxide and the interaction of carbon monoxide and oxygen in the presence of copper and of copper oxide: H. A. Jones and Hugh S. Taylor. (1) The reduction of copper oxide by carbon monoxide has been shown to be an autocatalytic process, copper being the autocatalyst; the reduction occurs at a copper-copperoxide interface; (2) The retarding action of carbon dioxide and of oxygen on the primary reaction of the reduction process, *i. e.*, the formation of the copper nuclei, has been pointed out; (3) The mechanism of the carbon monoxide-oxygen catalysis over copper oxide has been shown to be alternate reduction and oxidation of the copper oxide; (4) The mechanism of the catalysis in the presence of copper has been shown to be oxidation of an adsorbed layer of carbon monoxide; (5) It has been established that oxygen is a poison in the combination of carbon monoxide and oxygen over copper.

The calculation of critical values for binary mixtures: A. G. Loomis. One of the greatest experimental difficulties in the study of the pressure-temperature composition surface for binary mixtures in the accurate determination of the critical values for the various mixtures. It is shown in this paper that by employing the equation of Dieterici, which is quite accurate in the critical region, the entire critical line may be very closely calculated; this equation leads to better results than the equation of van der Waals. The composition of the mixture with minimum critical temperature can be very accurately calculated by finding the expression which makes $\frac{ax}{bx}$ a minimum, where ax and bx are the attraction and volume constants, each expressed as a quadratic function of the composition. By employing the conditions for phase equilibrium on the critical line and introducing the equation of state in the expression for the free energy of the system, the composition of the mixture with maximum vapor pressure is accurately calculated when the values V_1 and V_2 of each phase are equated and put equal to $2b$, as demanded by the equation of Dieterici.

Compound formation and ionization in fused salt mixtures: James Kendall, E. D. Crittenden and H. K. Miller. A study of the freezing-point curves for a large number of systems of the types aluminum chloride—metal chloride, aluminum bromide—metal bromide, antimony trichloride—metal chloride has shown that here, as in other fields, the extent of compound formation between the two components is primarily dependent upon the diversity of their constituent radicals. The effect of subsidiary factors, such as valence, unsaturation, internal pressure and atomic volume, has also been investigated. Ionization is found to run parallel with compound formation in the few systems for which data are now available. The work is being continued.

A low temperature electrolyte: W. H. Rodebush and Theodore O. Yntema. Hydrogen chlorid and nitric oxid form a compound at low temperatures of an intense purple color. This is of interest because G. N. Lewis has pointed out that nitric oxid is the only molecule containing an odd number of electrons that is not colored. It was predicted that this compound would show conductivity in the liquid state. This prediction was verified, a conductivity of 10^{-3} being easily obtained at 130° K. This is believed to be the lowest temperature at which electrolytic conduction will be obtained. Speculations are offered as to the nature of the compound.

Transference numbers of sodium and potassium in mixed chloride solution: R. F. Schneider and S. A. Braley. The transference numbers of sodium and potassium have been determined in solutions with a total concentration varying from 0.1 to 1.6 N and with varying salts ratios of from 3 KCl and 1 NaCl to 1 Kcl and 3 NaCl. While the conductance of such solutions conform to calculated values on the basis of the isohydric principle the ratios of the transference are widely different from the calculated. At a total concentration of 0.2 N and a salt ratio of 3 Kcl to 1 NaCl the transference number of the sodium becomes practically zero, indicating that the sodium is not only transported as the cation but is also tied up in a complex anion to such an extent that it moves in both directions at the same rate. The data show that the theory of complete dissociation as advocated by Ghosh can not possibly hold.

Charles L. Parsons,
Secretary