Temperatures vary quite badly from the normals. One year differs from another by about .5° F. One January differs from another by about 2° F. and one January 4 from the January 4 of another year by an average of 4° F. These departures are caused mainly by the passage of storms with their alternate warming or cooling effects. In the arid west where irrigation and dry-farming are practised (one fourth of the earth's land area is equally dry) 80 per cent. of the days are free from rain, the sky is clear most of the time and the humidity is only 50 per cent. The departures from normal are, therefore, slight. Equation No. 2 will therefore give actual temperatures aproximately for this large area.

These actual hourly temperatures differ from the normals by from 0° F. to occasionally as much as 15 or 20° F. The normal calculated from equation two differs from the actual temperatures in the arid west by 5° F. It should be remembered, however, that the same equations gave the normal temperatures correct to 2½° F.

The U. S. Weather Bureau has continuous temperature records for several hundred cities for several decades and daily maximum and minimum temperature records for several thousand more cities. The equation submitted states approximately the law of this change in temperature with the time. Its simplicity and its generality are striking.

It has practical value in such cases as the determination of early morning temperatures where heating to protect crops from frost is practised, in calculating hourly values where thermograph records have not been taken and for engineers engaged in laying concrete, in determining the normal time in the spring and fall when freezing temperatures are experienced during working hours.

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THE AMERICAN CHEMICAL SOCIETY

(*Continued*)

The dynamics of the catalase reaction: Sergius Morgulis and Victor E. Levine. Many of the recent investigations on catalase are of little value because of incorrect technique and lack of appreciation of the dynamics involved. To draw proper deductions from experimental data it is necessary to select the proper method for the preparation of the enzyme and the proper preservative, and to regulate the hydrogen ion concentration of the enzyme as well as of the substrate. The shaking must be uniform and must begin almost as soon as the substrate comes in contact with the enzyme. The determination of the rate of evolution of oxygen is of greater importance than that of the amount of oxygen yielded within a given time. A ratio between the enzyme and substrate must be established such that the amount of oxygen liberated is directly proportional to the catalase concentration. For every catalase concentration there is an optimum amount of hydrogen peroxide. Increasing the peroxide beyond this amount results in a considerable progressive showing up of the reaction. The decomposition of hydrogen peroxide is a monomolecular reaction under the conditions of a constant substrate: enzyme ratio. With a constant quantity of enzyme the relation between hydrogen peroxide and the reaction velocity becomes inverse and logarithmic as soon as the concentration of hydrogen peroxide exceeds a certain limit. With a constant quantity of substrate the relation between the catalase concentration and the reaction velocity is direct and either logarithmic or linear, depending upon the presence or absence of an excess of peroxide. With a constant ratio between catalase and hydrogen peroxide the reaction velocities tend to approximate each other. Three types of curves are obtained when the reaction velocity is plotted against time: first, of rare occurrence, a curve showing a temporary increase in the value of K followed after one or two minutes by a slow falling off; second, a curve showing a continuous falling off, which is the most common and the one obtained when the catalase is in excess of the peroxide; third, a curve represented by a straight line, as is required by the monomolecular reaction, when the hydrogen peroxide is greatly in excess of the catalase.

The action of proteins on the phenol reagent of Folin and Dennis: Victor E. Levine. The phosphotungstic-phosphomolybdic reagent of Folin and Dennis is not specific for the phenolic group. The reagent can not serve as a test for proteins yielding tyrosine or hydrolysis, for all the proteins tested including gelatine give positive reactions.

That the phenol reagent is not specific has already been pointed out by Abderhalden, who found oxyproline and tryptophane to yield positive results. R. A. Gortner has also observed a positive response by indol. On further study we have found the color reaction to be given by a very large number of inorganic and organic substances, among which may be mentioned cuprous and ferrous salts, bromides, iodides, nitrites and sulfites, amines, aldehydes and ketones, carbohydrates, especially glucose, amyl alcohol, benzyl chloride, benzoyl chloride, benzidine, hydroxylamine, phenylhydrazine, phenolphthalein, haematoxylin, naphthylamine, animal charcoal, etc. Generally speaking the reagent seems to be affected by all sorts of substances possessing more or less reducing properties. In comparison to other methods the Folin and Dennis procedure for phenol in urine gives higher results, which may be accounted for by the presence of non-phenolic compounds reacting with the color reagent.

Digestibility of some raw starches: C. F. LANGWORTHY and HARRY J. DUELL, JR. In the experiments here reported, the digestibility of raw arrowroot (*Zamia floridana*), cassava, and rice starches was determined when eaten in quantities of approximately 150 grams per day by normal men. They were eaten as a constituent of a frozen custard. Raw cassava and rice starches were completely digested and no trace of them could be found in the feces. The average of these experiments on arrowroot starch varying from 65.0 to 99.3 per cent. was made 82.2 per cent. The subjects remained in normal health during the three-day experimental period and no abnormal physiological effects were noted.

Uses in biological sciences for standardized, sterile buffer tablets, and for a single sterile buffer solution covering all P_H values: PAULINE M. AVERY, R. R. MELLON and S. F. ACREE. Studies of growth, respiration, sporification, reproduction, physiology and morphology can be made with bacteria, fungi and molds, as well as with higher plants and animals, by the use of buffer tablets containing standardized quantities of desired chemicals giving definite hydrogen ion concentrations. Such tablets or mixtures may also contain standardized quantities of desirable indicators, dyes, colloids or other materials. Sterile culture media with or without agar can be given any desired acidity or P_H value by the addition of sterile buffer tablets, with or without indicators. Such P_H value may be made the minimum, optimum or maximum for the organism in order to stimulate or to suppress its growth or some other function, and this method can be made diagnostic for mixtures of organisms. By employing a suitable combination of photometer and turbidimeter or nephelometer, the hydrogen ion and indicator changes can be investigated, along with changes in colloidal conditions in solutions or agar-like gels. Such an apparatus as that devised by Sheppard[1] can be used for measuring the rate of growth of bacteria along with hydrogen ion changes, or the rate of development of spores in fungi. Colloidal and dispersed conditions in soil extracts, plant extracts, pulp liquors, milky solutions or suspensions of all kinds, and waters of lakes and streams, can be studied accurately along these lines, together with hydrogen ion concentrations. A single sterile buffer solution covering all P_H *values* when treated with acid and alkali, has been tested thoroughly and replaces the five or six solutions used by other workers. Such a single buffer solution and the standardized buffer tablets simplify the chemical side of exact researches in biology to such an extent that the methods can be used without chemical control by the biologist and consequently save his time for use in his own research field.

On the ionization constants of glycerophosphoric acid and the use of carbohydrate phosphates as buffers and nutrients, especially in culture media: PAULINE M. AVERY, R. R. MELLON and S. F. ACREE. Glycerophosphoric acid has ionization constants about $K_1 = 2.5 \times 10^{-7}$. These values are so close to those of phosphoric acid that the latter can be replaced as a buffer to advantage for several reasons. Glycerophosphates, sucrose and mannite phosphates and others are sources of carbohydrate food as well as of phosphorous. Over 20 organisms, including tubercle bacilli, have been grown on such buffered glycerophosphate media adjusted to different P_H values. The sodium and other glycerophosphate salts can be made and kept in anhydrous form, easier to handle and weigh than sodium phosphate. The glycerophosphate titration curve is sufficiently close to that of phosphates to replace it in all work when corrected. The calcium, magnesium and other salts of glycerophosphoric acid are soluble in contrast with the insolubility of the phosphates and can be used to study the effect of such metallic ions on growths and other func-

[1] *J. Ind. Eng. Chem.*, 12, 167.

tions, and on all kinds of catalytic reactions in pure and industrial arts. In beef-broth-peptone media, for example, the glycerophosphates do not give the troublesome precipitates formed by phosphates, and can therefore be added in the form adjusted sterile tablets or solutions to warm sterile media, with or without agar; the resulting medium is buffered, adjusted, clear and sterile for immediate use. The glycerophosphates can be sterilized in solid or liquid condition without appreciable decomposition. Similar reports will soon be made on other carbohydrate phosphates.

Hydrogen electrode measurements of the acid and basic ionization constants of asparaginic acid and its value as a buffer and nutrient material in culture media: J. H. Hopfield, J. B. Halstead, Marguerite A. Brennan and S. F. Acree. The hydrogen ion concentrations of solutions of $M/50$ asparaginic acid vary from 10^{-16} to 10^{-12} when the asparaginic acid is treated with acid and alkali varying from two mols of the former to three mols of the latter. Between $C_H = 10^{-5}$ and 10^{-9} there is a sharp inflection in the titration curve because of the completion of the neutralization of the stronger acid and the beginning of the neutralization of the second carboxyl. From the complete titration curve and the ionization values of the salts the constants $K_{a_1} = 1.1 \times 10^{-4}$, $K_{a_2} = 1.4 \times 10^{-10}$ and $K_b = 1.2 \times 10^{-12}$ are calculated. These are in good agreement with the values of K_{a_1} and K_b obtained by conductivity, catalysis and hydrolysis methods. The value of K_{a_2} is new and is lower than the value of $K_a =$ about 10^{-9} for asparagin, as expected for an acid salt. In another article we have shown that the inflection curves of asparaginic and phosphoric or pyrophosphoric acid mutually annul each other, and make such mixtures very fine buffer materials as well as nutrients in media for bacteria and fungi.

The nitrogenous constituents of condensed milk as compared with fresh milk: A. W. Homberger and B. Mathin.

The buoying up of the equilibrium of milk salts during meat treatment: Harper F. Zoller. The precipitation of calcium from solutions of milk salts, prepared in accordance with the composition and concentration occurring in the average of normal cows milk and at the reaction of normal milk, was followed quantitatively and with the hydrogen electrode during the effect of temperature. The loss of calcium was progressive with the time and intensity of heat treatment. The hydrogen ion concentration proportionately with the removing of the buffer material (phosphates) by the calcium. Doubling the quantity of citrates above normal although not changing the initial pH of the solutions greatly reduce the precipitation of the calcium phosphate and at the same time maintained a higher final pH. Lactates and malates acted likewise. This serves to aid in explaining how the lactic souring of milk may increase its stability towards heat.

Hydrogen electrode study of the curdling in casein solutions at high temperatures: Harper F. Zoller. When solutions of pure Hammarsten casein in carbonate free NaOH or KOH are heated in sealed tubes to temperatures ranging from 118° C. to 135° C. a precipitation of curd takes place, the formation of which is dependent upon the hydrogen ion concentration and the duration of heating. The casein solutions contained no calcium. All of the caseinate solutions remained clear, whose initial hydrogen ion concentration is less than 3.16×10^{-7}, (pH 6.5) although the solutions had been heated to 135° C. for forty minutes. There is a regular heating period of from 0.18 to 0.54 pH corresponding respectively to solutions of initial pH of 5.78 and 8.26. The precipitated curd is soluble in acids and alkalies and resembles the curd made from sterilized milk or milk heated to high temperatures as described by the author in a previous communication. The term β casein is suggested for this product to differentiate it from the products obtained by Lacquer and Sackur from dry casein. The significance of this phenomena in connection with the coagulation in evaporated milk is discussed.

Chemistry of digitalis: H. C. Hamilton.

Charles L. Parsons,
Secretary

(To be continued)

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