ash free from calcium or magnesium. While the growth in Medium C was not as rapid as in Medium E the yeast continued vigorous and normal in appearance. The yeast undergoes no deterioration even after two years of growth in this medium.

The yeast so obtained was inoculated into a series of flasks containing per 100 cc. of medium: 10 grams of cane sugar and varying amounts of dipotassium phosphate. In all experiments the temperature maintained was 30° C. There was a distinct optimum at a concentration of 0.45 grams of dipotassium phosphate per 100 cc. This optimum maintained during subculture. The above concentration then was adopted as standard. Conductivity water was used as the solvent. The medium was sterilized under pressure. While still hot, rubber stoppers were inserted, carrying two glass tubes through one of which air was bubbled through the medium, the other tube serving as outlet. The medium was cooled while being aerated with air from which all ammonia and nitrogen oxides had been removed by passing the air through acid and through alkaline potassium permanganate. A sterile medium which had been aerated under the same conditions as the growing culture showed considerably less than one part of ammonia or of nitrites or of nitrates per million parts of medium. The yeast grows nearly as well in this ammonia free medium as it does in Medium C. The cells are normal in appearance and appear to be in an excellent state of nutrition.

These results bring out two points of interest:

(1) The fact that yeast will grow continuously in a medium composed of sugar and one salt. (Pyrex flasks were used which had undergone several hundred sterilizations. We have not as yet made any correction for materials dissolved from the glass.)

(2) *Saccharomyces Cerevisiæ* will grow in an apparently good state of nutrition using atmospheric nitrogen as the sole source of that element.

It may be that the benefits accruing from the aeration of yeast cultures is as much due to the addition of nitrogen as of oxygen.

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IOWA STATE COLLEGE,
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THE AMERICAN CHEMICAL SOCIETY

(Continued)

PHYSICAL AND ORGANIC CHEMISTRY

SECTION II. COLLOIDS

Standardization in the grading of glue: ROBERT HERMAN BOGUE. So-called standard tests are being developed by the National Association of Glue and Gelatin Manufacturers (*cf.* Alexander, ''Glue and gelatin,'' p. 225). This is to be commended, but the results will necessarily be prejudiced so long as manufacturers only are represented on their committees. A joint committee of manufacturers, consumers and independent experts is obviously necessary for actual and profound progress. Of particular significance is the *arbitrariness* of most or all of the specifications ''agreed upon'' by the association. Thus, concentration, temperature and procedure are defined by a compromise between extremes in ''present practice'' instead of by the only sound method—the determination by systematic investigation of the conditions which most accurately evaluate in terms of a fundamental property. Additional data on the use of the MacMichael viscosimeter in the determination of a fundamental property of glues and the conversion of these data to absolute units are given. The use of a pipette type of viscosimeter is discussed and some data bearing on its application and calibration in absolute units are presented.

The action of salts on hydrous cupric oxide: HARRY B. WEISER. Hydrous cupric oxide adsorbs ions strongly. If shaken with solutions of neutral salts, like NaCl or Na_2SO_4, hydrolysis takes place and the solution becomes distinctly alkaline, owing to stronger adsorption of acid than of base. On account of this strong adsorption, the presence of certain salts may accelerate the spontaneous loss of adsorbed water. The hydrous oxide may be heated to 100° without darkening in the presence of very small amounts of salts, such as $MnSO_4$, $CoSO_4$, $Al_2(SO_4)_3$, $Cr_2(SO_4)_3$, $ZnCl_2$ and $CuCl_2$. It has been demonstrated that the absence of darkening is not due to stabilization by adsorption of the hydrous metallic oxides as suggested by Bancroft and reaffirmed by Blucher and Farnau; nor to the formation of basic salts as suggested by Spring and Lucion. The explanation is to be found in the change in physical character from the highly gelatinous to the granular form of the oxide. Only those salts which hydrolyze appreciably giving H-ion are effective in low concentrations, since the slight solvent action of the H-ion destroys the gelatinous structure, and the denser granular modification which forms loses water and darkens less readily than the looser gelatinous mass.

The formation of inorganic jellies: arsenates: HARRY B. WEISER and ALLEN P. BLOXSOM. Grimaux has shown that the dialysis of a colloidal solution of ferric arsenate peptized by ferric chloride results in the formation of a jelly. This has been confirmed by Holmes. The latter finds that the dialysis removes acid and points out that the same result may be obtained by decreasing the H-ion concentration by allowing ammonia or sodium acetate to diffuse through parchment into the colloid. Ferric arsenate peptized by ferric chloride or HCl gives a positive colloid stabilized by preferential adsorption of hydrogen ion. Dialysis lowers the concentration of the peptizing agent below the critical value so that slow coagulation takes place—an important condition for the formation of a stable jelly. The same result may be obtained by suitable addition of an electrolyte having a strongly adsorbed anion. The important thing is to neutralize the adsorbed H-ion which gives the colloid its stability rather than to cut down the actual H-ion concentration in the solution, as Holmes implies. This is established by the observation that jellies are formed by the coagulation of positive colloidal ferric arsenate with acids, such as H_2SO_4 and H_3PO_4, H_2CrO_4 and citric and by any number of so-called neutral salts. Similar results were obtained with ferric arsenate colloids stabilized by hydroxyl ion and with colloids of other arsenates. The results are in accord with the author's general theory of the formation of inorganic jellies.

The viscosity of gelatin solutions: theoretical considerations (lantern): STERNE MORSE.

The viscosity of gelatin solutions: the influence of electrolytes (lantern): STERNE MORSE. (1) If the fluidity of a mixture is taken to be an additive function of the fluidities of the components when the latter are taken in terms of their molecular concentrations, and if it is assumed that there exists in a gelatin solution containing a salt two forms of the dissolved gelatin, differing in viscosity, the one reacting reversibly with the salt to form the other, an equation can be derived from these assumptions which satisfactorily fits the observed data. This equation has the form:

$$x^n = k \frac{a - v}{v - b}$$

where v is the observed viscosity of the system, x is the concentration of the salt, and n, k, a and b are constants. a is nearly equal to the limiting value of v where the amount of electrolyte approaches o and b is nearly equal to its limiting value where the amount of electrolyte is made large. The equation is only valid where the hydrogen ion concentration does not change. (2) If the hydrogen ion concentration changes all these constants change for a given salt. The constant a is shown to vary according to the empirical equation:

$$\frac{(p_H - p)'}{c} - (A - a)^n - k$$

where c, n, A and k are constants and where p is a constant, nearly equal to 3.0. (3) The viscosity of water is shown not to enter into the above equation if the amount of free water remains constant or is very small. The hypothesis is therefore advanced that the amount of free water in systems of this nature is very small as the preferable alternative. This is held to explain the very large effect of the presence of gelatin on the viscosity of its solutions. (4) The constants of the first equation are shown to exhibit *maxima* or *minima* in the neighborhood of the hydrogen ion concentration, $p_H = 3.0$. The importance of this point of acidity is further shown by the fact that the value of p in the second equation is usually or always in this neighborhood. (5) The limiting value of the viscosity in the presence of large concentrations of salts is dependent on the value of the cation in acid solutions, and for the salts tested appears to follow the ability of the cation to associate water.

Experiments on the swelling of ash-free gelatin: S. E. SHEPPARD, FELIX A. ELLIOTT AND ANBER J. BENEDICT. Two phases of the swelling of ash-free gelatin have been investigated conjointly; the effect of variations in the hydrogen ion concentration on swelling, with the effect of previous treatment on swelling. It was found that in ash-free gelatin swollen in buffered solutions of varying p_H's at 7°C. a minimum swelling takes place over a region centered at p_H 4.8, or the iso-electric point of gelatin, and swelling increases both with increasing and decreasing hydrogen ion concentration. This is in disagreement with Wilson and Kern, who found a second minimum at $p_H = 8$. It is believed that their observations may have been due to the presence of (1) other proteins not present in ash-free gelatin or (2) the presence of ash, *i.e.*, inorganic salts combined or otherwise. Experiments have also been made with sheets of gelatin of varying thicknesses dried from a solution of given concentration and with sheets of uniform thickness dried from solutions of varying concentrations. The results establish a definite effect of these factors on the swelling limit, which indicates that modifications of the Proctor-Wilson-Loeb theory of swelling are necessary.

Note on formation of a carbon gel in tar: S. E. SHEPPARD and L. W. EBERLIN. In the course of development of colloidal fuels considerable quantities of the residual "pressure still" tar from Burton stills was obtained and used. This residuum had the following properties: viscosity Engler, 7.3 at 20°C.; flash point, 290° F.; asphaltum, 4.6 per cent.; free carbon, 1.0 per cent. These figures are representative, the values fluctuating with different lots. The point of interest in the present connection is the behavior of the "free" carbon. This is present in the original tar as submicroscopic particles, which on dilution with benzine show for some time lively Brownian movement. There is some tendency on prolonged standing for the asphalt and carbon to sludge, but what is more remarkable is that on standing for a year or more—in the present case examination was made after three years—the "free" carbon had aggregated to form a semi-rigid gel, uniformly dispersed throughout the oil, although starting at the bottom and sides. The whole gel was easily broken up mechanically, but had a distinctly "gritty" feel; it appears evident that this slow coking produces a product similar in character to the normal petroleum coke from the still, but in this case gradually built up. The faculty of carbon atoms of building up chains and networks, postulated by I. Langmuir in connection with the structure of adsorbent chars, seems well demonstrated here. Protective colloids delayed but did not entirely prevent this carbon gel formation. Analyses for free carbon did not show any noteworthy increase in its amount.

The preparation of highly absorbent gels: HARRY N. HOLMES and J. ARTHUR HENDERSON. The authors slowly added a solution of ferric chloride to a water glass solution (very definite volumes and concentration). The deep yellow gelatinous precipitate was washed, dried, then activated at 145°. At 30° it absorbed 31 per cent. of its own weight of benzene from a stream of air saturated with benzene. A precipitate dried at 50° until hard before washing gave a gel of 43.1 per cent. absorptive power. A similar gel dried hard and then soaked with dilute HCl to convert the iron oxide into chloride was washed and activated. It adsorbed 49.3 per cent. benzene. This was white silica gel. The product purchased from the Silica Gel Corporation adsorbed 33 per cent. benzene.

Adsorption by activated carbon—theory of hydrolytic adsorption: F. E. BARTELL and E. J. MILLER. From our work on adsorption of electrolytes by activated carbon, we have been led to the view that the adsorption is hydrolytic in nature. The theory of adsorption is based upon recent work of Bragg and Bragg on crystal structure and work of Langmuir and Harkins on orientation of molecules in liquid surfaces. Solid carbon is assumed to have a crystal lattice resulting in adsorption points. Through the operation of residual forces from these points hydroxyl and hydrogen radicals are adsorbed; the former may be displaced by almost any anion, the latter only by cations of metals more electropositive than hydrogen. Radicals containing carbon groups readily displace H or OH radicals, *i.e.*, they are readily adsorbed. Introduction of CH_2 groups. Additions of polar groups as COOH, OH, $CONH_2$ decreases the adsorption. This theory accounts for the results obtained in the adsorption of acid and basic dyes by charcoal.

The adsorption of ammonia by metals: HUGH S. TAYLOR, ARTHUR F. BENTON and WALTER A. DEW. Ammonia is reversibly adsorbed by copper to a large extent in the temperature region 0°—218°C. It is adsorbed by iron, largely irreversibly, hydrogen first predominating and then nitrogen being pumped off on heating the iron-ammonia complex. With sodium, as is well known, sodamide is formed, doubtless preceded by a $Na\text{-}NH_3$ complex. The bearing of these observations on contact catalysis, on specificity of catalytic action and on catalytic mechanism in the light of newer theories of atomic and molecular structure will be discussed.

A quantitative study of the effect of the hydrogen-ion concentration in electric-endosmose work: J. W. ELDER and NEIL E. GORDON. A quantitative study of electric-endosmose was taken up with aqueous solutions of varying hydrogen-ion concentration, using silica gel as the membrane. It was found that the change of the charge on the membrane had nothing in common with the neutral point. The relation of the charge on the gel to the p_H value of the solution was also studied in the presence of salts, and the cation and anion effects noted.

Plasticity in colloid control: EUGENE C. BINGHAM and ALFRED G. JACQUES. The concentration of zero yield value and the concentration of zero mobility are characteristic properties in non-polar colloids, which are closely connected with the size and shape of the colloidal particles. Both of these properties are found to be independent of the fluidity of the medium. The effect of small percentages of impurities as well as the length of time in grinding in the process of mixing have been measured.

CHARLES L. PARSONS,
Secretary