

Section N (Medical Sciences): Knickerbocker Hotel, 163 E. Walton Place.

“ O (Agriculture): Morrison Hotel, Madison and Clark Streets.

“ Q (Education): Drake Hotel, Lake Shore Drive and Michigan Avenue.

The affiliated societies are in general housed in hotels of the section to which they are related. The engineering societies, however, are distributed as follows:

Palmer House: American Society of Civil Engineers; American Society of Mechanical Engineers.

Edgewater Beach: American Institute of Electrical Engineers.

Stevens Hotel: American Institute of Mining and Metallurgical Engineers; American Society for Testing Materials; Society of Industrial Engineers; American Ceramic Society; Society for the Promotion of Engineering Education; National Council of State Boards of Engineering Examiners; American Foundrymen's Association.

Hotel Sherman: Institute of Radio Engineers.

For those who may be coming to Chicago by car

and may be interested in automobile camps, the following operated by the Century Cabins, Inc., 7 South Dearborn Street, have been approved by the Century of Progress:

Desplaines Avenue where crossed by Chicago Rapid Transit Line, Forest Park, Illinois. On World's Fair marking—Illumination Route—U. S. 330—Lincoln Highway.

Milwaukee Avenue and Oakton Street, Park Ridge, Illinois. On World's Fair marking—Radio Route—Illinois Route No. 21—Milwaukee Avenue.

22nd and Manheim Road, Westchester, Illinois. On World's Fair marking—Illumination Route—U. S. 330—Lincoln Highway.

Other camps are no doubt available, information concerning which can be obtained from automobile associations and clubs.

Correspondence regarding reservations should be sent directly to the appropriate hotel. Members are advised to make early application for rooms and to specify their connection with the association. It is important to have a definite understanding regarding space and rates.

THE NATIONAL ACADEMY OF SCIENCES

ABSTRACTS OF PAPERS PRESENTED AT THE WASHINGTON MEETING

At the annual meeting of the National Academy of Sciences, held in Washington, D. C., on April 24 and 25, the following papers were presented:

Geometry of the Laplace equation: EDWARD KASNER.

The Laplace differential equation, $\frac{\partial^2 \varphi}{\partial x^2} + \frac{\partial^2 \varphi}{\partial y^2} = 0$, has its origin in the theory of gravitation, φ being the potential; but of course it is of importance in many other branches of physics and in the theory of functions of a complex variable. The curves $\varphi(x, y) = \text{constant}$ constitute an isothermal family, so called because they are the curves of equal temperature in a steady flow of heat. The author finds purely geometric properties of such families. We state seven of these properties as follows, each one being completely characteristic: (1) If we construct the osculating circles at any point P of the curve of the given isothermal family and the orthogonal trajectory, these circles meet at another point P₁, and the transformation T from P to P₁ is conformal. (2) A related transformation is of the Darboux type. (3) If we construct all the ∞^2 isogonal trajectories these form a natural family of the kind arising in optics and in the dynamics of conservative forces. (See Kasner's Princeton Colloquium Lectures.) (4) Of all the isogonal trajectories at any point P, two will admit circles of curvature of higher than second order contact, and these two will be

orthogonal. (5) The isogonal trajectories form a linear family (as proved by the writer in *Math. Annalen*, 1904), and therefore we can form a Desargues configuration. This gives a characteristic construction in finite form. (6) Any isothermal family and the two families of minimal straight lines form a Blaschke hexagonal web. (7) Any isothermal net may be regarded as the orthogonal projection of the asymptotic lines of some surface. In conclusion, various geometric operations are described by means of which given isothermal families yield new isothermal families. The generalization to the Laplace equation in three dimensions is not direct and will be studied in another paper.

The geometry of spinors: OSWALD VEBLEN.

Finding the velocities of the spiral nebulae: V. M. SLIPHER. This paper gives a brief account of the velocity studies of the spiral nebulae made at the Lowell Observatory, where work in this field was begun. It touches on the development of the efficiency of the instruments for the work and gives results. There are mentioned the early tests and the reasons stated in support of the velocities being real in spite of their most extraordinary magnitudes. Examples of nebulae in rapid rotation are cited, and objects are referred to which are of exceptional interest because of their speeds of translation or rotation or because of their exceptional spectra.

Absorption and space reddening in the galaxy from the colors of B-stars: JOEL STEBBINS and C. M. HUFFER. The stars of spectrum class B, with intrinsic luminosities ranging from a hundred to several thousand times that of the sun, furnish an excellent means for testing the presence of dark matter in space. With a photo-electric cell attached to a 15-inch telescope, the brightness and colors of some seven hundred B-stars have been determined at the Washburn Observatory of the University of Wisconsin. This survey of such objects in the northern sky, complete down to visual magnitude 7.5, has been supplemented by measures of fainter stars and clusters with the large reflectors at Mount Wilson. The observations confirm the existence of a layer of absorbing material in our stellar system, extending along the central plane of the Milky Way. For distances of the first few hundred light-years the effect of this dark gas or dust is inappreciable, but from five hundred to five thousand light-years from the sun the absorption and space reddening become increasingly evident. The present results are in striking agreement with distribution of extra-galactic nebulae determined by Hubble at Mount Wilson. Where the nebulae appear in great numbers the stars are normal in color, but in obscured regions, where the nebulae can not be photographed through the veil in the foreground, the stars show a pronounced effect of coloration. Due to the eccentric position of the sun in the galaxy, stars in the outer regions, like those of the constellation of Orion, are less affected than objects in the opposite direction toward the center of the galaxy, where the loss from absorption amounts to at least three fifths of the visual or five sixths of the photographic light. The growing evidence from B-stars, globular clusters and nebulae supports the conclusion that we do not see out as far as the galactic center, and that objects hitherto supposed to be beyond the nucleus are really on this side of the center of the system. The scale of stellar distances must be revised with allowance for the effect of absorption. Finally, because of the general amount and extent of the obscuration, it is shown that the dark matter in space, counting only that which has so far been detected, may well be greater in total mass than the luminous material which we see in the form of shining stars.

Luminosity curves and average density of matter in twenty-five groups of galaxies: HARLOW SHAPLEY. Preliminary calculations at Mount Wilson and at Harvard have indicated that the average density of matter in intergalactic space is of the order of 10^{-30} grams per cubic centimeter. Throughout large volumes of space, however, the density is much higher and its evaluation is of significance in consideration of the evolution of the Metagalactic System. The luminosity curves of the galaxies in twenty-five groups, differing in richness, angular extent and volume, have been found from Harvard observations, with appropriate corrections for the random galaxies of the general metagalactic field. The luminosity data permit estimates of distance and mean density. The number of galaxies per cubic megaparsec in the groups varies from ten times to more than a thousand times the average number for metagalactic space. These groups of galaxies

(super-galaxies) occur occasionally in pairs, the boundaries of the component groups separated apparently by less than the diameter of either.

On the masses of binary stars: HENRY NORRIS RUSSELL and CHARLOTTE E. MOORE. The dynamical parallaxes computed by the writers have been revised by the inclusion of new material for many stars, and compared with determinations from other sources. We are indebted to Dr. Schlesinger for access to the Yale card catalogue of trigonometric parallaxes, to Dr. Adams for unpublished spectroscopic parallaxes from Mt. Wilson, and to Dr. Aitken for valuable double star measures. These comparisons indicate a close agreement with Eddington's mass-luminosity relation, for giants and dwarfs alike, with the well-known exception of the white dwarfs. The total number of stars available for investigation of mass is approximately five hundred and sixty.

The absolute motion of the solar system and the orbital motion of the earth, determined by the ether-drift experiment: DAYTON C. MILLER.

Solar variations and atmospheric pressure: H. H. CLAYTON (introduced by C. G. Abbot).

Long-range forecasting: C. G. ABBOT. There is presented with verification a two-year forecast of the variation of the sun made in November, 1930, and published in February, 1931. The average deviation of observed from predicted monthly mean values is 0.3 per cent. The analysis of solar variation from January, 1924, to September, 1932, and its exhibition as the summation of seven regular periodicities of 6-2/3, 8, 11, 21, 25, 45, and 68 months, respectively is presented. The average deviation of this summation from observed monthly mean values, is 0.15 per cent. The author ventures a detailed forecast of solar variation to December, 1934. Expected values generally below normal, with strong minima June, 1933, and July, 1934. The author presents the analysis of the departures from normal temperature of Bismarck, North Dakota, from 1875 to 1925. In addition to the seven periodicities found in solar variation, he finds others of 9-1/2, 12-3/4, 18 and 135 months, respectively. All these periodicities continue over the 50-year period from 1875 to 1925, but with fluctuations of amplitude, phase and form. He attempts to determine empirical relations governing these fluctuations. Employing the preferred adjustments of this kind, he compares the summation of adjusted periodicities with the actual departures from normal temperature, 1875 to 1925. Finally, he compares his forecast for 1925 to 1932 with observed departures of that interval.

The phosphorescence of solid nitrogen and its relation to crystal structure: L. VEGARD.

Forbidden lines in astrophysical forces: JOSEPH C. BOYCE, DONALD H. MENZEL and CECILIA H. PAYNE (introduced by Harlow Shapley).

The physical state of Novae: DONALD H. MENZEL and CECILIA H. PAYNE (introduced by Harlow Shapley).

The action of the parenteral administration of sugars in the hydrogen-ion concentration of normal and malignant tissues in living animals: CARL VOEGTLIN, H. KAHLER and R. H. FITCH (introduced by C. S. Hudson). [To be printed in SCIENCE.]

Crystalline pepsin and trypsin: JOHN H. NORTHROP (introduced by Simon Flexner). A crystalline protein (pepsin) which digested other proteins in acid solution with great rapidity was isolated three years ago from commercial pepsin preparations. More recently another crystalline protein (trypsin) which digests other proteins in slightly alkaline solution has been isolated from pancreas. These proteins behave like pure substances in that the chemical and physical properties, including enzymatic activity, are the same in a number of different preparations and are not changed by repeated fractional crystallization. Partial destruction of the protein by heat, acid, gamma rays or ultra-violet light, results in a corresponding loss in activity. The inactivation by heat is partly reversible. These results confirm the conclusion that the enzymatic activity is a property of the protein molecule. A number of physical and chemical properties of the proteins have been determined.

Gluconeogenesis from Fat: JOHN R. MURLIN (introduced by Lafayette B. Mendel). There has been much theorizing but little convincing evidence in favor of the conversion of fatty acids to glucose in the animal body. It is certain that the reaction at best is difficult and probably takes place very little at a time, if at all. Studied by the method of respiratory metabolism the conversion should give a low R.Q., but if it were followed immediately by combustion of the sugar the low R.Q. would blend with a high R.Q. and the evidence consequently would be obscured. With the castor bean it has been possible to separate the two reactions clearly. Conversion of fatty acids to cane sugar takes place in the endosperm and its oxidation in the young plant. With the help of Drs. R. G. Daggs and H. B. Pierce we now have the evidence complete, (1) by the R.Q., (2) by combustion in a modified oxy-calorimeter, and (3) by chemical analysis. With the assistance of Drs. Estelle E. Hawley and Carroll W. Johnston, an attempt has been made to devise conditions for the human subject, which would possibly separate conversion from combustion. Deprived of glycogen the tissues, offered sugar, prefer to restore the glycogen rather than burn the sugar. If under these conditions easily assimilable fat were offered and if any glucose were formed, it would be converted to glycogen and retained, thereby disclosing low R.Q.s. Later it would be oxidized, giving a special sequence of quotients following a high-fat meal, namely, first low, then medium, then high. Seven subjects have been used, and rich cream (approximately 40 per cent. fat) furnished the sole diet for several days. Thereby glycogen was reduced and a flood of fatty acids became available suddenly to supply materials for replacement. The special sequence of quotients predicted was obtained several times especially at an early test for each subject. Later the phenomenon of adaptation or increased tolerance for fat supervened to obliterate this sequence. Many very low R.Q.'s were obtained, however,

outside the predicted sequence. There are three other known ways of explaining low R.Q.s, aside from the conversion of fatty acids to glucose: (1) Formation of sugar from protein; (2) formation of sugar from glycerol; (3) production of the acetone bodies. Consideration of these several reactions under the conditions of the experiments described proves that none or all of them combined can explain the lowest R.Q.s obtained. The latter undoubtedly are correct, for they have been duplicated many times by both the Benedict and the Tissot-Haldane techniques. It seems clearly possible, therefore, that we have here a method of demonstrating gluconeogenesis from fat. To make it perfectly convincing we should be able, as in the castor bean, to find the sugar. That has not yet been accomplished.

Origin of bioelectric potentials: W. J. V. OSTERHOUT. In *Nitella* (as in muscle and in nerve) we find an outwardly directed potential on which the current of action and the current of injury depend. Our experiments on *Nitella* indicate that this may be largely due to the diffusion potential of potassium salts which exist inside at a higher concentration than outside (the mobility of the potassium ion in the protoplasmic surface is apparently very high). This has a paradoxical look because the potassium must penetrate from the outside and thus diffuse inward against an electrical gradient created by itself. It is therefore of considerable interest to find that suitable models can do this very thing and can imitate in many other ways the behavior of the living cell. The apparent paradox is explained by the fact that potassium penetrates in one form and goes out in another and that it sets up less diffusion potential in entering than in leaving the cell. In the model, as in the living cell, a non-aqueous layer lies between two aqueous phases and more potential is produced in this layer by potassium than by sodium. But if certain substances be removed from the non-aqueous layer potassium produces no more effect than sodium. Experiments in collaboration with S. E. Hill show that a similar change is brought about by treating the living cell with suitable solutions. The cell is then in a state of anesthesia: it is no longer excitable by ordinary electrical stimuli. The process is perfectly reversible. This suggests that anesthesia is due to the removal of certain substances from the cell.

The precocious development of sexual characters in the fowl by daily injections of hebin: L. V. DOMM and H. B. VAN DYKE (introduced by F. R. Lillie). Brown Leghorn cockerels ranging from 1 to 47 days in age received daily subcutaneous injections of hebin. The quantities administered ranged from 4 to 32 rat units in single daily injections. The duration of the experiments varied from 14 to 36 days. The first effect noticed was a pronounced stimulation of head furnishings. This could be definitely noted, in some instances, as early as 48 hours after injections began. The comb revealed steady growth throughout and at the conclusion of experiments was usually considerably larger than controls. Precocious sexual behavior was noted. Young males were found crowing when 9 days old and to reveal

the initial treading reactions at 13 days. Post-mortem revealed hypertrophy of testes. These were usually larger and heavier than controls. Thyroids were likewise larger and heavier in treated birds. The spleen, liver and heart did not seem to show significant changes in weight though experimental spleens were fairly consistently somewhat lighter than controls. The ductus deferens revealed hypertrophy. In the cases studied histologically tubules of control testes were distinctly juvenile showing primordial germ cells, whereas those in treated testes revealed spermatogenesis. Thyroids from treated individuals revealed larger vesicles. In a second series of experiments brown Leghorn females received daily subcutaneous injections of hebin. Concentrations injected, age range, and duration of experiments were identical with the experiments on cockerels. Here also the first effect noticed was a striking growth of head furnishings. This was definitely noticeable within 48 hours in individuals receiving higher concentrations. In such experiments head furnishings revealed a continuous high growth rate throughout becoming masculine in character. The comb became stout of blade and erect whereas that of similar size in normals, only found in much older females, shows a thin lippy blade. Plumage and behavior were apparently unaffected. Post-mortem revealed considerable hypertrophy of ovaries. These were larger and heavier than controls but showed no indications of ovulation. The surface of more advanced ovaries had a mulberry appearance indicating follicular development. The more advanced oviducts showed astonishing hypertrophy comparable to that normally preceding ovulation. The weight of these frequently exceeded 15 times that of controls. Thyroids were larger and heavier than controls. Differences in weights of liver, spleen and heart were probably not significant though experimental spleens were usually heavier. Histologically experimental ovaries showed larger follicles. Sections of normal oviducts showed low mucous folds devoid of tubular glands and conspicuous muscle layer, whereas experimentals showed high mucous folds, well-developed tubular glands and conspicuous peripheral muscle layer. Experimental thyroids showed larger vesicles. Effects were in general proportional to concentrations injected. The results generally confirm the earlier experiments of Domm ('31) following daily hypophyseal implants on juvenile males and females.

The anterior hypophyseal substance which synergizes with prolan: HERBERT M. EVANS, MIRIAM E. SIMPSON and PAUL R. AUSTIN. In 1931 Evans, Meyer and Simpson¹ discovered that the gonadotropic effect of the substance found in the urine of pregnant women (prolan) is greatly increased if certain extracts of the anterior hypophysis, themselves of low gonadotropic potency, are added to prolان. The phenomenon has been recently confirmed by Leonard,² similar synergistic effects with prolان having been secured by him through the employment of extracts

high in gonadotropic potency. Our earlier experiments led to the suggestion of the growth hormone as the synergistic substance, while the Leonard series provoked his hypothesis that the gonadotropic hormone itself was involved. Continued study of the phenomenon has shown that the anterior hypophyseal substance which increases the gonadotropic effects of prolان (when mixed *in vitro* with prolان) is neither the gonadotropic nor growth hormone. The new substance does not possess either growth- or gonad-stimulating properties, and is characterized by physical and chemical traits which clearly distinguish it from the hormones in question.

The effects of deprivation of magnesium in the animal body: E. V. MCCOLLUM, H. D. KRUSE and ELSA R. ORENT. When young rats are deprived of magnesium but are given adequate amounts of other dietary essentials, they show a spectacular series of symptoms denoting a condition that is short and abruptly fatal in its course. Successively they pass through stages of vasodilatation and hyperirritability of the nervous system before succumbing in tonic-clonic convulsions. This syndrome fits into the category of tetany, when the term is used in its broadest sense. It has, however, characteristic features that differentiate it from all other forms of tetany. The chemical changes in the blood serve as further evidence to the distinctiveness of magnesium tetany, since magnesium is the only inorganic ion undergoing alteration. Adult males, restricted to the magnesium-deficient ration, suffer damage of the reproductive system, resulting in sterility. A study of females as yet is incomplete. In addition to these effects on the nervous and reproductive systems which may be designated as local effects, adult animals show constitutional changes in the form of nutritive failure, which is reflected in loss of body weight. Again, chemical examination of the blood offers an explanation of the nutritive failure, since it reveals an unusual disturbance in lipid metabolism unlike that seen hitherto in any other disease. It has been asserted that the mechanism of failure in fasting and deficiency diseases is identical; the blood picture in magnesium deficiency indicates that the mode of failure is entirely different in the two conditions. Studies of inorganic metabolism in animals deprived of magnesium reveal that while the animal runs a negative magnesium balance it retains calcium in the earlier stages to an extent far in excess of control animals. If the animal has a long survival, period, however, this retention of calcium is broken. The retention of calcium is reflected in the calcification of the long bones, analyses of which show a higher content of calcium.

Rate of development of primate embryos: G. L. STREETER. Being able to study macaque embryos of known age throws light on the rate of development during the first few embryonic weeks concerning which in human specimens only inadequate clinical data have thus far been available. The two genera differ in minor details of form and in rate of differentiation but these differences become progressively less in the early stages. The close morphological parallelism between embryos of monkey and man will be shown and a comparison will be made be-

¹ H. M. Evans, K. Meyer and M. E. Simpson, "The Relation of Prolan to the Anterior Hypophyseal Hormones," *Proc. Soc. Exp. Biol. and Med.*, 28: 845, 1931.

² S. L. Leonard, "Increased Stimulation of Immature Rat Ovaries by Combined Injections of Prolan and Hypophyseal Sex Hormone," *Proc. Soc. Exp. Biol. and Med.*, 30: 665, 1933.

tween some of the well-known human specimens and similar monkey specimens of known ages.

Morphine and the cat: WILDER D. BANCROFT, ROBERT S. GUTSELL and JOHN E. RUTZLER, JR. It is usually stated that the action of morphine on the cat is fundamentally different from its action on man or on the dog, the cat becoming violently excited. We have tested six cats with varying amounts of morphine—five to twenty milligrams per kilogram—injecting subcutaneously and intramuscularly. While the cats showed a slight excitement, there was nothing approaching mania, and it is not certain that the effect is anything more than the irritability corresponding to sub-anaesthetic doses. Oral administration of sodium rhodanate decreases the excitement produced in cats by morphine. Toxic, but not lethal, doses destroy the excitement almost completely. In the presence of histamine, an agglomerating agent, the effect of morphine lasts almost twice as long. Morphine caused dilatation of the pupils and a doubling under of the hind quarters in all six cats. Sodium rhodanate eliminated the doubling under but had no appreciable effect on the dilatation. A few men and more women are said to become violently excited under morphine and this is said to be true of all human beings in the manic state. There is therefore no fundamental difference in the action of morphine on men and on cats though the relative incidence of the drug is undoubtedly different. It is possible that a greater percentage of cats than of men become violently excited by morphine; but there is no real evidence either way.

The isotopic fractionation of water: EDWARD W. WASHBURN, EDGAR R. SMITH and MIKKEL FRANDSEN. When water is subjected to electrolysis an isotopic fractionation occurs.¹ It has been found that the heavier isotope of hydrogen and the heavier isotopes of oxygen are concentrated in the residual water. The specific gravity of the residual water rises continuously as the electrolysis proceeds. The rise in specific gravity is accompanied by a rise in the freezing point and in the boiling point and by a decrease in the refractive index. No indication of approach to an electrolysis equilibrium has been found, and there is every reason to hope that it will be possible to obtain the various isotopes of hydrogen and oxygen in a pure state, certainly in highly concentrated form. If the oxygen from the electrolysis of normal water is combined with normal hydrogen, the water produced has a lower specific gravity than normal water. If this water be again partially electrolyzed and the oxygen combined again with normal hydrogen, a further drop in the specific gravity of the water occurs. It will consequently be possible to prepare isotopically pure water of the composition $H^1O^{16}H^1$ and hence to determine very accurately the atomic weight of normal oxygen on the $O^{16} = 16$ scale. With the different isotopes of hydrogen and oxygen available in pure form, a new field of chemistry and possibly also of biology will be opened up, since the different isotopes of hydrogen, at least, may be expected to exhibit pronounced differences in chemical behavior. A survey is being made of water from different natural

sources to find out whether differences in isotopic composition occur in nature.

Neutrons and atomic nuclei: WILLIAM D. HARKINS. The neutron is an electrically neutral nuclear particle of about 10^{-13} cm diameter and of about the mass of a hydrogen atom. The existence of neutrons in the radiations from beryllium, when a piece of this material is bombarded by fast α -particles, was recognized by Chadwick in 1932. That the nucleus of the beryllium atom contains a neutron was assumed in 1915 by Harkins and Wilson, and the characteristics of free neutrons were given in 1920 by the writer and by Rutherford. Photographs of the disintegration of nitrogen nuclei by fast neutrons from beryllium have been obtained by Gans, Newson and the writer. One of these photographs shows the effect of a neutron of extremely high energy, which amounts to 15 million electron volts or a velocity of about 33 thousand miles per second. This is by far the fastest neutron thus far detected. The work of Feather in Cambridge, together with that of this laboratory, indicates that in disintegrations of nuclei by neutrons kinetic energy is either conserved or disappears and is converted into gamma-rays. The energy found to disappear in the reaction—Nitrogen 14 + Neutron 1 = Boron 11 + Helium 4—is represented by only a few definite energy values, so it seems probable that definite energy levels exist in some of the nuclei involved, in that of boron of mass 11. A neutron plus a proton may be assumed to form a hemi-alpha particle or nucleus of a hydrogen atom of mass 2. Certain interesting relations are found if it is assumed that atomic nuclei consist of alpha particles, neutrons and hemi-alpha particles. These will be discussed in connection with the Harkins-Masson nuclear formula $(np)_Z n_I$, or $(\frac{\alpha}{2})_Z n_I$, in which Z is the atomic and I the isotopic number; n, a neutron; p, a proton; and α represents an α -particle of group. The completion of an α -particle in a nucleus by the addition of a hemi- α -particle gives an extremely large amount of energy: 20 million electron volts or more. It is found that neon gives the smallest and nitrogen the largest number of nuclear disintegrations from bombardment by neutrons of the three gases thus far tested—nitrogen, oxygen and neon. Experiments with other gases, such as ethylene, are in progress.

A possible alternative formula for sucrose: C. S. HUDSON and C. B. PURVES. In an attempt to prepare a methyl fructoside possessing the same ringed structure as that depicted for the fructose residue in the generally accepted formula for sucrose, cane sugar was dissolved at room temperature in methyl alcohol containing hydrogen chloride. The reaction was found to proceed with remarkable rapidity and to give rise initially to glucose in a reducing condition and to a mixture of methyl fructosides of a gamma type. On the basis of the usual structure for sucrose, stable alpha methyl glucoside and an individual beta methyl gamma fructoside had been expected as the sole initial products of the reaction. This unforeseen result induced the authors to review the experimental evidence upon which the chemical constitution of sucrose is at present based and they point out that the

¹ Washburn and Urey, *Proc. Nat. Acad. Sci.*, 18: 496, 1932.

whole of these experimental data can be equally well satisfied by an alternative structure for the disaccharide. In the possible alternative structure sucrose is regarded not as a glucosido gamma fructoside but as a dicyclic acetal condensation product of open chain glucose and open chain fructose.

The widths of the K absorption limits in x-ray spectra: F. K. RICHTMYER and S. W. BARNES. By means of a two-crystal spectrometer the widths of the following elements have been studied: Mo(42), Ag(47), In(49), Sn(50) and W(74). Except in the case of Sn(50) none of the limits showed any trace of fine structure. After making an approximate correction for the width of the rocking curves of the pair of crystals used, the widths of the several limits in volts are as follows: Mo(42), 18 volts; Ag(47), 28 volts; In(49), 31 volts; W(74), 133 volts; Au(79), 160 volts. Within experimental error there seems to be no difference between the limit of Ag(50) in the metal and in the oxide. The absorption limit of Sn(50) seems to show a structure which perhaps may be associated with the fact that Sn has a large number of isotopes, in contrast with Ag, which has two, and In, which has only one constituent.

New optical properties of the alkali metals: R. W. WOOD. Continuing an investigation made over fifteen years ago, on the remarkable transparency of films of sodium and potassium to ultra-violet light, and their opacity and high reflecting power in the visible region, it has now been found that there is a fairly sharp transition point in the spectrum at which an alkali metal ceases to exhibit the properties of a metal and assumes those of a dielectric. A potassium film, through which the sun's disc is invisible, transmits 25 per cent. of the energy in the region between 3,000 and 1,860. For this spectral range it gives plane polarization by reflection of unpolarized light, having a Brewsterian angle of about 37°. The spectrum of a light source giving a continuous spectrum, reflected from a film of the metal several wavelengths in thickness, shows interference maxima and minima the fifth order or higher being recorded. The transition point, at which the properties change, descends in the spectrum, with decreasing atomic number being at about 4,000 for caesium and 2,000 for lithium. The use of the films as ray filters for spectroscopic work will be discussed.

Application of the three-color principle to oil painting: HERBERT E. IVES. The experimentally well-established fact that all colors may be matched by the mixture of three properly selected primaries has been extensively used in color photography and typographic printing. It has not, however, been heretofore successfully used in painting. The usual artist's palette consists of a dozen or more pigments, with the result that the number of ways of making desired colors by mixture is very large and quite unamenable to systematization. Learning how to use these numerous pigments is a matter of long experience. The simplification indicated by the three-color principle has been retarded in realization largely owing

to the mistaken but widely held belief, that the primary pigment colors are red, yellow and blue. Actually the pigment primaries, which act by subtraction or absorption of light from white, should be complementary in hue to the red, green and blue, which are the primaries for mixing light by addition. Those colors are a minus red (spectrum minus red) or turquoise, a minus green, or crimson, a minus blue, or yellow, each having wide overlapping spectral reflection bands. Pigments of these colors, of proper spectral characteristics, are capable of mixing in pairs to make red, green and blue, and all three together to make black. When mixed with white all variations of saturation and hue are obtained. The practical problem consists in procuring pigments possessing the indicated spectral reflectivities and having satisfactory chemical properties, such as freedom from reaction with the oil or other medium, and satisfactory permanence. Due to the very great advances which have been made in the dye industry to meet recent demands for permanent colors for automobiles and outdoor signs, it is now possible to select pigments nearly enough meeting the scientific requirements to test the practicability of the principle. This has been done with success, and pictures so painted are exhibited in connection with the presentation of this paper.

On supraconductivity and the Hall effect: EDWIN H. HALL. The experiments of Onnes from which he concluded that the Hall effect does not exist in the supraconductive state of metals are inconclusive. These experiments were of two kinds. In one the metal under examination was tested in the usual direct method which reveals the effect in the ordinary conductive state. In the other a metal spherical shell, in which persistent (self-sustaining) currents had been set up, was subjected to a magnetic field which, in the opinion of the experimenter, tended to swing the currents into new orbits within the metal. Failure to discover such a deflection led Onnes to infer the non-existence of a Hall effect. There is reason to doubt whether in either of these methods of experimentation the magnetic lines of force penetrated the metal to any appreciable degree. A different procedure for testing the question at issue is proposed.

The Pleistocene diversion of the Mississippi River across Crowley's Ridge, southeastern Missouri: F. E. MATTHES. The lower Mississippi Valley throughout its upper half is divided longitudinally into two parallel lowlands by a narrow strip of hilly upland, 100 to 250 feet high, known as Crowley's Ridge. Originally the Mississippi followed the lowland on the west side of this ridge, but now the river cuts across it at Thebes, Illinois, in spite of the fact that the ridge there is seven miles broad and composed in part of hard limestone. In consequence of this remarkable change in course the Mississippi now joins the Ohio 200 miles north of its original point of confluence with that river, and the entire drainage net in a valley area aggregating 17,000 square miles has been rearranged. Recent investigations have shown that the diversion of the Mississippi at Thebes and other

diversions of its waters at points now indicated by abandoned gaps in Crowley's Ridge were brought about, not by capture of the river by southward flowing streams, as has been supposed, but by overflow at a time, late in the Pleistocene epoch, when the Mississippi had aggraded its valley with silt derived from the continental ice sheet to a level about 50 feet above the present flood plain. Numerous terraces composed of glacial outwash material afford the principal evidence. The Ohio River also played a part in connection with the diversion of the Mississippi River. It flowed at that time across southern Illinois, through the valley now occupied by Cache River. By paring away the southeastern edge of Crowley's Ridge it beheaded several northwestward draining valleys and thereby created spillways at fairly low levels.

Archean formations of the Grand Canyon: IAN CAMPBELL and JOHN H. MAXSON (introduced by John C. Merriam). The oldest rocks exposed in the Inner Gorge of the Grand Canyon comprise a thick and varied metamorphic series (Vishnu schist). These rocks are invaded by granitic intrusives (phantom granite). So complex and so intimate are the relations between the metamorphic series and the igneous rocks that in many instances the resulting formation can only be described as a migmatite. The original sedimentary nature of the schists is shown by the occurrence of quartzite, calcareous members, iron formations and sandstone lentile in slightly altered schists. It is also indicated by retention of such characteristic sedimentary structure, as stratification and cross-bedding. Following the regional metamorphism of the sediments, the phantom granite was emplaced by processes of assimilation and granitization. Different facies of the granite and its associated pegmatites resulted from differing character and intensity of deuteric alteration.

Some features of flowers and fruit of a new Cordaites: DAVID WHITE. Fossil plant fragments of Pottsville age discovered in southeastern Illinois by the State Geological Survey disclose leaves, flowers and seeds of a single species of *Cordaites*. Male and female flowers, *Cordaianthus*, are small, bud-shaped and nearly alike. The young seed in the midst of the flower is narrow, soft and is deficient in wing. Stamens, protected like the ovules, by bracts when young, are numerous in the upper part of male flowers, protruding beyond the bracts and arching bouquet-like when mature, with oblong pollen sacs strewn along the upper ends. The base of the stamen seems exactly axillary. The small seeds (*Cardiocarpon*) are longitudinally oval-rhomboidal, with spinose glandular sarcotest, widely dilated as wing and narrow cordate-oval acute "hard" coat. No clearly defined pollen character is noted in the material, consisting of impressions and carbonized residues only. The micropylar canal is distinct, even in immature seeds. In some large seeds, structures, apparently tubular and seemingly continuous with the micropyle, extend, while dilating somewhat, far down into the interior of the endosperm. These structures, which the author is unable to regard as fungal, are interpreted as indicating a stage of development at

which the archegonial wall and part of the endospermic center had broken down. No embryo has definitely been recognized in any Paleozoic seed.

Primitive cephalopods: AUG. F. FOERSTE (introduced by David White).

Metaxenia and neophosis, two forms of morphogenetic influence exerted by the generation-complex of the embryo sac apparatus in higher plants: WALTER T. SWINGLE (introduced by R. A. Harper). [To be printed in SCIENCE.]

The effect of alternation from spores to vegetative cells on the growth and activity of certain anaerobic bacteria: E. B. FRED and E. MCCOY. In a study of the factors that govern the growth and activity of bacteria, little consideration has been given to the effect of periodic changes from the spore to vegetative stage. Occasional statements have been made that the spore stage represents a regenerative phase of the cycle and that vegetative cells immediately following germination are of greater vigor and activity. The anaerobic bacteria represented by *Cl. acetobutylicum* and *B. amylobacter* (Bredemann) were chosen for the study of the effect of serial transfer involving periodic change from spores to vegetative cells. At regular intervals of four to five days the cultures were subjected to heat treatment of 1.5 minutes at 90° C. and were then used for subcultures in the usual way. All tests were made in 2 per cent. corn mash, a medium known to be suitable for the growth and sporulation of these organisms. At the present time the experiment has been carried to the one hundred and tenth transfer. Results of the comparison of the first and the one hundredth transfer are now available. The fermentation products of these culture generations have been determined, both as to quantity and ratio of products, but no significant difference has appeared. Vigor of growth has been maintained and, if anything, has become more regular with successive transfers. Comparisons of spore formation of the first and the one-hundredth culture generations seem to indicate an increase in the number of spores produced. This increase may account for the consistent activity which has been obtained. During this long period of time no culture has dropped out of this series because of failure to grow. This is an unusual record for an experiment with an obligate anaerobe.

(To be continued)

BOOKS RECEIVED

- ADKINS, HOMER and S. M. McELVAIN. *An Introduction to the Practice of Organic Chemistry*. Pp. ix + 224. Illustrated. McGraw-Hill. \$2.25.
- BEEBE, WILLIAM and JOHN TEE-VAN. *Field Book of the Shore Fishes of Bermuda*. Pp. xiv + 337. 300 illustrations. Putnam's. \$3.50.
- COLBERT, J. C. *Laboratory Technique of Organic Chemistry*. Pp. ix + 341. Illustrated. Century. \$2.50.
- EHRET, WILLIAM F. *Laboratory Studies in General Chemistry*. Pp. viii + 312. 21 figures. Century. \$1.50.
- NAYLOR, NELLIE M. and AMY LE VESCONTE. *Introductory Chemistry with Household Applications*. Pp. x + 367. 41 figures. Century. \$2.60.
- PARSHLEY, H. M. *The Science of Human Reproduction*. Pp. xv + 319. 66 figures. Norton. \$3.50.