the increase in race 8 has exposed them to a new and dangerous biotic environment. Fortunately, still other varieties have been produced that are resistant to race 8. But race 7, which can attack some of these varieties, has been appearing in barberry areas. Whether it will ever become prevalent, as race 8 has, cannot be predicted. In the meantime, varieties are being produced which seem to be resistant to all known races, although there is some evidence that they are susceptible to certain of them at high temperatures.

Some of the best stem rust-resistant commercial varieties of spring wheats now grown in the United States are resistant to race 56 and the other races now prevalent but are susceptible to certain as yet unprevalent races that are found only near barberries. Crosses now are being made in the attempt to produce varieties resistant to these races, should they duplicate the history of race 56. Moreover, it is known that there are rust races in certain other countries that are far more virulent than anything yet found in North America. Whether these will ever be produced naturally in North America, whether they will be introduced, or whether they will be carried into North America by the wind are questions that only the future can answer. Plant breeders and plant pathologists proceed on the assumption that the sort of thing that has happened in the past may happen in the future. But to prepare for the future it is necessary not only to know the physiologic races of the present but also to learn the principles basic to predictions regarding those which are potential.

The National Academy of Sciences:

Abstracts of Papers Presented at 1947 Meeting

The Sun a Regular Variable Star

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The variation of values of the solar constant of radiation for the years 1924–44 reveals a regular periodicity of 6.6456 days. Statistical studies of temperature departures at Washington, D. C., St. Louis, Missouri, and Helena, Montana, show that this solar periodicity is attended by fluctuations of temperature of identical average period and an average range of 5°F. Apparently these temperature fluctuations have not hitherto been recognized as periodic because, while the solar period is invariable, its terrestrial effects are subject to phase displacements of ± 1, 2, and occasionally 3 days, and the amplitudes of the temperature effects range from 2° to 20°F.

Blood Protein Studies With Labeled Elements

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In mammals, absorption of the most essential foodstuffs from the gastrointestinal tract is indiscriminate; it does not depend on whether or not the body is already liberally supplied with this substance. The disposal of surplus amounts is through degradation and excretion.

The metabolism of iron has been found not to follow this general rule. Hemoglobin, the iron-containing red protein of the blood erythrocyte, is the primary means of oxygen transport in mammals. Iron is thus essential to mammalian life. Early studies with radioactive iron show that in this case the body excretes surplus iron only in negligible amounts. Instead, normal dogs and humans absorb iron from the gastrointestinal tract when needed and, when the need is satisfied, allow the iron to pass unabsorbed into the feces. Further experiment with radioactive iron, carried out by research groups a Rochester and at Berkeley, indicate that even sterile infections, such as abscesses induced by turpentine injections, prevent iron absorption in animals anemic through blood loss and needing iron. Also, such infections prevent hemoglobin formation even from injected iron.

An average life span of 120 days for the dog erythrocyte is indicated from studies on excretion of porphyrin breakdown products by Hawkins and Whipple. Studies with radioactive iron aimed at confirming this life-span figure failed to give adequate data for this purpose for an unexpected reason: it was found that the dog utilizes almost exclusively the iron liberated from his own worn-out red cells for building new ones, even with very large stores of other reserve iron in his body.

Later, Shemin and Rittenberg showed, by the use of the distinctive heavy isotope of nitrogen, that glycine nitrogen is the source of the porphyrin nitrogen of the hemoglobin. In subsequent experiments, in which such a labeled glycine was fed to a human subject and then the rate of disappearance of the resulting labeled hemoglobin followed, they have shown that the average life span of the human red cell is also about 120 days.

Distinctive isotopes, radioactive and stable, are also of proven value in investigations of blood-plasma proteins. Originally, it was supposed that in addition to forming a blood clot following injury, their function was principally that of maintaining the osmotic pressure of the blood and thus preventing plasma loss into the intercellular tissue spaces. Later, vital immunological functions were definitely attributed to certain of these proteins.

In 1938, Howland and Hawkins showed that injected plasma protein can be used by dogs for other nutritional purposes,

apparently without ever passing through an amino acid stage in the plasma. This indication that the plasma proteins may be important intermediaries in protein metabolism receives added support from work by Schoenheimer and his associates at Columbia University. From their data they suggest an average half-life of about two weeks for plasma protein molecules. Work carried out at Rochester in which tagged plasma proteins synthesized in one dog were reinjected into a second animal suggests an even shorter lifetime in the blood stream for the average plasma protein molecule. They find 50 per cent of the labeled material gone from the plasma in 30 hours and 75 per cent gone in 6 days.

Tarver and Reinhardt have recently carried out plasma protein studies which strikingly indicate the importance of the liver as a site of plasma protein production. When methionine, labeled with radioactive sulfur, is administered to completely hepatectomized dogs, they find that plasma globulin synthesis is depressed to $\frac{1}{4}$ of normal and albumin synthesis to below $\frac{1}{20}$ of the normal value.

Such results point out that one of the particularly valuable uses of labeled isotopes depends upon their ability in many short-term, acute studies to give valid data concerning the quantitative aspects of physiological functions. Such results also suggest that, through the use of suitable labeled amino acids, it will be possible to measure the efficiency of the human liver in synthesizing plasma proteins in health and disease.

Ovular Tumors Associated With Hybrid Embryos in *Datura*

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It has been shown by one of us (S.) that, following pollination of *D. stramonium* by a distinctly related species, *D. Metel*, hybridization takes place freely, but the hybrid proembryos abort usually at or before the 8-cell stage, accompanied by an enlargement and proliferation of the cells (endothelium) immediately surrounding the embryo sac. Such proliferating cells may invade the embryo sac and form ovular tumors or "pseudo-embryos." Similar abnormal growth has been found in other wide crosses. Ovular tumors are also the rule from the cross 4n x 2n as well as from the reciprocal cross 2n x 4n when both parents belong to the same inbred line of *D. stramonium*. The fact that van Overbeek and Conklin have induced such ovular tumors in *Datura* by injection of auxins indicates connection with chemical changes in their microenvironment and suggests the possibility of a further analysis of the factors in microenvironment responsible for differentiation in normal development as well as for abnormal growth with hope of their ultimate control.

The Surgical Treatment of Congenital Pulmonic Stenosis

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Congenital defects of the heart and the great arteries arising from the heart are not uncommon. There was no satisfactory surgical treatment for any of these prior to 1938. Since that time, advances have been made in the surgical therapy of three of the most common types, namely, patent ductus arteriosus, coarctation of the aorta, and pulmonic stenosis. Methods for treating some of the other deformities will probably be developed.

This presentation will be limited to a consideration of the treatment of pulmonic stenosis, which is a constricting deformity of the main artery to the lungs at the point where it arises from the heart. This deformity is usually associated with additional defects in the heart, but the major disturbances are caused by the pulmonic stenosis. Patients with this deformity are cyanotic and are commonly called "blue babies." More important than the color change is the fact that the patients have definite restriction in their physical activities. The red blood cell count is greatly increased, and the oxygen saturation of the arterial blood is greatly decreased. As stated previously, the major factor responsible for these findings is an inadequate flow of blood through the lungs as a result of the pulmonic stenosis. Oxygen is available in the lungs, but the flow of blood to the lungs is so reduced that an adequate quantity of oxygen is not delivered to the body.

The operation which has been developed for the treatment of these cyanotic patients is a shunt or by-pass procedure and consists in the making of an anastomosis between a large branch of the aorta and the pulmonary artery distal to the point of stenosis. Fortunately, the pulmonary artery is usually essentially normal except for the stenotic area. Following the establishment of this artificial communication, the high pressure in the aorta causes a large quantity of inadequately oxygenated blood to flow through the pulmonary artery and the lungs, and this blood returns to the heart with a high degree of oxygen saturation.

During the past 30 months 375 cyanotic patients who were diagnosed as having pulmonic stenosis (the tetralogy of Fallot) by Dr. Taussig and her associates have been operated upon in the Johns Hopkins Hospital. The ages have ranged from 4 months to 26 years. The over-all mortality rate has been approximately 17 per cent. Most of the patients who have survived the operation are strikingly improved. In many of these the cyanosis and the clubbing of the fingers and toes have disappeared, the red blood cell count has declined to normal, and the oxygen saturation of arterial blood has increased greatly. Some of the patients who could walk only a few feet before operation can now walk miles.

Relativistic Correction to the Magnetic Moment of the Deuteron

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The corrections referred to are considered for a proton and neutron moving in each other's field. Two alternative equations are used as starting points for the calculations. One of these is an extension of the electrodynamic laws of interaction between charged particles; the other is typical of Hamiltonians giving rise to inverted (Thomas term-like) vector spin orbit doublets and is an extension of the scalar field one-body equation. The calculations reported on here show about the same degree of sensitivity of the relativistic correction of the deuteron's moment to the type of interaction assumed between particles as has been obtained previously

(G. Breit. *Phys. Rev.*, 1947, 71, April 15) in simplified considerations with a single particle model. It is concluded, therefore, that one cannot be sure of estimates of relativistic corrections to approximately their whole magnitude and that even the sign of the correction cannot be considered as certain. Considerations regarding additivity of nuclear moments involving an accuracy of much better than .01 nuclear Bohr magneton appear to be obscured not only by the presence of relativistic corrections but also by the remoteness of sufficient knowledge concerning the interactions between particles which is essential for the determination of the effects of relativity.

This work was assisted by Contract N6ori-44, Task Order XVI of the Office of Naval Research.

The Physical Basis for the Use of Isotope Tracers in Biology and Medicine

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Some of the characteristics of radioactive isotopes which make their use so valuable in biological research are discussed. These include the ease of detection of extremely small quantities of certain of the isotopes, the rapidity of scanning a large number of samples for qualitative measurements, and the ability to trace a particular element (once tagged by being made radioactive) in the presence of large amounts of that same element. Certain limiting characteristics such as half-life, energy of the emitted particles, low specific activity, and physiological changes produced by the radiation of the labeled substances are presented. The stable isotopes are also considered in a similar manner, the extremely valuable characteristics as well as the limitations being given.

Production of Mutations in *Drosophila* by Treatment With Some Carcinogens

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Males of *Drosophila melanogaster* have a large supply of mature sperm in their testes. A method has been developed for treating these males with various chemicals by keeping them in an atmosphere containing an aerosol of a solution of the desired chemical. It has been found that by means of such treatment the sperm in the testes of exposed males may be reached and genetic changes in the sperm produced.

After the effect of aerosols of 19 chemicals had been tested without any detectable genetic change in the sperm, an aqueous aerosol of a nitrogen mustard—methyl-*bis*(β-chloroethyl)amine—was tried, because Auerbach and Robson had induced mutations by exposing *Drosophila* males to a vapor of that mustard. Results of the treatment with mustard aerosol were positive. Both mutations and chromosomal rearrangements were obtained. These results proved the effectiveness of the aerosol method.

Subsequent experiments with aerosols of four carcinogens (1,2,5,6-dibenzanthracene, methyl cholanthrene, benzpyrene, and β-naphthylamine) gave positive results. Experiments with dibenzanthracene have progressed far enough to show that this chemical induces both gene changes and breaks in chromosomes. The gene mutations are not specific. Analysis indicates that the affected genes are distributed at random along the X chromosome. The genetic effect of dibenzanthracene is very similar to the genetic effects induced by radiations (X-rays, ultraviolet, neutrons).

Up to the present time, mutations have been induced experimentally by radiations, mustards, and the four chemicals mentioned here. All known mutagenic agents that have been adequately tested are also carcinogenic. This close correlation between carcinogenicity and mutagenicity gives experimental support to the hypothesis that cancer may originate as a result of a mutation occurring in a somatic cell.

Solar Effects in Cosmic Rays

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During the past 10 years three unusual and sudden increases in cosmic ray intensity, lasting several hours, have been observed simultaneously in different parts of the world, except at the equator, where no increase was observed. All three increases began nearly simultaneously with unusually long and intense radio fadeouts and solar flares and were similar and simultaneous on the day and night sides of the earth. Magnetograms from several magnetic observatories indicate that the increase in cosmic ray intensity cannot be ascribed to changes in the earth's magnetic field. While such increases might be ascribed to changes in the sun's general magnetic field, which would permit more cosmic rays from outer space to reach the earth, such a mechanism should be equally effective whether the solar flare occurred on the front or back side of the sun. This, with other arguments, indicates that changing magnetic fields associated with a sunspot or flare may act as a magnetic accelerator for charged particles. Similar processes on stars might account for all cosmic rays.

Beneficial Mutations in Laboratary Strains of *Drosophila*

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Experimentally observed mutations are deleterious or, at best, neutral to their carriers. This seems to contradict the view that the process of mutation supplies the raw materials from which evolutionary changes are compounded. The contradiction is, however, spurious. Any mutation found in experiments has, presumably, arisen many times in the history of the species. A mutation that furthered the adaptation of a species to its normal habitat would have been selected and established as the "normal" or wild-type condition. To detect beneficial mutations, strains that carry deleterious genetic variants, which reduce the viability below normal, must be chosen as initial materials; in such strains, mutations that cancel the deleterious effects and bring the vigor and vitality back to normal may be expected to occur. This expectation has

been tested by observing the behavior of 7 strains of *Drosophila pseudoobscura* for 50 generations. The initial 7 strains were known to be homozygous for certain second or fourth chromosomes that reduced either the viability of the flies or their development rate, or both. The strains were kept in overpopulated cultures at 21°C. for 25 generations, and at 25½°C. for the following 25 generations. In one subline of each strain the male parents were given a treatment of 1,000 r-units of X-ray in each generation; the second subline was untreated. To test the changes in the viability and development rates, 410,784 flies were classified and counted. Improvements of the viability were observed in 5 of the untreated and in 6 of the X-ray-treated lines; in some of these lines, the improvements were quite striking. Speeding up of development rates was also observed in several strains. The behavior of the X-rayed and the untreated lines was, on the whole, similar, although irradiation is known to have induced many deleterious changes; such changes were eliminated by natural selection.

Studies on the Permeability of Mammalian Membranes

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The vascular system and placenta are discussed as examples of those membranes of mammals which have been studied in this laboratory by means of radioactive and stable isotopes.

When water tagged with heavy water, sodium, or chloride, each labeled with one of its radioactive isotopes, is injected intravenously into the guinea pig, the concentration of the labeled substance rapidly decreases in the blood plasma and is at equilibrium in less than 10 minutes. The loss of labeled substance with time follows a rather regular curve from animal to animal. This curve is fitted by a single exponential from which the normally occurring rate of loss of the water, sodium, and chloride of the plasma can readily be determined. We have been surprised by the extraordinarily rapid rate at which the water, chloride, and sodium of the plasma are exchanged through the walls of the blood vessels with water, chloride, and sodium of extravascular fluids. Water of plasma is exchanged at the rate of 140 per cent/minute; chloride, at the rate of 128 per cent/minute; and sodium, at the rate of 60 per cent/minute. From these values it is evident that the walls of the blood vessels are 2.3 times as permeable to water as to sodium and 2.1 times as permeable to chloride as to sodium.

The permeability of the placenta, *i.e.* the rate at which a substance reaches the embryo from the maternal blood stream across a unit weight of placenta, has been studied with heavy water and radioactive isotopes of sodium and phosphorus. The permeability increases markedly as pregnancy proceeds. In man, for example, the permeability to sodium increases about 70 times from the 9th to the 36th week of gestation. A reasonable explanation of this increase is to be found in changes in the microscopic anatomy of the placenta. The placenta of the guinea pig is about 10 times as permeable to water as to sodium and about twice as permeable to inorganic phosphate as to sodium. The embryo receives, on the average, about 300 times as much water across the placenta from the mother as is retained in its growth and about 50 times as much sodium, whereas the inorganic phosphate supplies little more than meets its needs.

It is to be remarked that observations of this kind could hardly have been made in any other way than by the use of the isotope technique.

A New Structure for Soap Micelles and the Polymerization of Rubber

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Solutions of soaps and other detergents have many remarkable properties which have been utilized in manifold ways, from the killing of bacteria to the preparation of fabrics and to cleansing. Several of these properties are of fundamental importance in the emulsion polymerization of rubber and other polymers in which aggregates of soap molecules known as micelles play a most important role. The size of these aggregates is not definitely known and has been the subject of much discussion for many years. For example, McBain considers that there are two types of micelles in aqueous solutions: (1) a small, spherical aggregate which is highly ionized, and (2) a "great," or lamellar, micelle which consists of a pile of double layers of soap. Recently, in the laboratory, R. W. Mattoon and R. S. Stearns have measured the thickness of soap micelles by a newly discovered X-ray band, and this, together with certain theoretical considerations, leads to the following picture:

A moderate number of soap molecules, possibly 100–200, at a certain definite, or critical, soap concentration, collect together in order to escape as much as possible from the water and yet remain inside it. In the case of an ordinary soap, the negative ions—for example, $C_{13}H_{27}COO^-$, if it is a myristate, consisting of the long paraffin chain $C_{13}H_{27}^-$ and the polar group COO^-—aggregate with the hydrocarbon chains lined up against each other in a double ionic layer. The polar COO^- groups turn toward the water and the hydrocarbon chains toward each other to make a double layer of soap molecules, which, with this particular soap, has a thickness, as determined by X-rays, of about 45 A.—twice the length of a molecule of potassium myristate. These micelles, or double layers of soap, possess the remarkable property that they dissolve excessively thin layers of oil from 6 to 15 A. thick between the ends of their hydrocarbon chains. In the synthesis of rubber this layer of oil consists of 25 per cent of styrene and 75 per cent of butadiene.

Thus, there is formed a two-dimensional solution which, for its third dimension, gives a thickness of only 15 A. This, under the action of a catalyst, polymerizes and gives rise to molecules of rubber. In cleansing the skin, a similar two-dimensional solution is formed from the oils of the skin. Part of the cleansing action of a soap is due to this property, known as solubilization, although much of it is due to the emulsifying action of the soap.

Recently, in work by M. L. Corrin, a new rapid and powerful method has been discovered for the emulsion of the critical concentration at which soap micelles aggregate. By the use of this method it has been found that in their formation the general principles involved in the behavior of aqueous solutions

of ordinary electrolytes, such as the principle of ionic strength and the Debye-Hückel relations, are entirely invalid. By the uses of changes in fluorescence of certain dyes it is found possible to determine the concentration of free soap in rubber latex, a quantity which is intimately related to the rate at which the polymerization of rubber and other polymers occurs.

Other interesting relations are involved.

The Use of Isotopic Carbon in Metabolism Studies

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A brief résumé on the use of isotopic carbon in the study of reactions involved in the conversion of lactic acid to glycogen is given and the role played by CO_2 in the reactions discussed. A method for producing glycogen *in vitro* and the preliminary results obtained from the use of the long-life carbon isotope, C^{14}, are presented.

Forces Between Polyatomic Molecules

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A number of the properties of liquids and solutions composed of nonpolar, polyatomic molecules obey rather well certain equations derived by the aid of models with spherical molecules and radical force fields; nevertheless, the volatility of species such as OsO_4, UF_6, and Ni $(CO)_4$ indicates that the buried atoms contribute but little to the molecular field and suggests that the peripheral atoms might well be considered as the main centers of attraction. This is tested by comparing the entropies of vaporization of liquids whose molecules differ considerably in size but whose peripheral atoms are identical. Pitzer has shown that two liquids should have the same entropy of vaporization when compared at temperatures where they have the same ratio of vapor to liquid volume, provided, among other things, that they have the same type of radial force field, as is the case with the rare gases. An approach free from this restriction leads to equality when the free volume in the liquid is substituted for the total liquid volume. Comparing in both ways chlorine with carbon tetrachloride and ethane with diisopropyl, the results are in favor of the nonradial field.

Modern Processes of Color Photography

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Photography in natural colors is not new, but until recently the processes by which color photographs could be made were difficult to practice, and their use was restricted, therefore, to a small number of experts. In all processes of color photography, three separate photographic images are recorded, each being formed by the light of approximately one-third of the visible spectrum, *i.e.* by red light, green light, and blue-violet light. These three recorded images are then reproduced as colored images formed in dyes, the image recorded by red light being printed in blue-green, that recorded by green light in magenta, and that recorded by blue-violet light in yellow dye.

Modern processes of color photography depend upon the use of films coated with three superposed photographic emulsions sensitive to the three colors by which the images are recorded. In processing, the three images are transformed into the three required dye images, and a direct color photograph results. This method of color photography was suggested about 40 years ago, but it was not until 1935 that it could be realized in practice, the first color film of this type being a 16-mm. motion-picture film for use by amateurs. This first film was soon followed by others suitable for use in amateur photography and for commercial photographs from which color pictures could be printed. Today almost all fields of photography employ the multilayer films.

The dyes that produce the color images either may be supplied from the processing solutions, in which case the processing must be done under rigid laboratory control, or couplers to form the dyes may be incorporated in the coated layers of the film, which can then be processed by a much simpler method. The films may be developed by reversal to give positive transparencies in color, or they may be developed to negatives from which color prints on paper may be made.

Algebraic Orthogonal Curves

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Three kinds of orthogonality for two algebraic curves in the plane are studied: (1) simple or *weak orthogonality*, where the curves are orthogonal at one point; (2) complete or *strong orthogonality*, where they are orthogonal at all points of intersection; and (3) *total orthogonality*, where the related families $\phi = a$, $\psi = b$ form an orthogonal network. Relation to hydrodynamics and function theory is discussed.

The Effect of Centrifugal Force on the EMF of Galvanic Cells

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When a simple galvanic cell of the type

$$\underset{r_1}{Pt} \; ; \; I_2, KI, I_2 \; ; \; \underset{r_2}{Pt}$$

is placed in a centrifugal field, with the electrodes at radii, r_1 and r_2, the resulting potentials, E, are given by the thermodynamic equation

$$EF = 2\pi^2 n^2 (r_1^2 - r_2^2) [t_K(M_{KI} - \bar{V}_{KI}\rho) - (M_I - \bar{V}_I\rho)]$$

in which F is the faraday; n^2, the rotational speed; t_K, the transference number of the positive ion constituent; M_{KI} and M_I, molecular weights; $\bar{V}_{KI}$ and $\bar{V}_I$, partial molal volumes; and ρ, the density of the solution. The measurements may be used to determine transference numbers and, it is expected, be useful for determinations in which other methods have failed, since the electrodes do not have to carry appreciable current. Early work on the method was carried out by T. des

Coudres (*Ann. Phys. Chem.*, 1893, **49**, 284) and R. C. Tolman (*Proc. Amer. Acad.*, 1910, **46**, 109).

To develop the method to yield accurate results it has been necessary to recognize and eliminate sources of error. The chief of these were found to be (a) oxygen in the solution and surroundings of the cell; (b) the colloidal particles in the solution which are thrown to one or both of the electrodes; and (c) temperature gradients in the cell.

The first of these errors has been eliminated by replacing the oxygen with nitrogen; the second, by ultrafiltration; and the third, mainly by causing the rotor to operate in a vacuum. High precision in the measurement and control of the speed has been attained.

Topological Methods in the Theory of Functions of a Complex Variable

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The study of harmonic functions u(x,y) by the method of investigation of the singularities of the level lines of u(x,y) can be extended to that class of functions which are termed pseudo harmonic and which are obtained from harmonic functions by a local 1-1 deformation of the (x,y) plane near any given point. This theory, carried over to the theory of functions f(z) of a single complex variable, permits the discovery of new theorems connecting the count of zeros, poles, and branch point antecedents of f in terms of topological characteristics of the boundary values of f.

Geographical Aspects of the Epidemiology of Poliomyelitis

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During the recent war years there have been opportunities for the epidemiological study of poliomyelitis as it has affected American soldiers and native populations in various parts of the world, such as North Africa, the Middle East, and the Far East. From this experience it appears that in certain countries where poliomyelitis had previously been regarded as uncommon, the disease was actually acquired by American troops at a far higher rate than at home. In most of these areas sanitation is primitive. Investigation of the areas has revealed that *epidemics* of poliomyelitis in the native population have been seldom recorded, although the prevalence of sporadic cases may not be particularly uncommon.

In areas such as the Middle East and Japan, where the disease is *endemic*, clinical aspects of poliomyelitis differ from those seen in the United States; a much younger age group is involved, and native *adult* cases are almost unknown. In other words, endemic poliomyelitis, as seen among natives in these areas, is comparable to the clinical disease as it existed in Europe, Scandinavia, and the United States prior to 1880.

Strains of poliomyelitis virus collected in North Africa, the Middle East, the Philippines, China, and Japan do not appear to be different from those isolated in the United States, although no adequate immunologic comparisons have been made.

Dielectric Heating

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In the applications of dielectric heating to various industrial processes, alternating frequencies between 1 and 30 megacycles, and rates of temperature rise of 50° F. and upward, are common. The properties of dielectric materials vary widely under these conditions, as must also the magnitude and character of the load on the source of high-frequency power. Methods so far proposed for the measurement of dielectric properties at high frequencies are commonly restricted to low electric stresses and constant temperature, and so are not available for a rapid heating cycle. The present paper describes a calorimetric substitution method for the measurement of power, dielectric constant, loss and power factors over the heating cycles of a well-known industrial process. Interesting variations of dielectric properties are revealed.

The Use of C^{13} and C^{14} in Studying Metabolism in Animals

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Some experiments of our own and others, involving the use of the carbon isotopes C^{13} and C^{14} in aiding to unravel details of fat and uric acid metabolism, are discussed. The theory of beta oxidation of long-chain fatty acids with recombination of the two carbon units to form acetoacetic acid (in liver) is believed to be proved.

Acetate and acetoacetate, products of fat metabolism, were found to be oxidized via the tricarboxylic acid cycle by which carbohydrates are oxidized.

Isotopic lactate, when fed to a phlorhizinized rat, caused a great increase in excretion of glucose although it contributed only a small part of its isotope. Ten per cent of the isotope of the lactate was found in the ketone bodies. Lactate had been changed to ketone bodies without first becoming fat.

Thus, we have shown how both fat and carbohydrate material can enter the metabolic pathways of each other.

Uric acid in pigeons has been shown to be formed from small units, one carbon being furnished by $NaHCO_3$, two others by the carboxyl group of acetic acid or formic acid, and two others by glycine.