THE NATIONAL ACADEMY OF SCIENCES

PAPERS PRESENTED AT THE WASHINGTON MEETING

AT the annual meeting of the National Academy of Sciences, held in Washington on April 25, 26 and 27, the following papers were presented:

The cure of drug addicts: WILDER D. BANCROFT, R. S. GUTSELL and J. E. RUTZLER, JR. Morphine coagulates albumin, and sodium rhodanate should therefore counteract the effects of morphine. We have shown that it does for rabbits, dogs and men. Since sodium rhodanate is said to increase the activity of the tuberculosis bacillus, sodium rhodanate should not be given to a tuberculosis patient. If a patient has taken morphine to minimize the pain from some such disease as cancer, there is nothing permanent to be gained by curing the drug habit unless one can alleviate the pain. From experiments on six patients we believe that it is possible to cure any drug addict who is not tuberculous, who does not have a weak heart, who does not suffer from a pain-producing disease and who really wants to be cured. This last is very important. If a man is down and out after the treatment, he will probably relapse. If he is a criminal addict and his friends take drugs, he will probably relapse. He will not relapse because of tremendous depression or an intense craving; and he can pull himself out again without much trouble if he wishes to. One patient did. While we believe that we have proved that it is not necessary for anybody without the special complications to remain a drug addict, we do not feel that the details of treatment are standardized. Our patients all have some delirium, which is probably unnecessary. Since many drug addicts have psychoses, it is also necessary to cure the psychosis, which means that this work is tied up with the treatment of the insane.

A study of van der Waals forces between tetrahalide molecules: J. H. HILDEBRAND and J. M. CARTER. A knowledge of van der Waals forces is essential to an understanding of many problems involving properties of gases, liquids and solids and the transitions between them. The approach of the authors is chiefly through the problem of solubility. In order to avoid dipole forces it was desired to investigate molecules of the highest possible symmetry, and for this the tetrahalides appeared most suitable, owing to the variety offered by their molecular sizes and fields. The authors have worked with the liquid tetrachlorides of carbon, titanium, silicon and tin and the tetrabromides of the last two. The properties thus far measured have been the expansion on mixing and the change in pressure with temperature at constant volume, the latter property for the six pure liquids and for eight of their mixtures. From this can be calculated the coefficient of energy with respect to volume, $(\partial E/\partial v)_T$. This is given with great accuracy for the range studied by the van der Waals function, a/v^2. The values of a are as follows, in atmospheres times liters squared: carbon tetrachloride, 31.21; silicon tetrachloride, 34.00; silicon tetrabromide, 53.36; titanium tetrachloride, 41.90; stannic chloride, 44.84; stannic bromide, 64.79. These values are only approximately simple functions of the molecular dimensions, even for the chlorides. Values for eight mixtures were measured and their relation to the values for the pure liquids discussed. The value of a between different molecules is given by the van der Waals relation $a_{12} = \sqrt{a_1 a_2}$ with a maximum disagreement of 2.2 per cent. However, the agreement between observed and calculated values for the solutions is better if the function $v(\partial E/\partial v)_T$ is regarded as additive. The maximum deviations for both relations as well as the maximum expansion on mixing is shown by the tetrachlorides of carbon and tin, although these do not represent extreme members of the series according to any of the properties considered. This is taken to indicate that the tin-halogen bond is more or less polar. The vapor pressures of these solutions are being measured in order to test theoretical connections between intermolecular forces and deviations from ideal solution laws.

Some new contributions to nucleic acid chemistry: P. A. LEVENE, R. S. TIPSON and S. A. HARRIS. The complex nucleic acids are composed of several nucleotides. Each nucleotide is, in turn, a glycoside of ribosephosphoric acid. A complete knowledge of their structure requires information as to the ring structure of the riboside and the location of the phosphoric acid radicle on the sugar. The first of these two problems has now been solved satisfactorily in the following way: Adenosine was acetylated and the acetyl derivative was methylated. The trimethyl ribose obtained from it differed in optical rotation and in other physical properties from the trimethyl-d-ribose derived from the normal-methyl-d-riboside and hence did not possess the pyranose structure. Furthermore, on rigorous oxidation it yielded (i)-dimethoxy succinic acid, thus establishing the furanose structure of the nucleoside. For the solution of the second problem it was necessary to find a method for partial hydrolysis of the nucleotides in a way which would yield ribosephosphoric acid. After many failures the following method was devised. Guanylic acid was converted by diazotization into xanthylic acid. The latter on standing in aqueous solution at its own pH at 50° yielded the desired substance. In the substance obtained in this manner the location of the phosphoric acid residue is restricted to one of two possible positions, namely, carbon atoms 2 or 3 of the sugar.

The chemical bond: GILBERT N. LEWIS.

Combination of carbon monoxide and oxygen under the influence of radon: S. C. LIND and CHARLES ROSENBLUM. When alpha particles traverse a gas or mixture of gases capable of reacting chemically under this in-

fluence, the amount of reaction is proportional to the ionization produced in the gas phase. It has been found that when a foreign gas is also present, its ions contribute to the amount of chemical action in the same degree as if they were ions of the reactant gas. Carbon dioxide, however, appeared to behave abnormally. In the oxidation of CO or CH_4 by oxygen, the CO_2 generated did not appear to contribute to, or disturb, the course of the reaction even when the quantity of CO_2 produced exceeded the quantity of the reactants by several fold. This abnormality has been examined by adding an excess of CO_2 to a mixture of $2CO + O_2$ before any reaction had taken place. It has been found that CO_2 ions do have an enhancing effect, but one that is only about 14.5 per cent. efficient. In addition, the effect of recoil atoms has been examined in this reaction. Its magnitude is that predicted from the synthesis of water by radon after taking into account the differences in stopping power, specific ionization and the fact that gaseous CO_2 does not condense like H_2O vapor and, therefore, serves to screen partially the recoil atom effect, thus diminishing its intensity. The influence of the size of the reaction vessels (spheres) has also been investigated with a result which confirms the law of the inverse square of the diameter which results from considering the linear paths of the alpha particles in small spheres and the pressure change produced by the chemical action.

The rediscovery of nitryl chloride: WILLIAM ALBERT NOYES. In 1862 Richard Müller gave an accurate description of the preparation, properties, analysis and determination of the vapor density of nitryl chloride, NO_2Cl. Several other chemists claimed that they had obtained the compound, but in 1905 Gutbier and Lohmann obtained only nitrosyl chloride, NOCl, in their attempts to repeat the work of former observers and came to the conclusion that the compound does not exist. During a study of the reaction between nitrogen tetroxide and nitrogen trichloride evidence was obtained indicating the presence of nitryl chloride among the products of the reaction. A repetition of some of the work of Richard Müller has also given a small amount of the compound.

Resonance of a molecule among several electronic structures: LINUS PAULING (introduced by A. A. Noyes). A study of energy relations and interatomic distances has shown that many molecules in the normal state can not be represented by a single electronic structure of the Lewis type, but instead resonate among several. The recognition of this phenomenon clarifies a number of previously puzzling points relative to the correlation and explanation of physical and chemical properties.

Experiments on the nature of the structural unit of metals: ALFRED STOCK (by invitation). On the electrolysis of solutions of the boron hydrides B_2H_6, B_4H_{10} and $B_{10}H_{14}$ in liquid ammonia. This work is a section of the investigations carried on for a number of decades, in Stock's laboratory, into the chemistry of boron. It was carried out by the high-vacuum method, whereby the substances come in contact with only glass and mercury, under the complete exclusion of air and moisture. The experiments showed definitely that the ammonia compounds of the above hydrides must be regarded as salts of ammonia, and the hydrides themselves as acids.

Biographical memoir of Edward Charles Pickering: HARLOW SHAPLEY. (Read by title.)

Biographical memoir of Solon Irving Bailey: HARLOW SHAPLEY. (Read by title.)

Biographical memoir of Frank Wigglesworth Clarke: L. M. DENNIS. (Read by title.)

Biographical memoir of Arthur Williams Wright: E. S. DANA. (Read by title.)

The racial element in human metabolism: FRANCIS G. BENEDICT. A recent survey of the metabolism measurements of Mayas in Yucatan, the pure-blooded aboriginals of the Kokata Tribe in South Australia, Tamils and Malayalis in Madras, and a group of American-born, pure-blooded Chinese girls in Boston has demonstrated clearly that wide differences in the heat production of these various groups exist. They can not be explained on account of size, and only in part by sex differences, and with due regard to all possible differences in dietetic habits and climatic conditions, the assumption of a definite racial factor is justified.

Experiments on the mode of infection and means of prevention of poliomyelitis: SIMON FLEXNER. The mode of infection is an essential problem always arising during epidemics. Means of prevention to be adopted correspond, as far as practicable, to the manner of infection. The prevailing view is that the virus of poliomyelitis enters and leaves the body in the nasopharyngeal secretions. This view is based (1) on the presence of virus in these secretions from patients and healthy carriers; and (2) the ready infection of monkeys by way of the nasal membranes. Other modes of infection may exist. One which has often been considered is the carriage of the virus by lower animals living in close relation to man. Wild rats and mice caught in the severely affected districts of Brooklyn, New York, during the epidemic of 1931, were free of virus, and virus introduced into them experimentally survived only a few days. The gastro-intestinal tract in monkeys is traversed by the virus either not at all or with great difficulty. Monkeys resisting virus feedings respond to nasal inoculation. The recovery of virus from the contents of the intestine and the mesenteric lymph nodes in man has been effected very rarely. The conclusions drawn from these observations are that the virus is confined to the human host, and its main portal of entry into and escape from the body is by way of the nasal membrane, in which structure it selects the nerves of smell, passing along these to and from the brain and spinal cord. Specific prevention of poliomyelitis in monkeys can be accomplished by

the use of blood serum from recovered human beings and from monkeys given the disease experimentally. Certain adult persons, not known to have had poliomyelitis, also yield protective blood sera. This prevention, by passive transfer of immunity, is, however, effective for relatively brief periods of time. An enduring active immunity can be produced in monkeys through inoculations of virus. The methods hitherto employed have been uncertain in their action, for in exceptional instances, they have been followed by paralysis. Active immunization has, therefore, never been undertaken in man. New experiments to be described have had for their purpose a refinement of the methods of inducing active immunity in monkeys. They have dealt also with the problem of variation of the virus under conditions of natural and artificial propagation.

The time of ovulation in the menstrual cycle: CARL G. HARTMAN (introduced by G. L. Streeter). Gynecological data point to the middle of the menstrual cycle as the time when ovulation takes place in women but indicate that ovulation is possible at any time, even during the menstrual flow. The latter conclusion is reached upon testimony which does not bear scientific scrutiny. The crucial evidence, however, is the recovery of the egg, now accomplished six times in the human and about thirty times in the monkey. In all these cases ovulation occurred between days 9 and 18 (counting the beginning of the flow as day 1). Furthermore, sixty ovulation days were determined by rectal palpation of the monkeys' ovaries; these all occurred between days 9 and 17. The average for man and monkey is about day 14.

Models showing accumulation in the steady state: W. J. V. OSTERHOUT and W. M. STANLEY. It is often stated that living cells contravene physical laws, since in the process of accumulation penetrating substances attain a higher concentration inside than outside and thus appear to diffuse inward against a gradient. As attempts to explain this by the Donnan principle have failed in the case of *Valonia* the hypothesis of the steady state has been formulated to explain what occurs. In order to see whether this hypothesis is in harmony with physico-chemical laws attempts have been made to imitate its chief features by means of a model. The model consists of a non-aqueous layer (representing the protoplasmic surface) placed between an alkaline aqueous phase (representing the external solution) and a more acid aqueous phase (representing the cell sap). The model reproduces most of the important features of the hypothesis. One important feature of the hypothesis is not seen in the model: this is the exchange of HCO_3 for Cl. Experiments on this point are in progress. Equations have been developed which enable us to predict the composition of the "artificial sap" in the steady state.

The concentrations of uric acid, sugar and phosphates in the glomerular urine of frogs, snakes and necturi: A. N. RICHARDS, ARTHUR M. WALKER and JAMES BORDLEY, III. Existing methods for the quantitative determination of substances have been adapted to the minute amounts of fluid which can be collected by micropipettes from the renal corpuscles of lower animals. The analyses indicate that the glomerular fluid has the composition of an ultrafiltrate of the blood plasma from which it is derived.

The implantation of the ovum in Macacus rhesus as compared with man: G. L. STREETER. Attention is called to three features that characterize the embedding of the human ovum. First of these is the superficial location of the site. The ovum does not penetrate deeply into the endometrium but just barely disappears under cover of the surface epithelium. On enlarging, it at once begins to bulge into the uterine cavity. The appearance of deep implantation results from transformation of the underlying endometrium. Secondly, the primary reaction of the endometrium is localized in the immediate vicinity of the ovum. And thirdly, there is marked reaction of the vascular system directly underlying the ovum resulting in large venous sinuses which spread around the ovum so that the latter, during this period, lies in an environment of relatively stagnant blood. The hemal environment is further added to by the destructive effect of the trophoblast upon the adjacent capillary walls, resulting in extravasations which promptly fill the trophoblastic lacunae, the precursors of the intervillous spaces. In the macaque similar principles prevail, though here the picture is somewhat altered, chiefly because of temporal difference in response of the endometrium and differentiation of ovum. The two opposing sites are definitely differentiated before the attachment of the ovum is completed. As in man, however, modifications in the capillary bed and subsequent communications between it and the trophoblastic lacunae establish the foundation of an intervillous circulation. This study is being made jointly with Dr. George B. Wislocki, of the Harvard Medical School, Boston.

Heredity of otosclerosis: CHARLES B. DAVENPORT. (Read by title.)

Critical geologic features of the Hoover Dam site: CHARLES P. BERKEY. Hoover Dam, because of its unprecedented height and the consequent exceptional physical changes that will be established by such a dam and reservoir, has required greater assurance than usual of satisfactory rock foundations and other geologic conditions. The great load calls for sound support and the increased water pressure tending to develop leakage and destructive attack emphasizes the importance of good petrographic quality. There must be provision also for the handling of flood waters in emergency through tunnels of enormous size, and this raises a question concerning stability under construction and danger to the workmen. Selection of the site in Black Canyon instead of Boulder Canyon was determined largely by its more favorable geologic conditions, including depth and cross-section of the gorge. The foundation rock is sound, essentially impervious, not badly jointed, is virtually free from constituents susceptible to ready attack by water, and comparatively resistant to destructive weathering. Such a fortunate combination of natural features

is seldom found in a region of so complex geologic history. The actual conditions thus far revealed at the present stage of construction tend to confirm the anticipated behavior. In addition to the special requirements at the dam site, there are equally critical features connected with the impounded water and its delivery. The heavy load of silt, tending by its accumulation in the reservoir to reduce its storage capacity; the salt deposits of the basin, tending to contaminate the water; the shifting sands of the dune belt crossed by the All-American canal, tending to obstruct its flow—all present problems that have had to be taken into account. The discussion is devoted to the relation between these geologic features and the plan and execution of the project.

1932 International Expedition to the West Indies. Marine geology: RICHARD M. FIELD (introduced by William Bowie). The purpose of the 1932 International Expedition to the West Indies was to determine whether a geological study of an oceanic area might yield results which would appreciably advance our knowledge of geological processes and subcrustal conditions. The decision to make this effort was strengthened by fundamental investigations by Dr. F. A. Vening-Meinesz in the East Indies and his 1928 expedition in the Gulf and Caribbean. The expedition, which completed its program at Miami on March 19, is also in a measure the result of a number of oceanographic investigations in the region of the Bahamas and neighboring waters, beginning with the cruise of the *Wild Duck*, directed by Alexander Agassiz, and ending with the series of Princeton expeditions initiated in 1927. The results of the 1929 expedition to the Bahamas are already in print or are in the course of publication, the latest paper being "The Microbiological Precipitation of Calcium Carbonate in the Tropical Sea." Following the 1929 expedition, it became obvious that the related problems presented by the region covered such a wide field of geological and biological research that an International Council was formed for the further investigation of these West Indian problems. Since it was felt that, at present, the fundamental question was the relation of the structure and stability of the islands to the origin, migration and alteration of the sediments which mantle their surfaces, the 1932 expedition was planned as a geophysical survey to provide further data as to the submarine topography and related subcrustal conditions affecting the local intensity of gravity. The expedition was made possible principally through the cooperation of Dr. Meinesz, the British Government, the United States Navy and the U. S. Coast and Geodetic Survey. Four thousand miles of sonic soundings have been made and sixty-six gravity stations determined (fifty-four at sea and twelve on the islands). The submarine profiles are already available, and a number of the gravity stations have been computed. Upon the completion of the isostatic reductions, a chart will be issued by the Hydrographic Office of the United States Navy which will show not only the results of the 1932 expedition but also all the geophysical data, including seismic epicenters, for the entire Gulf and Caribbean region and contiguous continental areas. It is expected that this chart will be available for distribution early this summer. The full report on the 1932 gravimetric survey (marine unit) will be published by the Hydrographic Office of the United States Navy.

The reports of the Princeton University expeditions to Patagonia: W. B. SCOTT.

Two types of sex determination in dioecious strains of maize: R. A. EMERSON. In some organisms the male is the heterogametic sex, producing two kinds of sperm, and the female is homogametic, producing only one kind of egg, with respect to sex determination. In other forms the male is homogametic and the female heterogametic. To the first group belong flies, man, certain fishes and some dioecious plants. To the second group belong moths, birds and certain fishes. Recently Jones has reported a dioecious strain of maize in which the male is the heterogametic sex. Using somewhat different material, I have synthesized two dioecious strains of maize, the male of one strain and the female of the other being the heterogametic sex. The male type used in producing these strains is what is known as barren stalk, *ba*, a simple Mendelian recessive having normal anther-producing tassels but no ear shoots. The female types employed are known as tassel-seed, producing seeds not only on the ear but also in the tassel to the exclusion of anthers. One of these, ts_1, is a simple Mendelian recessive and the other, Ts_2, is a simple dominant. These strains maintain an approximately 50–50 numerical relation between the sexes as do most dioecious species of plants and animals. Moreover, the known linkage relations of the heterozygous genetic factors of one strain make it readily possible to demonstrate typical sex linkage of certain common maize characters.

(*To be concluded*)

BOOKS RECEIVED

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