over calcium in an animal will produce tetany.

H.[7] Narcotics lower the metabolism of nervous tissue.

I. Sodium increases the permeability of cell while calcium lowers it.

This hypothesis affords an explanation of the make and break of contact at the synapses. The contact is broken so far as conductivity is concerned, when the lipin phase is on the outside, that is, when it is continuous. The contact is made when the water phase is on the outside.

This changing of the phases of the water-lipin two phase system will also account for many other little understood phenomena of other living cells and brings into coordination many isolated facts in the field of biology.

If experiments which are now being conducted in this laboratory bear out the above hypothesis it will be of great value to those interested in the manufacture of synthetic drugs. It will give the neuro pathologist a real basis on which to work. But, still more important, it will give to the experimental psychologists the physical basis for nerve impulse for which they have been searching without success and will establish psychology as a truly natural science.

J. S. HUGHES
H. H. KING

DEPARTMENT OF CHEMISTRY
KANSAS STATE AGRICULTURAL COLLEGE

THE NATIONAL ACADEMY OF SCIENCES

THE annual meeting of the National Academy of Sciences was held in Washington on April 23, 24 and 25, when the following scientific program was presented:

AFTERNOON SESSION

Important mammals and reptiles recently discovered by the Third Asiatic Expedition in the heart of Mongolia, and their significance: H. F. OSBORN.

Asiatic relationships of American Pliocene faunas: J. C. MERRIAM.

Preliminary report on the life zones of Ecuador: DR. FRANK M. CHAPMAN. A study of the results of the field work in Ecuador, extending over a period of ten years, confirms previous conclusions in regard to the zonal distribution of bird-life based on similar data from Colombia. Both the character of the avifauna and the altitude of zones in southwestern Ecuador have, however, been strongly affected by a branch of the Humboldt current which washed the Ecuador coast north to about 1 degree S. lat. Four life-zones exist in Ecuador between sea-level and snow-line, a tropical, subtropical, temperate and paramo. The tropical zone in eastern Ecuador is wholly humid and composes the Ecuadorian portion of the Amazonian fauna. The tropical zone in western Ecuador contains two strikingly unlike faunas, one of which is humid and of northern, the other of which is arid and of southeastern origin. The more northern, extending southward on the coast to about 30 degrees S. lat., is the southern end of the Colombian-Pacific fauna which occupies the tropical zone of western Colombia and eastern Panama. For the more southern part of the tropical zone of western Ecuador, the name equatorial arid fauna is proposed. Climatically, this is a transition area between the humid coastal region of Colombia and northwestern Ecuador, and the arid coastal area of Peru and northern Chile. The collections of Noble and explorations now in progress by Watkins for the American Museum indicate the important discovery that the characteristic bird-life of this fauna has been derived from the valley of the Maranon with which it has been faunally connected at a very recent period. The bird-life of the entire western, or Pacific portion of the tropical zone, is believed to be, geographically, of post-Andean origin. The subtropical zone, or zone of mountain rain-forest, lies between the altitudes of 4,000 to 5,000 and 8,000 to 9,000 feet on the eastern slope of the Andes, but on the southwestern slope the lower temperature produced by the Humboldt current brings the inferior limits of this zone locally down to 1,200 feet above the sea. The temperate zone has well-defined humid and arid divisions. The former includes the upper forested areas on both slopes of the Andes. The latter is contained in the treeless interandine tableland. Like the subtropical it reaches a lower altitude in southwestern Ecuador than in other parts of the republic, and in western Peru it actually falls to sea-level. The fourth, or paramo zone, lies between the upper limits of the temperate zone and the lower limits of snow. On the outer slopes of the Andes the trees of the upper margin of the humid temperate zone border the treeless slopes of the lower limits of the paramo zone. The bird-life of the former includes ar-

[7] Shiro Tashiro, "A chemical sign of life," 1917.

boreal species presumably derived from tree-haunting, tropical ancestors. That of the latter is composed of terrestrial species, most of which have apparently come from the plains of the south temperate zone. The birds of tropical ancestry are, however, much more widely differentiated than those which originated in the south temperate zone, indicating that the degree of differentiation is related to the extent of environmental change rather than its distance from the place of origin.

Studies of the larger tertiary foraminifera from tropical and subtropical America: T. WAYLAND VAUGHAN. For more than a year I have been principally engaged on an investigation of the tertiary larger foraminifera of America in order to make more secure the basis of certain geologic correlations, to extend the correlation ring in the Caribbean region, and to work out in more detail the morphological features of the species of several genera, especially the genus *Lepidocyclina* and its allies. Some of the results of these investigations will be reported.

Interrelationships of the higher invertebrates: A. H. CLARK (introduced by L. O. HOWARD).

Recent discoveries of ancient man in Europe: ALEŠ HRDLIČKA. Under a grant from the Joseph Henry Fund of the National Academy of Sciences and upon conclusion of his work as chairman of the American delegation to the twentieth International Congress of Americanists at Rio de Janeiro, Dr. Aleš Hrdlička proceeded to Europe to examine the more recent discoveries of skeletal remains of early man and several of the most important sites where these discoveries have been made. In this quest Dr. Hrdlička visited Spain, France, Germany, Moravia and England. The important specimens studied included the jaw of Banolas in Spain; the La Quina site and specimens in southern France; the La Ferrassie skeletons, now beautifully restored, in Paris; the Obercassel finds in Brno; the Ehringsdorf discoveries and site at Weimar and at Ehringsdorf; the Taubach site near a village of that name, with the specimens at Jena; and the principal Predmost skeletons now preserved in the Provincial Museum at Brno, as well as the site of these important discoveries at Predmost (in northern Moravia) itself. In addition to these, thanks to the courtesy of Dr. Smith Woodward, Dr. Hrdlička was enabled to submit to a thorough study the Piltdown remains at the British Museum of Natural History and to see there the originals of the Boskop skull as well as the highly interesting Rhodesian skull and parts of skeleton from South Africa. He was finally once more able to see, at the Royal College of Surgeons, London, the originals of the Galley Hill and Ipswich skeletal remains. The examination of the specimens and the visits to the sites where most of them were discovered produced a deep impression on the one hand of the growing importance as well as complexity of the whole subject, and on the other of the vast amount of the deposits in western and central Europe bearing remains of early man and giving great promise for the future. It was also once more forcibly impressed upon the mind of the observer how much more satisfactory is the handling of the original specimens than of even the best made casts. So far as the scientific results of the trip are concerned, Dr. Hrdlička feels confident that he was able to reach a definite conclusion and position as to the human nature of the Piltdown jaw; and to satisfy himself on the more or less intermediate nature, between Neanderthal and the present type of man, of the Obercassel, the Predmost and some other crania; and to see the admirable restorations of both the La Ferrassie and the very important La Quina discoveries, the latter including the highly interesting and, so far as ancient remains of man are concerned, unique specimen of a skull of a child. Plaster casts of nearly all the important specimens not yet represented in the U. S. National Museum were obtained for the institution.

Heredity of body build: C. B. DAVENPORT. Body build is measured as chest circumference in relation to stature. If data concerning chest circumference are absent and weight is known the closest relation to the relative chest girth index is that obtained in adults by dividing weight by the square of stature. Build varies physiologically from birth to maturity. Relative chest girth is about two thirds stature in the infant, declines to 47 per cent. of stature at 12 or 13 years of age and rises on the average to about 53 per cent. in the third decade of life. Stature becomes more variable from infancy to adolescence and then declines in variability into the third decade of life. An analysis of various types of mating of parents of known build with known grandparents leads to the conclusion that fleshy build usually depends upon two or more gametic factors, although there is a type of heavy build that depends upon only one. In general, it is concluded that build depends on multiple factors and that the factors that make for heavy build are dominant over their absence or those which make for slender build. The evidence for this conclusion rests upon relatively small regression in the offspring of very slender parents, as compared with very fleshy ones,

the relatively greater variability of the offspring of fleshy parents as compared with slender ones and various findings in the first and second filial generations from matings of parents with dissimilar build.

Parasitism and evolution: CHARLES A. KOFOID. The digestive tracts of termites or white ants are crowded with teeming hordes of microscopic parasites belonging to the flagellated protozoans distantly related to those found in the blood of cattle in the tsetse fly disease and to those occurring in the diarrheas of mammals, including man. These parasites occur only in those white ants which eat wood and have the power in association with bacteria to hydrolyse the wood. These parasites live in this fluid, which is viscous. The striking thing about the more than a hundred kinds of parasites found in the termites is the fact that they have undergone an evolutionary development of an order of magnitude which in diversity of structures developed and degree of progress attained outruns a hundred fold that which their free-living ancestry and most of their parasitic relations have attained elsewhere. These parasites live compactly crowded together and are ceaselessly moving and rubbing each other. Their evolutionary development consists in an extraordinary increase in number and structural complexity of the nervous and locomotor organs apparently in response to the specialized parasitic type of life in a viscous medium. The organs most stimulated by this mode of life have evolved to a degree without parallel elsewhere in the group to which they belong. The result is the evolution of a number of orthogenetic series of increasingly complex species along diverse lines in each of which a number of the successive steps are still preserved. These animals seem to lack entirely the power of sexual reproduction and therefore may not utilize the advantages arising from the Mendelian laws of genetics. The parasitic environment, the viscous medium in which they live, and the excessive functioning of certain organs are the tools which nature has used in moulding the evolution of these strangely developed organisms. The fact that the neuromotor system, which is so excessively developed in them, is directly and continuously connected with the nucleus, the carrier of hereditary qualities, is significant in this connection.

The nature of resistance to cereal seedling blight: J. G. DICKSON (introduced by L. T. Jones).

Ancient high-level potholes near the Colorado River: F. L. RANSOME. Black Canyon is a narrow and deep gorge cut by the Colorado through a series of andesitic lavas a few miles south of the point where the river turns from a general westerly course to flow nearly due south to the Gulf of California. At the request of the U. S. Reclamation Service, the canyon was examined late in 1922 with a view to determining its suitability from a geological point of view as the site of a high dam. The topography of the canyon suggests that it was rapidly cut in late geological time. Certain faults, that is, fissures, along which there has been movement of the rock on one side relatively to the rock on the other side, appear in the canyon walls. The character of these faults suggests that no recent movement has taken place along them. It is important that the rocks at a dam site should have practical immobility. Accordingly additional evidence was sought to show that the faults are not now active. This was found in the occurrence of typical water-worn potholes and smooth channels, worn in hard andesite, on the brink of the gorge, about nine hundred feet above the present water surface. These were the work of the Colorado before it cut Black Canyon. Some of the smooth channels were cut across one of the faults exposed in the canyon walls. As the channels have not been dislocated it is evident that there has been no movement on this particular fault during the time occupied by the river in cutting down nine hundred feet. The excellent state of preservation of the potholes corroborates the conclusion drawn from other evidence that the cutting of the gorge was, in a geological sense, a rapid process.

The evidence of recent tectonic movement within an area of the western Pacific: W. H. HOBBS (introduced by H. S. Washington).

Geological overthrust and underdrag: W. M. DAVIS.

The marginal belts of the Coral Seas: W. M. DAVIS.

EVENING SESSION

Address: *Résumé of results obtained by the Crocker eclipse expeditions from Lick Observatory:* DR. W. W. CAMPBELL, Auditorium, U. S. National Museum.

TUESDAY, APRIL 24

MORNING SESSION

Symmetric tensors of the second order whose first covariant derivatives are zero: L. P. EISENHART.

Birational transformations simplifying singularities of algebraic curves: GILBERT AMES BLISS. There is a famous old theorem in the theory of algebraic curves which states that every such curve can be transformed by a birational transformation into one which has no singularities

except double points with distinct tangents. The theorem is not a simple one to demonstrate, and many of the proofs which have been given are incomplete or inaccurate. In a preceding paper, to appear in the *Bulletin* of the American Mathematical Society, the author has commented upon these proofs and has signalized two of them as being especially interesting. One is by Walker, who developed an alteration, suggested by Klein in 1894, of a method originally devised by Bertini for the projective plane. In the second, by Hensel and Landsberg, reasoning proposed by Kronecker in 1881 is extended to apply to curves in the function-theoretic plane. Both of these proofs are lengthy and complicated when all the details are taken into consideration. In the present paper the author has remodeled the method of Kronecker so that it can be applied to both planes, and has attained what he hopes will be regarded as simpler proofs of the two theorems.

On the approximate solution in integers of a set of equations of the first degree. Second paper: H. F. BLICHFELDT. To the theorem read by the author at the meeting of the academy on April 26, 1921, is now added the following: Let $F_1, F_2, \ldots, F_{n-1}$ represent $n - 1$ linear and homogeneous expressions in n unknowns $x_1, x_2, \ldots, x_n$, of such a nature that no set of numbers $c_1, c_2, \ldots$ (not all $= 0$) exist for which $c_1F_1 + \ldots + c_{n-1}F_{n-1}$ would be rational in all the coefficients of $x_1, x_2, \ldots, x_n$; furthermore, let there be given a set of n numbers $b_1, b_2, \ldots, b_{n-1}, \varepsilon$. Then integers exist which, when substituted for the unknowns $x_1, \ldots$, will solve the equations $F_1 = b_1 \ldots, F_{n-1} = b_{n-1}$ approximately, the errors being all less than ε in absolute value. Moreover, the product of the errors is less than N/R, where N is a certain number depending only upon the coefficients in $F_1, \ldots, F_{n-1}$ and $R = \sqrt{(x_1^2 + x_2^2 + \ldots + x_n^2)}$.

Properties of path curves in the Einstein theory: E. KASNER. If a family of curves is given at random it will not usually be possible to obtain a Weyl geometry (or more specially an Einstein geometry) in which the curves are the paths of natural motion. A necessary (and for the Weyl geometry a sufficient) purely geometric condition is obtained in Professor Kasner's paper. If the curves are represented in any way in euclidean space the orthogenal projections of the curves touching a given plane at a given point have their centers of curvature on a cubic curve of special type (the given point is a conjugate point with the minimal lines as tangents).

The synthesis of new cinchophen (atophan) types: M. T. BOGERT.

The synthesis of new rose alcohols of geraniol type: E. M. SLOCUM and M. T. BOGERT.

Researches in the thiazole field: M. T. BOGERT.

The exchange of oxygen and carbonic acid between blood and air (illustrated): L. J. HENDERSON.

The relative physiological action of various kinds of protein: D. L. RAPPORT (introduced by Graham Lusk).

The components of amplified nerve action currents demonstrated by means of the cathode ray oscillograph: JOSEPH ERLANGER and H. S. GASSER. Action currents of mixed nerves recorded by this method are shown to be compounded of two or more waves of potential originating simultaneously at the site of stimulation, but propagated at different rates.

Recent problems in radiation: R. W. WOOD.

The limit of accuracy in optical measurement: A. A. MICHELSON.

Tracks of alpha particles: W. D. HARKINS.

Isotopes and atomic stability: W. D. HARKINS.

AFTERNOON SESSION

A study of motions in double stars: H. N. RUSSELL.

Irregularities in spectroscopic binary orbital curves: H. D. CURTIS.

The trigonometric parallaxes of 350 stars determined by photography with the 26-inch McCormick refractor: S. A. MITCHELL (introduced by C. G. Abbot).

Some results of the Yale photographic meteor campaign: C. P. OLIVIER (introduced by Frank Schlesinger).

Pressures at the sun's surface: H. N. RUSSELL and J. Q. STEWART.

The solar prelude of an unusual winter: C. G. ABBOT and colleagues. Does the sun's variation influence the weather? If so, the year 1922 and following months ought to show it. The general mean of "solar constant" values determined by my colleagues and myself at the two Smithsonian Institution solar observing stations, Mount Harqua Hala, Arizona, and Mount Montezuma, Chile, are given below. These observations cover all months from October, 1920, to September, 1922. The extraordinary drop of solar values during 1922 at once is apparent. It is confirmed at both stations. The general mean of solar constant values, in calories, was: October, 1920, 1.943; November, 1.949; December, 1.955; January, 1921, 1.958; February, 1.951; March, 1.946; April, 1.947; May, 1.949; June, 1.934; July, 1.945; August, 1.936; September, 1.944; October, 1.947; November, 1.954; December, 1.951; January, 1922, 1.945; February, 1.946; March, 1.934;

April, 1.927; May, 1.927; June, 1.917; July, 1.911; August, 1.917; September, 1.907. A tabulation of the mean monthly values for the past four years, as determined at Calama alone to July, 1920, and thereafter at Montezuma and Harqua Hala, would show prevailingly high solar constant values until 1922, usually exceeding the normal solar constant value of about 1.94 calories as we have determined it. The figures show that nothing so outstanding as the change of 1922 to low values has occurred in all that interval. Indeed, nothing so marked has occurred since we began these observations in 1905, so far as our Mount Wilson work can show. That work, however, was fragmentary. Low solar radiation values continued to prevail in later months of 1922 and early months of 1923, as results yet unpublished will show. A full account of the individual values here summarized may be found in Volume IV of the Annals of the Astrophysical Observatory of the Smithsonian Institution, supplemented by a forthcoming detailed publication to appear as a supplement of the U. S. Weather Bureau's *Monthly Weather Review*. All this being so, has anything unusual occurred in weather conditions which may have been connected with solar changes? We are not to look for anything so simple as a general drop of temperatures all over the world. Oceans, deserts, mountains, clouds and winds make up too complex a system for such simple reactions. Profound departures of some sort from normal conditions, however, we might expect. It will be recalled that the prevailing characteristic of the weather of the United States for the last couple of years or more is a condition generally warmer than normal. Thus from the summary for 1921, U. S. Weather Bureau, Climatological Data: "The outstanding feature of the year was the unusually warm weather in nearly every month. The annual mean temperature was 66.3 degrees, or 2.7 degrees above the normal, making it the warmest year since the beginning of the state-wide records." The monthly reports for 1922, while less pronounced in this sense, indicate warmer than normal conditions on the whole. We start, then, with an excess of heat. Quoting now from "Climatological Data": "The record of December, 1922, shows unusual contrasts as to the temperature and precipitation in different parts of the country. In the southeast it was the warmest or almost the warmest December for thirty years or more, while in the far northwest it was the coldest December in a like period. The precipitation over Tennessee, Mississippi and considerable parts of the states adjoining was about as great as ever yet recorded there in December, while an area centering in Kansas had no precipitation or practically none."

Note on the visible radiation from germanium oxide and on its melting point: E. L. NICHOLS. In the experiments to be described the oxide, mounted on an alundum block, was treated in an oxy-hydrogen flame. The brightness of three regions of the spectrum—red, green and blue—was measured at intervals of about fifty degrees throughout the range from a red heat to the point of fusion. Germanium oxide does not have the remarkable property first noted by Ch. Fery in certain other oxides, and recently studied in some detail by Dr. Howes, the present writer, of radiating selectively at certain temperatures with intensities greatly in excess of the corresponding "black body" brightness. Its departures from normal radiation are, however, very striking. At the lowest stages of incandescence the red is almost absent (at 700 degrees C. less than one per cent. of black body brightness), whereas the blue nearly equals the blue in the spectrum of a "black body" of that temperature. At 1,200 degrees C. the reverse is true, *i. e.*, the blue of the spectrum is less than one per cent. of "black body" brightness and the red equals the corresponding intensity of the "black body." The oxide is therefore *blue* at the "red heat" and *ruddy* when "white hot." At an intermediate temperature of about 1,050 degrees the radiation is non-selective—having the distribution of a black body spectrum and an intensity of about forty per cent. At 1,400 degrees C. the beginnings of fusion became apparent in the field of the optical pyrometer and until more precise measurements are available that temperature may be taken as the approximate *melting point* of *germanium oxide.*

Electric conduction: E. B. WILSON. According to the free electron theory of electrical conduction the conductivity is proportional to the number of free electrons per cubic centimeter. According to a theory recently developed in a series of papers presented to the National Academy and published in their proceedings, Dr. E. H. Hall has proposed to take into account not only the free electrons but the residual charged atoms from which the electrons have departed. He finds that the major part of the conductivity appears to be due to the behavior of these residual positively charged atoms instead of to the free electrons. On the free electron theory it is reasonable to suppose that a negatively charged conductor might be very slightly more conducting than in the neutral state. On Hall's theory it is reasonable to suppose that a negatively charged conductor should be slightly less conducting than in

the neutral state. Professor Henry Perkins, of Trinity College, working in Langevin's laboratory last year, found (albeit with a very delicate experiment) that apparently a negatively charged conductor became less conducting and a positively charged conductor more conducting. If this experiment should be substantiated it would seem to be additional support for Hall's theory. Professor Wilson discusses the matter theoretically.

The quasi-equation $P = T\frac{dV}{d'T}$: EDWIN H. HALL. The P is the Peltier effect, the V is the Volta effect. Lord Kelvin, to whom the equation, if it can be called such, is due, found that it was very far from being verified by experimental evidence and concluded that something had been over-looked in the argument. Compton's experiments (*Physical Review*, Vol. 7, 1916, p. 209) on nickel and iron made the ratio of the two sides of the equation about fifty. The paper now offered will propose an amendment, on theoretical grounds, making the two members much more nearly equal.

The thermal conductivity of metals under tension: P. W. BRIDGMAN.

The transfer of radiation momentum in quanta to matter: WILLIAM DUANE.

Further experiments on the mass of the electric carrier in metals: RICHARD C. TOLMAN. The production of an electromotive force by the acceleration of a metallic conductor was apparently demonstrated by the work of Tolman and Stewart, by measuring the pulse of electric current produced by suddenly stopping a coil of wire rotating around its axis. The purpose of the work described in the present article has been twofold. In the first place it seemed desirable to obtain a new demonstration of this production of an electromotive force by the acceleration of a metal, using some method of attack as different as possible from that of Tolman and Stewart, in order to increase our certainty as to the reality of the effect. In the second place, it seemed desirable to try to find a method which would eliminate direct electrical connections between moving and stationary parts and would avoid the sudden stopping of a coil of wire, with the attendant chance of irregular electromotive forces due to buckling or slipping of the wire. The apparatus finally used consisted of a copper cylinder 9⅛ inches long, 4 inches outside diameter and 3 inches inside diameter, oscillating about its axis with a frequency of 18.9 cycles per second. Surrounding this copper cylinder was a coil containing about 60 miles of No. 38 copper wire (diam. 0.1 m.m.), which acted as the secondary of a transformer. Connection from this secondary was made through a specially designed three stage amplifier with a vibration galvanometer. The tendency of the electrons in the oscillating copper cylinder to lag behind because of their inertia leads to an electromotive force, the effects of which were finally measured by the deflection of the vibration galvanometer. These galvanometer deflections were then compared with those produced by the known electromotive force accompanying transverse oscillation of the cylinder in such a way as to cut the earth's magnetic field.

"Permalloy," a supermagnetic material: H. D. ARNOLD AND G. W. ELMEN. This material, an alloy of nickel and iron, is more easily magnetized than any previously known, its susceptibility in weak fields being many times that of the best soft iron or silicon steel. Because of its extraordinary magnetic permeability it has been given the name "permalloy." The sensitiveness of its magnetic and related properties to heat treatment and to mechanical control adds to its scientific interest. In the electrical arts and especially in telephony and telegraphy it promises great advances, among which is a revolutionary change in submarine cables.

Some recent measurements of Trans-Atlantic radio transmission: RALPH BROWN. During the winter of 1922-23, measurements have been made in London of signals received from the radio station at Rocky Point, Long Island, U. S. A. The transmission was at a wave length of 5,300 meters (frequency 57,000 cycles per sec.) using a continuous wave. In London the measuring apparatus determined the absolute value of the electric field of the received radiation. The electric field of the radiation was also measured at a point in New Jersey to get a check on the amount of radiation sent out. Curves are given showing the typical daily variation of the transmission during January, February and March, 1923. The data are the most complete of their kind yet published.

New telegraph alphabet: GEORGE O. SQUIER. From these measurements it was possible to calculate the ratio of mass to charge for the electric carrier in copper. Within the limits of experimental error this ratio was found to be the same as that for an electron in free space.

Biographical memoir of Harmon Northrup Morse: IRA REMSEN (by title).

Biographical memoir of Samuel James Meltzer: W. H. HOWELL (by title).

Biographical memoir of Alexander Smith: W. A. NOYES (by title).

Biographical memoir of J. C. Branner: R. A. F. PENROSE, JR. (introduced by C. D. Walcott) (by title).