tion of steam vessels, which carried their supply of water in closed tanks, the breeding of mosquitoes on board ship no longer went on, and steamships did not carry the disease from port to port. The incubation period of the disease is short, five or six days, and as the voyage from yellow fever ports to the United States was usually longer than that, the danger of its introduction of the disease rapidly diminished.

With the introduction of air travel, the whole situation changed, the duration of the voyage was so shortened that persons could arrive from the yellow fever regions within the incubation period of the disease, and we know that the person who is first taken sick after arrival in Miami might infect the local mosquitoes before any one was aware of the danger. Furthermore, a mosquito in nature probably has a life span of about three weeks, and during that time it can carry the disease up to the last day of its life. The carriage of mosquitoes by airships thus becomes a problem of first importance. I will return to this aspect of the problem later.

The number of cases of yellow fever reported from the regions where it is constantly present is always small, and yet we know that cases must be constantly present or the disease would die out. There must be many mild cases which give no characteristic symptoms, and as a result of field and laboratory studies a method was discovered by which one could reach a decision regarding the diagnosis of mild cases, and we found as a result of extensive studies that most cases of yellow fever are mild; they are diagnosed as headache, malaria, influenza and many other things, yet the protection test, with yellow fever virus, and the patient's blood serum indicated that the patient, no matter how mild the attack, was now immune as a result of a mild infection. This being true an extensive survey was planned of the yellow fever area in the Americas and in Africa. As a result of those studies, it is now possible to draw maps showing the extent of the disease in the two regions. These show that the infection has not occurred in recent years in the United States, Mexico, Central America or on the West Coast of South America. On the other hand, they show that it is still present in the Amazon Valley, particularly the upper valley, and that the region includes parts of Colombia, Equador, Peru and Bolivia as well as Brazil. On the African continent, it prevails along the West Coast from Dakar south almost to Portuguese East Africa, and extends inland almost to the borders of Ethiopia. It involves the southern part of Senegal and the Anglo-Egyptian Soudan, and the area extends south to include the upper half of the Belgian Congo.

Both the South American and the African regions, where the disease is endemic, are traversed by air travel routes, and the time of the journey is within the incubation period of the disease. We know, therefore, that the possibility exists of again introducing the disease into Southern Europe and the Southern States, but with this knowledge we can act intelligently and introduce safeguards in air traveling.

Strangely enough, Europe, which has always regarded Yellow Jack as an American disease in which it had no interest, has now become very much alive to the danger, and the Colonial powers and the League of Nations are awake to the need for proper safeguards for air travel from Africa to Europe. In the Americas, the Public Health Service has already taken measures in cooperation with the South American republics to insure safety.

I cite these things to serve as an example of the work which was done by various governments and voluntary organizations in the control of one of the world's most dreaded plagues. Work of this sort, as you see, can and must ignore political boundaries, and the results can only be obtained as a result of understanding between the workers of different nations who all have a common objective, of conquering a plague and providing better conditions for the nationals of many different countries. The work is done by many persons, and of course they all deserve credit, and in a gracious way you have recognized this, in the setting up of the Marcellus Hartley medal, which you have granted me this year, and which I am delighted to accept, with the feeling that in granting it you recognize the merit of the many persons who have shared in the work and that I am merely a symbol for cooperative, scientific effort to improve the condition of mankind through the application to human welfare, of whatever scientific truths and methods that are possible.

Again, Mr. President, I thank you for the honor and for this opportunity of speaking for my coworkers.

FREDERICK F. RUSSELL

ABSTRACTS OF PAPERS PRESENTED AT THE WASHINGTON MEETING OF THE NATIONAL ACADEMY OF SCIENCES

Torsion of rectangular tubes: WILLIAM HOVGAARD. The stresses in tubes subject to torsion are generally determined on the basis of a hydrodynamical analogy first pointed out by Lord Kelvin or by means of a membrane analogy developed by Prandtl. For thin-walled tubes an approximate solution was worked out by Bredt, applying Stokes's theorem. The shearing stresses are conceived to flow in the manner of an ideal fluid as a

steady stream around the tube between the inner and outer contours of the walls. If the walls are of uniform thickness the stresses are the same everywhere except quite locally at the re-entrant corners, and a minor difference exists between the stresses at the inner and outer contours. The experiments described in this paper were made to test the correctness of this theory. Several drawn steel tubes were tested; the angles of torsion were accurately determined and the strains were measured with Huggenberger tensometers. While most of the strains were taken on the external surface of the tubes, internal strains were measured in one of them. The observed angle of torsion was found to be in fair agreement with the theory, but the stresses departed widely from it. Generally, on the external surface of the tubes, there was one maximum at the center line and one near the edges of each wall, all considerably higher than the theoretical stress. The internal strain measurements revealed the fact that along the central part of the sides the shearing stress was much smaller than it should be according to theory, and at points near the sides, but still at a good distance from the re-entrant corners, the stress distribution was very erratic. The most important phenomenon was that breakdown of the tubes occurred when the theoretical shearing stress was still far below the yield point in shearing of the material. It seemed clear that at this low value of the theoretical stress extensive regions of plastic flow must have existed somewhere, probably in the vicinity of the corners. Evidently the theory does not give a true picture of the stress distribution and may lead in certain cases to a dangerous underestimate of the stresses.

Conformal and equilong symmetry: EDWARD KASNER. Conformal transformations preserve or reverse angles and are connected with functions of a complex variable $x \pm i\,y$, where $i^2 = -1$. Equilong transformations preserve or reverse distances and are connected with functions of a dual variable $u \pm j\,v$, where $j^2 = 0$. If we are given any analytic curve C, there is a unique reverse conformal transformation S, which leaves fixed the points of C, and also a unique reverse equilong transformation S^1, which leaves fixed the lines of C. We define S as conformal symmetry (or Schwarzian reflexion), and S^1 as equilong symmetry (a new operation). When C is given the direct construction of S^1 is easy (by means of ordinary symmetry in the parallel tangent lines); but the real construction of S is extremely difficult and is accomplished in this paper by successive approximations using the normals to the curve and the curvature and higher derivatives of the curvature of all orders.

By means of S and S^1 the bisection of a given curvilinear horn angle is defined in two distinct ways, thus giving a unique conformal and a unique equilong bisector. In the latter case all the metric invariants take values midway between the given values; in the former case this is true only for the first three invariants. In each case the two sides of the angle are symmetric with respect to the bisecting curve.

The groups generated by all symmetries are discussed for both theories. Thus the decomposition of complicated conformal and equilong transformations into a finite number of symmetries is accomplished. (For the conformal theory see *Amer. Jour. Math.*, vol. 38 (1916) pp. 177–184).

Abstract equilibrium theory: MARSTON MORSE. Questions of the nature and existence of equilibria are to the fore in economics, biology, physics and mathematics, the latter discipline abstracting and completing ideas that arise in the other fields. In economics in particular, there has been much confusion in the formulation of the basic problems. One finds equilibrium defined as stable equilibrium, ignoring the fact that in general there are at least as many different kinds of equilibria, that is, as many different types of stability and instability as there are variables involved. In historical physics there has been an almost mystical preference for principles of least action, the minimum representing one of types of stability, but there has not been a clear-cut analysis of equilibria in general and a recognition that the so-called minimum principles are in general not effectively associated with minima. By studying equilibria both locally and in the large, the author has developed a theory which is bound to be one of the principal tools of non-linear analysis of the future. A problem proposed by Poincaré in connection with his studies in celestial mechanics, but not solved by him, has been solved by a use of the author's theory. The present studies of the author are in the direction of universalizing his methods. Various other names might be applied to these studies—"Analysis in the large," "Functional Topology" and, in particular, "Calculus of Variations in the large." The results now available enable one to work with curves and configurations in general as if they were point elements in an abstract space and have one set of principles applicable to all. Group theory is the bone, topology the flesh and analysis the superficial exterior in the composition of this theory.

On the problem of stability in dynamics: GEORGE D. BIRKHOFF. It has been shown by the author that the general formally stable motion of a dynamic system is either ultimately unstable or is surrounded by an infinite succession of zones of instability. In the present note the author gives further reasons leading to the conclusion that the general case must be that of actual instability. If this conclusion be applied to an idealized solar system, it would mean that ultimate instability is highly probable. However, this instability would only arise after enormous lapses of time.

Problems of closest approximation in two variables: DUNHAM JACKSON. In papers read before the American Mathematical Society the writer has presented theorems specifying upper bounds for the magnitude of polynomials and trigonometric sums normalized with respect to a given weight function, and corresponding inequalities relating to the approximate representation of functions of a single real variable. The present paper contains results of similar character for functions of two variables. While the extension is immediate in some of its aspects, it also introduces new considerations which

give the problem in two variables a degree of interest for its own sake.

Equilibrium between excitation and ionization in a high pressure discharge: FRED L. MOHLER (introduced by W. W. Coblentz). Measurements of intensities of line emission spectra and of reversal temperatures of absorption lines in a columnar cesium discharge show that at pressures above 70 μ the population of all states of the S,P,D and F series beyond the second or third term have a temperature distribution. On the basis of the intensity of the continuous spectrum and probe measurements under low pressure conditions one can obtain values for the number of ions and electrons per cubic centimeter in the discharge at higher pressures. Substitution of these numbers in Saha's equation gives a value of T which comes out to be the same as the reversal temperature found for higher series lines under the same discharge conditions. There is evidence that probe measurements are systematically in error at high pressure.

Scattering of slow neutrons: ALLAN C. G. MITCHELL (introduced by S. A. Mitchell). Fermi has shown that neutrons which have been slowed down by collisions with hydrogen nuclei, in substances such as paraffin, have a greater probability of being captured by certain atomic nuclei such as boron, cadmium and silver than fast ones. Others have measured the absorption coefficients of slow neutrons in various substances and found large variations in atomic absorption coefficient from one element to the next. To decide whether the large absorption cross sections determined in these experiments are due to capture of the neutron or to scattering we have measured the scattering of slow neutrons from some thirteen elements distributed throughout the periodic table. The experiments give the relative scattering cross-section and also some indication as to the ratio of scattering to capture. We have shown that, for those elements exhibiting anomalously large absorption coefficients, the probability of capture is great and that of scattering is small. This is not in agreement with the original theory proposed to explain the large capture cross-sections, but is in agreement with the more recent theory of Breit and Wigner. Finally, evidence has been found for selective absorption and scattering for the different groups of neutrons found by Fermi.

The transmutation of platinum by deuterons: E. O. LAWRENCE and J. M. CORK. One of the noteworthy results of recent investigations in our laboratory is the production of radioactive forms of many of the elements high in the periodic table, by bombardment with five million volt deuterons. Platinum was chosen first for careful study because of its chemical properties, which are favorable to the reduction of contaminating effects. Chemical separations of the elements in the bombarded platinum targets showed that radioactive isotopes of both iridium and platinum are formed. Radio-iridium probably is the product in a reaction in which the deuteron is captured by the platinum nucleus and an alpha particle is emitted. On the other hand, the production of radio-platinum involves only neutron capture. The transmutation function, *i.e.*, the probability of the nuclear reaction as a function of the energy of the bombarding deuteron, exhibits several maxima and these are interpreted as evidence of resonance penetration of the deuterons into the platinum nucleus.

Systematic determination of wave-lengths and intensities of the spectral lines of the chemical elements: GEORGE R. HARRISON (introduced by K. T. Compton). The analysis of complex atomic spectra has been retarded by an insufficiency of accurate data on the wave-lengths and intensities of the lines emitted by the chemical elements. Several million measurements on more than a million spectrum lines in the range 10,000 to 200 Angstroms are needed, accurate to 1 part in 5,000,000 or better as to wave-length, and with objective intensity determinations. A comprehensive program is now under way with these ends in view, utilizing recently developed automatic wave-length measuring, computing and recording machinery which expedites the obtaining of data by from 20 to 200 times, and increases accuracy several fold. More than 3,000 twenty-inch spectrograms, at dispersion of 0.4 A/mm, of the arc spectra of the more complex atoms have already been obtained and measured. Thirty-four foot and 21-foot Wood concave gratings are being used in the air and vacuum regions, respectively, both having 30,000 lines per inch. The wave-lengths and intensities, which are recorded directly on motion picture film by the machine, are being tabulated, correlated and averaged by a staff of 60 WPA workers. Wave-length data on any elements will be supplied as obtained to any qualified investigator wishing it for analysis of spectra. It is desired to check as many of the wave-lengths as possible by the combination principle before publication.

New radioactivity detection technique applied to the study of radium poisoning: ROBLEY D. EVANS (introduced by J. C. Slater). Radium poisoning is the result of the fixation in the human skeleton of one or more micrograms of radium, following intravenous injection or oral administration of radium or other radioactive salts. The physical problems involve the determination of the total amount of radium fixed in the skeleton and of the actual amount of radium removed from the skeleton by treatment. That part of the body radium which yields radon expired in the breath is determined by emanation analysis of the breath. The remainder, and larger fraction, of the body radium disintegrates *in situ* into lead and, in passing through the radium C state, emits penetrating gamma radiation. This gamma radiation from the body is accurately measured by the use of a new type of screen-cathode quantum counter, which is from 10 to 100 times as sensitive as the electroscopes formerly employed for such tests. The instrument has detected radium in at least one fatal case, which had been erroneously reported as negative by repeated electroscopic tests elsewhere. This increased sensitivity also permits measurements at a distance of a meter or more from the patient. Under these conditions geometrical simplifications permit the direct determination of the radium C in

the patient, without the use of an artificially activated cadaver or of post-mortem analysis of previously measured victims, for calibration purposes. The amount of radium removed from the patient by treatment is determined by direct analysis of the feces and urine, either by the radon technique with double ionization chamber detection or in some cases by direct gamma ray analysis with quantum-counters. In collaboration with Dr. J. C. Aub, of the Huntington Memorial Hospital, Harvard University, extensive studies of a typical case of radium poisoning have been made, and a treatment developed which has given interesting results. These will be briefly discussed. The development of the quantum-counters used in this investigation is supported by a grant from the American Philosophical Society.

Changing direct current to alternating current by means of thyratrons: ALBERT W. HULL. The use of direct current rather than alternating for transmission of electric power has many well-recognized advantages, but has been considered impractical for lack of a satisfactory method of changing the high voltage direct current into alternating current at the end of the line, for distribution to customers. The Research Laboratory of the General Electric Company has, for several years, been studying the application of thyratrons to this problem of changing direct current to alternating current. The study has progressed to the point where its scientific aspects may be reported. Although our developmental studies included the use of constant voltage, it was found that the problem, at least for the present, could be greatly simplified by using electric circuits which maintain *constant current* in the line, allowing the voltage between line and ground, rather than the current, to vary with load. A short-circuit under these conditions reduces the flow of power and does no harm to either tubes or circuit. This type of circuit not only facilitated research, by making it permissible to produce failures at will in order to study their effects; but proved to have many practical advantages. An extensive study has been made of the mutual effects of tubes and circuit. One of the most important discoveries is a circuit condition such that inverter tubes will immediately resume operation, generally within one cycle, after a failure of either tubes or circuit. Circuit conditions for high voltage operation have been investigated. It is found that the maximum voltage at which tubes will operate is inversely proportional to the current which they carry. With the tubes available at present, this limit is 15,000 volts at 200 amperes. A rectifier unit using twelve such Phanotron tubes is required, to change 200 amperes of alternating current to 200 amperes direct current at 30,000 volts; and a similar unit using twelve Thyratron tubes to change it back to alternating current. The tests indicate that the voltage of this unit may be doubled, trebled, etc., by using two, three, etc., tubes in series in place of one; and that the units themselves may be connected in series to give any desired voltage. The life of tubes is found to depend upon the circuit, which determines the velocity, and hence the destructiveness, of impacts of positive ions upon the anode. Circuit conditions have been found which minimize this effect, and promise a tube life of adequate length.

Cosmic rays at high altitudes on two sides of the world in the equatorial belt: R. A. MILLIKAN, H. V. NEHER and SERGE KORFF. Automatic Neher recording cosmic-ray electroscopes have been carried in a considerable series of flights made on both sides of the earth, one group in Peru, the other in Manila, up to altitudes some of which reach two thirds of the way to the top of the atmosphere. In Peru in a latitude only a degree removed from the magnetic equator at an altitude of 29,000 feet, where the pressure is but 3.3 meters of water, or 32 per cent. of its sea-level value, the ionization within a closed electroscope at 1 atmosphere is 18 times its value at sea level and amounts in absolute measure to 49 ions per cc per second. In Manila, in essentially the same magnetic latitude, it is practically the same—a few per cent. lower on account of the longitude effect. This longitude effect is certainly no larger—as measured in percentage—apparently somewhat smaller at these high altitudes, than at sea level. On both sides of the earth in the equatorial belt the ionization rises essentially exponentially with altitude, the apparent coefficient of absorption being $\mu = 0.50$ per meter of water. The only notable difference between the curves picturing the ionization as a function of altitude in the equatorial belt as contrasted with the same curves in the temperate and polar zones up to these altitudes is that in the latter zones the apparent coefficient of absorption is $\mu = 0.55$ per meter of water instead of $\mu = 0.50$ per meter of water, its value in the equatorial belt. These facts remove the most cogent arguments that have recently been used for the assumed great predominance of the electronic over the photonic component of the cosmic rays as they enter the earth's magnetic field. In the present state of our ignorance, however, they do not in themselves entirely remove the possibility of assuming, as some have wished to do, that the incoming rays consist only of charged particles. They merely render this assumption one of considerably less probable validity.

Preliminary study of temperature effects of short solar fluctuations: C. G. ABBOT. Solar radiation stations 7,000 miles apart in opposite hemispheres agree, indicating day-to-day changes of the sun's output of radiation. These fluctuations frequently fall in sequences of several days' duration, when the sun's radiation increases or decreases. The range of such changes is seldom greater than 1 per cent. All such occasions, indicated as of fair probability of reality in the years 1924 to 1930, inclusive, were selected from the recorded solar constant observations of the Smithsonian station at Montezuma, Chile. The departures of temperature from the normal at Washington, from the initiation of each such solar change till 16 days thereafter, have been tabulated. These departures are computed from recorded means of maximum and minimum temperatures. It was expected that if real temperature changes were disclosed by the tabulation, they would be in opposite senses depending on whether the solar sequences were rising or falling. It was also expected that if real temperature effects were disclosed they

would vary with the season of the year, because the atmospheric paths followed by meteorological disturbances are changeable. Accordingly, tabulations of the temperature march were made for each month of the year separately, and separately for rising and falling solar radiation sequences. The results are shown in slides. They show that the solar variation is a major weather factor. They indicate a real opposition of temperature marches for all months of the year. The effects are surprisingly large. They are of the order of 5° F. at maximum for 0.5 per cent. change in solar radiation.

Periodogram analysis of rainfall of the Pacific Coast: DINSMORE ALTER (introduced by Robert J. Trumpler). The present paper discusses briefly the methods of periodogram analyses and applies one of these to the rainfall of two sections of the Pacific Coast. It is the first of a series in which, in so far as data are available, the coast will be examined from Alaska to the Canal Zone. The sections examined here are western Washington and the northern third of California. Only stations west of the foothills of the Coast Range have been included. The results show very definitely cycles of such length that it is impossible to discard an hypothesis of solar influence. In western Washington a fundamental cycle of 220 months is exhibited with its third harmonic very strong. When divided into thirds, the periodogram shows that the minor maxima match excellently and indicate that a short cycle has been continuously present in addition to the long cycle. For northern California the periodogram is more striking than in the former case, both in regard to the amplitude of the cycle that is found and the regularity of the pattern exhibited. The author believes the results to be incapable of interpretation as accidental, but wishes to stress the fact that at present they have no economic application. Any solution of the problem of long-range forecasting is in the future.

Periodic departures of the motion of minor planets of the Hecuba group from prediction with the Berkeley tables of perturbations: A. O. LEUSCHNER, SOPHIA H. LEVY, CLAUDE M. ANDERSON and BARBARA P. RIGGS. Contrary to expectation, observations of the minor planet (175) Andromache in the 1935 opposition showed large departures from the positions predicted on the basis of mean elements and perturbations based on the Berkeley tables. The elements used were the original mean elements derived with the tables from Berberich's elements osculating in 1877 after their correction by a least squares solution on the basis of oppositions extending from 1894 to 1907. A study of the available comparisons between theory and observation from 1877 to 1935 on the uncorrected mean elements and tables revealed that the planet departed from prediction periodically, the period of variation being that of the planet. After introducing the necessary additional terms in the perturbations of Andromache, the discrepancies were removed. The question arose as to whether the departures were peculiar to Andromache for which the heliocentric perturbations in mean anomaly have undergone so far a change of nearly 50°, the largest hitherto encountered, or whether they are inherent in the tables. A study of the departures for other minor planets of the Hecuba group shows similar periodic departures, though less pronounced, depending in magnitude on the perturbations themselves. It is, therefore, evident that the Berkeley Tables of perturbations for the Hecuba group have to be extended to include terms which hitherto have been considered inappreciable. For the present the necessary correction of the perturbations is being made empirically for individual planets, without correcting the original elements. This investigation demonstrates that elements should not be corrected unless all appreciable perturbations have been taken into consideration.

Selective absorption of starlight by interstellar clouds: FREDERICK H. SEARES. The colors of 454 stars, mostly between magnitudes 10 and 13.5, have been studied from the standpoint of selective absorption produced by interstellar clouds. The stars are in 30 different fields (Selected Areas of Kapteyn), covering a wide range in distance from the Milky Way. The criterion for selective absorption is an excess of color over that inferred from the spectral types of the stars (stars redder than normal). The observed colors (color indices) were obtained from photographic and photovisual magnitudes, all on the international system; inferred colors were derived from a relation between color index and spectral type established for regions far from the Milky Way and hence but slightly affected by absorption. The mean values of the color excess for groups of eight or ten stars show the following characteristics: (1) All fields within the zone of avoidance for extra-galactic nebulae or in regions of partial obscuration as outlined by Hubble's counts of nebulae (15 fields in all) include groups of stars showing a conspicuous color excess. (2) Eight fields beyond the well-marked region of partial obscuration also show color excess, smaller in amount but in most cases apparently definite. A sporadic region of low nebular density occurs within a few degrees of each of these fields. (3) Nineteen fields include stars which are normal in color: 8 are the fields referred to in (2), 7 are unobscured, 2 are partially obscured and 2 are within the zone of avoidance for extra-galactic nebulae. (4) Fields showing an excess of color often include stars that are normal. For example, 12 of the 23 fields under (1) and (2) also occur in (3). (5) The mean color excess for 185 stars in 23 fields is 0.5 mag., with a maximum of 0.8 mag. for a group of 13 stars in Selected Area 40, midway between α Cygni and the North America Nebula. Ninety-nine additional stars in 10 of these fields show a mean color excess of 0.2 mag. The average color excess for the 19 groups of normal color (170 stars) is $\pm$ 0.05 mag. (6) Color excess increases as the galactic latitude of the fields decreases, but the data are too scanty to justify a discussion of the relation of color to either latitude or longitude. Closely related to the foregoing results are the following: (a) For color indices on the international system the zero point of the relation between color index and spectral type is such that for A0 stars in unobscured regions the color index is -0.14 mag., with an uncertainty of perhaps 0.03 or 0.04 mag. (b) For 271 stars north of 80° declination

(Draper Catalogue spectra) the spectrum-color relation gives for A0 a color index of −0.04 mag. (c) Comparison of (a) and (b) indicates for the brighter stars within the polar cap (galactic latitudes 18° to 38°) a *mean* color excess of approximately a tenth of a magnitude. The region includes dark nebulosity and is deficient in extragalactic nebulae.

Results of the Yale photographic meteor work, 1893–1909: CHARLES P. OLIVIER (introduced by Frank Schlesinger). The study of meteors by photography was carried on for a long period at Yale Observatory by Dr. W. L. Elkin. Much of the material had been reduced by him when his failing health intervened. By mutual agreement both data and computations were turned over to C. P. Olivier in 1922 for discussion and completion. This paper presents the results. Elkin devised and successfully used apparatus for photographing meteors. By having two stations occupied, he obtained simultaneous observations which permitted accurate determinations of the meteor's radiant and heights in our atmosphere. From plates made with a rotating wheel in front of the camera, the linear velocity of the meteor at different heights could be determined, and its actual orbit in space could be computed. About 125 trails were recorded, and measurements of them were made with a high degree of accuracy. The calculations of heights, velocities and radiants were only partly carried out by Elkin before ill health forced him to stop work, and he was unable to undertake a general discussion of results. Olivier undertook to finish the computations, and then to extend and discuss the results in view of advances made in meteoric astronomy during the intervening thirteen years. Methods were devised to test both the accuracy of the data and the suitability of Elkin's formulae for the purposes for which they were employed. Some of the results were made more concordant by handling the data in a different manner. Elkin's work, excellent in general plan, was by far the best of its kind completed up to 1909, and in fact it has not yet been equaled. A number of valuable results have been derived from it. It would have been more successful had the stations been farther apart, and it is now obvious that the plates were measured with a higher degree of accuracy than the average trail permitted. These and other facts lead to a partial modification of some of the widely-quoted tentative conclusions published by Elkin in 1900 on the basis of the earlier data. A similar program carried out in a clearer climate, with modern cameras, would yield results of great importance.

The underlying causes of submarine canyons: FRANCIS P. SHEPARD (introduced by William Bowie). Investigations of submarine canyons carried on for a number of years with the cooperation of the Coast and Geodetic Survey, the Geological Society of America, Scripps Institution and other organizations have revealed that these sea-floor canyons have all the characteristics of river canyons and are distinctly different from fault valleys. Also tests of the idea that the submarine canyons might be the product of currents have produced negative results so that they have evidently been cut by rivers. The significance of this sub-aerial erosion on the present sea floor is particularly disturbing, since the submarine canyons extend out to depths of from 2,000 to as much as 10,000 feet and are found off practically every coast of the world. Also all available evidence favors a Pleistocene age for the canyons. Accordingly, there is the implication that the coasts of the world were greatly elevated above their present positions during the glacial period. That all the continental margins both off stable and unstable coasts could have been subjected to such movements in comparatively recent times is scarcely credible. The alternative that there have been sea-level changes connected with the cause seems much more reasonable. Such changes are indicated not only by the submarine canyons but also by many of the phenomena of coral reefs and by oceanographic data from various parts of the world. The only cause of sea-level change which does not meet with almost insurmountable objections is that of glacial control. It seems quite possible that the continental glaciers during some of the earlier glacial epochs may have been sufficiently thick and sufficiently extended to have allowed a lowering of 3,000 feet or more. While such a lowering was probably insufficient to account for the deeper canyons it is felt that it would have resulted in the development of a universal canyon system which, connecting with much older sunken canyons in some places and modified by subsequent sinking elsewhere, would account for the present situation.

Correlation of erosion surfaces in southwestern Wisconsin: DOUGLAS JOHNSON and ROBERT E. BATES. The upland of southwestern Wisconsin, excluding the Baraboo region, consists of a submaturely dissected plateau underlain by Paleozoic formations that dip gently southward. It is characterized by numerous broad, flat summit areas, limited to the crests of cuestas and the principal divides, and by more extensive flat areas at slightly lower elevations between the cuesta crests and along the larger streams. Geologists have differed widely in their interpretation of these forms, some holding that two peneplane surfaces are represented, others recognizing but one, while still others find stripped surfaces of resistant formations but no peneplane surface. Projected profiles[1] of the region show that the crests of the three cuestas developed on the Prairie du Chien, the Platteville-Galena and the Niagaran are distinctly beveled by the broad, flat summit areas. These areas are, therefore, interpreted as peneplane remnants. Most of the lower parts of the upland coincide with the structure to such degree that they seem better interpreted as stripped structural surfaces rather than as peneplane remnants. Since all the areas beveling the structure can be included in one surface of low relief, it is concluded that one peneplane, but only one, the Dodgeville, is required to explain the present topography. This conclusion is of interest in connection with studies of Appalachian erosion surfaces which seem to demonstrate the existence of (1) one major peneplane of Tertiary age (the Schooley peneplane), (2) parts of several resurrected peneplanes of more ancient date, and (3) two or possibly three partial peneplanes of late Tertiary or

[1] Made possible in part by a grant from the Marsh Fund of the National Academy of Sciences.

subsequent date. Definite correlation of the Dodgeville peneplane in southwestern Wisconsin with its correlative in the Appalachian area must await further study. In the meantime we observe that results of the Wisconsin study, like those carried out in the Appalachians, confirm former wide-spread base-leveling, but are opposed to the indefinite multiplication of erosion cycles advocated by some investigators.

The system, albite-fayalite: N. L. BOWEN and J. F. SCHAIRER. The study of the system, albite-fayalite, is a first step in the investigation of phase equilibrium in mixtures of alkali alumino-silicates with ferrous silicates. The system is of the simple eutectic type, the eutectic composition at 84 per cent. albite and its temperature 1050° ± 5° C. Albite, that most reluctant of crystallizers, readily forms typical twinned crystals in mixtures of this system. Among natural rocks fayalite trachytes and related types (fayalite-bearing rocks rich in albite) are of wide-spread occurrence, though not abundant, and the investigation of which this is a part is designed to throw light upon the thermodynamic properties of these mineral associations and upon the problem of their genesis. In connection with the hypothesis of their derivation through fractional crystallization the albite-rich character of the eutectic is of particular significance.

Stolon-systems of communication between the equatorial chambers of orbitoidal foraminifera: T. WAYLAND VAUGHAN. The orbitoid foraminifera range in age from Upper Cretaceous to lower Miocene and are of much value in solving problems of geological correlation. Their tests are composed of three layers of chambers, a median or equatorial layer, on each side of which there are lateral chambers, usually more numerous over the center and less numerous toward the periphery. There are no canals. The roofs and floors of both the equatorial and lateral chambers are pierced by cribriform perforations and there are stolons through the walls between chambers. The arrangement of the stolons connecting the equatorial chambers presents different plans which apparently are of phylogenetic and taxonomic significance. These features can now be readily studied by a method of impregnation with Canada balsam, with subsequent decalcification, developed by Hofker. Although it would be premature to claim that all the systems of the stolon-communication between the equatorial chambers have been recognized, the following may be enumerated: (1) Four-stolon system: Stolons at two places on each side of each chamber (recognized by H. Douvillé in *Orbitoides,* and by Whipple, Vaughan, and van der Geyn and van der Vlerk in other genera and subgenera). (2) Stolon system rather indefinite: Three, four or more stolons between chambers, some of them through the lateral walls of the chambers, others radial in position. Example, *Clypeorbis mamillata* (Schlumberger), for which I have recently established the presence of stolons. (3) Five- or six-stolon system: Stolons as in number 1, but with a radial stolon through the proximal or the distal wall of a chamber or through both walls. This system when complete is a six-stolon system. I have just found this arrangement in two species of *Helicolepidina.* The presence of radial stolons in *Polylepidina proteiformis* Vaughan suggests that similar stolons may occur in other genera and subgenera classified under number 1. (4) Six-stolon system: Two oblique stolons passing through the chamber walls at four places and an annular stolon passing through the chamber walls at two places. This arrangement was worked out in *Lepidocyclina mantelli* (Morton) by Carpenter and published in 1862. Recently Whipple, Tan Sin Hok, van de Geyn and van der Vlerk, and I have added other species to this category. I have just found that in both the Upper Cretaceous species *Lepidorbitoides socialis* (Leymerie) and *Lepidorbitoides minor* (Schlumberger) there are six stolons. (5) Eight-stolon system: Similar to number 4 but with a radial stolon across both the proximal and the distal chamber walls. This arrangement has just been found by me in *Lepidocyclina yurnagunensis* Cushman. (6) The stolon systems of *Miogypsina* and *Miolepidocyclina* have also been studied, but as these genera probably should be removed from the Orbitoididae, they will not be considered here. As a result of studies of the stolon systems of the Orbitoididae changes in the classification of the foraminifera referred to that group appear to be necessary, and such changes are now under consideration. Names proposed by van de Geyn and van der Vlerk to replace earlier names proposed by H. Douvillé and myself are invalid.

The helium method applied to Pre-Cambrian chronology problems: WILLIAM D. URRY. In collaboration with the National Research Council Committee on the Measurement of Geologic Time, the radioactive disintegration helium method has been applied to the basic igneous rocks. In the helium method the accumulating end-product, helium, is measured in place of the lead in the more familiar lead method. A post-Keweenawan to Pliocene geochronological scale set-up from some sixty results by the helium method is found to be in general agreement with the lead method results and ages on the basis of sediments. The helium method has the advantage of applicability to all fresh basic igneous rocks, with a possible extension to other types of rocks, compared to the sporadic occurrence of radioactive minerals necessary for lead method determinations. The question now arises as to how far the method can be applied to the Pre-Cambrian rocks. To test such an application, the geochronological sequence in the Horne mine, Noranda, Quebec, has been studied from the latest dikes in the area, now correlated with the Keweenawan on the basis of the helium method, to the Keewatin Andesite. Similarly, the Sudbury Nickel Irruptive is placed in the middle Keweenawan, and with a dating of the fresh olivine diabase dikes in the Sudbury area it should be possible to determine the chronological position of the Killarnean Revolution more accurately than is known at present. Other terrains studied which indicate the applicability of the method to the Pre-Cambrian are the Huronian Gogebic Range in Northern Michigan, the Beltian and the Great Bear Lake region. It is concluded that the method can be applied to the Pre-Cambrian terrains at least back to the Keewatin.

The hot spring problem in Yellowstone Park: ARTHUR L. DAY. The problem of the Yellowstone hot springs is intimately related to earlier volcanic activity. We are concerned to-day with the origin of the continuing heat supply, the origin of the water supply, the water circulation, the magmatic gases and their corrosive action upon the rocks, the age of the geysers and the theory of their operation, and finally, what mineral matter is deposited and what is carried away by the circulating water. The studies which will be described have covered a period of seven years, including four winter seasons. The geysers do not "freeze up" in winter, even at temperatures of 40° or more below zero. They continue in action with little change in heat or volume of water, though the surrounding country may be covered with 6 to 10 feet of snow. During this period a new geyser of magnificent proportions (since named the Imperial) has burst forth, has erupted twice daily for more than a year with an immense volume of water and then has suddenly died out and become again a quiet warm spring. Also, for the first time in Yellowstone Park, two borings have been made for information of the actual conditions below ground. In one of these a temperature of 205°C. and a steam pressure of more than 300 pounds was developed at a depth of 250 feet. This indicates an enormous store of energy. Dissolved mineral matter carried away daily amounts to as much as 390 tons, although no more than 5 per cent. of Yellowstone Park water is hot.

The quantitative index of resemblance in geographic distribution: HARRY H. LAUGHLIN (introduced by A. F. Blakeslee). In its simplest and most useful form a correlation index is a single value, less than 1.0000, which measures the degree of resemblance between two sets of measured qualities in one set of individuals or between two sets of individuals in reference to one measured quality. When such resemblance is very high, if the index is properly based, the correlation measure approaches 1.0000; it reaches 1.0000 when the statistical interdependence is perfect. When there is absolutely no such interdependence, other than that caused by chance, the measure of correlation equals 0.0000. When measured correlation runs high the investigator is justified in looking for causal relationships. Thus the coefficient or index of correlation is a very valuable tool in research. But the basic thing in statistical correlation is measure-distribution among individuals of a given class regardless of their place-relationship. Hence, the coefficient of correlation does not cover the field of resemblance in geographic or geometric distribution. As the geographical sciences become more exact the demand becomes more pressing for an index with which to measure the degree of resemblance in the geographic or geometric distribution of measurable qualities. The present purpose is to devise such an index, based on sound principles, and made available for use in the geographic and geometric aspects of definite problems in different fields of investigation. This problem and its proposed solution were stated.

Interspecific hybrids involving factors for ascus abortion: B. O. DODGE.

A method of isolating tertiary 2n+1 forms in Datura from prime types by use of double half chromosomes: A. F. BLAKESLEE, A. G. AVERY and A. D. BERGNER. Prime Type 4, which is a race from nature, has the chromosomes 3·21 and 4·22 in place of the chromosomes 3·4 and 21·22 of our standard Line 1. The form 2n+4·22 frequently appeared in offspring of parents heterozygous for PT 4, but the form 2n+3·21 did not appear under similar conditions, although large plantings were made to secure it. It was finally obtained by the following procedure. A secondary 2n+3·3 was rendered homozygous for PT 4 by continued back-crossing to the latter as the male parent. Secondaries regularly throw their primaries and therefore, among the offspring of the homozygous 2n+3·3, a 2n+3·21 appeared through segregation. This was a primary 2n+1 form of PT 4. By back-crossing to the standard Line 1 it can be rendered homozygous for the 3·4 and 21·22 chromosomes and thus become a tertiary form of our standard line.

Chimpanzee metabolism: FRANCIS G. BENEDICT and JOHN M. BRUHN.

Studies on the body temperatures of elephants: FRANCIS G. BENEDICT and ROBERT C. LEE. It is impracticable to measure the rectal temperature of the elephant. An index of its body temperature can be readily obtained, however, from temperature measurements of the large volumes of urine and feces periodically discharged. These excretory products are residual within the abdominal cavity for some time before discharged and hence must assume the body temperature. Measurements of urine temperatures of 45 adult, female, Indian elephants showed a variability of about 1° C., and an average of 35.9° C. The urine was collected in a wide-mouthed thermos jar, previously warmed with water at 37° C. The measurements were made with an ordinary clinical thermometer within one minute after collection of the urine. Feces temperatures were determined immediately after defecation, by inserting a thermometer 3 cm. into the bolus, leaving it there for half a minute, pushing it in another 3 cm. and recording the maximum reading. Records thus obtained averaged 0.7° C. higher than the urine temperature, a difference explained by the fermentation processes still going on in the feces. A practical method of determining the elephant's body temperature is, therefore, to take the feces temperature as indicated and deduct 0.7° C. from the reading. If the result differs much from 35.9° C., additional feces temperatures should be taken to establish the real difference. As the elephant defecates 14 or 15 times daily and can frequently be stimulated to defecate by suggestion, this method of measuring body temperature presents no difficulty.

Development of the cells of the blood and bone marrow in the rabbit: FLORENCE R. SABIN. Studies of the blood cells of young rabbits show that the red cells increase at a different rate from the white cells. During late fetal stages, the number of red cells is low, but, as was known, each cell has a high content of hemoglobin. Thus the fetus has an adequate mechanism for the elaboration of

hemoglobin, but not for the multiplication of the red cells. At birth the marrow is relatively inactive, but by the fifth day it has become hyperplastic with erythroid elements. Thus, after the animal has begun to eat, adequate numbers of red cells are readily produced. The number of red cells per cubic millimeter of blood characteristic of the adult animal is reached during the second and third weeks of life. The high proportion of hemoglobin per cell is not completely reduced until the third month. The white cells increase for the most part more slowly and reach their full quota only by the fifth and sixth months of life. The monocyte is an exception to this, for it increases rapidly to its final number per cubic millimeter during the first week. During the first month, while the bone marrow is predominantly erythroid, the major group of the granulocytes, the pseudo-eosinophiles, does not increase in the peripheral blood. During this month, on the other hand, the lymphocytes increase rapidly. For the next four months granulocytes and lymphocytes increase slowly and at the same rate.

Second attacks and reinfection in poliomyelitis:[2] SIMON FLEXNER. A characteristic of virus diseases, of which poliomyelitis or infantile paralysis is a notable example, is that an attack leaves the recovered individual protected from a subsequent infection. The rule is not, however, absolute and exceptions occur in many, if not all, kinds of virus diseases, not excepting poliomyelitis. Despite the worldwide prevalence of infantile paralysis during the past twenty-five years, in which many thousands of children were paralyzed, the number of instances of second attacks recorded in the literature is very small. Perhaps a dozen such cases have been reported which, at best, must be a fraction merely of those having occurred. The phenomenon is an important one from both practical and theoretical considerations. The manner of infection in poliomyelitis is peculiar in that the virus, which enters the body from the nose, uses the nerve of smell exclusively in order to reach the brain and spinal cord. In following this nerve route, the virus avoids coming into direct relation with the protective blood immunity substances which are developed in man and the monkey from an attack of the disease. There are difficulties surrounding the detection of undoubted second attacks of infantile paralysis in human beings. No such difficulty exists in respect to monkeys. Hence the manner in which these second attacks arise can be most completely studied in the disease as experimentally induced in monkeys. Old World monkeys are subject to inoculation with the virus of poliomyelitis dropped into the nose, which then passes to the central nervous organs by way of the nerves of smell and produces in the animals pathological effects, attended by symptoms corresponding to those present in persons attacked by the disease. When the monkeys recover from an experimentally induced infection, they are comparable to human beings who have recovered from the disease. In addition, monkeys can be rendered actively immune by repeated, subinfective injections of the virus of poliomyelitis. These animals are comparable in resistance to those which have recovered from actual infection. Also, the artificially immunized monkeys can be secured for study in any convenient numbers, while the recovered or convalescent animals can be assembled but slowly. Monkeys which have passed successfully through mild and severe attacks of poliomyelitis, or been actively immunized, have been subjected to the reinstillation of the virus into the nose, and the effects have been studied. The first indication of infection can be detected in the cerebrospinal fluid, where cellular and chemical changes occur. This delicate index enables the experimenter to follow the action of the instilled virus from the first influence through the subsequent events, which may or may not lead to a typical second, paralytic attack of the disease. The response of these recovered monkeys to virus strains of different origins and of varying activity or virulence can thus be determined, as can be the existence of a durable or only partial and passing immunity in the animals previously affected.

[2] From the laboratories of The Rockefeller Institute for Medical Research, New York City.

Effectiveness of various wave-lengths of ultraviolet light in experimental rickets: JOHN W. M. BUNKER and ROBERT S. HARRIS (introduced by V. Bush). Work reported at the Spectroscopy Conference at M. I. T. in July under the title "Precise Evaluation of Light Therapy in Experimental Rickets" has not been published, but has now been refined and brought to a satisfactory precision for a report. Lines 3025, 2967, 2804, 2650, 2537 Angstroms have been evaluated in terms of the ergs of each required to duplicate a definite degree of recovery from standardized rickets, standardized in terms of the International Units of Vitamin D required for test healing. Energies have been measured by both thermopile-galvanometer and by Louis Harris Chemical Actinometer method. Line 2967 is twice as efficient erg for erg as 3025 or as 2537. More than twice the ergs necessary for these latter two lines if applied in wave-length 3150 or 2480 give absolutely no healing.

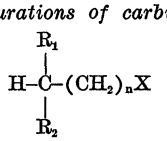
Phytopharmacological reactions of normal, toxic and atoxic blood sera: DAVID I. MACHT and RAYMOND E. GARDNER (introduced by D. H. Tennent). Phytopharmacological studies begun by the senior author fifteen years ago revealed that many drugs and chemicals affect plant tissues more profoundly than they do living animal preparations. In this way was made the first demonstration of certain toxins in the blood, not detectable by animal experiments or physico-chemical methods. The simplest quantitative technique for such studies consists of determination of root growth of *Lupinus albus* seedlings in physiological solutions under uniform conditions of nutrition, light, temperature, etc. Normal blood sera of many genera of animals were found to have the same phytotoxic index as human beings; that is, about 75 per cent., as compared with the reading given by normal controls grown in plant-physiological saline (Shive). The only exception was the blood sera of reptiles (turtles, alligators, lizards, gila monsters and snakes), which were more toxic than those of other cold-blooded animals. Blood serum of "non-poisonous" snakes was as toxic as that of poisonous serpents. From a physiological point of view a most interesting finding was a demonstration in the

blood and other secretions of menstruating women of the presence of a toxic substance absent in the intermenstrual period. Of pathological and diagnostic value were the findings obtained in studies on bloods from several grave diseases: pernicious anemia, pemphigus and leprosy. Such sera revealed marked and specific degrees of toxicity, useful in establishing a differential diagnosis and offering criteria for evaluation of therapeutic procedures. Phytopharmacological examination of pernicious anemia blood sera revealed that liver treatment, while increasing the blood count, did not detoxify the serum. Phytopharmacological examination of over two thousand sera from various dermatoses proved conclusively the remarkable reliability of the phytotoxic reaction in establishing a diagnosis of pemphigus. The toxicity of leprosy blood differentiates it from "non-toxic" sera of syphilis and tuberculosis. During the past year the present authors, engaged in a study of blood sera from certain virus diseases, have made an interesting observation on these etiological agents as a class. Blood specimens were obtained from cases of experimental vaccinia, fowl pox, herpes simplex, rabies, infectious myxomatosis, Shope's fibroma, Rous's sarcoma, lymphocytic meningitis and virus III of rabbits. All these conditions yielded blood sera which were *a*toxic; that is, much *less* toxic than normal sera, a finding of as great interest as that made in connection with the phytotoxic sera mentioned above. These results are in agreement with the findings obtained some years ago in tests made on clinical cases of varicella, rubeola and scarlet fever. Curiously enough, a series of blood sera from monkeys infected with poliomyelitis did not reveal this phenomenon, the resultant index being within the normal range. Previous phytopharmacological examination of one hundred trachoma bloods revealed that they possessed a specific toxicity not exhibited by sera from other pathological eye conditions which, in the light of the present study, leaves trachoma in the doubtful class. With the exception of tuberculosis and syphilis sera, which yielded slightly higher readings, blood sera from ordinary bacterial and protozoan infections gave the same phytotoxic index as normal sera.

Electrical potentials from the human brain: E. NEWTON HARVEY, ALFRED L. LOOMIS and GARRET HOBART. Extensive records of electrical potentials from the human brain have been made when the subject is awake, asleep and during hypnosis, with special attention to the regular 10-cycle rhythm called by Adrian the Berger rhythm. This appears in a person resting quietly with eyes closed or in the dark and the "mind at peace." It is abolished by the attempt to see, by emotional states and by attention. When awake, disturbances appear which interfere with the rhythm every few seconds. In sleep the disturbances which abolish the 10-cycle rhythm become more and more frequent (when drowsing) and the record changes to random potentials with an occasional short 14-cycle burst of waves, most marked from the top region of the head. The change in character from awake to sleep is not sudden, not coincident with loss of consciousness. Sounds or other disturbances during sleep even though not awakening the sleeper bring back the 10-cycle rhythm, which appears to be connected with a change in the general level of brain activity. During hypnosis the 10-cycle frequency is slightly slower than normal but otherwise the record is no different from a normal person awake. There was no indication that this condition is similar to sleep. A pin thrust through the skin stopped the 10-cycle, although there was no movement and no evidence that pain was felt. By suggestion that the subject could see or could not see, the 10-cycle rhythm could be stopped or started again. This was true whether the room was light or completely dark.

Growth curve of infants: C. B. DAVENPORT and WILLIAM DRAGER. Growth during the first twenty-four months, postpartum, is being considered as part of the entire growth curve. This period corresponds approximately with Robertson's first monomolecular autocatalytic cycle of growth. We tried fitting various theoretical curves to the curves of growth data of this cycle. The parabola does not fit satisfactorily. Finally, we have hit upon the exponential form $y = 10\ a + bx + cx^2$. This makes a fair fit for the first 18 to 20 months. Of the three terms in the exponent a represents the condition at birth; bx, the acceleration factor; cx^2, the retardation factor which makes itself strongly felt during the second year. A careful comparison of the observed and theoretical curves of growth shows with great uniformity an excess of growth above the theoretical curve at 6 months and a deficiency in growth at about 18 months. These deviations are not seasonal. If the excess growth at 6 months is seasonal, then there should be an excess growth again at 18 months, which is not the case. Also the babies were born at different times of the year. In rapidly growing babies the excesses and accelerations occur earlier than in slow growers. In a pair of uniovular twins the excesses and deficiencies occur at about the same time and at about the same degree. These irregularities are found not merely in weight, but also in stature, sitting height and leg length. It appears then that we have not to do with a simple autocatalytic reaction during this period; but already the curve of growth is complex. The further interpretation must rest on future study.

The absolute configurations of carbinols of the type



($n = 0$ or 1; $R_1 = CH_3$ or C_2H_5; $X = OH$):
P. A. LEVENE and ALEXANDRE ROTHEN. The configurations of a large group of substances of the above type (having X = a functional group) have been correlated to that of the simplest optically active hydrocarbon and those of another large group to that of the simplest optically active secondary carbinol. It is now attempted to correlate the configurations of the two reference substances on the basis of the theories of absolute configuration.

The magnetic properties and structure of hemoglobin and related substances: LINUS PAULING and CHARLES D.

CORYELL. It is shown by magnetic measurements on blood and hemoglobin solutions that oxyhemoglobin and carbonmonoxyhemoglobin contain no unpaired electrons; the oxygen molecule, with two unpaired electrons in the free state, accordingly undergoes a profound change in electronic structure on attachment to hemoglobin. The magnetic susceptibility of hemoglobin itself (ferrohemoglobin) corresponds to an effective magnetic moment of 5.46 Bohr magnetons per heme, calculated for independent hemes. This shows the presence of four unpaired electrons per heme, and indicates that the heme-heme interaction tends to stabilize to some extent the parallel configuration of the moments of the four hemes in the molecule. The bonds from iron to surrounding atoms are ionic in hemoglobin, and covalent in oxyhemoglobin and carbonmonoxyhemoglobin.

The sexual and reproductive cycles of chimpanzee: ROBERT M. YERKES and JAMES H. ELDER. Current knowledge of reproductive and sexual phenomena in chimpanzee is very unsatisfactory because of incompleteness and meagerness of observations. Norms based upon a statistically significant number of comparable observations are lacking. From Yale Laboratories of Primate Biology information accumulated during the past six years is presented in partial satisfaction of these deficiencies. The authors describe the 35-day sexual cycle of the chimpanzee, which typically, although not necessarily, includes menstrual bleeding, genital swelling, oestrus and ovulation; and the reproductive cycle, which includes the sexual cycle, as defined above, together with mating, fertilization, gestation, parturition and infant care. Whereas the sexual cycle of chimpanzee is approximately one week longer (35 versus 28 days) than in man, the gestational period is about one month shorter. It is indicated by the data reported that the average interval between conception and parturition is 236 days for chimpanzee, as compared with 266 days for man. Neither menstrual bleeding nor genital swelling recur regularly and typically during pregnancy; nor, under normal social conditions and for sexually mature and experienced individuals which have previously bred, does sexual intercourse occur after conception.

Altruism and cooperation among chimpanzees: H. W. NISSEN and M. P. CRAWFORD (introduced by Robert M. Yerkes). Three main types of mutual aid among animals may be distinguished. (1) Genetically determined patterns of response, usually restricted to specific external stimuli (*e.g.*, young of the species) or particular physiological states (hormonal activity). (2) Immediate reciprocity of individual gain or concerted effort towards a common goal; barter, exchange of favors, team-work. (3) Assistance or gift to another individual without direct or apparent return to the donor; altruism. The first type is relatively common in the animal kingdom and probably finds its highest development among the insects. In chimpanzee it finds its expression in maternal care, in concerted attack on an aggressor and perhaps in grooming. Unambiguous instances of the last two types among infrahuman organisms are exceedingly rare. Experiments giving definite evidence for occurrence in chimpanzee of the second, and indicative evidence for presence of the third type, will be described. A number of problem situations, originally learned individually and then so modified that they could not be solved by one animal working alone, were mastered when two animals were given opportunity to coordinate their efforts. Cooperation did not appear at once or suddenly, and it was therefore possible to trace its development. An important feature of this development was the use of gestures, adapted to the specific demands of the situation, by one animal in stimulating the other individual to do its part of the task. When only one member of a pair had access to a limited supply of food, it shared what was available with its partner by responding to well-defined begging behavior on the part of the latter or by unsolicited giving. Previously established social relations between the individuals involved was found to be the most important of several factors determining the amount of sharing which took place. Results of these investigations will be illustrated in part by cinematic records.

The startle pattern: WILLIAM A. HUNT and CARNEY LANDIS (introduced by R. S. Woodworth). Ultra rapid moving picture photography reveals the presence of a definite bodily behavior pattern in response to a shot stimulus. This pattern is too rapid to be seen with the eye. It includes head movement, raising and drawing in of the shoulders, abduction of the upper arms, bending of the elbows, pronation of the lower arms, clenching of the fists, contraction of the abdomen, bending forward of the trunk and bending of the knees. Its facial components include moving the head forward and down, blinking of the eyes, contraction of the risorious muscle (grin) and involvement of the sternomastoid, trapezius and platysma muscles in the neck. It differs quantitatively in various subjects, but its course is regular. It can not be voluntarily inhibited. We have studied the effects of habituation, of facilitation by other stimuli and by the injection of adrenalin, of superposing it upon other responses and of tension.

Body type and success in college: W. B. PILLSBURY. A study of the relation between the marks of students who fall into the different body types of Kretschmer shows that the pyknic group are less successful in college work than the athletic and the asthenic. Some 980 men were divided into types by computing the Pignet Index from gymnasium measurements. It was found that there was a positive correlation ranging from 0.06 to 0.29 for different classes. The short, heavy man is not so successful as the tall slim individual. The correlation was confirmed by the fact that in the different classes, two to three times as many pyknics dropped from school and that the average standing was considerably lower. Not body form itself, but some unknown factor that affects both body form and brain is probably responsible.

The psychology of a musical ornament: CARL E. SEASHORE. Report of progress in the psychology of the vibrato, listing the definition and identification of three

kinds of vibrato, instruments for analysis and production of all aspects of the phenomenon, a consistent terminology and graphic musical scale, statistical survey of use and abuse, the establishment of norms in voice and instruments, experimental contributions toward ideal norms of achievement, the nature of its beauty, psychophysical determination of its characteristics in hearing, explanation of some of the illusions involved, determination of the limits of tolerance and range of variability, tracing the ontogenetic and phylogenetic development, an appraisal of its contribution to the psychology of emotion and a foundation of scientific esthetics.

The effects of American environment on immigrants and their descendants: FRANZ BOAS. The general problem of the assimilation of alien populations can be solved only by a study of the modifications which bodily forms and functions undergo under new environment, and require long-continued observations on immigrants and their descendants. The data to be discussed were assembled during the past twenty-five years and certain conclusions may be presented as definitely determined. Every population investigated proved to be highly complex, including many distinct genetic lines. In every European population these are so varied that it is impossible to assign any one individual with certainty to any one population. With the transfer to American environment the bodily traits do not remain stable but undergo considerable changes. In some types the heads and faces of the descendants of immigrants are narrower than those of their ancestors. Their stature increases materially, while that of the immigrants themselves who came here in the course of fifty years does not partake of the general increase observed in Europe. The tempo of development of different races in the United States and West Indies is remarkably uniform. Contrary to opinions generally accepted no differences in the onset of puberty are found among Negroes and Whites, nor in different climates. Differences occur according to economic status. Nevertheless, each family has a characteristic tempo of development of the life span which is in part hereditary. The motor habits of East European and South European immigrants, as expressed by gestures, differ considerably. The question is in how far these are determined by heredity or by environment. A study of Italian gestures shows that these are symbolic, expressing definite ideas and have been transmitted from antiquity. Those of East European Jews are rarely symbolic, rather emotionally determined. The Italian moves symmetrically with a wide sweep from the shoulders, the Jews jerkily and asymmetrically from the elbows, which are held close to the body. American gesticulation is much more lively than is generally assumed but is almost entirely either descriptive of forms or oratorical. In descendants of Italians and Jews who have left their national environment, a rapid transition to American posture and movement was observed. On the other hand, Englishmen were observed who had acquired Italian or Jewish gesture habits. The behavior of each individual depends also upon momentary setting in so far as it is influenced by that of the people with whom he converses. Occupational gestures were also observed. In regard to postures and gestures as expressions of motor habits complete assimilation may be predicted. Similar assimilation has been observed in regard to the general tempo of movement. Much has been said in regard to the frequency of mental diseases among immigrants and their descendants. Most of these data are based on statistical fallacies, due to the different age distribution among immigrants and natives. When these are allowed for, it appears that the differences between immigrants and natives are slight and that the second generation approaches the values found among natives; often it is less. In this investigation Irish, Italians and Germans were studied. It is noteworthy that the complete elimination of imbeciles among immigrants does not seem to have had an appreciable effect upon the frequency of imbecility among their descendants. The distribution of various types of crime differs much in different nationalities. A comparison has been made between the relative frequency of types of crime among immigrants and their descendants, and here also an approach to the relative frequencies of crimes in the native population has been determined. While individually, heredity is an important element in determining the form and functioning of the body, all these observations show that the pressure exerted by social environment brings it about that the behavior of whole populations tends to be moulded by the pattern of the dominating society.

Biographical memoir of Theobald Smith: HANS ZINSSER. (Read by title.)

Biographical memoir of Benjamin Lincoln Robinson: M. L. FERNALD. (Read by title.)

Biographical memoir of George Fillmore Swain: WILLIAM HOVGAARD. (Read by title.)

Biographical memoir of William Duane: P. W. BRIDGMAN. (Read by title.)

SCIENTIFIC EVENTS

THE ZOOLOGICAL SOCIETY OF LONDON

THE report of the Zoological Society of London for 1935, summarized in the London *Times*, states that the society has passed through one of the most successful years of its history.

1,963,136 visitors were admitted during the year, this being the highest number since 1930 and the sixth highest since the society was founded.

The assets of the society have increased by more than £14,000 and its income by nearly £19,000 over the