SCIENCE

VOL. 79 FRIDAY, APRIL 27, 1934 No. 2052

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. MCKEEN CATTELL and published every Friday by

THE SCIENCE PRESS

New York City: Grand Central Terminal
Lancaster, Pa. Garrison, N. Y.
Annual Subscription, $6.00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

THE NATIONAL ACADEMY OF SCIENCES

ABSTRACTS OF PAPERS PRESENTED AT THE WASHINGTON MEETING

AT the annual meeting of the National Academy of Sciences, held in Washington, D. C., on April 23 and 24, the following papers were presented:

Two large-fruited bud sports of Bartlett pear identified as tetraploids by pollen size: J. L. CARTLEDGE, A. D. SHAMEL and A. F. BLAKESLEE. The paper presents the results of a joint study of two freak branches which arose as bud sports on otherwise typical trees of the Bartlett pear. The peculiar branches were characterized by broader leaves and by larger flowers and fruits than normally occur on this variety. They were described by the second author in 1931 in one of a series of publications on bud sports of various types which he had found of not uncommon occurrence on different kinds of fruit trees. A chance reading of this article suggested to the other authors that the cause of the increased size of these sports might be due to their being tetraploids (that is, having twice as many chromosomes as are usually present). Such tetraploid sport branches have been found occasionally on jimson weeds. Since in these cases the doubling of chromosome number brings about similar increase in size of the parts affected, including pollen grains, it is possible to determine a tetraploid by merely looking at the pollen of one of its flowers without the tedious process involved in examining chromosomes. Flowers of the bud sports were sent from California, and both were found to have pollen grains of twice the volume of normals, a fact which indicates that they are tetraploids and have twice the number of chromosomes of normal Bartletts. A confirmation will be made by actual chromosome counts, but the use of pollen sizes to determine tetraploid mutations is a method which is available to any one with even a low power microscope and avoids the special technique necessary to chromosome study.

A lethal for ascus abortion in Neurospora: B. O. DODGE. Mutations or saltations observed in cultures of certain species of fungi following treatment with x-rays or ultra-violet light have been reported from time to time, but they have never been adequately tested out by the study of the progeny resulting from sexual reproduc-

tion. Such a test has been applied to certain abnormalities which followed x-ray treatment of ascospores of *Neurospora tetrasperma*. The ascospore normally contains two nuclei of opposite sex-reaction at its origin and these nuclei divide once more before the spore matures, showing that, between nuclear fusion at the origin of the ascus and spore germination, four successive simultaneous nuclear divisions occur. The x-ray treatment of the bisexual ascospore, from which the cultures studied were made, brought about a change in one or more of its four nuclei, with the result that the mycelium produced is much dwarfed or stunted, and only very rarely do the ascocarps that are formed in the culture produce asci with spores. Most of the perithecia are absolutely sterile. Mating this strain against tester strains separately it was found that there was an excellent mating reaction with tester strain S_1 (''sex B''). The ascocarps produced all contained some asci with from one to eight ascospores, and also large abnormal sterile asci in which no spores were ever delimited. Cytological examination proved that the fourth nuclear division in the ascus, not waiting for spore delimitation, immediately follows the third division, after which all sixteen nuclei undergo degeneration. The ascus wall takes over the color changes and wall markings characteristic for the ascospores themselves. That this condition can be passed on from generation to generation through sexual reproduction involving nuclear fusion and segregation of the factors concerned has been fully proved. The mechanism by which it is possible to observe through generations the effects of the original x-ray treatment in causing mutations is such that one can maintain, in culture, haploid races carrying 'lethal' factors which for other species of plants and animals could not be perpetuated in the haploid condition. The same or similar 'mutation' or abnormality reported here had previously been observed three or four times in cultures of *N. tetrasperma* and certain hybrids between that species and *N. sitophila*. These cultures had not been irradiated. It is clear that the same deficiency, gene mutation or condition, or whatever it is, that leads to ascus abortion can evidently arise again and again even without x-ray treatment. The 'lethal' action noted above can prevent spore germination so that it would not be easy to perpetuate races of unisexual species because the uninucleate ascospore would either be normal, or if it carried the 'lethal' condition, would not germinate at all. If such a spore did germinate its mycelium would be so greatly dwarfed that it would have little vitality and would probably die very early.

Anesthesia produced by distilled water: W. J. V. OSTERHOUT and S. E. HILL. In cells of the fresh-water plant *Nitella* stimuli are transmitted by negative variations which travel along the cell just as in muscle and nerve. Sufficient exposure of *Nitella* cells to distilled water abolishes the characteristic production of negative variations when stimulated by an electric current. This effect is accelerated by the addition of acid or of alkali and is inhibited by calcium. Irritability is restored when the cells are replaced in tap water. Evidently the protoplasmic surface is greatly modified, for after exposure to distilled water the surface no longer gives the normal electric potential when we lead off from a spot in contact with 0.01 M KCl to one in contact with 0.01 M NaCl. The simplest explanation is that an organic substance, which we may call R, is dissolved out of the surface by distilled water, and this takes place more rapidly in the presence of acid or of alkali but more slowly in the presence of calcium. At certain times of year R is apparently produced more slowly than it is dissolved out by the pond water, for the cells lose their irritability. Apparently R is stored in the vacuole, and when cells have lost their irritability, pressure, which forces sap from the vacuole into the surface, can restore irritability and the normal behavior toward potassium. It seems possible that other cases of anesthesia may be due to the fact that substances are removed from the cell.

A genetic factor for localization of tobacco-mosaic virus in Capsicum: FRANCIS O. HOLMES (introduced by L. O. Kunkel). Most common varieties of the garden pepper, *Capsicum frutescens* L., when inoculated with tobacco-mosaic virus, develop a systemic infection with resultant stunting, production of mottled leaves and reduction of yield of fruits. A few varieties, although equally susceptible to infection, localize the virus in or near necrotic lesions at the site of inoculation, thus preventing development of systemic infection; these varieties soon free themselves from virus by abscission of affected leaves and subsequently grow as healthy plants. The Tabasco pepper is one of the latter type. The capacity to localize tobacco-mosaic virus has been shown by intervarietal crosses to be controlled by a single dominant factor. This factor is inherited in typical Mendelian fashion, and is not influenced by other factors or combinations of factors thus far observed. No morphological character of the plant has been found constantly associated with ability to localize the virus. This is the only known instance, in a plant, of a single genetic factor which prevents systemic spread of a virus. By hybridization it has been possible to develop peppers combining large size of fruit and some other desirable commercial qualities with immunity to systemic tobacco-mosaic disease.

On photosynthesis and free nitrogen fixation by leguminous plants: E. B. FRED and P. W. WILSON. Recent quantitative studies on the biochemistry of nitrogen fixation emphasize the intimate relationship between carbohydrate synthesis and nitrogen fixation. Such experiments reveal an integration of the functions of the plant and bacteria which are not brought out by qualitative studies. To investigate the biochemistry of this problem experiments of a quantitative nature were made to discover the factors which control the process. The carbohydrate-nitrogen relation in the biological system consisting of plant and nodule bacteria was varied in four distinct ways: First, the carbohydrate supply was increased by growing the plants in an atmosphere rich in CO_2; second, the quantity of nitrogen fixed was de-

creased by growing the plants in an atmosphere of low nitrogen tension; third, the carbohydrate content was varied through a wide range by growing the plants in atmospheres of differing oxygen tensions; fourth, the nitrogen tension in relation to the available carbohydrate was varied by the addition of combined nitrogen in the presence and absence of added CO_2. The results of all these studies were consistent and showed that the carbohydrate-nitrogen relationship is an extremely important although not the only factor in the various functions of symbiotic nitrogen fixation. The significant conclusions of these studies may be summarized as follows: First, under natural conditions, in the presence of suitable supply of inorganic plant food, carbohydrate synthesis is the limiting factor in the assimilation of free nitrogen. Second, any factor which increases the available carbohydrate in relation to the nitrogen present increases the number of nodules. Likewise, a decrease in the available carbohydrate will reduce the nodules. The effect may result in change in the size rather than the number of nodules. Third, an increase in carbohydrate is accompanied by the formation of nodules on the lateral roots of the plant. This fact suggests that the normal position of the nodules on or near the primary root is determined in part by the carbohydrate supply. Fourth, the retarding effect of combined nitrogen on the fixation process seems to be associated with the lowering of the carbohydrate level in the plant. The combined nitrogen reacts with carbohydrate to form complex nitrogen compounds and thus reduces the available carbohydrate. This results in the development of fewer and smaller nodules, as noted in other experiments in which the carbohydrate level was varied. If the carbohydrate level is raised, *e.g.*, supplying additional CO_2, the effects of combined nitrogen can be reduced.

Cellular oxidations—some phases of the respiratory activity of normal and blocked embryonic cells: JOSEPH HALL BODINE (introduced by C. E. Seashore). Intensive studies have been made of the oxygen consumption of normally developing and blocked (diapause) cells of the embryo of the common grasshopper (*Melanoplus differentialis*). By means of accurately controlled experimental conditions it has been possible to make extremely close correlations between the morphological and physiological activities of embryonic cells throughout various phases of activity as well as during periods of developmental block or diapause. The effects of different tensions of oxygen and carbon monoxide as well as the action of cyanides and loss of water have been studied. Marked differences in response to these reagents are found for the embryonic cell when actively developing, as compared with the same cell during periods of rest or developmental block. The resting or blocked embryonic cell appears to react as a very sensitive type of cell, while the actively developing one is usually markedly inhibited in its activities. An analysis of the oxidative mechanisms concerned in reactions of the embryonic cell in the active and blocked condition is given.

Ontogeny and phylogeny of man's appendages: CHARLES B. DAVENPORT. The human appendages, like those of the lower mammals, begin their development as four buds on the sides of the body between neck and base of tail. Very soon differentiation appears. The arms at first grow a little more rapidly than the legs, but some time before birth the latter surpass the former. A curve showing the changes in the relation in these two appendages is given. In the anterior appendage the segments at birth, in humans, are nearly equal, but in later life the upper segment becomes greater than the lower segment. Similar change takes place in the segments of the legs. The relation in length of the appendages to each other and of the segments to each other in each appendage are adaptive for man, as an organism that stands erect and uses his arms to handle tools. The proportions have, however, a phylogenetic significance, for in other mammals that stand erect, like the kangaroo and certain jumping mice, the anterior appendages are greatly reduced in size from that found in their close relatives that walk upon the surface of the ground instead of jumping. Such reduction in the arms would be highly disadvantageous for man not as a walking animal but as one that uses his arms to handle tools. We may say that it is fortunate that man was derived from arboreal ancestors whose long arms were necessary to living in trees. The relative shortening of arms in relation to the terrestrial locomotion of man in his upright position has not been disadvantageous, because the reduction from the primitive long arms has only left a length suitable for the purposes for which man employs his arms as a tool user.

The life history of an anatomical feature: ALEŠ HRDLIČKA. The growth of the anthropological and primate collections in this country is beginning to permit what hitherto has been impossible to either anatomy or anthropology. This is the study of the entire life history, together with a large part of the racial, sex and individual variation, of individual morphological features. This applies particularly to the features presented by the skull and the skeleton, the collections of human brains and soft organs being still far from adequate for such purposes. By a "life-history" of a feature is meant the evidence showing its incidence, development and growth throughout life and its eventual fate during senility. For such a study it is indispensable to have adequate materials from all stages of existence, and here is where the great difficulty of obtaining juvenile and adolescent remains in sufficient normalcy and numbers has up to recently offered a serious obstacle. Such collections however were eventually realized with other races than the whites and are proving of great value. The life-history presented in this communication is that of one of the most interesting features of the human thighbone —namely, the so-called hypotrochanteric fossa. This hollow, a survival from our pre-human ancestry, begins to appear occasionally during the fifth month of the fetal life. After that it manifests its first great peculiarity. Instead of finishing its appearance within a reasonable time it keeps on originating in diverse femora throughout the entire human growth period, or at least so until late adolescence, when, in diverse human groups, it has become almost universal and has reached its opti-

mum development. And then, though not seldom even before, there sets in a gradual regression, through the encroachment upon the fossa of the neighboring ridge which gives attachment to the gluteus maximus. In the large anthropoid apes the fossa itself had evidently served for the attachment of this muscle, while the gluteal ridge remained quite secondary. In the human subject the attachment has shifted to the ridge and the fossa apparently became "obsolete." As a phylogenetic feature of probably long duration it still appears in man and develops, though the period of appearance has been greatly lengthened and in many instances the development of the hollow itself has suffered. But when the gluteal ridge reaches the need of expansion (through increased activity of the muscle) the fossa is encroached upon, there take place within it secondary deposits of bone and this new bone, which in instances comes to fill the whole fossa or to leave but a trace of the same, coalesces eventually with the gluteal ridge. Thus terminates the highly interesting life-history of the hollow under consideration. The observations that permitted this survey of the life history of an anatomical feature involved roughly ten thousand human femurs of all ages. The detailed results will be published by the Smithsonian Institution.

Senescent hypotheses as to the nature and causes of evolution: HENRY FAIRFIELD OSBORN. Biology at present can not be ranked with physics or chemistry as a branch of science. We await the arrival of a master mind which can synthesize the generalizations and inductions now being made in widely separate fields of research. The facts are multiplying at an enormous rate and from these facts hasty inductions are being made which are more or less biased by preconceptions in the mind of the observer, also by the special field of research in which the observations have been made. Among the host of facts which are wholly uninterpretable at present it is only natural for us to seek for interpretation or to try to fit the facts into the more or less senescent hypotheses as to the nature and causes of evolution. Despite Huxley's warning that science commits suicide when it adopts a creed we find many observers still strongly influenced by ancient scientific creeds. To my knowledge the most ancient is the "chance" hypothesis which dates back to Empedocles of Agrigentum and is still entertained by such modernists as T. H. Morgan and J. B. S. Haldane. There is a general failure to distinguish between Darwin's positive demonstration of the selection of the fittest combinations of energy which we observe in organisms, and the origin of a single organ or of a single species through the selection of variations which in any sense of the word could be designated as "chance." The next in age is the Lamarckian creed, which extends at least from its expression by Aristotle down to the modernists, McDougall and Kammerer; this creed, first assailed by Weismann in 1880, is now in a moribund condition; like the "chance" creed there is amassed overwhelming evidence against Lamarckism. Much less senescent and in a much more healthy condition at present is the doctrine of the direct action of environment not only upon the organism but upon the geneplasm. It seems fair to connect this creed of direct environmental action with the names of Buffon and Geoffroy St. Hilaire, because these distinguished Frenchmen of the eighteenth and beginning of the nineteenth centuries were the first to formulate the theory of environmental action and to adopt it. It now seems to be well established that one of the direct causes of the origin of species is the gradual and inherited modification of the geneplasm by the forces of the environment. The fourth creed is that of an internal perfecting principle or "entelechy," which originated in a misunderstanding of Aristotle's very sound inductions of an internal principle governing evolution and reappeared in the "neovitalism" of Driesch and the *élan vital* of Bergson. This, too, is a creed which does not bear the crucial test of observation. In concrete observation and researches of the past quarter century it has been positively demonstrated that there are two entirely distinct principles in evolution—the second principle applies to development which is quantitative or intensive, and to such development new applications of the selection principle of Darwin and the indirect influences of environment and habit of Buffon and Lamarck more or less distinctly apply. Entirely apart from this is the first principle of evolution which embraces the origin of entirely new characters. Such origins have thus far only been demonstrated positively in a limited number of characters, but there is the inevitable inference that this originative or creative principle will ultimately extend to a much larger number of characters. If it does it will inevitably revolutionize our whole biological philosophy. In the meantime let us quietly drop all these senescent hypotheses as to the nature and causes of evolution and make a wholly fresh start along entirely new and original lines of observation and experiment, directed toward the discovery of the now wholly unknown factors in this most mysterious of natural phenomena.

A method for observing the solar corona without an eclipse: A. M. SKELLETT (introduced by Herbert E. Ives). The problem of viewing the solar corona at times other than those of eclipses has not as yet found adequate solution. The reason is that the brightness of the glare around the solar disk, due to atmospheric and telescopic scattering, is many times the brightness of the corona. Excellent progress in reducing such glare by photographic methods has been made recently by Lyot (*Compt. Rend.* 195, 21, 1932). His results, however, serve to emphasize the need of a method which will give greater discrimination. The mechanism of present television technique appears to offer a solution to this problem. The proposed method is as follows: The image of the sky around the sun's disk is to be scanned by a small hole behind which a photoelectric cell is placed. The resulting photoelectric current will be made up of high frequency components, due to the details of the coronal image and a relatively large direct current component plus some low frequency components due to the glare. These various components will then be separated by appropriate electrical filters, and only those due to the corona will be amplified and used in the television receiver for the reproduced image.

It should thus be possible to reproduce the major features of a solar eclipse at any time when the sky is clear. Tests, covering the essential features of this proposal, have been made with laboratory television apparatus. It has been found possible to flood the photoelectric cell with steady light of several thousand times the intensity of the primary image before reaching the level at which electrical noise interferes seriously with the quality of the image. These tests, considered in the light of the known brightness of the sky relative to the corona, show that the method should be adequate. A necessary condition is that the scanning method must be substantially free from any features which can introduce high frequency components, such, for instance, as those due to mechanical masking of the scanned field. It is believed that these requirements can be satisfactorily met. The use of such technique for image discrimination, particularly to increase contrast, is not, of course, necessarily limited to the specific application mentioned above.

An application of the photoelectric amplifier to the photometry of faint stars and nebulae: JOEL STEBBINS and ALBERT E. WHITFORD. The combination of a photoelectric cell and a vacuum tube make a sensitive and useful device for the measurement of the light and colors of stars. This instrument, called the photoelectric amplifier, was perfected at the Washburn Observatory of the University of Wisconsin. It has been used on a 15-inch telescope, and last summer it was installed on the 100-inch reflector at Mount Wilson, Calif. Experiments at Madison showed that the amplifier, even without a telescope, was sensitive enough to detect an ordinary candle set up at the distance of one mile. In fact, the instrument will indicate about a one-thousandth part of the light of a candle at that distance, or a full candle at thirty miles, where it would be quite invisible to the eye. On the 100-inch telescope the amplifier would detect a candle at three thousand miles. As used at Mount Wilson the new instrument has proved capable of measuring faint luminosity in the sky beyond the range of the photographic plate; it also will give more precise measures of the colors of stars than can be made either by the eye or by photography. Previous measures of the colors of faint stars and clusters of stars with the photoelectric cell had confirmed the presence of quantities of dust between the stars, revealed by the reddening effect on the light of distant objects seen through the dust, just as the sun appears reddened when we see it through a great amount of air at sunset. The improved amplifier has extended the distance over which this interstellar dust can be studied. In the direction of the center of the galaxy, the system of stars to which the sun belongs, the stars increase in redness in proportion to their distance, but in the opposite direction, away from the center, there is a limit to the reddening and we seem to see out where the dust is much thinner. Simply by measuring the colors of stars around the Milky Way we can tell that we must be at one side of the system; the stars are redder toward the summer constellation of Sagittarius than toward the winter constellations of Orion and Taurus. In two ways the amplifier, or so-called electric eye, has enabled us to see better our own position in space. The other galaxies, like the nebula in Andromeda, are shown to be larger than was supposed, and the calculated dimensions of the Milky Way system come out smaller when allowance is made for the obscuring effect of the dust between the stars. Our own galaxy may still be the largest one in sight, but it is not so great and important as we thought.

Studies of weather periodicities: C. G. ABBOT. Author describes the method he employs to discover and evaluate periodicities in a complex curve of observation, and shows by a test analysis of an unknown complex curve prepared by an assistant that periodicities may be closely evaluated thereby. Seeks whether seven periodicities discovered in solar variation 1920–1932 exist in weather records of past century. Since his own and Clayton's studies show that periodicities in weather are subject to large changes in phase when solar activity changes, author restricts the computations to epochs when the Wolf sunspot numbers were below 30. Results show that for several stations the solar periods assumed, 7, 8, 11, 21, 25, 46 and 69 months, give evidence of persisting for nearly a century in weather records, often with individual amplitudes of from one to two degrees F. in temperatures. Slow progressive changes of phase, however, indicate slight corrections to the length of the assumed periods. Applying these corrections, an approximate least common multiple of all these seven periodicities is found as follows:

Corrected period	$7^{mo}0^{d}$	$8^{mo}0.5^{d}$	$11^{mo}5^{d}$	$21^{mo}0^{d}$	$24^{mo}25.5^{d}$	$45^{mo}0^{d}$	$68^{mo}0^{d}$
Number ...	39	34	24	13	11	6	4
	mo.	mo.	mo.	mo.	mo.	mo.	mo.
Product ...	273.0	272.6	268.0	273.0	273.2	270.0	272.0

Thus in about 272 months, or 22 years, 8 months, all these periodic tendencies return nearly to the same phase. Inasmuch as this interval is almost exactly double the length of the well-known sun-spot period, it is apparent that relative phase changes attending alterations of solar activity should nearly disappear at times 22 years, 8 months separated. Expecting, therefore, that weather data should tend to show similarity when plotted in 23-year intervals, author has obtained such plots of departures from normal temperature and from normal percentage precipitation for numerous stations throughout the world. Considerable similarity is often found, but frequently it is subject to displacements of several months, and is obscured also by differences of amplitude of the features. Similar plots of thickness of clay varves of glacial age, thickness of tree rings of the past century and level of the Great Lakes during the last century also indicate recurrences of features at approximate 23-year intervals. Test forecasts of weather progress one year in advance have been made for numerous stations from 1922 to 1930 and compared with actual data. The results seem to show such considerable correspondence as to raise the hope that such forecasts may be of value for future weather forecasting.

On the implications of a variable velocity of light: P. I. WOLD (introduced by F. K. Richtmyer). In a recent meeting of the American Physical Society a speculation was conducted on the implications of the velocity of light being a function of time, but not of position, throughout space. The speculation was found to lead to a very simple explanation of the redward shift of spectral lines from nebulae. It was shown that if the velocity of light is taken as $C_t = C\ (1 - \alpha t)$, the redward shift reported by Hubble and Humason would be accounted for by a value of $\alpha = 5.72 \times 10^{-10}$, with the year as unit of time. The speculation has now been carried further and yields an apparent "photon leak," as has been desired by some in connection with the redward shift. The consideration also leads to the conclusion that in a space in which the velocity changes as a function of time the energy of a given photon changes with the velocity; the momentum of the photon remains constant; the radiation density for a volume traveling with the wave remains constant and the number of photons passing an observer remains constant. The last item is hard to reconcile with any present picture of the nature of the photon.

Interpretation of data from world cosmic ray survey: ARTHUR H. COMPTON. Data collected during the past two years by our associated expeditions under the auspices of the Carnegie Institution have established the existence of variations of cosmic ray intensity with geographic position, correlated closely but not exactly with the latitude relative to the earth's mean magnetic poles. These variations are much more prominent at high altitudes, where they extend also over a wider latitude range. These findings are shown to require the presence in the cosmic rays of electrified particles coming nearly uniformly from all directions far outside the earth. Details of the latitude effect suggest that these particles are positively charged, a conclusion established by directional experiments stimulated by the results of this survey. Analysis of the high altitude intensity measurements made as a part of the survey seems to show that the rays capable of traversing the atmosphere consist chiefly of protons or positrons, but that in the upper atmosphere rays of another type exist, which may well be heavier atomic nuclei. Comparison of absorption and transition effects at different latitudes shows that most of the rays reaching the earth are of approximately the same type, presumably protons or positrons or both. The energy spectrum of these rays in remote space must extend at least from 2×10^9 to 4×10^{10} volts, and probably over a much wider range. No evidence is found for either photons or electrons in the cosmic rays as they enter the earth's atmosphere. Relatively low energy photons may, however, constitute part of the absorbable cosmic rays observed in the upper atmosphere or high energy photons part of the relatively weak component of very penetrating cosmic rays which is prominent at great depths. The latter component may also consist in part of electrons, as far as these experiments are concerned.

The third major mechanical factor in the circulation of the blood: YANDELL HENDERSON, A. W. OUGHTERSON, L. A. GREENBERG and C. P. SEARLE. To be printed in SCIENCE.

Surface temperature and radiation of heat from the human body: EUGENE F. DU BOIS and JAMES D. HARDY. The human body loses more than half of its heat by radiation. It has been found that the white human skin acts as an almost perfect black body radiator. This makes it possible to determine the surface temperature of the skin by measuring the radiation. An instrument for this purpose has been devised which is sensitive, rapid, rugged and accurate. It consists of a small receiving disk of four thermocouples with four cold junction units in the immediate neighborhood but not exposed to radiation. The measurements are made in about ten seconds by placing the radiometer close to the skin but not in contact with it. The instrument is calibrated by means of a Leslie cube at temperatures the same as those of the skin. Tests of contact surface thermometers have shown that all of them are influenced by the air temperature. Measurements have been made of the surface temperatures of a number of normal subjects and of patients with various diseases. It has been found that under standard conditions the temperatures of different individuals are surprisingly uniform. The study of the chills of malarial fever shows that large amounts of heat may be stored in the body for short periods without affecting either rectal or surface temperature. The heat lost in radiation from the surface has been measured in connection with respiration calorimeter experiments and it is estimated that radiation contributes, under the standard conditions employed, approximately 65 per cent. of the total heat loss. Vaporization accounts for about 20 to 30 per cent. and convection for about 10 per cent.

The potentialities of extreme old age: FRANCIS G. BENEDICT and HOWARD F. ROOT. Hospital records are full of information with regard to the pathology and disintegrations of old age. Physiological studies of those who are hale and hearty are relatively rare. Such studies indicate the potentialities or possibilities of health and vigor in extreme old age. Observations were made on a man 91 years of age, with extraordinary physical and mental preservation. A study of the medical history is presented, with an attempted analysis of the factors contributing to this superior mental and physical state, or what may be termed "ideal" old age. With a family history conspicuous for the absence of arteriosclerotic diseases, with exemplary habits of life with regard to food, drink and matters of hygiene and, above all, with a philosophy doing away with worrying, this man has passed, good and strong, fourscore and eleven years.

Source and mode of infection in poliomyelitis: SIMON FLEXNER. At the meeting of the National Academy of Sciences held in November, 1933, I reported on the nerve path of infection in poliomyelitis. The present report is intended to complete the evidence for the sole transport

of the virus of the disease to the brain and spinal cord in man by way of the olfactory nerves. Two other modes of infection have been held possible. Levaditi, at the Pasteur Institute in Paris, emphasizes the alimentary tract as the portal of entry of the virus, and concomitantly Kling of Stockholm regards the epidemic disease as being water-borne in nature. The other possibility is that of a lower animal carrier of the virus, without the animal itself suffering the disease, but communicating it to human subjects. The 1931 and 1933 epidemics of poliomyelitis in New York City and State permitted a reinvestigation of these two possibilities. Earlier studies of the alimentary portal and of domestic animal carriers of the virus had given mainly negative results. But during the past few years improved, more delicate and certain methods of detecting the virus have been secured. These methods were applied in the new investigations. The intestinal mucous membrane and the adjacent mesenteric lymph nodes obtained from fatal cases of poliomyelitis were inoculated, under suitable conditions, into monkeys. In no instance was the presence of the virus detected, although the spinal cords taken from the same subjects proved infectious. *Macacus cynomolgus* monkeys were fed large amounts of the virus. This species was employed for the feeding experiment, since Levaditi succeeded with it, while he failed with the closely related *Macacus rhesus,* which is subject to infection by way of the nasal route. In our hands, the two species behaved in an identical manner—neither became paralyzed, and both quickly eliminated or destroyed the virus introduced in large quantities by stomach tube. Our experiments were carried a step beyond those previously made. Individual differences in response or susceptibility to the virus have been observed in the Macacus monkeys. Hence it was desirable to test the reaction of the cynomolgi, which resist the feeding, to the nasal instillation of virus. The resistant monkeys proved highly sensitive to these instillations, developing the experimental form of poliomyelitis in the same manner as the control animals. The feeding of virus neither leads to infection nor confers immunity, and individual susceptibility was shown to play no part in the failure of the feeding tests. Ordinary domestic, pet animals can not be infected with the virus of poliomyelitis; when inoculated, they spontaneously free themselves of the virus in a few days, by internal destruction. The wild animals which commonly live in close association with man in ordinary circumstances are rats and mice. These animals were trapped in regions in which poliomyelitis was epidemic, and their organs examined for the presence of virus. None was found. The captured animals were in part injected with virus, in order to determine the ability of the virus to survive in them. Human virus, as well as monkey passage strains, was employed for inoculation. It was thought possible that the strain existing in human spinal cord might prove better adapted to survival than the strains which had been altered somewhat by monkey passages. But neither virus survived beyond a few days. The results of this experimental study may be summed up as follows: The virus of poliomyelitis is highly neurotropic and finds in the exposed olfactory nervous structures in the nasal membrane a means, apparently the sole means, of entering the central nervous system directly. It is incapable of penetrating the mucous membrane of the alimentary tract, just as it is incapable of penetrating the intact skin. The virus can be made to pass to the spinal cord when inoculated in such a manner as to bring it into intimate relationship with usual nerve endings and fibers; but this inoculation does not reproduce the conditions under which infection with the virus ordinarily occurs in man. The evidence is strong that the virus is confined to the human host, and passes from individual to individual in the secretions of the nose and throat. Lower animals living in proximity to man do not act as healthy carriers and accidental transmitters of the virus to human subjects.

On the natural widths of the L-series x-ray spectrum of gold: F. K. RICHTMYER and S. W. BARNES. Much of our knowledge of spectra has been derived from measurements of the wave-lengths of the several spectral lines. It is generally recognized, however, that data both on the intensities and on the shapes and widths of lines are necessary to a complete understanding of the mechanism of radiation. The present paper reports measurements on the shapes and natural widths of 23 lines in the L-series spectrum of Au(79), determined by use of the two-crystal x-ray spectrometer. To get the true widths, W_n, from the observed widths, W_o, (full widths at half maximum) we have used the following empirical formula: $W_n = W_o - W_R/2$, where W_R is the width of the rocking curve in the $(1, -1)$ position of the crystals. This formula is qualitatively consistent with the observed shapes of lines $(1, +1$ position) and rocking curves $(1, -1$ position) for the wave-length range covered in this work. The correction is of the order of a few per cent. Additional confidence in the validity of this method of correction is obtained by applying it to the data reported by Williams (*Phys. Rev.* 45: 71, 1934), whose crystals gave $(1, -1)$ rocking curves some 30 per cent. narrower than ours. When so corrected, the widths of three of the four L lines of Au(79) reported by Williams agree with corresponding lines herein reported by better than 1 per cent., data on the fourth of his lines being not comparable with ours. The natural widths of the several lines of the L-series of Au(79) vary from 0.53 X.U. for $L\gamma_6$ to 3.41 X.U. for Ll.

"Appearance" of atoms as observed with x-rays: ARTHUR H. COMPTON and E. O. WOLLAN. Photographs are shown which are the images of atoms of helium, neon and argon as obtained by x-ray diffraction, magnified about 2×10^8 times on the lantern slide. The images are obtained by photographing a rotating template whose shape is calculated by a mathematical transformation of our measured values of the x-rays scattered by the respective gases. This mathematical-mechanical procedure corresponds to the lens which forms the image when a microscope is used. The images formed by our procedure should be true representations of the electron distributions in the atom, except for the limited resolving power

and certain minor aberrations. The photographs show the helium atom as a diffusely continuous region filled with electricity. In neon, the inner group of K electrons is clearly distinguishable from the L electron group. The resolving power is insufficient to distinguish the K and L groups of electrons in argon, but does separate these from the M electrons. The appearance of these atoms is in good accord with modern quantum theory of atomic structure. These experiments afford probably the most direct information now available regarding the way in which electrons are distributed in atoms.

(To be concluded)

SCIENTIFIC EVENTS

THE BRITISH ASSOCIATION OF SCIENTIFIC WORKERS[1]

THE annual report of the Executive Committee of the Association of Scientific Workers presented to the council on February 24 refers to the formation of a National Parliamentary Science Committee as an outcome of negotiations with the British Science Guild as the outstanding special work of the year. The support of twelve leading institutions has been obtained, and the committee includes Sir James Henderson, Professor Miles Walker, Professor Blackman, with Commander Bernacchi as chairman, and Mr. A. Howard and Mr. H. J. W. Stone as joint honorary secretaries. In consequence, the Parliamentary Committee of the British Science Guild and of the Association have been disbanded. The compilation of a "Handbook of Extra-University Research in Pure and Applied Science," giving data concerning commercial, endowed and private research laboratories, has been completed and negotiations for publication are in progress. It is believed that the handbook will serve as an advertisement of British research activities and of the interest taken by British industrialists in maintaining the highest efficiency in factories. The book may become a standard work of reference alongside the "Universities Yearbook" and the "Year-Book of Scientific and Learned Societies."

The association has been active in combating the evil of bogus degrees and has been in negotiation with the universities to secure their support of successive bills introduced in the House of Lords by Lord Jessel to deal with this evil. The association collected a considerable amount of information regarding the granting of degrees by five different British "degree-mongers" but has so far been unable to induce the universities to withdraw their opposition at the third reading of the bills. The finance of the research associations has received attention and is being considered by a joint Committee of the Association and the British Science Guild. The production of "Science in Parliament" has continued and a memorandum has also been prepared on the relation of the unification of national transport, the construction of ship-canals across Britain, the reconstruction of derelict canals and land-drainage. The report concludes by directing attention to the resolution passed that members should seek to assist towards a better adjustment between scientific advances and social progress.

[1] From *Nature*.

THE U. S. BUREAU OF STANDARDS

AT the recent meeting of the American Chemical Society, a resolution was passed urging increased financial support by the Federal Government for the U. S. Bureau of Standards. The resolution reads:

The establishment and maintenance of certain fundamental standards are vital to the advancement of the science of chemistry.

These standards have been established and maintained by the Bureau of Standards under the authority of Congress for many years, and new standards are developed by the bureau as need is found for them.

The bureau is performing its proper functions in an expanding national and international program. This work conforms to the original purpose for which the bureau was established, and has been done so well as to gain it national and international favor and reputation.

The American Chemical Society, an organization of 17,000 members practising their profession in the scientific, academic and industrial fields, believes this work to be of great scientific value, and necessary to practical advances in both pure and applied chemistry.

As a consequence of the retrenchment policy of the Federal Government, the continuance of these activities of the Bureau of Standards has been put in jeopardy.

The attention of proper committees and members of Congress is called to this critical situation with the request that, in making appropriations, provision be made for the necessary and adequate standardization and research activities of the Bureau of Standards, so that it may continue its valuable service to chemical science and industry.

A PALEONTOLOGICAL RESEARCH INSTITUTION AT ITHACA, N. Y.

DURING the past few decades considerable Neozoic material has been collected and brought to Ithaca, N. Y., for study by paleontological students. Bulletins of American paleontology have offered a ready means for publishing descriptions and illustrations of this new material. It relates largely to the Southern States, West Indies and South America with con-