and Pre-Cambrian deposits, Mrs. Walcott has established the medal for especially meritorious research in this field. The committee in charge of its award comprises the secretary of the Smithsonian Institution, *ex officio,* two eminent geologists of this academy, a representative of the Institut de France and a representative of the Royal Society of London.

The committee has unanimously recommended the award this year to Dr. A. H. Westergaard, of the Swedish Geological Society of Stockholm, for his eminent researches on the stratigraphy and paleontology of the Cambrian formations of Sweden.

Westergaard's major work, published in 1922, "is a complete description of the trilobite species of which about 28 were new. The beds of Norway and Denmark are correlated with the Swedish formations." Now a man of 60 years, Westergaard is still active in the Cambrian field, having published frequently and regularly right up to the present time. His latest publication, in 1938, describes a deep boring through the Cambro-Silurian at File Haidar, in Gotland, and contains accounts of Lower and Middle Cambrian deposits therein and of the contained faunas.

In view of Dr. Westergaard's valuable contributions to both stratigraphy and paleontology of the Cambrian period, and his continued zeal in these investigations, the committee of award has much pleasure in recommending that the Charles Doolittle Walcott Medal and Award be presented to him.

C. G. ABBOT

The medal was received for Dr. Westergaard by the Minister of Sweden, the Honorable W. Bostrom, for transmission to him through diplomatic channels.

ABSTRACTS OF PAPERS

The probability concept: EDWIN C. KEMBLE. The long-standing controversy over the nature of probability may be resolved by the type of operational analysis so fruitful in physics. Probability is related to our subjective sense of expectancy in much the same way that a thermometer reading is related to our subjective sense of heat and cold. Probability can be defined as a number derived by standardized mental operations from a definite state of information. In so far as it is dependent on information it is subjective. In so far as the evaluation of probabilities from given data is standardized in a manner acceptable to many persons the concept becomes objective. There is no *a priori* necessity for a *single* rule for evaluating probabilities from all states of information, and one must admit that where the information is vague *no* calculation of an acceptable probability is possible. Evaluation of probabilities on the basis of a principle of indifference is appropriate to one type of informational situation, whereas calculation from relative frequencies in a collective is appropriate to another. There is use for both types of probability in practical and scientific matters. Either one can be used with the standard calculus of secondary probabilities from primary probabilities. However, there is a sharp distinction between the totality of implications which can be drawn from the two corresponding states of information. Failure to observe this distinction is a common and serious error in probability calculations.

Recent experiments on cosmic rays at high altitudes: WILLIAM P. JESSE (introduced by A. H. Compton). During the past year the cosmic ray investigators at the University of Chicago have carried out three different experiments to investigate some of the interesting phenomena associated with cosmic rays at altitudes of twenty thousand feet and higher. Marcel Schein and E. O. Wollan in collaboration with the writer have been able by coincidence counter apparatus carried by balloons to determine as a function of altitude (1) the vertical intensity of the mesotrons in the atmosphere and (2) the number of mesotrons generated in a block of lead 2 cm thick by non-ionizing radiation. The mesotron intensity was found to increase rapidly with altitude up to a maximum value at about 6.6 cm pressure and then to decrease. The production of mesotrons in the lead block becomes noticeable at an altitude of 5 km and from this point on increases with altitude at about the same rate as does the soft component of cosmic rays. In a second high altitude experiment by G. Herzog a counter-controlled cloud chamber and magnet were carried in an airplane to a height of 29,000 feet to obtain photographs of slow mesotron tracks. Mesotrons can be distinguished from electrons in a cloud chamber by reason of the increased ionization along the tracks only when the momentum of the mesotron lies within a range of relatively low values. Mesotrons of such low momentum values occur so rarely at sea level that from thousands of cloud chamber photographs made at the surface of the earth not more than a dozen tracks have been clearly distinguished as mesotron tracks, and mass estimates made. Above twenty thousand feet such slow mesotrons were found by Herzog in much greater abundance. From 230 photographs obtained, more than twelve tracks could be definitely identified with the passage of a mesotron. A third experiment by the writer has consisted of a series of thirteen balloon flights in which an ionization chamber was carried up to an altitude of approximately 25 km in an attempt to determine a possible time variation in the total intensity of cosmic rays near the top of the atmosphere. Time changes of more than fifteen per cent. have been observed during the past year. Such changes follow quite closely the "world-wide" variations of Forbush and others and are probably due, in part at least, to intensity changes in the magnetic field surrounding the earth. However, when the high altitude values are corrected on the basis of ground values for the "world-wide" variations, a residual effect remains with a maximum in the early spring and minimum in the late summer. Further experiments are necessary to determine whether this is a true seasonal effect.

Toxicity of alpha and fast neutron radiation: ROBLEY D. EVANS (introduced by John C. Slater). Results of experiments on neutron tolerance in animals can not be accurately extrapolated to man because the relative radia-

tion sensitivities are entirely unknown for small doses. Biological effects of neutrons are due to the secondary recoil rays which they produce in the body by collision with hydrogen, carbon, nitrogen, oxygen and other atoms. The average specific ionization, and hence the ionic effectiveness, of the neutron recoil rays is closer to that of alpha rays than to any other radiation which has been the subject of extensive biological investigations. Data are available from studies of chronic radium poisoning and of lung cancer produced by radon inhalation, concerning the effects of alpha rays on human tissue. Using these data, it is shown that a dosage of 0.01 n per day of fast neutrons may be unsafe if the exposure continues over a period of about ten years.

Remarks on the theory of nuclear resonances: G. BREIT. Pronounced resonances are observed in a number of nuclear reactions and it is customary to interpret these as due to the formation of temporarily stable states of the compound nucleus. While this qualitative picture is applicable in many cases its quantitative validity is doubtful. Some limitations of the "dispersion" treatment which become apparent when the wave equation is treated accurately are as follows: (a) Coupling through the field changes the position of the levels in addition to the Dirac frequency shift. (b) The same energy level should not show peaks at the same energy in different reactions. Shifts of the order of the level width are expected. Sufficient conditions for the absence of shifts are known. (c) The combined effect of several levels shows itself in interference in both the numerator and denominator of a fraction. (d) Neither the regular nor the irregular (F, G) solutions of the radial wave equation are universally applicable to the computation of mean lives of compound states. Green's function for two and more dimensional separable problems is used for an estimate of competitive effects of nuclear excitation. Additional justification is given to the form of dispersion theory worked out by Wigner and the writer.

The magnetic properties of the transition elements: F. BITTER (introduced by Karl T. Compton). The main objective of the present cryomagnetic research at M. I. T. is to provide information about electronic configurations and interaction energies in solids. Our first experiments have been on compounds and alloys of the transition elements Cr, Mn, Fe, Co, Ni, Cu. We plan to complete a general survey of these substances from 14° to 1,200° Abs. in large and small fields. By way of illustration, the properties of iron will be discussed. α-iron, Fe_3O_4, one form of Fe_2O_3, FeS are ferromagnetic. γ-iron and hematite (Fe_2O_3) are not. Our own results on $FeCl_2$, $FeCl_3$ and on alloys of copper containing less than 1 per cent. of Fe in solution show strong paramagnetism with interesting anomalies at low temperatures. Also an alloy of gold containing 12 per cent. of iron in solution, although it has a face-centered cubic structure like γ-iron, is ferromagnetic up to 230° C. (*Bulletin Am. Phys. Soc.*, 15: 20, 1940). The theory of solids is sufficiently advanced to attempt at least a qualitative description of the above facts. Such an attempt will be outlined, starting with assumptions about the Fermi energy resulting from the application of the exclusion principle and about the Heissenberg exchange energy, and then calculating the properties of iron atoms in various geometrical configurations.

Zeeman effects and preliminary analysis of singly-ionized praseodymium (Pr II): GEORGE R. HARRISON and NATHAN ROSEN (introduced by Karl T. Compton). The magnetic resolution of spectrum lines emitted by the singly ionized praseodymium atom has been studied at fields up to 95,000 gauss, using a 1,700-kilowatt Bitter electromagnet. Three concave gratings of 10-meter radius were used simultaneously to photograph the spectrum between 2,200 and 8,000 A, giving dispersions of 0.8 A/mm for the ultra-violet range and 1.6 A/mm for the visible and near infra-red. The wide hyperfine structure and complicated overlapping of many of the Zeeman patterns renders their separation difficult, but several hundred patterns have been reduced to obtain information about spectral terms. Many intense lines are found to be multiplet second-order satellites, indicating wide departures from LS coupling, as is to be expected. An unusual number of terms having the same g-values are found, possibly indicating a degradation of many terms to a common value through strong mutual perturbations between them. Since the spectrum is rich in lines and of intermediate coupling, no single method of analysis is found sufficient, and it is only by the combined use of improved wavelength measurements, hyperfine structure analysis, Zeeman effect analysis and excitation studies that the many possible quadratic arrays, which applications of the combination principle through the interval sorter and recorder have brought to light, can be critically compared. By using all these methods a rapidly growing array involving several hundred lines has been set up.

An apparently fundamental minimum lethal ion equivalent: ALEXANDER GOETZ (introduced by Robert A. Millikan). It is well known that living cells are affected by extremely small concentrations of ions of heavy metals, so small that they may be beyond the limit of microchemical detection. It is generally estimated that a living cell is killed by $10^5 - 10^8$ ions, depending on the biological state of the cell and the nature and conditions of the environment. Extended investigation of the exact magnitude of the lethal cell-metal ion equivalent (ν) have been made for the case of silver ions and yeast cells (Sacch. cerevisiae) in order to find the conditions for which the value of ν is a minimum. A differential staining technique indicative of the affection of a cell by Ag ions was developed, permitting thus the accumulation of considerable statistical material by microscopic count. It was found that ν decreases with the concentration of protecting colloidal material present and the avoidance of ion absorption on the walls by proper mixing methods. The techniques finally developed bring the value of ν down to numbers so small that the Poisson relation $\frac{(n/N)^\nu}{\nu!} \cdot e^{-n/N}$ (n and $N \sim$ number of ions and cells respectively per unit volume) could be applied for solutions of silver of 10^{-6} γ/liter ($1\ \gamma = 10^{-6}$ gr) obtained by a special diluting tech-

nique and cell concentrations of the order of $10^8 - 10^7$ per cc. The result of a large number of counts shows a considerable probability for the fact that if the conditions for "ideal" statistical mixing are well approximated by the experiment $\nu = 1$, *i.e., one ion only is capable of producing an irreversible change of the cell.* This is indicated by the absence of a maximum in the function $\triangle (N)_{\nu=1}$ ($\triangle \sim$ number of dead cells) for a variation of N between 0 and 10n. This finding implies that in a sense the living yeast cell acts towards a metal ion as *one* large molecule. The effect of the ion on the cells takes less time than the manipulation, and the changes produced appear not to impair the capacity of the cell to absorb almost any additional quantity of ions, which fact gives cause to a "shielding" effect among the cells for cell concentrations above 5×10^7 cells/cc.

A new conduction of heat phenomenon: G. W. STEWART. It is currently accepted that the transfer of energy in the conduction of heat in solids and liquids occurs by means of acoustic waves. In solids these consist of longitudinal elastic waves. In liquids it has recently been argued by Lucas that the more important carriers are transverse waves of viscosity and inertia. A new phenomenon in heat conduction has been found which is most easily interpreted by the presence of these transverse waves of viscosity and inertia. If the molecular swarms in liquid crystalline para-azoxyanisol are studied by means of x-ray diffraction, facts may be obtained concerning the orientation of these elongated swarms under the application of either the magnetic field or heat conduction. It is demonstrated that the swarms are oriented by the conduction of heat, their long axes perpendicular to the direction of the conduction. This phenomenon has been established by two experimenters, Holland and Reynolds, with different apparatus and methods. The orientation of the swarms corresponds to the effect of a cross-convection current. The transverse waves of Lucas may produce this result. These experiments demonstrate a new phenomenon and also add credence to the importance of the transverse waves of viscosity and inertia.

Absorption spectra of gases in the extreme ultra-violet: T. TAKAMINE and Y. TANAKA (introduced by Walter S. Adams). With the aid of a vacuum spectrograph provided with a concave grating of 20 cm radius, which was used at grazing incidence, the resonance series of H, He, Ne and A, lying in the region of extreme ultra-violet, were investigated. Lyman continuum from a quartz capillary discharge was as a rule used as the background. Excepting the case of hydrogen, the spectrograph was filled with different gases whose pressure could be varied. In He, beside the fact that several members of the 1'S–m'P series were obtained as absorption lines, the following features were noted: (1) The continuous emission spectrum of helium which shows two distinct maxima near λλ800A, 650A, produced by a condensed discharge is not absorbed even when the pressure of helium in the spectrograph is fairly high. This fact is significant because it shows that the helium continuum is of molecular origin, as has been generally accepted. (2) With increasing pressure of helium, the absorption line λ584A showed an unsymmetrical broadening toward shorter wave-length, coinciding exactly with Hopfield's[1] observation in the case of emission. For neon, the line λ736A was seen as an absorption line, and for argon the observations of Beutler[2] were confirmed. Here again, with increasing pressure, quite an unsymmetrical broadening of the line λ1048A was noticed just as shown by Beutler for corresponding lines of krypton and xenon. In the case of hydrogen, dry hydrogen at about 1 mm pressure was kept flowing through the quartz capillary discharge above mentioned. Several earlier members of the Lyman series were obtained in absorption. This part of our work is still in progress.

Infrared transmission of the human body: C. HAWLEY CARTWRIGHT, JOHN DANIEL and ALEX PETRAUSKAS (introduced by Karl T. Compton). The percentage reflection and transmission of a human cheek was measured as a function of wave-length in the visible and infrared spectra. Absolute values were obtained to 12,000A by using a special photocell and an integrating sphere, for collecting all the light. The reflection of the cheek reaches a maximum of about 50 per cent. in the visible red and gradually decreases for longer wave-lengths. The cheek (10 mm thick) is opaque below 6,050A and increases its transmission linearly to about 2 per cent. of that entering the skin at 7,000A. Between 7,000A and the water absorption band at 10,000A, the transmission is rather uniform. Beyond 10,000A, the transmission rises, reaches a maximum value of about 3 per cent. at 11,000A and decreases to zero beyond 13,500A, due to the water absorption. Using as a control a bearable discomfort on the outside of the cheek, measurements of the temperature rise inside the mouth were made using various sources of radiation. The best of these was a tungsten lamp with a water filter. An increase in temperature of 3° F. was obtained inside the cheek without external discomfort.

Introduction of liquids into tissues by means of a high velocity jet: G. FAILLA and T. R. FOLSOM (introduced by Harold C. Urey). Injuries have resulted from oil found at considerable tissue depths in workers with high pressure oil. The oil, emerging in a fine stream from a tiny hole, penetrated the tissues without the person being aware of it. This and tests made elsewhere, suggested the possibility of similarly introducing liquids into tumors (*e.g.*, distilled water to enhance the effect of x-rays or radioactive isotopes in solution or suspension). Preliminary tests with pressures under 15,000 pounds per square inch and a diamond orifice 0.002 inch in diameter, show the penetration of water jets through the skin to depths of two or more centimeters, depending on the structure of the underlying tissue. Skin itself offers considerable resistance. The water jet is capable of traversing seven or more centimeters of raw potato. The serious objection of the large amount of air carried into the tissue by the jet is overcome readily by exhausting the air from the applicator held in contact with the tissue. A distinct superiority of the jet over the needle method of introducing liquid into tissues is not apparent so far.

[1] J. J. Hopfield, *Ap. J.*, 72: 133, 1930.
[2] H. Beutler, *Zs. f. Phys.*, 92: 177, 1934.

Anthropological relations between Siberia and America: ALEŠ HRDLIČKA. In 1939, due to the courtesy of the Soviet Government and the wholehearted assistance of the Russian men of science together with the Russian Organization for Cultural Relations, the speaker was able to examine the important anthropological and archeological collections in Leningrad, Moscow and Irkutsk; and to participate briefly in some excellent field work carried on by Russian scholars along the Angara River in the Irkutsk region, now known to have been a center of a large neolithic population. This population, as it becomes better known, is proving of the utmost interest to students of prehistoric Siberian-American connections. The anthropological and cultural collections of Leningrad and Moscow have fortunately, during the World War and the troubled times thereafter, escaped serious damage, and are now gradually being brought again into order. They contain precious and now largely unique materials from the Russian territories in America, particularly from the Aleutian Islands, and they include many and in some cases large series of skulls of the native peoples of Siberia, which are essential for the studies on Siberian-American relations. All this material was placed freely at the speaker's disposal. It showed group after group of closely related forms to American remains, both Indian and Eskimo. The chief evidence, however, was presented by the neolithic skulls and skeletons of the Angara region. These remains by various features connect still with paleolithic man; aside from this all their important characters are American-like. The resemblance is with the Shoshonean-Algonkin and Piman-Aztec American type. The Angara skulls and bones, if mixed with the skulls and bones of these Indians, could not be told apart. This neolithic population lived in the Irkutsk regions to about 3,000 years ago—perhaps even later—then vanished. But along the northern Yenisei, of which the Angara is a tributary, there are to this day among the natives many individuals whose features resemble the American Indian.

A synthesis of radioactive lactic acid: G. B. KISTIAKOWSKY and RICHARD CRAMER. Radioactive lactic acid containing the C^{11} isotope in the carboxylic position was synthesized from carbon oxides produced by the bombardment of boron oxide by deuterons in the Harvard cyclotron. The oxides were converted to carbon dioxide and were reacted with ammonia and potassium to give KCN in good yield. Potassium cyanide combined with acetaldehyde in alkaline solution to give a α-hydroxyl-propionitrile which was hydrolyzed by hydrochloric acid to lactic acid. The mixture was made alkaline again, evaporated to dryness and extracted with acidic dry ether to eliminate inorganic materials. The ether phase was then extracted with water to separate lactic acid from polymerized acetaldehyde and concentrated to about 2 cc volume containing some 50 mgr of lactic acid, to which 100 mgr of ordinary d-l lactic acid were added when needed. The entire synthesis took approximately 1½ hours, the yield on C^{11}, allowing for radioactive decay, being about 30 per cent. The residual radioactivity was sufficiently strong to follow it for approximately five hours and thus the biological experiments described in the following abstract could be performed.

Liver glycogen from lactic acid containing radioactive carboxyl carbon: A. B. HASTINGS, G. B. KISTIAKOWSKY, R. D. CRAMER, F. W. KLEMPERER, A. K. SOLOMON and B. VENNESLAND. The fate of lactic acid, containing radioactive carbon in the carboxyl group ($CH_3 \cdot CHOH \cdot C^{11}OOH$), has been studied in rats. The immediate purpose of the experiments has been to determine whether the increase of liver glycogen is or is not accompanied by radioactivity, proportional to the amount of lactate converted to glycogen. When rats were fed 150 mg of radioactive d-l lactate, the total liver glycogen increased, on the average, 50 mg within a two and one half hour period. This corresponds to 33 per cent. of the administered lactate. The radioactivity of the glycogen was only from < 1 to 3.6 per cent. of the administered radioactive material. During the same time, the expired CO_2 contained more than 10 per cent. of the radioactive carbon administered as lactate. These results suggest either (1) that the lactate molecule may undergo a stage of decarboxylation before conversion to glycogen (*cf.* Conant and Tonberg, *Jour. Biol. Chem.*, 88: 701, 1930), or (2) that the increase in liver glycogen may have arisen in these experiments from some precursor other than the radioactive lactate. The possibility that a small amount of glycogen may be synthesized directly from lactate without decarboxylation is not entirely excluded.

Antihemorrhagic compounds: E. A. DOISY, S. B. BINKLEY, S. A. THAYER, R. W. MCKEE and D. RICHERT. Subsequent to our isolation of the natural antihemorrhagic compound, vitamin K_1, our investigations were extended in several directions. The structure of vitamin K_1 was deduced from the results of degradation experiments and the deduction confirmed by synthesis. Study of the structure of the other natural antihemorrhagic compound, vitamin K_2, has shown that, similar to vitamin K_1, it contains a 2-methyl-1,4-naphthoquinone structure but differs from the latter in the nature of the substituent in the 3-position. The substituent in vitamin K_2 is a hydrocarbon radical of thirty carbon atoms. Since the natural vitamin K compounds are not soluble in water and superior therapy could be attained in many cases by parenteral administration, several different water-soluble antihemorrhagic compounds have been prepared. They have been administered intravenously to chicks showing severe symptoms of vitamin K deficiency and their activities determined by the capacity to restore the prothrombin time to normal.

The difference between men and women in their response to heat and cold: EUGENE F. DUBOIS and JAMES D. HARDY. This study is a natural sequence to the researches recently carried out in our laboratory on the reaction of men to environmental temperature. Previous work has been restricted to a study of men, and as there is some evidence of differences in the reactions of men and women to heat and cold the study could be considered only half done. Six women subjects between the ages of twenty-two and thirty-five were studied in the human calorimeter of the Russell Sage Institute. The subjects were in a basal condition and nude. From the calorimeter itself, thermal heat loss, heat loss from vaporization and heat production were obtained. Measurement of the skin tem-

perature was done radiometrically by the subjects. The absolute humidity for all experiments was low and varied little from time to time. The reaction could be related to a single variable, the calorimeter temperature, which was varied from 22 to 35° C. in different experiments. The observations were: (1) The rectal temperature decreased 0.15° from the warm to the cold environments and was essentially the same as that for the men. (2) The average skin temperature in the cold environments was colder by 1.0° C. than that for the men, and in the warm environments was 2.0° C. higher than that for the men. (3) The heat loss for the women was less by about 5 cals/m²/hr than that for the men and decreased in the neutral environments to an average of 28 cals/m²/hr. The lowest value of heat loss for the men was 36 cals/m²/hr. (4) The conductance of the peripheral tissues for the women was less than that for the men by the equivalent of 4 mm of fat tissue. (5) Both sexes obeyed physical laws of cooling and lost 5.3 cals/m²/hr/°C. (6) Vaporization in women was the same as that in men at temperatures lower than 28° C. For temperatures higher than 28° C. the vaporization loss in the women was much smaller than that of the men. (7) Metabolic rate for men was constant throughout the experimental range at 35 cals/m²/hr. The metabolic rate for the women at temperatures lower than 28° C. was the same as that for the men. Warmer than 28° C., the metabolism of the women decreased with temperature to an average of 29 cals/m²/hr. This is the first evidence that we have been able to find of the chemical adjustment to temperature, and this response appears to be a response to heat and not to cold.

Studies in pain sensitivity: GEORGE A. SCHUMACHER, HAROLD G. WOLFF and HELEN GOODELL (introduced by Eugene F. DuBois). Quantitative measurements of the pain threshold were made by exposing 2.5 cm² of skin surface on the forehead for three seconds to thermal radiation. The intensity of radiation which barely evoked pain was denoted as the pain threshold. By this means the normal pain threshold level was established to ± 2 per cent. On over 100 subjects of both sexes, of different ages, education and social experience, the pain threshold was ascertained by this method. Each subject was asked to express an opinion about his own pain sensitivity. With few exceptions there was no relation between the personal estimation of hypersensitivity or hyposensitivity and the pain threshold as here measured. The series of pain threshold determinations when plotted produced a bell-shaped curve with ± 16 per cent. as the limit of deviation from the mean, and with 91 per cent. of all the determinations falling within ± 8 per cent. deviation from the mean. From these data it is inferred that the pain threshold in man, as with temperature, pulse and respiration, is relatively stable. In contrast to this uniformity in the threshold for the perception of pain are the wide individual variations which occur in the reaction to pain. This latter seems to be dependent upon individual experience and attitude.

Bombarding atoms (illustrated): ERNEST O. LAWRENCE.

The control of respiration under artificial respiration: YANDELL HENDERSON. Normal respiration is mainly controlled by the carbon dioxide produced in the body. The respiratory center in the brain regulates the breathing so that the volume of air with which the lungs are ventilated is almost exactly twenty times the volume of carbon dioxide that the blood brings from the tissues of the body to the lungs. A man walking slowly produces twice as much carbon dioxide as when sitting still, and he breathes twice as much air. When he does enough work to produce three times as much carbon dioxide as at rest, he breathes three times as much air. But suppose that a man, instead of breathing for himself, is subjected to artificial respiration, as if he were being resuscitated from drowning. Or suppose that he has been submerged in water until he is unconscious, and has stopped breathing; and that a policeman or a boy scout is administering artificial respiration. How much air will enter his lungs? And will the operator or the victim's own respiratory center regulate the amount? The answer is important; for, if the operator controls, it is possible that by pulling or pushing or poking the victim in some particular way, more air can be got into the lungs than by the standard Schafer, or prone pressure, method of artificial respiration. A number of methods have been devised that claim to be better than that method. But in fact, as the evidence to be presented to the Academy shows, the respiratory center, even when a man is unconscious and breathless, still controls the tonus and elasticity of the muscles of the chest; and this tonus determines how much ventilation can be produced. The conclusion, which is both of theoretical interest and practical importance, is that the method now used is the best, or is as good as the best, that can ever be invented. In order to promote a decision on this matter, I have placed 100 Swiss francs in the hands of the International Congress of Life Saving and First Aid (headquarters in Zurich) to be awarded as a prize to any one who can devise a manual method that, after application for 15 minutes on a normal man, will induce an apnea vera of 3 minutes. As I believe that no such method can be devised, I have also authorized the congress, after five years, to use the prize for any other suitable purpose.

A new group of filterable saprophytes: L. O. KUNKEL. A group of filter-passing organisms commonly found in juices from tobacco and tomato plants affected by tobacco mosaic or certain other virus diseases and occasionally found in juices from healthy plants of these species has been isolated and cultivated in cell-free media. Several members of the group have been passed in series in sterile juice from healthy tobacco plants. One isolant is now in the twelfth passage. The organisms produce characteristic translucent colonies that are birefringent and resemble spheroid crystals. They are composed typically of radiating needle-shaped or plate-shaped structures that may be dissolved in dilute solutions of sodium or potassium hydroxide. When films from solutions in which colonies have dissolved are dried and treated with Morosow's stain, large numbers of minute spherical particles become visible when viewed under a microscope. The particles occur singly or in chains of twos, threes, and fours. The chains suggest that multiplication is by division and that the particles are minute cells. All members of the group readily pass

Berkefeld filters of grade W, and some pass collodion filters having pores of such fineness that they hold back the virus of ordinary tobacco mosaic. The chief interest attaching to the organisms, whose taxonomic affinities are still undetermined, arises from their ability to pass filters and to build crystal-like colonies.

The division of mature plant cells induced by wounding: EDMUND W. SINNOTT and ROBERT BLOCH. In the development of wound cork stimulated in plant tissues by surface injury, cells which are large, vacuolate and mature may be induced to divide. Division here occurs in a plane parallel to the wound surface. An early step in the process is for the nucleus to become spherical and to move toward the center of the vacuole, where it is suspended by strands of cytoplasm. In this position it undergoes mitosis. A characteristic feature of the division of such cells and one which has not been generally recognized is the tendency for the cytoplasm to become aggregated very early in the position where the future cell wall will be developed. The location of this cytoplasmic plate, for which the authors propose the term *phragmosome,* thus indicates the plane of cell division considerably before the nucleus has done so. This feature of cell division is also characteristic of normal meristematic tissues where the dividing cells are markedly vacuolate.

Growth changes resulting from chromosome rearrangement: D. F. JONES. With the discovery of material that is particularly favorable for the study of changes during development it has been possible to make a new approach to the problem of abnormal growth. The endosperm of the maize seed has genetic characters that can be used as markers to detect nuclear alterations that are ordinarily never seen in somatic tissues by direct cytological examination. By the use of these chromosome markers it has been shown that there are many changes in the nucleus that have their effect in the cytoplasm. These changes are relocations of chromosome parts removing marker genes from some cells and replicating them in others. These relocations are not visible in the animals usually used for tumor investigations but are easily seen when the altered chromosomes are paired with their normal homologs in synapsis at the formation of reproductive cells in favorable plant material or in the salivary glands of flies. The new evidence derived from paired mosaic areas in the endosperm of maize and other food storage tissues shows that chromatin rearrangements may result in permanent alterations in growth activity as well as in color, size, shape and composition of cells. Thus the same process that is involved in the formation of new species of living organisms also produces new kinds of cells in somatic tissues and these new cells may become independent of normal control. Up to the present time it has been considered generally that chromosomal alterations are the result and not the cause of abnormal growth. This is true for the gross chromosomal aberrations visible in somatic cells but these have obscured the significant alterations that are responsible for the changes from normal at the start. It is now apparent why external agents such as physical radiations, carcinogenic chemicals, hormones, viruses, parasitic organisms and what next, can produce the same result as inherited tendencies, either by increasing the frequency of chromosome breaks and relocations or by altering the growth-regulating regions in the chromosomes.

Utilization of induced periclinal chimeras in determining the constitution of organs and their origin from the three germ layers in Datura: ALBERT F. BLAKESLEE, SOPHIA SATINA and AMOS G. AVERY. Study has been made of 69 periclinal chimeras in *Datura stramonium* which had been induced by colchicine treatment. In these chimeras it is possible to label individual germ layers and the tissues derived from them by means of differences in chromosome number and resultant differences in size of cells and their nuclei. The evidence points to the presence of three germ layers in Datura. Nine different types of periclinal chimeras were identified in which one or more of the three germ layers had an altered number of chromosomes ($4n$ or $8n$ in contrast to the normal $2n$ condition). The most frequent type (42 cases) had a doubled number of chromosomes in the dermatogen or outermost layer; the next frequent type (29 cases) had a doubled number of chromosomes in the plerome or innermost layer; the least frequent type (19 cases) had an altered number of chromosomes in the periblem or middle layer. The three germ layers differ in the contributions which they make to the primordia of different organs. Thus the interior of developing leaves, sepals and petals is made up chiefly from the middle germ layer or periblem but the interior of the developing stamen and pistil consists chiefly of the innermost layer of plerome. This difference suggests that sepals and petals are homologous but that stamens and pistils may have a different phylogenetic origin. From the morphological appearance of the different kinds of periclinal chimeras, it is evident that each of the three germ layers has a recognizable effect upon the size and shape of the various organs of the plant. Increase of chromosome number in either of the two inner layers (periblem and plerome) appears to have a more marked influence upon the external morphology than does increase of chromosome number in the outer layer (dermatogen).

(*To be continued*)

OBITUARY

DAVID M. MOTTIER

DR. DAVID M. MOTTIER, professor emeritus and former head of the botany department at Indiana University, died on March 25 at the home of his daughter, Mrs. Lyman R. Pearson, of Indianapolis.

Dr. Mottier was born near Patriot, Switzerland Co., Indiana, September 4, 1864, the son of David and Lydia Mottier. He attended Indiana University, receiving the A.B. degree in 1891 and the A.M. degree in 1892. Here he was a student of David Starr Jor-