

was made in 1908 and had been standing unchanged since that time. A general new culture of rotifers was made from these fertilized eggs and then a few females were selected at random and fed upon a continuous diet of the colorless *Polytoma* in watch glasses. After a few generations a very high percentage of females were produced. At this period adult females were taken from several of the watch glasses and placed in some filtered water from a jar in which a general culture of rotifers were thriving. Then there was added to this culture water the green flagellate, *Dunaliella*.

ous diet of *Polytoma* to a diet of the green *Dunaliella*.

Several other green flagellates have been reared and used as food, but they do not seem to be effective in causing males to be produced. Many other observations are being made in a further study of the problem, and the detailed results together with the exact methods used will be published in a later paper.

D. D. WHITNEY

BIOLOGICAL LABORATORY,
WESLEYAN UNIVERSITY,
MIDDLETOWN, CONN.

Experiment	Continuous Polytoma Diet			Adult Females taken from Cultures that had been Living on a Continuous Diet of <i>Polytoma</i> , a Colorless Flagellate, for Several Generations and Put upon a New Diet, the Green Flagellate, <i>Dunaliella</i>														
	Control			Lot A			Lot B			Lot C			Lot D			Lot E		
	Adult Females	Daughters	Per Cent. of ♂♀ Daughters	Adult Females	Daughters	Per Cent. of ♂♀ Daughters	Adult Females	Daughters	Per Cent. of ♂♀ Daughters	Adult Females	Daughters	Per Cent. of ♂♀ Daughters	Adult Females	Daughters	Per Cent. of ♂♀ Daughters	Adult Females	Daughters	Per Cent. of ♂♀ Daughters
1	5	52	9+	5	50	78	5	47	80+	5	54	75+	5	60	80	5	54	83+
2	5	60	3+	5	51	83+	5	50	74	5	56	82+	5	54	81+			

The controls were also placed in this filtered culture water and the colorless flagellate *Polytoma* was added.

The above table giving the details of two experiments shows the decided and striking results obtained. The continuous diet of *Polytoma* caused the adult females to produce 6 + per cent., as an average, of daughters that were male-producers, while the diet of the green *Dunaliella* that was given to the other adult females caused them to produce as an average 79 + per cent. of daughters that were male-producers.

These experiments are not exceptional, but are only two from many others already completed that are equally as good as these and which were obtained in a series of successive experiments. In all other experiments during the last eight years on *Hydatina senta* there has occurred from time to time a sudden production of males, but such experiments never could be repeated with equal success. Now the male-producing females can be caused to appear at any time from any stock in the laboratory by the sudden change from a continu-

³ Females which produce male offspring.

THE AMERICAN PHILOSOPHICAL SOCIETY

THE annual general meeting of the American Philosophical Society was held in the rooms of the society in Philadelphia, April 23 to 25 inclusive, and constituted a most interesting series of sessions. There was a large number of papers presented, their general character being of a high order of merit and the scope of subjects included being wide.

The meeting was opened on Thursday afternoon, President W. W. Keen, LL.D., in the chair, when the following papers were read:

The Physical Cause of the Unsymmetrical Equilibrium of the Earth Between the Land and Water Hemispheres, with a Theorem on the Attraction of the Terrestrial Spheroid: T. J. J. SEE.

Some Observations on the Psychology of Juries and Jurors: PATTERSON DU BOIS, ESQ.

Factors of Influence in the Origin and Circulation of the Cerebro-spinal Fluid: CHARLES H. FRAZIER.

Aspects and Methods of the Study of the Mechanism of the Heart Beats: ALFRED E. COHN. (Introduced by Dr. Keen.)

Interest in the mechanism of the heart-beat was stimulated by the discovery that the electric currents which the heart discharged during contraction could be registered by a moderately sensitive, but rapidly reacting galvanometer. A general use of such galvanometers was introduced in 1906-08. At the same time structures dealing with impulse formation (the sine-auricular node of Keith and Flack) and conduction (the auriculo-ventricular node of Aschoff-Tawara and the auriculo-ventricular bundle of Kent and His, Jr.) in the heart were discovered. These discoveries form the basis of contemporary studies.

The various waves which are found in the electrocardiogram, which is the name given to the photographed curves of the cardiac action currents, have been identified as representing definite events in the cardiac cycle. The validity of electrocardiograms as records has been established, not only for different classes of animals, but for species as well. So far as man is concerned, records can be differentiated as between individuals, and the record of the individual recognized over long periods of time as peculiarly his own. This individuality of records applies not only to normal, but also to abnormal conditions.

Alterations in the established form of electrocardiograms occur, and the conditions which cause a number of the changes were described. Most of these conditions depend on changes within the structure of the heart, while others on the physical relation of the heart to the body of the individual. Finally, a number of observations indicating the value of the galvanometric method in studying the control of the central nervous system over the heart were presented.

The Kinetic System: GEORGE W. CRILE.

Animals are transformers of energy. Adaptation to environment is made by means of a kinetic system of organs evolved for the purpose of converting potential energy into heat and motion. The principal organs comprising the kinetic system are the brain, the thyroid, the suprarenals, the liver and the muscles. The brain is the great central battery which drives the system, the thyroid governs the conditions favoring tissue oxidation; the adrenals govern immediate oxidation processes; the liver fabricates and stores glycogen; and the muscles are the final means by which the latent energy is converted into heat and motion. The positive evidence regarding the response made by these organs to various forms of stimulation contained in a large amount of experimental data

is verified by the negative evidence that the power of the body to convert latent into kinetic energy is impaired or lost when the brain, the thyroid, the suprarenals, the liver or the muscles are impaired.

Clinical as well as experimental evidence shows that any change in any link of the kinetic chain modifies the entire kinetic system proportionately. Such a change may result in an immediate breakdown—acute shock; or else the gradual modification of one or more of the kinetic organs may give rise to a number of diseases. This theory has already given us the shockless operation and it opens a possibility of controlling certain chronic diseases which are the result of overstimulation of one or more of the organs in the kinetic chain.

The Hereditary Basis of Certain Emotional States: CHARLES B. DAVENPORT.

Syriac Socrates—A Study in Syrian Philosophy: W. ROMAIN NEWBOLD.

The speaker argued that this dialogue, which has been entirely neglected since its publication in 1858, represents a philosophical system so intimately related to that of Bardaisan of Edessa, that it must be regarded as written either by him or by some member of his school.

The Evolution of Pine Barren Plants: JOHN W. HARSHBERGER.

Segregation of "Unit Characters" in the Zygote of Enothera with Twin and Triplet Hybrids in the First Generation: GEORGE FRANCIS ATKINSON.

The segregation of "unit characters" is a phenomenon now widely and well known, particularly as it relates to Mendelian segregation, with the production of different hybrid types in the second generation. But the segregation of several distinct hybrid types in the first generation of a cross between two species is a rare phenomenon. The fundamental distinction between these two types of segregation is apt not to be appreciated at once, since we are so accustomed to think in terms of Mendelian segregation.

Further, in Mendelian segregation, the production of "dihybrids," "trihybrids," etc., according to the number of contrasting allelomorphs in the parents, is so familiar that it requires some special emphasis for the mind to grasp how fundamentally different "twin hybrids" are from dihybrids, "triplets" from trihybrids, etc.

In the experimental studies here briefly outlined the two parents are *Oenothera nutans* and *O. pyenocarpa*, wild species of the evening primrose

in the vicinity of Ithaca, N. Y. They differ by more than thirty easily recognizable contrast pairs of "unit characters," or allelomorphie pairs, or, in terms of the "presence and absence" hypothesis, there are more than sixty "factors" of recognizable characters which meet in the fertilized egg of the cross between the two parents. These characters relate to the habit and color of the adults; features of the rosettes, foliage and inflorescence.

When *pyncocarpa* is the mother two distinct hybrid types are segregated in the first generation, and have been brought to maturity. These are *twin hybrids*. When *nutans* is the mother the same twin hybrids appear, and in addition a triplet which at present is in the rosette stage.

An analysis of the hybrids shows a distinct linking, or association, of certain characters. The bond between these characters is stronger than that of the total composition of either parent, and in the case of certain characters stronger than the total composition of certain organs or members. This results in a splitting of the total composition of both parents, and also a splitting of the total composition of certain members of the plant body. Examples of this linking of characters are as follows: First, habit characters; second, color characters; third, petal characters; fourth, broadness and toothedness of rosette leaves; fifth, narrowness and cutness of rosette leaves; sixth, crinkledness, convexity and red-veinedness of rosette leaves; seventh, plainness, furrowedness and white-veinedness of rosette leaves.

This splitting of the parental constitution resulting in the segregation into twin and triplet hybrids in the first generation occurs in the zygote or fertilized egg. Therefore it is of a very different type from that which takes place in Mendelian segregation due, according to general belief, to a qualitative, or differential division or reaction, in the gonotokonts (mother cells of the pollen grains and embryo sac). No such qualitative division is known to take place regularly in the fertilized egg. Therefore the usual karyokinetic process in the first division of the zygote can not be invoked in an interpretation of segregation of "unit characters" in the fertilized egg. The following hypotheses are considered.

First. De Vries's hypothesis of twin hybrids from mutating species. It does not appear probable, in the case of the two species considered here, that the segregation is due to the mutating character of one parent with its consequent splitability of constitution, combined with the splitting power of the constitution of another non-muta-

ting parent, which is de Vries's interpretation of twin hybrids in the first generation of a cross between *Æ. lamareckiana*, or certain of its mutants, and a wild non-mutating species.

Second. Theory of a differential division in the zygote. The meeting, in the fertilized egg, of such a large number of homologous, but contrasting, "qualities" or "bearers," may be less favorable for a blending of the contrasting members of a pair, than for some other combination. The different positions which the linked "factors" or "qualities" occupy as they approach the nuclear plate of the first division may well be due in a large measure to chance. In this way different combinations might establish a working relation in different eggs. The material representing the groups of characters not entering into any one working combination may then be left behind in the first suspensor cell of the embryo, or cast out into the cytoplasm. The material in the first suspensor cell plays no part in the formative processes of the new individual, since this cell is side-tracked by the basal wall formed during the first division of the zygote.

Third. The reaction theory. In view of the fact, which seems to be now quite well established, that certain hereditary qualities are governed by enzymatic action, it may not be improbable that all the factors, or bearers, may work through enzymatic or catalytic or other chemical processes. But when the substances mixed are alike in all cases, and the conditions are the same, it is not intelligible, from a chemical point of view, why in some eggs one reaction should take place, while in others the reactions should be totally different. Even if we accept in principle the reaction theory, the different reactions taking place in different hybrid eggs seem to point to a differential division or segregation of material portions or regions of the hybrid egg cell.

The Vegetation of the Sargasso Sea: WILLIAM G. FARLOW.

The Sargasso Sea through which Columbus passed on his first voyage to America is characterized by the scattered masses of gulf weed which float on the surface of the ocean in patches generally from fifty to a hundred feet in diameter. The question as to the origin of the gulf weed has never been definitely settled. Some consider that the gulf weed whose botanical name is *Sargassum bacciferum* is merely a mass of sterile branches of some species of *Sargassum* which grows attached in the region of the West Indies

and fruits. Others believe that in its present floating form the gulf-weed is a distinct species which has lost the power of fruiting and increases only by offshoots. In recent years the species of *Sargassum* growing in different parts of the West Indies have been more carefully studied and a comparison with the floating gulf-weed shows that mixed with the latter are found in small quantity fragments of at least two species known to grow in the West Indies. In only one instance has there been found mixed with the gulf-weed a seaweed which must have come not from the American coast, but from Africa or southern Europe.

In spite of the fact that most recent writers consider the gulf-weed as a distinct species, there is reason to think that it is really derived from some *Sargassum* growing in the West Indies, fragments of which are carried by the Gulf Stream to the Sargasso Sea. There are, however, still many doubtful points to be settled.

THURSDAY EVENING, APRIL 23

Meeting of the Officers and Council
At 8:30 O'clock

FRIDAY, APRIL 24

Executive Session—9:30 o'clock

Proceeding of the officers and council submitted.

Morning Session—9:35 o'clock

Albert A. Michelson, Ph.D., Sc.D., LL.D., F.R.S., Vice-president, in the chair.

Phase Changes Produced by High Pressures:
PERCY W. BRIDGMAN. (Introduced by Professor Goodspeed.)

The packing and the form of apparatus were described with which it has been possible to reach high pressures. These pressures have been pushed as high as 30,000 or 40,000 kgm. per sq. cm., or 15 or 20 times as high as that in modern artillery. The methods were then described by which it is possible to tell when a liquid is frozen to a solid or one solid changed into another by the application of pressure. One of the problems of particular interest is as to the character of the melting curve. There have been theories proposed, but hitherto sufficient pressure has not been obtainable to submit these theories to experimental test. Examination of the melting of a number of liquids over a wide pressure range has shown that the theories hitherto proposed do not hold at high pressures. The fact seems to be that as far as we can judge the melting curve con-

tinues to rise indefinitely, so that a liquid may be frozen by the application of sufficient pressure, no matter how high the temperature. A number of results are also obtained for the reversible transition from one crystalline form to another. Several new solid forms have been obtained; of particular interest are the new forms of ice, which are denser than water. In addition to these changes, which are completely reversible, one example has been found of an irreversible reaction produced by high pressure; yellow phosphorus may be changed by 12,000 kgm. and 200° to a modification in appearance like graphite, which is 15 per cent. more dense than the densest red phosphorus.

The Influence of Atmospheric Pressure on the Forced Convection of Heat from Thin Electric Conducting Wires: ARTHUR E. KENNELLY.

Some New Tests of Quantum Theory and a Direct Determination of "h": ROBERT ANDREWS MILLIKAN. (Introduced by Professor Goodspeed.)

It has been known for 25 years that when light of sufficiently short wave-length, *i. e.*, of sufficiently high frequency, falls upon a metal, it has the power of ejecting electrons from that metal.

It has been known for seven years that the kinetic energy possessed by the electrons thus ejected is larger the higher the frequency of the light which ejects them. In other words, blue light throws out electrons with greater speed than does red light.

Whether or not the energy of ejection is directly proportionate to frequency has been a matter of some uncertainty and of considerable dispute up to the present time.

The work herewith presented furnishes in the first place the most conclusive proof which has yet been found that there is exact proportionality between the energy of the ejected electrons and the frequency of the light which ejects them.

The second and most important contribution which it makes is the proof, given here for the first time, that the factor of proportionality between the energy of the ejected electrons and the frequency of the incident light is exactly the same quantity which has figured so largely in the recent developments of theoretical physics, namely, the fundamental constant which appears in Planck's theory of the discontinuous or explosive character of all radiant energy of the electromagnetic type. This constant is known as Planck's "*h*" and its value is directly deter-

mined in this work with an error which does not exceed one per cent. The value found is in very close agreement with that obtained by other methods. It is probable, however, that none of these other methods are capable of as high a precision as the photo-electric method here used.

The discovery that an electron ejected from a body under the influence of mono-chromatic light acts as though the whole energy content of the light wave were transferred without loss to the electron has important bearing on the whole framework of theoretical physics. It constitutes a new triumph of Planck's atomistic theory of radiation or, better, perhaps, a new proof of the usefulness in a new domain of Planck's "*h*."

The full theoretical significance of the mass of facts connected with "*h*" which have come to light within the past three or four years has not, however, as yet been fully discerned.

Discussion of "A Kinetic Theory of Gravitation"

—(1) *Gravitation is Due to Intrinsic Energy of the Ether*; (2) *Transmission of Gravitation can not be Instantaneous*: CHARLES F. BRUSH.

A kinetic theory of gravitation was outlined by the author at the Minneapolis meeting of The American Association for the Advancement of Science,¹ in which the ether is assumed to be endowed with vast intrinsic kinetic energy in wave form of some sort capable of motive action on particles, atoms or molecules of matter, and propagated in every conceivable direction so that the wave energy is isotropic. Particles or atoms are imagined to be continually buffeted in all directions by the ether waves like particles of a precipitate suspended in turbulent water. There are no collisions because neighboring particles follow very nearly parallel paths. Each atom or particle is regarded as a center of activity due to its energy of translation initially derived from the ether; whereby it has a field of influence extending in all directions, or casts a spherical energy shadow, so to speak. The energy shadow of a body of matter is the sum of the shadows of its constituent parts. The energy shadows of two gravitating bodies interblend, so that the energy density between them is less than elsewhere, and they are pushed toward each other by the superior energy density or wave pressure, on the sides turned away from each other.

In the present discussion the author employs some impressive illustrations to show that the energy acquired by falling bodies has some ex-

ternal source, and that it must be ethereal energy or energy of space; and he holds that the term "potential energy of position," as applied to a system of gravitating bodies implies the energy-endowed ether as a necessary part of the system.

As a corollary, the author explains how bodies falling toward each other by reason of their mutual attraction, and thus *accelerating*, that is to say, absorbing energy from the ether, can not rigidly obey Newton's law of inverse squares of distance. The force of attraction instead of varying as $1/D^2$, as it does for bodies at rest or in uniform motion, varies as $1D^{(2-x)}$ for bodies accelerating in the line of attraction, wherein x is a very small quantity which appears to vary with the rate of energy transformation or velocity of fall. When acceleration is negative, that is to say when energy transformation is *from* the accelerating body *to* the ether, x becomes positive.

In the case of a planet of the solar system, x obviously increases in importance with eccentricity of orbit, and may become appreciable in the highly eccentric orbit of Mercury. The author expresses the hope that this alternately plus and minus deviation from Newton's law will be found adequate to explain the secular advance of the perihelion of Mercury's orbit. He also calls attention to the fact that the moon moves toward and away from the sun almost the whole diameter of her orbit every month, and hopes that, in this connection, the deviation from Newton's law above indicated may explain the outstanding lunar perturbations, and perhaps cancel another to be mentioned later.

In the second division of the paper the author describes the premises from which Laplace drew his famous conclusion that gravitation is transmitted with infinite, or virtually infinite, velocity; a dogma which "for more than a century has blocked the path of fruitful thought on the physics of gravitation." The radically different premises growing out of the theory under discussion are then described and contrasted with those of Laplace, to explain why and how the author reaches such a widely different conclusion. He concludes that, even if the velocity of transmission is no greater than that of light, the moon's mean motion will be *retarded* a very few seconds of arc only, in a century; and the retardation will be correspondingly less if the velocity is greater than that of light. This retardation, of course, adds to the unexplained acceleration, if any, of the moon's motion; but the author further hopes that this retardation, plus the outstanding acceleration,

¹ SCIENCE, March 10, 1911; *Nature*, March 23, 1911.

will be explained by the deviation from Newton's law already described.

Behavior of Metals and Other Substances under Stress Near the Rupture Point: A. A. MICHELSON.

On Highly Radioactive Solutions: WILLIAM DUANE. (Introduced by Professor Goodspeed.)

At the annual meeting last year the author spoke on "Some Unsolved Problems in Radioactivity." At that time he stated that a number of superficial cancers had been cured (some of them only temporarily) by the proper application of a sufficient quantity of radium, but that the problem of treating internal cancers had not been satisfactorily solved. There appears, he said, to-day to be no reason for changing that statement.

Since that meeting the Cancer Commission of Harvard University has purchased about 250 milligrams of radium element, and has been investigating the effects due to the rays from radioactive substances on tissues, using methods that the author has devised and that are somewhat different from those employed before. He dwelt particularly on one of these methods, namely, that in which a concentrated radioactive solution is injected into the tissues.

Before describing the experiments he recalled the following well-known facts. Firstly: radium is continually transforming itself into a gas called radium emanation, and this emanation is continually transforming itself in turn into a succession of substances called radium A, B, C, etc., which are grouped together under the general term "deposited activity." These substances are radioactive as well as the radium itself. Any sealed glass tube containing radium contains these other radioactive substances also.

Secondly: these substances emit three types of rays, the alpha, beta and gamma rays. The alpha rays carry with them about 90 per cent. of the energy of the radiation, and the other 10 per cent. is divided between the beta and gamma rays. The alpha rays, however, are the least penetrating of the three types; they are stopped by about 1/25 of an inch of ordinary flesh.

Thirdly: radium, the emanation and radium A practically emit alpha rays only. Radium B emits weak beta and gamma rays and no alpha rays; but radium C emits all three kinds and is by far the most powerful radiator of the whole group. In the ordinary application of radium to tumors the methods are of such a nature that the alpha rays are absorbed before they reach the tissues, and the beta and gamma rays, therefore, are the only

ones used. Hence over 90 per cent. of the energy is wasted; and further the rays that are used come exclusively from radium B and C, and not from the radium itself or from the emanation.

The emanation and deposited activity can be separated from the radium and used alone. The method the author has perfected for doing this is as follows: The radium salt itself is in solution in a small glass tube, from which the air has been completely exhausted. Under these circumstances the emanation escapes from the solution. A simple mercury pump pumps the emanation into a second tube containing phosphor pentoxyl and a copper wire heated red hot by an electric current. The hot wire absorbs the hydrogen and oxygen that have been produced by the decomposition of the water, and the pentoxyl absorbs the water vapor. After purification a second pump pumps the emanation into a small glass bulb containing a few grains of common salt. The emanation remains in contact with the salt for several hours, depositing radium A B C on it. The salt thus becomes very radioactive, and on being removed from the bulb and dissolved in a small amount of water carries with it the activity, thus making the solution itself radioactive.

He has used several other methods of making these radioactive solutions. The deposited activity may be deposited on sodium hydroxide, and this may be dissolved in a few drops of water containing just enough hydrochloric acid to neutralize the hydroxide; or the emanation may be sealed into a small glass bulb with a capillary glass tube attached. If this is placed under water or a saline solution and the capillary tube broken, the liquid runs up into the bulb and dissolves the emanation, forming a radioactive solution. Solutions made by these methods may be millions of times more active than those hitherto used. In fact, they may be made weight for weight far more active than any solution containing radium itself could be.

The advantage in using these solutions in studying the effects produced on tissues is that after injection the radioactive substances come into intimate contact with the tissues, and thus the full power of the alpha rays is utilized.

If a solution of radium itself is injected, the process is not only costly, but very dangerous on account of the long life of the radium. The deposited activity solutions do not have these objections, for the radium is not wasted in producing the solutions and the activity lasts for only a short time.

He made a number of experiments to find out

where the radium A B C goes to after the injection. The injection is absolutely painless. If the injection is made subcutaneously a large fraction of the activity remains in the neighborhood of the point of injection, and the rest is carried off in the lymph and blood streams. The rapidity with which the activity gets into circulation is astonishing. A drop of blood taken from another part of the body only a few seconds after the injection is more radioactive than carnotite or pitchblende ores. It would seem that this might prove to be a delicate method of studying the flow of fluid through the tissues.

On making tests by means of the gamma rays an hour or an hour and a half after the injection he found that there was very little activity in the brain and lungs, but that there was a tendency for the substances to deposit out in the liver, spleen and kidneys.

Histological examinations were made by Dr. E. E. Tyzzer, who found a marked destruction of the bone marrow and of the leucocytes. Further, if the injection is made either into the tumor or the veins of a mouse with a tumor there is a decided destruction of the tumor cells.

Some Further Considerations in the Development of the Electron Conception of Valence: K. G. FALK. (Introduced by Professor Bogert.)

The Valence of Nitrogen in Ammonium Salts: WILLIAM ALBERT NOYES. (Introduced by Professor H. C. Jones.)

The specific rotation of solutions of aminocamphonanic and of aminodihydrocampholytic acids have been determined, also the rotations of the anhydrides, hydrochlorides and sodium salts of these acids. A comparison of these rotations furnishes strong evidence that the free aminocamphonanic and the aminodihydrocampholytic acids exist in the form of cyclic salts, containing a ring of six atoms and nitrogen in the quinquivalent form. The α -aminocampholic and β -aminocampholic acids, on the other hand, as indicated by the rotation of their solutions, do not form such cyclic salts, probably because the salts, if formed, would contain a seven-atom ring. The study of these compounds furnishes considerable evidence that nitrogen is in reality quinquivalent in ammonium salts and that such salts are not merely addition compounds formed by the union of the acid with the amino compound in such a manner that each molecule retains its original structure.

Determination of the True Atomic Weight of Radium: GUSTAVUS HINRICHS.

FRIDAY, APRIL 24

Afternoon Session—2 o'clock

Edward C. Pickering, D.Sc., LL.D., F.R.S., Vice-president, in the chair.

Presentation of a portrait of the late Samuel Pierpont Langley, LL.D., a former vice-president of the society, by Cyrus Adler, A.M., Ph.D., on behalf of a number of members of the society.

The Magnetic Phenomena of Sun-spots; The General Magnetic Field of the Sun: GEORGE E. HALE. (Illustrated with lantern slides.)

Summary of Researches, Department of Terrestrial Magnetism, 1904-14: LOUIS A. BAUER. (Illustrated.)

On the Colors of the Stars in the Cluster M 13: EDWARD E. BARNARD.

The Use of a Photographic Doublet in Cataloguing the Position of Stars: FRANK SCHLESINGER.

The Distribution in Space of 90 Eclipsing Stars: HENRY NORRIS RUSSELL.

The Eclipsing Variable Stars ψ Oriones and 88 d Tauri: HARLOW SHAPLEY. (Introduced by Professor H. N. Russell.)

Some Features of Moon's Motion and a Problem in Isostasy: ERNEST W. BROWN.

The United States as a Factor in World Politics: LEO S. ROWE.

After an analysis of the circumstances that have made the United States an important factor in world politics, Dr. Rowe proceeded to discuss the lack of adjustment between the international position of the United States and the national thought of the American people. The country has advanced to the rank of a world power, but the standards of public opinion with reference to international affairs have failed to make a corresponding advance. In discussing the situation, the speaker said:

We are at the present moment witnessing one of the most serious consequences of this lack of adjustment which is affecting the international position and influence of the United States to a degree which can not help but arouse the grave concern of every thoughtful and patriotic citizen. In a brief period of fifteen years we seem to have sacrificed the position of leadership in the maintenance of world peace, and have become one of the disturbing factors in world politics. How is it, it will be asked, that a nation which through the contributions of more than a century has gained an enviable position as a leader in the great movement for the advancement of international good-will, a nation whose founders dreamed of a period of uni-

versal peace, should within so short a space of time sacrifice this enviable position and come to be looked upon by all nations of western civilization as an uncertain factor in the orderly development of international relations?

Every student of international law and of world politics has been deeply impressed by the important part played by the United States, in placing the conduct of international relations on a distinctly higher plane. It seems, at first glance, extraordinary that during the first half century of its national existence a nation so weak and in many respects so unorganized should have been able to exert so important an influence on international law. When, however, we stop to reflect that during the first decades of the nineteenth century the United States held the balance of power, the apparent paradox is really explained.

The far-seeing statesmanship of the founders of the republic led to the adoption, as a cardinal principle of American foreign policy, of the rule that the United States must be kept free not merely from entangling European alliances, but from any participation in the conflicts then raging in Europe. This principle of aloofness from European entanglements led to the assertion of those principles of American neutrality which, while serving primarily the interests of our national integrity, accomplished the still larger purpose of laying the foundations for the modern law of neutrality, which has done so much toward eliminating the causes of international irritation and, therefore, of promoting the interests of world peace.

It has been the laudable ambition of successive Secretaries of State to continue and to strengthen those lofty and noble traditions which gave to the country a position of such unique power amongst the nations of both eastern and western civilization. In spite of these efforts, however, there is noticeable, during recent years, a distinct falling off in our international prestige. Little by little, the confidence of the peoples of Europe and of the American continent has been undermined until to-day we find ourselves in a situation which possesses none of the elements of that splendid isolation which so long characterized the position of Great Britain and which, if not remedied, is likely to deprive us of the possibility of continuing a mission which constitutes the chief glory of American foreign policy during the first century of our national existence. It is, therefore, a matter of real national moment to inquire into the causes that have brought about this change, and to seek a remedy, if such exists.

Of the elements contributing to the present situation, some are of long standing, the cumulative effects of which are now being felt, while others are of comparatively recent development. Amidst the splendid record of achievement during the first century of our national existence there looms up one aspect in our policy which has been a source of deep concern to successive Presidents and to successive Secretaries of State. I refer to the inadequacy of our national legislation for the protection of aliens resident within our borders. A long series of massacres, beginning with the Chinese massacre at Rock Springs, Wyo-

ming, in 1895, and ending with the lynching of Italians in 1899, 1901 and 1910, have placed our national government in the humiliating position of acknowledging to foreign powers that although the sole responsibility for the conduct of our foreign relations rests with the federal authorities, they lack the power to fulfill that primary and fundamental international obligation, namely, that the persons responsible for such crimes shall be brought to justice.

It is clear that no nation can shirk the responsibilities of its international obligations without arousing widespread opposition. The constitutional authority granted to our federal government is sufficiently broad and comprehensive to include all powers necessary to meet our international obligations. We can not permit our states, which occupy no international status, to plunge us into irritating controversies with foreign countries. The dignity of the national government and the demands of national self-respect require that the federal executive be given statutory powers and that the federal judiciary be given jurisdictional authority sufficiently broad to enable the national government to do its full duty in the protection of the persons and property of aliens resident within our borders. The first step in this direction is the enactment of a law giving the federal courts jurisdiction over all cases in which the treaty rights of a citizen or subject of a foreign country are involved. A bill to this effect has been before the congress of the United States on several different occasions.

The remedy for this situation is so simple that there is no excuse for further delay in making it effective.

A second influence which has played an important part in estranging the good-will of foreign countries is the widespread belief that there exists in the congress of the United States a marked tendency to force upon the executive a narrow and technical interpretation of treaties. Secretary Hay once said of certain senators who attempted to defeat every treaty presented to the senate that their idea of a treaty was a document which gained everything for the United States and gave nothing to the other party. The ruthless way in which the congress of the United States has at times swept aside treaty obligations, and the unwillingness to bring national legislative policy into harmony with our international obligations have created the impression that the promises of the United States can not be depended upon, and that even the best intentions of the President and his advisers are apt to be thwarted by the action of congress.

The culminating point of a series of instances was reached in the provision of the Panama Canal Act exempting American coastwise shipping from the payment of Canal tolls. Whatever may be our views as to the desirability of the exemption clause viewed as a question of domestic policy, it is clear from the history of the Clayton-Bulwer and of the Hay-Pauncefote treaty and from the testimony of those who assisted in the negotiation of the latter that the United States made no attempt to reserve to itself the right to give preferential treatment to its own merchant vessels. The privileges acquired

by the United States under the Hay-Pauncefote Treaty involved certain sacrifices on the part of Great Britain, for which she exacted the observance of the principle of equality of treatment. It would be a reflection on our country's reputation for fair dealing if, after securing the abrogation of the Clayton-Bulwer Treaty, we were to repudiate the concessions, the making of which rendered possible the ratification of the Hay-Pauncefote Treaty.

Fortunately for the good name of the United States, the President has courageously taken a position, which has not only aroused the admiration of the civilized world, but has placed our country under a debt of obligation. In his address of March 5, 1914, to the congress of the United States, he sounded a note which served to impress upon the nation the sacredness of treaty obligations.

The magnitude of the President's service goes far beyond the vindication of the Hay-Pauncefote Treaty. These words and the determination which lies back of them place the international relations of the United States on a distinctly higher plane, and, if properly supported by the united opinion of the country, will do much toward regaining for the United States the enviable position which we once occupied. All secondary and party interests must be made to bow before that higher standard of international dealing which the President so vigorously champions.

Passamaquoddy Morphology: J. DYNELEY PRINCE.

The present article on the morphology of the Passamaquoddy language of Maine is the first result of the rehabilitation of my exhaustive treatise on the Maine Passamaquoddies which was destroyed by fire, together with all notes, in 1911. The Passamaquoddies of Maine, as well as their close congeners, the Micmacs of New Brunswick, are second to the Micmacs in numerical importance among the eastern Algonquin tribes. The Micmacs of Nova Scotia, the Passamaquoddy-Micmacs of Maine and New Brunswick, and the Penobscot-Abenakis of Maine and Quebec constitute the family of the Wabanaki "people of the dawn-land" whose extraordinary folklore and interesting linguistic structure have been strangely neglected. In the paper especial attention was paid to the verbal formation of the Passamaquoddy with a comparison between its forms and those of the Abenaki of Canada, and in his oral presentation of this subject Professor Prince gave a few brief specimens of eastern Algonquin folklore poems in order to illustrate the character of these Indians.

A Sumerian Nature Hymn from Nippur, of the Time of the Dynasty of Agade, 2800-2600 B.C.:
GEORGE A. BARTON.

This cylinder was found at Nippur by Dr. Haynes and, after its arrival in Philadelphia, re-

mained until recently unpacked in the basement of the University Museum. The cylinder was originally six and one half inches long and approximately four and one half inches in diameter. It was inscribed with nineteen columns of writing, each slightly less than three fourths of an inch wide. One side of the cylinder, to the width of eight columns of writing, is broken away, but seven fragments of this portion have been found in the packing-boxes. From these fragments it has been possible to recover a portion of each of the columns of writing. On account of the crumbling of the clay, parts of some of the columns on the main portion of the cylinder are illegible. The script of the inscription is that of the dynasty of Agade, 2800-2600 B.C. The language is pure Sumerian. From the frequent references to a "foundation" in the text, it is probable that this was a foundation cylinder. Similarly the frequent references to sickness make it probable that a plague had recently visited Nippur. Parts of the text remind one of the incantations of later times; in parts there are beautiful descriptions of nature.

The name of the rebuilder of the temple and the author of the inscription have been broken away. The following are samples of its text:

The lord of darkness guards man;
The lord of light guards man;
The lord of life guards man;
The lord of the sanctuary guards man;
The grain for thy animals he increases;
God favors man.

The following extract shows that the Nippurians were not strangers to the charms of the flowing bowl:

The eye of wine presents 36,000 openings,
The bright eye is very brilliant,
Like the goddess, the great mother.
O our lady, mighty one, brilliant goddess,
Unspeakable is the splendor of thy vegetation!

The sickness is referred to in the following:

The fiery tablet of Enlil
To Nippur
Against the sickness he has brought;
With Ishtar of Erech for the protection of thy
land from death
Against the sickness he has brought it;
With Ea thy chief,
Against the sickness he has brought
The fiery tablet of Enlil.

And again:

Enlil declares:
"Gone is the sickness from the face of the
land."
As a protector he removed it—
Enlil's are they—
As a protector he removed it.

The last words that can be made out of the remaining text are:

He protects thee from death
And an evil fate.
This foundation Enzu laid,
Tappinu-grain he makes abundant,
Thy land he protects, he establishes for men.

FRIDAY EVENING, APRIL 24

Reception from 8 to 11 o'clock

at

*Hall of the Historical Society of Pennsylvania,
S. W. Corner of Locust and Thirteenth Streets*

Arthur L. Day, Ph.D., director of the geophysical laboratory of the Carnegie Institution of Washington, gave an illustrated lecture on "Some Observations of the Volcano Kilauea in Action," at 8:15 P.M.

SATURDAY, APRIL 25

Executive Session—9:30 o'clock

Stated Business.—Candidates for membership balloted for.

Morning Session—10 o'clock

William B. Scott, Sc.D., LL.D., Vice-president, in the chair.

Primary Cambrian Manganese Deposits of Newfoundland: NELSON C. DALE. (Introduced by Professor W. B. Scott.)

Geology of the Wabana Iron Ores of Newfoundland: ALBERT O. HAYES. (Introduced by Professor W. B. Scott.)

Hewettite, Metaheuwettite and Pascoite, Hydrated Calcium Vanadates: W. F. HILLEBRAND.

The Relations of Isostasy to a Zone of Weakness—the Asthenosphere: JOSEPH BARRELL. (Introduced by Professor Charles Schuchert.)

The mass of every mountain or mountain range tends to deflect the plumb-line toward it and slightly away from the true vertical, so that the measured latitude and longitude of any locality will differ slightly according as it is determined by triangulation from other regions or by independent astronomic determination of the point in which the observed vertical pierces the celestial sphere. But Hayford has shown that the deflections of the vertical are actually only one tenth of the deflections calculated as due to the terrestrial relief. This is a quantitative test of the degree of isostasy and shows that the continents stand high above the ocean floors because they are underlaid with lighter matter. Such a relation of density to relief explains the almost complete neutralization of the gravitative effect of the relief and

accounts for the smallness of the observed deflections of the vertical, averaging for stations in the United States only about three seconds of arc. Dynamically it implies a state of flotation of the crust upon the inner earth analogous to the flotation of an iceberg in the ocean.

Yet the earth as a whole is known to be about as rigid as steel; the nature of earthquake vibrations transmitted through the earth shows it to be solid throughout and more incompressible and rigid at great depths than near the surface. Within the limited range of temperatures and pressures open to experiment Adams has added to the evidence and shown that rocks possess greatly increased strength under cubic compression. Furthermore, the writer has published recently some calculations which show that the loads supported by the strength of the crust are much greater than had been generally supposed. The delta built out by the Niger River, for example, is equivalent in mass to at least 2,000 feet of rock above sea-level, extending over a circular area not less than 300 miles in diameter.

How then shall the geodetic evidence pointing toward a general flotation of the crust near to equilibrium be reconciled with this other evidence of great rigidity and strength? It has long been supposed that a mobile zone may explain the apparent contradiction, but the necessity of postulating such a zone becomes greater as the accumulated evidence of weakness, on the one hand, of strength, on the other, diverges more and more. It is the consideration of the depth and physical nature of this zone which is the thesis of the present paper.

By means of a study of the area of the surface loads and their degree of departure from isostatic equilibrium this zone is located far deeper than other estimates have placed it; the level of minimum strength being thought to lie as much as 150 to 200 miles deep. The maximum strength is probably at a depth of 10 to 20 miles and falls off rapidly below. At great depths the earth is doubtless again much stronger and resists deforming stresses as would a globe of steel. In physical character this zone of weakness is thought to possess high elasticity, but, under prolonged stresses, a low elastic limit. This shell of the earth plays such an important part in geologic dynamics that it is thought to merit a special name—the sphere of weakness—the asthenosphere.

Evidence for a Pulsational Change of Climate in the Libyan Desert: WILLIAM H. HOBBS.

The Cretaceous-Tertiary Boundary in the Rocky Mountain Region: F. H. KNOWLTON. (Introduced by Professor John M. Clarke.)

As a result of certain stratigraphic and paleobotanical work in the Rocky Mountain region, Mr. Knowlton became convinced some years ago that the then accepted boundary line between Cretaceous and Tertiary would require readjustment to bring it in harmony with ascertained facts. Evidence bearing on this point has been cumulative, and as a final result he feels justified in presenting and defending the following thesis: The dinosaur-bearing beds known as the Ceratops beds, Lance Creek beds, Lance formation, Hell Creek beds, Sombre beds, Lower Fort Union, Laramie of many writers, Upper Laramie, Arapahoe, Denver, Dawson, and their equivalents, are above a major time break and are Tertiary in age. Stratigraphic, diastrophic and paleontologic evidence in support of this contention were presented.

The Geologic and Biologic Results of a Study of the Tertiary Floras of Southeastern North America: EDWARD W. BERRY. (Introduced by Professor William B. Clarke.)

The results of several years of study of the exceedingly rich Tertiary floras of southeastern North America were announced for the first time. Their botanical relationships and their bearing on the evolution of types and upon geographical distribution were summarized. The geological results include the recognition of hitherto unknown intervals during which many thousands of square miles were above sea-level. These studies have also afforded for the first time fossil floras of fixed stratigraphic position for comparison with the floras of the Rocky Mountain Province on the border between the Cretaceous and the Tertiary whose age has been the occasion of several decades of controversy. They also afford means for correlation with the type section of the Paris basin, and likewise furnish a large body of evidence bearing upon geological climates and other physical features of the past.

The Burgess Shale Fauna of the Canadian Rockies: CHARLES D. WALCOTT.

On Multiple Treatment of One and the Same Story "Motif": MAURICE BLOOMFIELD.

Some Biblical Miracles: PAUL HAUPT.

The Sumerian Pronunciation of the Name "Ninib" as the Chief Deity of Umma: ALFRED T. CLAY.

Panama Tolls and Tonnage Rules: EMORY R. JOHNSON.

SATURDAY, APRIL 25

Afternoon Session—2 o'clock

William W. Keen, M.D., LL.D., President, in the chair.

Unveiling of a medallion portrait of the late Sir Joseph Dalton Hooker, O.M., G.C.S.I., C.B., by William G. Farlow.

Symposium on Physics and Chemistry of Protoplasm—

The Germ Plasm as a Stereochemic System: EDWARD T. REICHERT. (Introduced by Dr. Keen.)

Arrangement and Distribution of Substances in the Cell: EDWIN GRANT CONKLIN.

Vital Staining of Protoplasm: HERBERT MCLEAN EVANS. (Introduced by Professor Pier-sol.)

Protoplasm does not exist as a substance, but only as an organism; it is never found in the mass, but only in the form of cells. Even the simplest cells are complex structures consisting of many parts. In practically all cells there is a central portion, the nucleus, which is sharply marked off from the surrounding portion or cell body. Each of these portions is further subdivided into different parts or substances; the most constant differentiations of the nucleus are chromatin and achromatin, of the cell body cytoplasm and metaplastm. Other differentiations which are frequently present are centrosomes or division centers, with surrounding archiplasm, cell membranes, cortical layer of cytoplasm, central cytoplasm and perinuclear plasm.

The relative positions of different cell constituents vary in different kinds of cells, and in the same cell at different phases of cell life or under different environmental conditions. In cells which are not dividing the nucleus usually lies near the center of the cytoplasm, though it may be eccentric toward the side on which nutriment is received and away from the free border of epithelial cells. The centrosome usually lies at the pole opposite the nucleus and toward the free border of epithelial cells. The chief cell axis is the line connecting centrosome and nucleus. Thus many cells have a definite polarity.

In some plant and animal cells the contents circulate in a more or less definite manner; this is called cyclosis. In dividing cells the movements of cell contents are most marked, the movements taking place largely around the centrosomes which serve as centers of diffusion currents. These diffusion currents start at the time when the sub-

stance of the nucleus begins to mingle with that of the cell and they not only distribute the cell contents in a definite way, thus causing differential or non-differential division, but they also probably cause the separation of the chromosomes and the division of the cell body.

When a spermatozoon enters the cortical layer of an egg, or when this cortical layer is pricked by a needle, the substance of this layer flows rapidly to the point of entrance, where it forms an entrance cone, while the sperm head with some of the cortical substance penetrates to the interior, and the egg and sperm nuclei then approach one another. Then the cell movements connected with the first cleavage begin and the egg substances become segregated and localized by means of these currents into areas which give rise to particular organs. Since the pattern of this localization is different in different groups of animals, it must be that there is an internal regulating mechanism which determines the direction and extent of the movements within the cell.

Finally the relative sizes, positions and order of appearance of different parts of a cell during division, or of an egg during the early stages of development, are indicative of certain generic relations between these parts. The centrosome and archiplasm are thus found to be causally connected with the achromatin of the nucleus; the chromatin grows at the expense of the achromatin; and the cell body influences the growth of the nucleus, while the nucleus influences the differentiations taking place in the cell body.

All of these complicated morphological and physiological phenomena are doubtless the expression of chemical and physical processes occurring in the cell; a few of these processes may now be indicated, but that which is known is as nothing compared with what remains to be learned about the physics and chemistry of the cell.

The Physical State of Protoplasm: G. L. KITE.
(Introduced by Professor McClung.)

An accurate knowledge of the physical state or conditions of living matter has been gained for the first time by the employment of new methods for the dissection of living cells under the highest power of the microscope. Most living matter has been definitely proved to be in the jelly state. In a few kinds of cells the living substance is a liquid. Micro-dissections have thrown new light on the distribution of jellies and liquid in living cells and proved for all time the physical reality of such important structures as chromosomes, nucleoli and spindles.

The Physico-chemical Organization of the Cell:
LAWRENCE J. HENDERSON. (Introduced by Dr. H. F. Keller.)

At the banquet on Saturday evening at the Bellevue-Stratford about eighty members and guests were present, the toasts being responded to as follows:

"The Memory of Franklin," by Hon. Mayer Sultzberger.

"Our Institutions of Learning," by Professor J. Dyneley Prince.

"Our Guests," by Professor Maurice Bloomfield and Sir Ernest Rutherford.

"The American Philosophical Society," by Russell Duane.

ARTHUR WILLIS GOODSPEED

PHILADELPHIA,

May 4, 1914

THE BIOLOGICAL SOCIETY OF WASHINGTON

THE 525th regular meeting was held April 4, 1914, in the assembly hall of the Cosmos Club, with Vice-president Dr. W. P. Hay in the chair, and 35 persons present.

Wm. Palmer gave the first paper on the regular program: "Notes on the Hatching of a Local Terrapin (*Kinosternon pennsylvanicum*).'' From 4 to 5 eggs are found in nests of this turtle. The contents of one were transferred to the yard of Mr. Palmer's house in Georgetown, and apparently hatched, only after a lapse of 13 months. Mr. A. A. Doolittle and the chairman discussed the paper, the latter remarking that the diamond-back terrapin presents a similar case. The eggs are laid in the spring, and although hatched in the fall, the young sometimes remain in the nests until the following spring.

The second paper by Dr. O. P. Hay, was "An Account of a Visit to Some of the Smaller Museums." On a recent trip the speaker had visited some 40 towns for the purpose of examining specimens of Pleistocene vertebrates. He gave an account of the size and character of the collections in various towns and remarked upon the conditions under which the fossils were deposited. At Mount Union Scio College, Ohio, was seen a skull of the giant beaver, which was 13 inches long, the largest known. At Norwalk, Ohio, was found a specimen of the ground sloth (*Megalonyx*), which establishes the fact that these animals existed after the retreat of the last ice sheet. At Kansas City, Kansas, is the head of a whalebone whale, said to have been found in Oklahoma. It is undoubtedly modern, and the datum erroneous. The