Barbatia (Scapharca) patricia (Sowerby).

Arca patricia Sowerby, 1850, Geol. Soc. London Quart. Jour., Vol. 6, p. 52. Guppy, 1876, Geol. Soc. London Quart Jour., Vol. 32, p. 531. Not *Arca patricia* Guppy, 1903, Trinidad Botanical Dept. Bull., p. 541. (Reprint, Bull. Am. Paleontology, Vol. 8, pp. 279–280.) Not *Scapharca patricia* Maury, 1917, Bull. Am. Paleontology, Vol. 5, p. 337, pl. 53, fig. 1. Not *Arca (Scapharca) patricia* Woodring and Mansfield, 1921, in Vaughan and others, Dominican Republic Geol. Survey Mem., Vol. 1, pp. 102, 154, 164. Not *Scapharca (Scapharca) patricia* Maury, 1925, Bull. Am. Paleontology, Vol. 10, pp. 209–210, pl. 13, fig. 5.

Arca (Anadara) grandis Gabb, 1873 (part, not Broderip and Sowerby), Am. Philos. Soc. Trans., new ser., Vol. 15, p. 253.

Scapharca (Argina) tolepia Dall, 1898, Wagner Free Inst. Sci. Philadelphia Trans., Vol. 3, pt. 4, pp. 649–650, pl. 33, figs. 7, 8. (The citation of Bowden, Jamaica as the locality of the figured specimen is an error.)

Scapharca arthurpennelli Maury, 1917, Bull. Am. Paleontology, Vol. 5, p. 342, pl. 55, figs. 9, 10.

Arca (Scapharca) arthurpennelli (Maury), Woodring and Mansfield, 1921, in Vaughan and others, Dominican Republic Geol. Survey Mem., Vol. 1, pp. 97, 122.

Arca (Argina) tolepia (Dall), Pilsbry, 1922, Acad. Nat. Sci. Philadelphia Proc., Vol. 73, p. 406.

Arca patricia has the external features of an *Argina,* but has the cardinal area and hinge of the so-called *Scapharcas.* Both *Arca chiriquiensis* Gabb and the Miocene species from the Dominican Republic, Trinidad, Tobago and Colombia resembling *Arca grandis* Broderip and Sowerby belong to the group of *Arcas* called *Senilia* by Gray (type, *Arca senilis* Linné, a species living on the west coast of tropical Africa from Senegal to Angola). No *Senilias* and no so-called *Scapharcas* similar to *Arca patricia* are living in the Caribbean Sea at the present time. These species illustrate the remarkable deployment of *Arcas* in the Miocene Caribbean Sea and their present relatively impoverished representation there.

Pilsbry considers that the giant Miocene *Arca* from the Dominican Republic is *Arca grandis.* Specimens from the Dominican Republic and also from Colombia and Trinidad have crudely beaded ribs, whereas *Arca grandis* has clean-cut ribs, except in very large and heavy specimens, and usually only a few anterior ribs are beaded. Fossil and living specimens are variable in shape and have essentially the same cardinal area and hinge. The Caribbean Miocene fossils seem to represent a different species or at least a recognizable subspecies, but it seems inadvisable to propose a name in a note that could easily escape attention.

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ABSTRACTS OF PAPERS PRESENTED AT THE MADISON MEETING, NOVEMBER 9, 10 AND 11

Proper motions of stars obtained with the blink microscope: FRANK E. ROSS (Introduced by Edwin B. Frost). In the past, proper motions have been obtained by comparing positions of the stars measured with the meridian circle at distant epochs. In this way the motions of all the brighter stars have been obtained. The accuracy, however, is not great, on account of the uncertainty of the zero point at different epochs. Direct measures of photographs secured at epochs well separated in time, in general greater than ten years, yield better values. The blink comparator has been devised for the rapid comparison of photographs of the same field of stars secured at different epochs. With this instrument stars of large proper motion are instantly detected. There is urgent need of surveying the entire sky in this manner, for the detection of all the stars of large proper motion, in order that a true picture of the space which is contiguous to our sun may be built up. Professor E. E. Barnard secured the photographs of the necessary quality covering approximately one half of the sky. These fields are now being duplicated and compared by the writer. The minimal magnitude is approximately 15, and the lower limit of proper motion about 0.1 per year.

Radial velocities of 368 helium stars: EDWIN B. FROST, STORRS B. BARRETT and OTTO STRUVE. This paper gives the results of the measurement of 2,431 spectrograms of 368 helium stars (Harvard class B). The work has been in progress since 1901 and includes nearly all stars of the class, brighter than visual magnitude 5.5 and north of 15° south declination. Forty-two per cent. of these stars, or one out of 2.4, have been found to spectroscopic binaries, necessitating many plates for finding the velocity of the center of gravity of the pairs.

A solution for the whole group yields a velocity of 17.2 km per second for the solar motion, directed toward $\alpha = 284°$, $\delta = +12°$, with a value of the K-term of +5.6. The average residual velocity was 10.0 km per second. A distinct increase in the residual velocity is shown in passing from the brightest to the fainter stars. Inclusion of data from other sources, for the southern stars of which we have no plates, changes the position of the solar apex very slightly, but increases the solar motion to 26 km per second.

The constancy of the light of stars: JOEL STEBBINS. "It has been demonstrated by the work of the Smithsonian Astrophysical Observatory and its stations, under the direction of Dr. C. G. Abbot, that the sun may be called a variable star," said Dr. Stebbins. "That is, the amount of radiation in the form of light and heat which the sun emits is not always the same, but changes to the extent of several per cent. on each side of the average. The results of the Smithsonian observers are being used to study the connection between weather

changes and variations in the sun, with considerable promise of success.'' Since the sun is only one of many million stars, the question arises how near is this variability of the sun typical of the stars in general. Roughly, the stars may be divided into those which are white hot, yellow hot and red hot, the sun being a yellow star. The chief work of the Washburn Observatory lies at present in the measurement of minute fluctuations in the light of stars by means of an electric-cell photometer. With this instrument it is possible to measure the constancy of the light of one star by referring it to two or more other stars for comparison. In this way the eclipses of stars by dark companions may be studied and also other variations in light. Several cases have been found where white-hot stars have changed as much as one per cent. between one year and the next, and other cases where the change is more rapid—two or three per cent. in as many weeks. Some yellow stars like the sun seem to have irregular variations of two or three or even five per cent., while certain red stars may change as much as twenty, thirty or forty per cent. ''These minute changes like that of one per cent. per year may not seem very great,'' Dr. Stebbins commented, ''but when it is considered that the stars are supposed to shine with much the same brilliance for thousands or millions of years, it is evident that any progressive change of one per cent. annually can not continue for many years in succession. It is suggested that the stars have some way of automatically regulating their radiation so that when they are so much below normal in some way they recover, and likewise when they become brighter than normal the successive radiation is made to decrease.''

Recent physiographic observations in the Laramie Range, Wyoming: JAMES FURMAN KEMP. The speaker has been in the field in the Laramie Range during two recent summers, with Professor S. H. Knight, of Laramie, and with him has studied the phenomena. An interesting case of superimposed drainage is furnished by Sybille Creek, a small stream twenty-five to thirty miles north of Laramie City. It rises in the Precambrian center of the range, flows westward to the outside Mesozoic, turns north for three miles, and then abruptly east and northeast across the range in a deep canyon, ultimately joining the North Fork of the Platte. Inside its bend and now the location of a small tributary is a glacial valley, excavated in the granites, of perfect U-shape, and with small hanging valleys and waterfalls. The canyon, known as Long Canyon, is about two hundred feet deep, five hundred to six hundred feet wide and three to four miles long. It cuts squarely across the earlier drainage and is obviously of quite recent age. A few pictures were given of the large canyon of the North Fork of the Platte, below the Pathfinder dam, showing its superimposed character and, in the more open part of its course, its passage squarely across an anticlinal ridge several hundred feet high, formed of the Casper (Pennsylvanian) strata.

When certain mathematical formulas became true: G. A. MILLER. If we substitute for sin x and cos x in the common modern formula $\sin^2 x + \cos^2 x = 1$, the values of these functions for an arbitrary angle as given in the well-known table by J. Napier (1550–1617) the first member of this equation will be the enormous number of one hundred trillion instead of one, as required by this formula. Hence it is clear that at the time of Napier this formula would not have been generally regarded as true even if it is true for the values of sin x and cos x found in certain earlier tables. The trigonometric functions were probably never defined as pure lines, but they were commonly defined as *measured* lines until the time of L. Euler (1707–1783). While in a particular case our modern ratio definition appears already in the ancient Egyptian work by Ahmes this was replaced by measured line definitions, and the ratio definitions did not receive clear and permanent recognition until the time of Euler. The main object of Professor Miller's paper was to exhibit relations between the times when certain modern mathematical formulas actually appeared and when they would have been regarded as true in their modern form. The paper is expected to appear in *Science Progress*.

Hysteresis and atomic magnetostriction: G. W. STEWART and R. L. EDWARDS. The remarkable properties of permalloy has led McKeehan to an atomic theory of magnetostriction which is an interesting contribution. The phenomena herein reported can not be explained by the McKeehan theory but indicate a strong influence of crystalline condition upon hysteresis. The phenomena are: (1) The hysteresis of thin films (made by evaporation) of Ni and Fe, its increase with freedom from gas and with larger crystals; (2) the critical thickness of Fe films. A study of these effects shows the inapplicability of atomic magnetostriction, for there is no strain present in the films, and the effects caused by variation in treatments are large.

A spectroscopic study of the excitation of mercury vapor by positive ion impact: B. M. KNUTSON and JOHN T. TATE. The spectrum of mercury when excited by positive ion impact in mercury vapor differs from that excited by electron impact in the great preponderance in intensity of 2,537 over all other lines. When the positive ions have a velocity less than 100 volts, it requires a long over-exposure of 2,537 to detect the other arc lines. As the velocity is increased these lines become more prominent, but even at 1,800 volts they are relatively fainter than in an electron arc at 15 volts. It may be concluded that the efficiency of ionization by positive ion impact increases steadily up to at least 1,800 volts. A comparison of the spectra due to sodium ions with those due to mercury ions shows that sodium ions at 150 volts give about the same relative intensities of lines as mercury ions at 1,300 volts. This suggests that the extent of the excitation produced in an atom by positive ion impact is largely controlled by the velocity of the ion and not by its energy.

Polarization of resonance radiation in magnetic fields: A. ELLETT. In the absence of an applied magnetic field some resonance lines show polarization, while others do

not. It appears that those lines which would be expected to show polarization in a magnetic field parallel or perpendicular to their electric vectors always show more or less polarization in the absence of a field and that lines which would not be expected to show polarization in a field show no polarization in the absence of a field. Briet has put forward a theory to account for the polarization of resonance radiation in strong magnetic fields, and this theory gives remarkably good agreement for certain resonance lines, with certain orientations of the impressed magnetic field, while in other cases there are outstanding discrepancies. The rotation of the plane of polarization and the decay of polarization with increase of magnetic intensity of the light emitted parallel to the impressed field in weak fields may be accounted for qualitatively by the Larmor precession of the excited atoms, as Eldridge and Breit have shown. However, the usual law of distribution of the lines of excited atoms leads to equations for the per cent. polarization and angle of rotation which are not similar to the experimentally determined relations. If we assume that the law of decay of excited atoms is of the form $\frac{dN}{dT} = -N_0\ e^{-a(H+B)T^2}$ where a and B are arbitrary constants and H the impressed field then we find that the law of decay of polarization is $P = P_0\ e^{-KH}$ where P_0 and K determine a and B. The equation connecting the rotation of the plane of polarization and the field strength becomes $\tan 2\ O = e^{q^2}\ (2q - \frac{(2q)^3}{6}\ \frac{(2q)^5}{60} \cdots$ etc.) where $q = \frac{KH^2}{H+B}$ and this gives very good agreement with the observed values in the case of the 2,536 Hg line. The value of T, the mean life of an excited atom in a field of .60 gauss, is computed from observed values of P_0 and K to be .99 10^{-7} seconds which agrees well with Wien's value of 1.02 10^{-7}.

A study of the thermal properties of air: J. R. ROEBUCK. The thermal properties of air were studied by means of a series of experiments on the Joule-Thomson effect. Air compressed to a chosen pressure (100 to 220 Atm.) was passed through a temperature equalizing coil in an oil bath held at a series of temperatures between 25° and 300° C., and then through a porous partition, across which the pressure dropped a chosen amount and the change in temperature of the air was carefully measured. For this to be experimentally possible, the bath temperature and initial pressure required very careful regulation, and apparatus suitable for these purposes was developed. To obtain the maximum amount of information the measurements were arranged in groups, in which the pressure dropped successively from the same initial pressure to a series of successive values. A plot of the resulting values of pressures and temperatures gives an isenthalpic curve, and a group of such curves were obtained filling in the above regions of temperature and pressure. The slope (μ) of these curves is called the Joule-Thomson coefficient, which was obtained from the data of these curves by taking successive differences, and μ has been plotted as a function of temperature and pressure. These values of μ have been used to obtain the values of the specific heat of air as a function of the pressure when it is already known as a function of the temperature. They were used also to calculate the value on the Centigrade scale, of the thermodynamic zero, giving −273.15° C., depending somewhat, however, on the value used for the coefficient of expansion. This also allowed of calculating the value of the coefficient of expansion as a function of pressure. The work is being extended to temperatures below that of the room.

Polarized summary of paper on diffraction of X-rays by a ruled grating: A. H. COMPTON and R. L. DOAN. For many years we have believed that X-rays are like light rays but of much shorter wave-length. The most usual method for measuring the length of light waves is by means of a "grating" of lines ruled close together on the surface of a mirror of speculum metal. When light is reflected from such a grating, in addition to the beam directly reflected, there are sent out in different directions "spectra," in which the light is spread into the colors of the rainbow. These are the diffracted rays. From the directions in which these spectra are diffracted one can calculate the wave-length of the light. Many unsuccessful attempts have been made, ever since the time of Roentgen, to measure the wave-length of X-rays by similar reflection from a ruled grating. About twelve years ago, Professor Laue, of Vienna, discovered that the regularly arranged atoms in a crystal would act toward X-rays as the lines on the ruled grating act toward light, spreading the X-rays out into a spectrum. Since he knew about how far apart the atoms in the crystal were, he was thus able to estimate the X-ray wave-lengths. But it remained very desirable to be able to determine the wave-lengths directly in terms of the measured distance between ruled lines on a grating. The chief difficulty which had been met in earlier attempts to get a spectrum of X-rays with a ruled grating was that no X-rays were reflected from the surface of the mirror. Recently, however, we found that the X-rays are reflected from a polished surface if they strike it at a sufficiently fine grazing angle. Making use of this discovery we were able to photograph the spectrum of a beam of X-rays reflected at a fine angle from a grating ruled on speculum metal. Our success in this experiment was due in large measure to the fact that we had available Professor Michelson's remarkable ruling engine, on which the largest optical gratings in existence have been made, for ruling a grating especially adapted to the purpose. Just a few months before our work, Professor Carrara performed at Pisa a series of very similar experiments, which apparently failed only because the gratings which he had available were not exactly suited to the purpose. The immediate result of these experiments is to measure in a more direct manner than ever before the wave-length of the very short X-rays waves. This length is only about three billionths of an inch. The outgrowth of the work will probably be the extension of spectroscopic methods to hitherto unexplored

regions of the spectrum, and a more precise measurement of the distances between atoms and of the charge of an electron.

Direct proof that conduction electrons in metals at ordinary temperatures do not share in the energy of thermal agitation: R. A. MILLIKAN. The laws brought to light by Millikan and Eyring's recent study of field-currents, particularly the entire independence of such currents from cold metals upon temperature and their definite dependence upon temperature in the case of hot metals, constitute direct evidence that the bulk of the conduction electrons do not possess energies of thermal agitation at low temperatures, but that some of them acquire such dependence at high temperatures. The observed laws governing the pulling of electrons from cold metals by intense electrical fields are all interpreted in terms of the conception of conduction electrons as very light atoms of high boiling point which follow the quantum specific heat laws in the dependence of their energies of agitation upon temperature.

Chemical decomposition by collision with activated molecules: FARRINGTON DANIELS. A true unimolecular reaction is thought to be uninfluenced by molecular collision and the actual mechanism of such a reaction is a matter of considerable theoretical interest. Recent investigations indicate that the decomposition of nitrogen pentoxide is truly unimolecular. It is shown that nitrogen pentoxide is not decomposed by the infra-red radiation which it absorbs, and that the short infra-red radiation from the walls of the containing vessel does not bring about the reaction. Although nitrogen pentoxide does not now appear to be decomposed by ordinary molecular collisions, it is decomposed by collisions with molecules which are in a condition of abnormally high energy content. Nitrogen dioxide, when activated by blue light, causes its decomposition. Quantitative measurements show that an energy input somewhat less than the critical increment, calculated from the temperature coefficient of the reaction rate, is sufficient to cause decomposition. The quantum relations and the Einstein law of photochemical equivalence are discussed. The introduction of activated molecules may be accomplished also by mixing a reacting gas, such as hydrogen, with the nitrogen pentoxide. Experiments are shown which illustrate the accelerated decomposition brought about in this way. Collision with activated molecules can not be a factor in the normal thermal decomposition of nitrogen pentoxide, since the rate is only slightly affected by the presence of a solvent and the ultimate cause of the thermal decomposition is still an unsolved problem.

The importance of light for the maintenance of animal life: H. STEENBOCK and E. B. HART. Since 1907 there have been in progress at the University of Wisconsin experiments with various types of animals designed to establish the inadequacy of the usually accepted feeding standards. In this the experiments were unusually successful, but when it came to determine the nature of the deficiency variable and contradictory data were obtained continually up to approximately two years ago. Since then it has become established that the unappreciated vitiating factor was sunlight acting either directly upon the animal or upon its food. Sunlight is indispensable to man and beast in that it is the determinant of the efficiency with which calcium can be assimilated and retained; and calcium is one of the elements which needs to be efficiently conserved because in proportion to the body needs it is not found abundantly in foods and feeds. Sunlight plays this particular rôle by virtue of its content of ultra-violet radiations of approximately 250 to 302 millimicrons in wave-length, but unfortunately these are not present in sufficient degree to provide a wide margin of safety for the animal. As a result we have rickets in the young and poor dentition, restricted lactation, abortion and impoverishment of the skeleton in lime to a dangerous extent in the adult. All of which appears to be of greater importance in animal welfare than has been generally realized. The ultra-violet rays bring their effect through the medium of certain compounds widely distributed in plant and animal tissue so that practically any foodstuff can be "antirachitically" activated. "Make hay when the sun shines" is more than a mere poetic slogan, for hay made in the dark is devoid of rickets preventing properties. However general may be the effect of light upon foods, present indications are that only a very limited number of compounds can be affected. Unsaponifiable compounds of a sterolic nature are especially affected. Cholesterol, for instance, can be "activated" by exposure to light, but subsequent heating again inactivates it and thus the process can be reversed apparently an indefinite number of times. These general observations and deductions are presented not as a complete survey but as a beginning study of the indirect physiological and therapeutical action of light.

The isotopic composition and the atomic weight of terrestrial and meteoric chlorine: WILLIAM D. HARKINS and S. B. STONE. Accurate determinations of the atomic weights of meteoric and terrestrial chlorine indicate that this element has the same isotopic composition in the meteorite as on earth, which is favorable to the hypothesis of Harkins that the percentage of isotopes in elements is determined at least largely by the relative stability of the different types of atoms. The average atomic weight on earth of the meteorites is found by these determinations to be 35.457_6, which indicates 77.13 per cent. of the light isotope and 22.87 per cent. of the heavy, provided the atomic weights of the separate species are exactly 35 and 37. The table listed below gives in parentheses the number of determinations and the values represent the ratio of silver-chloride to silver, found by direct weighing, with the probable errors calculated by the method of least squares.

(7)	Apatite	1.32867$_4$	± 0.0000033
(7)	Wernerite	"	± 43
(7)	Hydrochloric Acid	"	± 43
(21)	Terrestrial	"	± 31

(7) Meteoric	1.32868_0	±	47
(28) Meteoric and Terrestrial	1.32867_6	±	23
(8) Sodalite	1.32868_0	±	67

The separation of chlorine into isotopes (lighter isotope): WILLIAM D. HARKINS and FRANCIS JENKINS. Further work upon the separation of the element chlorine into isotopes has resulted in a decrease of the atomic weight from 35.457 to 35.417 or by four one hundredths of a unit. An earlier separation in this laboratory raised the atomic weight from 35.457 to 35.512, or by .055 units. Thus relative separation thus far attained amounts to about one part in 360, which is by far the largest relative separation obtained by any element.

Distribution of sizes of droplets in emulsions: WILLIAM D. HARKINS and NORVIL BEEMAN. Earlier work of a number of investigators indicated that if an oil is emulsified in water by the use of a soap as an emulsifying agent, the droplets decreased in size as the metal of the soap is changed from sodium to potassium to rabidium and caesium. This result corresponds with the predictions of a certain form of what is known as the oriented wedge theory of emulsions. However, the present work indicates that the distribution curve of sizes is not affected by such a change in the metal ion of the soap, since practically identical curves are obtained when any one of these soaps is used. Furthermore, the distribution curve is almost the same if the emulsion is inverted, that is, if an emulsion of water in oil is obtained by the soap of bi- or trivalent metals. In general the peak in the curve, that is, the largest number of drops of course, is at a size of about 1.5 microns. If a viscous oil is emulsified, the position of the peak is not shifted by many more large drops of oil remaining in the emulsion, so that the interfacial area is greatly reduced, in some cases from 15,000 to 8,000 cm per cu cm of oil. The area occupied per molecule of soap in the interface depends somewhat upon the concentration of the soap solution, but is found in general to be about 40 Ångstrom units of area.

Polymolecular and monomolecular films: WILLIAM D. HARKINS and J. W. MORGAN. Up to the beginning of the present work, no direct measurements had been made upon films on water thicker than a molecule. Monomolecular films are formed readily by putting upon the surface of water an organic substance, the molecules of which contain both a polar and a non-polar group. If the polar group is not present, general experience indicates that the substance will not spread, but it has been found possible by the proper choice of such substances to obtain films which vary in thickness from 40 to 200 Ångstrom units. The remarkable feature about these films is that an almost negligible force is sufficient to compress them until they become about 4 to 6 molecules thick but upon further compression to a thickness of 10 to 20 molecules. They exhibit the same characteristics as monomolecular films except for the fact that they are much more easily compressed. Measurements made upon films composed of mixtures of polar with non-polar molecules indicate that the former form in general a monomolecular film over which the molecules of the latter are spread. Measurements were made upon monomolecular films much thinner than any which have been measured previously. The thinnest films of this type had a thickness of 6 Ångstrom units or 6 x 10^{-8} cm.

The surface tension of water at various temperatures: T. F. YOUNG, P. L. K. GROSS and W. D. HARKINS. While collecting data for International Critical Tables, we perceived the importance of an accurate knowledge of the surface tension of water, for this liquid is the best standard with which to compare many old measurements. When we attempted to employ the many measurements which had been made on water, we found that most of them were known to contain serious errors. Except for a few measurements made at room temperature, there was none which appeared to be entirely dependable. To obtain surface tension values for our purpose, the calculations of several observers were corrected for the mistakes believed to have been made in them. The magnitudes of the corrections were determined with the aid of a value for the surface tension of water at room temperature which has been generally accepted. An equation was derived which represents the results of the new calculations very precisely. In spite of the apparent validity of our corrections and the very good agreement between the recalculated values of various observers, we desired to increase the reliability of our equation. We have made some new determinations by the "capillary rise" method which appear to be very trustworthy. The new measurements made at three temperatures confirm not only our equation for the variation of surface tension with temperature, but the accepted value at twenty degrees Centigrade as well.

The problem of the cerebral cortex: C. JUDSON HERRICK. What is cerebral cortex? No one of the anatomical or physiological criteria hitherto proposed is of itself adequate to define it. Combining the anatomical, physiological and genetic evidence, we are led to the conclusion that cerebral cortex emerged from pre-existing reflex mechanisms of innate and habitual activities in the service of more labile individually acquired behavior patterns. It serves two types of higher function: (1) a tonic function as an activator of lower reflexes and conditioned reflexes; (2) a phasic function as a "decider" between various possible modes of response in an unfamiliar situation. The first type is more primitive than the second. The development of the cortex introduces a new type of mnemonic pattern and a new type of learning, *viz.*, the ability to retain and profit by individual experiences as contrasted with more primitive sorts of learning by repetition and trial-and-error. Cortical functions are delayed reactions which are served by correlation mechanisms which are dissociated in space and in time from the apparatus of immediate response to stimulation of reflex, chain-reflex and (primitive) conditioned reflex type.

American coal balls: A. C. NOÉ. A coal ball is a calcareous or silicious concretion found sometimes in the coal seam and containing plant fragments which are so well preserved that their structure can be studied under the microscope. Such coal balls have been observed since 1835 in England and soon afterwards on the continent. Our entire knowledge of the morphology of coal measure plants has been based on the coal balls of England, France and Germany. No coal balls had been found in America until the writer succeeded in obtaining, in 1922, the first genuine American specimens. These came from Danville, Illinois, and Harrisburg, Illinois. Others were found soon in Calhoun, Richland County, Illinois, and in Streator, Illinois. Other American deposits were discovered in Iowa, Indiana, Kentucky and Texas. These investigations were carried on partly through the granting of a subsidy from the Marsh Fund of the National Academy of Sciences and partly under the auspices of the State Geological Surveys of Illinois and Iowa. The University of Chicago has equipped a laboratory for the preparation of microscopic sections from these coal balls and a number of graduate students have prepared their master's and doctor's dissertations on the study of American coal balls. More than twenty-five different species of fossil plants from American coal balls have been recognized and described, among which the most conspicuous were stems and roots which showed close similarity with living Angiosperms. The conclusion that Angiosperms existed already in the Paleozoic was subject to a keen controversy in which American and English paleobotanists participated. While this question is not yet completely settled to everybody's satisfaction, it has thrown considerable light upon the possibility that Angiosperms might have existed in the Paleozoic or that plants were living at that time showing a tendency towards Angiospermic structure. Since a great deal more American material is in the process of investigation, still more light will be thrown upon this interesting question. Whatever the final outcome of the controversy may be it can be seen at present that a great deal of interesting information about the morphology of carboniferous plants can be drawn from American coal balls and that the science of Paleozoic plant morphology will be greatly enlarged and promoted through the American material and will not be in the future, as it was in the past, a purely European domain.

The direct results of Mendelian segregation: CHARLES E. ALLEN. Much the greater part of experimental genetic work to date has been upon diploid organisms. Such an organism has developed from a zygote formed by the union of two gametes. The gamete nuclei were produced, either immediately (Metazoa) or through the intermediacy of a few-celled sexual generation (seed plants), by two divisions in which the hereditary substances were rearranged and segregated into qualitatively different groups. The exact nature of these two segregating (or reduction) divisions constitutes one of the major problems of cytological and genetic research. The genetic study of diploid organisms affords a very indirect approach to this problem. Somewhat more direct is the study of haploid organisms developed from spores which were themselves formed by the segregating divisions. In a few plants it is possible to recognize and isolate the four spores formed by division from a single mother cell. If these four spores can be germinated, the four resultant plants exhibit the hereditary potentialities which, all present in the spore mother cell, were distributed in consequence of the two segregating divisions among its four descendant spores. *Sphaerocarpos Donnellii* furnishes an opportunity for a study of this nature, because the four spores derived from a single mother cell remain adherent. The present paper deals with the distribution of two pairs of alternative characters (femaleness *vs.* maleness and polyclady *vs.* non-polyclady) among the plants developed from the respective spores of individual tetrads. Without exception, to date the four spores of a tetrad give rise to two male and two female plants; and, in offspring of a cross between polycladous and non-polycladous parents, to two polycladous and two non-polycladous plants. In matings of this nature, the tetrads fall into three classes: (*a*) Two non-polycladous females, two polycladous males; (*b*) two polycladous females, two non-polycladous males; (*c*) one non-polycladous female, one polycladous female, one non-polycladous male, one polycladous male. Of fifty-six tetrads derived from four such matings, thirty-two fell in class *a*, sixteen in class *b*, and eight in class *c*. It is evident that class *c* (four qualitatively different spores in the tetrad) is much less numerous than classes *a* and *b* (in which each tetrad is composed of two classes of spores). The combinations of characters shown by the spores of class *a* are the combinations characterizing the respective parents. The discrepancy between the numbers of tetrads in classes *a* and *b* suggests the possibility of a linkage of some nature between non-polyclady and femaleness on the one hand and between polyclady and maleness on the other.

Insect transmission and host range of aster yellows: L. O. KUNKEL. The aster yellows disease which causes serious annual loss to growers of the China aster has been shown to be spread by the leafhopper Cicadula sexnotata. Several other species of leafhoppers passing freely from diseased to healthy plants do not transmit yellows and no other means has been found by which it can be transmitted. Although very specific as to insect host the disease attacks a wide range of plant hosts. It has been transmitted experimentally through the insect to fifty different species in twenty different families of plants. Great variation in symptoms is shown by the disease in its different host plants. Several obscure diseases such as "bunchy top" of the straw flower, yellows of several garden plants and the "Rio Grande" or "rabbit-ear" disease of lettuce have been shown to be identical with aster yellows and to be transmitted to these plants by the aster leafhopper. Peach yellows, though similar to aster yellows, is not related to it etiologically. No evidence has been found that the virus of aster yellows causes disease in its insect host.