ing the direction of an Acoustical Ray," by A. G. Webster.

"The Propagation of Transverse Waves in a Bar," by Louis Thompson.

"The Exceptions to the Law of Dulong and Petit," by J. E. Siebel.

"Experiments with Slow Positive Rays," by A. G. Dempster.

"Theory of the Free Vibrations of a Lecher System," by F. C. Blake.

"Springs of Minimum Weight," by Henry C. Lord. (By title.)

"Spectra of Some Halogen Compounds and Phenomena Connected Therewith," by Charles Sheard and C. S. Morris.

"On a New Method of using the Reversible Pendulum for the Determination of $g$," by J. C. Shedd.

"The Effect of Absorbed Gases in Photoelectric Emission," by Robert J. Piersol. (Read by E. P. Lewis.)

At the special session in charge of Section B on Wednesday afternoon the following program was presented:

"The Dependence of Progress in Science upon the Development of Instruments" (Vice-presidential address before Section B), by Anthony Zeleny.

"A General Survey of the Field of High Pressure," by P. W. Bridgman. Discussion by A. G. Webster.

The Northrup Visible Molecules Apparatus was demonstrated at the close of the session.

At a short business session on Wednesday the result of the mail ballot for officers for 1916 was announced as follows: for president, R. A. Millikan, of Chicago; vice-president, H. A. Bumstead, of New Haven; secretary, A. D. Cole, of Columbus; treasurer, J. S. Ames, of Baltimore; members of council, Irving Langmuir, of Schenectady and G. B. Pegram, of New York; members of editorial board, A. Trowbridge, E. P. Lewis and W. C. Sabine. Several other items of business were transacted.

The registration for the meeting was 158. About one hundred were present at the Physicists' dinner on Wednesday evening. Whether judged by the number and character of the papers presented, by the attendance or by the amount and interest of the discussion following the papers, this meeting was one of the best that the American Physical Society has ever held.

A. D. Cole,
*Secretary*

## THE BOTANICAL SOCIETY OF AMERICA. II

*The Evolution of Reproductive Mechanisms in Seed Plants:* E. C. Jeffrey and R. E. Torrey.

Mechanisms strictly so called are not numerous in plants. Among them may be classed the annulus which causes the opening of the sporangium in ferns and fern allies, including the cycads. The annulus is obviously a structure of epidermal origin, sometimes showing the presence of stomata. In the seed plants from *Ginkgo* upwards the opening mechanism of sporangia is not primarily of this nature. In the lower Gymnosperms the cryptogamic wood of centripetal development persists strongly, clearly indicating their filiation with the fern series. In the higher Gymnosperms the centripetal or cryptogamic wood becomes merged in the so-called transfusion tissue. The purpose of the present communication is to make clear that the transfusion tissue of *Ginkgo* and the Abietineae obviously furnishes the mechanism for opening the microsporangium. In the higher Conifers as well as in the Gnetales and angiosperms the fiber layer or mechanical system of the anther wall is no longer related to the fibrovascular system. The considerations advanced make it clear that sporangial mechanisms are of diverse origins. In the Cycadales and their allies the fern-like plants, the epidermis supplies the mechanically active layer. From the Ginkgoales upwards the tissues of the fibrovascular system, particularly the vestiges of the cryptogamic centripetal wood known as transfusion tissue, take on the function of providing for the opening of the spore sacks. The sporangium of the lower forms may appropriately be designated ectokinetic since its action depends upon the mechanical action of an external tissue, the epidermis. The sporangium of the higher forms, in which the fibrovascular tissue is primitively related to the mechanically active layer, is appropriately designated endokinetic.

*The Comparative Rapidity of Evolution in Various Plant Types:* Edmund W. Sinnott.

Given an equal degree of heritable variability, the rapidity with which a plant undergoes evolutionary change depends on the growth-type to which it conforms. Herbs, with their very brief period from seed to seed, accumulate changes much more quickly than do trees and shrubs, with their much longer generations. Local specific and generic types therefore arise most readily among herbs. Herbs occur in a much smaller number of

families than do woody plants, but their number of species per family is greater. A study of the rapidity of evolution in these two types throws light on the antiquity of the angiosperms.

*Experimental Evolutionary Investigations with the Genus Drimys:* E. C. JEFFREY AND R. D. COLE.

The genus *Drimys* of the Magnoliaceae has long excited interest as a dicotyledon entirely without the vessels, which are such characteristic features of wood structure in the angiosperms as a group. The value of experimental work in connection with evolutionary problems has been particularly emphasized in recent years and there can be no doubt that experimental studies on the part of those who are sufficiently acquainted with the history and morphology of plants to interpret the meaning of the structures experimentally produced, is of great value. Experimental investigation has in the past few years thrown great light upon the evolutionary history of the conifers and has begun to be applied to the elucidation of the course of evolution to the dicotyledons. The present communication is for the purpose of calling attention to the highly interesting fact that structures resembling vessels can be recalled in *Drimys* as a result of experimental procedure. It has not yet been found possible to bring about the return of such structures in the stem, but vessels are readily recalled in that most conservative of all plant organs, the root. The experimentally recalled vascular structures resemble those found in the Magnoliaceae as a whole. The consequence of this demonstration is of considerable evolutionary importance on account of the primitive position often accorded to the Ranales and in particular to the Magnoliaceae. It seems clear that *Drimys* can no longer furnish an argument in favor of this view since the simplicity of wood structure, resembling that of the Conifers, is not primitive but clearly the result of reduction.

*Is the Vesselless Secondary Xylem of Certain Angiosperms a Retention of Primitive Gymnosperm Structure?* W. P. THOMPSON AND I. W. BAILEY.

Vessels are entirely absent in the xylem of *Tetracentron, Trochodendron* and *Drimys*. Vestiges of vessels do not occur in the root, seedling, young stem, petiole, traumatic tissue, and other regions that have been considered to be retentive of ancestral characters. The form, structure and arrangement of the tracheids of the xylem closely resemble those of gymnosperms, and there seems to be no valid reason for not considering the three genera primitive as far as their xylem structure is concerned. The wood-parenchyma is "diffuse" in *Tetracentron, Trochodendron* and *Drimys winteri*. In *D. colorata* and *D. axillaris* it shows transitions from diffuse to banded and terminal. The distribution of parenchyma in these three genera makes it seem very improbable that the "terminal parenchyma" of the Magnoliaceae originated through reduction from the "vasicentric" condition. There appears to be no reliable evidence to indicate that the Magnoliaceae and allied families are forms that have become highly specialized through "reduction" from advanced types of Angiosperms.

*Some Observations upon the Secondary Xylems of Gymnosperms and Angiosperms:* W. W. TUPPER AND I. W. BAILEY.

From measurements of tracheid-lengths and wood-fiber-lengths taken from the secondary xylems of a large number of gymnospermous and angiospermous woods, respectively, the authors have confirmed and supplemented the work of Sanio, De Bary, Record and others, which show a very great difference between the lengths of gymnospermous tracheids, on the one hand, and the tracheids and wood-fibers of the dicotyledons, on the other.

The former elements average more than twice as long as do those of the dicotyledons of about the same age, with the very striking exception of the vesselless angiosperms, *Tetracentron, Trochodendron* and *Drimys*, which seem to have the typical gymnospermous length of wood elements.

*Climaxes and Climates of Western North America:* FREDERICK E. CLEMENTS.

Each climax vegetation is regarded as a developmental unit, and hence is designated as a formation. The vegetation of the continent is consequently made up of a number of climax formations, each with a development and structure more or less peculiar to itself. As a result, it becomes desirable to distinguish two kinds of units, developmental and climax, the one typical of succession, the other of the final adult condition of vegetation during a particular climatic period. Each climax is coextensive with its climate, and is in fact the indicator of the latter. Climaxes, moreover, exhibit a phylogenetic sequence due to differentiation and shifting in the face of a climatic crisis, such as glaciation. Such a shifting is recorded in the zones, such as are characteristic of

the Rocky Mountains, where five formations occur, namely plains grassland, woodland, montane forest, subalpine forest and alpine grassland. Finally, while each climax is more or less stable during a climatic period, the transition between two climaxes bears eloquent testimony to the shiftings of dominants and subdominants produced by minor climatic cycles.

*A Photometer Battery for Habitat Analysis:* F. E. Clements.

A series of photometers has been devised for the comprehensive study of the intensity and quality of light in the various kinds of habitats. Those used to measure light intensity are based upon the Bunsen-Roscoe photographic method. The simple photometer is designed for use on reconnoissance trips or in connection with a base station. Its most desirable form is the stop-watch photometer in which the personal factor in timing is eliminated. It is further modified into the water photometer for securing light readings at various levels in ponds and lakes. The recording photometer or selagraph consists essentially of a clock mechanism and a photographic shutter, permitting hourly exposures for a week without attention. The electric spectro-photometer is a compact instrument for determining the light quality in forest and thicket or at different altitudes, without the use of a tripod.

*What is Tolerance of Forest Trees?* George P. Burns.

*The Root Growth of Forest Trees:* W. B. McDougall.

Direct observations were made on the roots of *Acer saccharinum, Tilia americana, Carya alba* and *Quercus macrocarpa,* nearly every week during the growing season and occasionally during the winter, from April, 1914, to September, 1915.

Growth begins in April, the exact time varying with the season. It ceases in autumn or early winter when the soil becomes too cold for absorption. In 1914 there was a resting period of about five weeks in July and August when no root growth occurred. During this time the soil was very dry. In 1915 there was no dry season and no resting period. No attempt has been made to determine accurately at what temperature growth ceases or how much soil moisture is necessary for growth, but it is believed that enough has been done to establish the following general facts: (1) The root growth of forest trees begins as early in spring as the soil becomes warm enough for absorption, and ceases in autumn when the soil becomes too cold. (2) There is not necessarily a summer resting period. (3) When there is a summer resting period it is due to a lowering of the water supply, and not to any inherent tendency toward periodicity.

*The Marine Algae of Beaufort, N. C., and Adjacent Regions:* W. D. Hoyt.

Contrary to the belief that the Atlantic coast from Long Island to Florida is barren of Algae, 138 species and varieties have been found, all except 10 of these occurring at Beaufort. Of the total number, 130 have been obtained in sufficient amount for determination. There are represented 83 genera and 34 families, including all four divisions of Algae. The identified species are distributed as follows: Myxophyceae, 10, 7.7 per cent.; Chlorophyceae, 25, 19.2 per cent.; Phaeophyceae, 27, 20.8 per cent.; Rhodophyceae, 68, 52.3 per cent. Because of its intermediate position, Beaufort has an algal flora of unusual interest, 20 genera and 41 species reaching here their northern known limit on our coast, while 3 genera and 9 species reach here their southern known limit. Eighteen species new to North America have been found, 8 of these being hitherto undescribed. The seasonal differences are strongly marked in the flora of Beaufort harbor, only 12 species having been found throughout the year and 4 others in both spring and summer. The appearance and disappearance of the seasonal floras are strikingly coordinated with the observed temperature of the water. Measurements of the light show that this penetrates to very slight depths. Correlated with this fact, the algae seldom extend to a depth greater than 90 cm. below the low tide line. With the exception of a very few species, no Algae are found in summer above the low-tide mark. Several submerged coral reefs lying offshore offer extremely interesting conditions and a very interesting flora resembling that of subtropical regions.

*Endemism in the Flora of the Vicinity of New York:* Norman Taylor.

Endemism, as found in the flora of the vicinity of New York, does not appear to be a criterion of antiquity, for many endemics are very recent. Neither are the endemics prevailingly woody, for only 4 woody forms out of a total endemic element of 22 species disproves this contention. Nor does antiquity or woodiness prevail among the species of endemic genera. Rarity or commonness does not

appear to have much to do with the age of our local endemics, for it has been shown that some of our most widely spread species are among the newest in point of origin. "Relict endemism" accounts for 5 of the local species which are shown to be outpost survivals of a preexisting flora. All of these are species of endemic genera; only one is woody, although these are probably the most ancient of all our endemics. Generic and specific instability seems to account for the great majority of our endemics, 14 in all. These species are all shown to belong to genera that dwindle, or to be related to species that are on or near their limits, in the local region. Further support of this view is given by the proportion of species in eastern North American genera containing endemics, to the number of species found in the rest of the country and abroad. Only 20 per cent. of our whole vegetation finds its limits in the area, but much over half of our total endemics belong to genera that dwindle, or are related to species that find their limits, here or very near here. "Habitat endemism," where a species seems to have been thrust off from a well-known and widely dispersed form, into a totally different habitat from that of the supposed progenitor, seems to account for two of our local endemics.

*On the Occurrence of Pinus Banksiana Lamb. in the Driftless Area of Southeastern Minnesota:* C. O. ROSENDAHL AND F. K. BUTTERS.

The main pine forests of Minnesota occur to the north of a line drawn from the northwestern corner of the state to the Wisconsin boundary, about latitude 45° 30′. *Pinus Strobus* L. is found in a number of isolated localities down through the Mississippi River valley to northern Iowa, but outposts of *Pinus Banksiana* are very unusual. In June, 1915, a grove of jack pine was found near Rushford in the Root River valley, near the southeastern corner of the state. This is about one hundred and eighty miles south of the previously known limit in this state and at least eighty miles from the pine areas of central Wisconsin. It lies inside the driftless area and the indications are that it is a natural relict, probably from glacial times. The largest trees are estimated to be from fifty to sixty-five years old, thus dating back a few years beyond the oldest settlement of the region. Associated with the pines are a number of species which occur typically in the jack pine forests. Among those noted the following appear to be of special signficance: *Oryzopsis pungens* (Torr.) Hitchc., *Carex siccata* Dewey, and *Vaccinium pennsylvanicum* Lam. The grove is located on a very sandy, steep, north-facing hillside which is built up from disintegrating paleozoic sandstones.

*The Distribution of Quercus alba L. in the State of Minnesota:* F. K. BUTTERS AND C. O. ROSENDAHL.

The white oak, *Quercus alba* L., occurs in southeastern Minnesota, extending to a point about thirty-five miles northwest of Minneapolis and somewhat farther due north of that city. It is local in its distribution, but where it occurs it is often very abundant. The explanation is that, at least in the climate of Minnesota, it is exacting as to its soil requirements and flourishes only on well-drained, non-calcareous soils which are moderately retentive of moisture. Such soils are the residual clays of the unglaciated region, the less calcareous portions of the loess, and the sour red clays frequently found in that part of the Wisconsin glacial drift which came from the northeast, and on all these soils the white oak abounds. The gray glacial clays from the northwest which underlie the main deciduous forest region of central Minnesota are generally too calcareous for this species, and it has succeeded in penetrating that region for only a few miles and in a few favorable localities. Near the middle of the state are some tracts of red clay similar to those which occur farther south and east, but no white oak has reached them, its place being taken by a form of *Quercus macrocarpa* Michx. It is suggested that the region of calcareous clays has acted as a sieve or selective barrier, allowing one of these species to migrate freely while greatly retarding the progress of the other. Culture experiments support the evidence derived from the distribution of the species. In four years, a seedling white oak grown in fine clean quartz sand grew about four times as large as a seedling of the same species planted in sand containing five per cent. of chalk, while bur oak seedlings grew almost equally well in the two soils.

*The Patanas of Ceylon:* H. A. GLEASON.

The patanas, or natural grasslands of Ceylon, occupy extensive areas in the southern end of the island, mostly at high elevations. They are usually located in valleys among the mountains, and at their upper margin come in contact with the subalpine forests. They occupy various types of soil, and receive various amounts of rainfall, depending on their location in reference to the mountain

ranges. The boundary between the patanas and the adjoining forests is remarkably sharp. The origin of the patanas is obscure, but their perpetuation is due entirely to the fires which sweep over them annually. Near plantations where the fires are excluded, a thicket association, characterized by *Rhododendron arboreum* and *Hypericum mysorense*, develops immediately, and is followed by the regular subalpine forest.

*Observations on the Revegetation of the Katmai District of Alaska:* Robert F. Griggs.

Under the auspices of the National Geographic Society the author has undertaken the investigation of the return of vegetation to the country devastated by the eruption of Mt. Katmai in 1912. Where the deposit of ash did not exceed one foot in depth, as, for example, at Kodiak, vegetation has made a most surprising recovery so that the grass and berries for which the district is famous, are finer than ever before. The new growth, however, is made up exclusively of surviving plants. Where for any reason the original plants did not persist the ground is nearly always as bare as when the ash first fell. Except in sheltered situations the ash is picked up by the wind, giving rise to a severe sand blast and forming great dunes which give little opportunity for the start of new seedlings. In more sheltered situations seedlings have started, but as yet form no important element in the vegetation, for their growth is very slow. Near the volcano the deposits were deeper; almost all vegetation was destroyed, leaving the country a bare desert. But some of the herbage persisted in sheltered nooks where the ash was quickly washed off the surface before the plants were suffocated. Such oases are, however, entirely insignificant in the barren landscape. Except for sporadic accidental instances, revegetation has not yet begun on the mainland.

*The Cactus Columns of the Bad Lands:* Raymond J. Pool.

Few cases are on record of cactus species serving as soil binders in opposition to the erosive forces of the environment. It appears that the root systems of cactuses are mostly characterized by the presence of shallow but more or less extensively spreading horizontal roots. Such plants are ordinarily rather easily uprooted. However, several instances have been noted in the Bad Lands of northwestern Nebraska of certain species of *Opuntia* which have a root system considerably deeper and less widely spreading than most cactus species. Furthermore, cushions or colonies of this species resist erosion to a surprising degree. The soil surrounding such cushions has been weathered away, leaving erect columns of the soil capped by the closely aggregated cushions or colonies of the cactus. These columns are sometimes more than ten feet high and vary in diameter from two feet to ten feet.

*Modern Changes in the Prairie Groves of Iowa:* B. Shimek.

It is often asserted that since the cessation of prairie fires the groves in the prairie region, including Iowa, have extended beyond their earlier limits. So far as Iowa, at least, is concerned, this is disproved by the testimony of old settlers, but especially by the records of the original government surveys. Several specific cases are presented in detail and illustrated by maps. The condition of the prairie groves is discussed with special reference to changes of an ecological character which are taking place and in which fire has played an unimportant part. The most marked change which is noticed is the increased density of both forest and undergrowth in the undisturbed groves. Incidentally this weakens or destroys one of the strongest supports of the view that fires caused the treelessness of the prairies. The results achieved in artificial tree-planting are also discussed.

*Illustrating the Prickly Pears and Their Allies:* David Griffiths.

In connection with the investigation of cactus conducted by the U. S. Department of Agriculture, distinguishing records of the species and varieties handled soon became imperative. In a group whose vegetative characters have in the past been relied upon mainly for taxonomic purposes, the task of distinguishing and depicting accurately the species dealt with in field tests and breeding investigations has been decidedly difficult. Some years ago it was decided to illustrate the species as accurately as possible. A living collection of 2,400 numbers of *Opuntia* has been accumulated at Chico, California. These are grown under field and sash house conditions and at present form the basis of the work. Characteristic portions of the plants, *i. e.*, old and young joints, flowers, buds and fruits are photographed to scale. Where the objects are large and the details complicated, as in the case of the joints, these photographs are used as a base for the water-color painting. In the case of fruits and buds, especially, they are outlined by the use of a camera lucida adapted to macroscopic work. Every effort is made to pre-

pare illustrations which are scientifically accurate. The cameras attend to the facts of form and Mr. L. C. C. Krieger, who has had varied experience and training in plant illustrating, attends to the remainder of the work about as successfully.

*Relation of Catalase and Oxidase to Respiration in Potato Tubers:* CHAS. O. APPLEMAN.

Respiration in potato tubers is not only greatly accelerated by various artificial treatments, but is subject to fluctuations under natural conditions, such as greening and sprouting. The rate of respiration varies in different parts of the same tuber and tubers of different varieties. The modification of the intensity of respiration in tubers under such conditions was determined and at the same time measurements were made of both the oxidase and catalase activity in the juice. The data seem to justify the following conclusions: (1) The oxidase content in potato juice gives no indication of the intensity of respiration in the tubers. In other words, there is no correlation between oxidase activity and the rate of respiration in these organs. The author does not disclaim any rôle of the demonstrable oxidases in respiration, but they certainly are not the controlling factor in regulating the rate of respiration in potato tubers. (2) Catalase activity in the potato juice shows a very striking correlation with respiratory activity in the tubers.

*Lipolytic Action in Germinating Teliospores of Gymnosporangium juniperi-virginianae:* G. H. COONS.

Teliospores from mature telial horns of *Gymnosporangium juniperi-virginianae,* were ground with fine sand and a small amount of water extract obtained. This extract when mixed with some neutral fat (olive oil, castor oil) colored violet by litmus, caused no change in color even after standing over night. When columns in which the spores were germinated were similarly ground and an extract of approximately the same amount obtained, this was found to produce acid from neutral fats. Reddening of the litmus which could readily be detected by comparison took place in two to four hours. In these experiments chloroform was used as an antiseptic. The experiments were repeated with changes in the technique. Telial horns were cut from several large galls. These were divided into three portions. One portion was left dry, the second was placed in water at approximately 80° C. to kill the teliospores, while the third was soaked in tepid water until the jelly-like telial columns were swollen. The water in which the third portion was soaked was then poured over the heated sori. This was an attempt to balance the bacterial and fungal flora of these two portions. The second and third portions were then drained and kept under similar moist conditions until the next morning. The columns were then ground with a small amount of water and a few cubic centimeters of water extract obtained. Tests were made with neutral fats colored violet with litmus. The third portion was the only one to give an extract which had the power to produce acid from the fats. In these tests small test tubes kept in the incubator at 37½° C. were used. Potassium cyanide was used as an antiseptic. When the active extract was boiled for a few moments it gave a negative result in acid production. The amounts of extract obtained were so small that no attempt was made to precipitate with alcohol. When oil which had been acted upon by the extract from the germinated teliospores was tested, glycerin was found to be present. None was found in the oil untreated. The conclusion seems justified that in germinating teliospores, lipase is present. This places the rust fungi in the long list of organisms now known to possess lipase. Attention may be called to the rôle of lipase in germination. The rust spores are especially rich in oils and in the short period required for germination one or more basidia, larger than the spore itself, are sent out. In addition two or more spores are formed on the basidium. The conversion of the globules of oil into soluble products easy of transport, seems to be a factor in this rapid germination process.

*The Action Upon Soil Nitrogen of Certain Crops:* K. F. KELLERMAN AND R. C. WRIGHT.

Twelve representative field crops were grown alone and in certain combinations in large galvanized iron buckets holding 100 pounds of soil. When two species of plants were grown in association, one half the number of plants of each species was used as when each was grown separately. Crops were all grown to maturity and harvested close to the surface of the soil. With the growth of millet, corn, Kafir corn and oats, practically all the total nitrogen removed from the soil was recovered in the crop. With wheat, barley, rye and sugar beets, all the nitrogen removed from the soil was not recovered in the crop. Also when hairy vetch, red clover and field peas were grown there was a distinct loss of nitrogen. With the growth of soy beans alone of the legumes, there

was a fixation or increase in nitrogen over that removed from the soil. When grown in association there was a loss of total nitrogen with the following combinations: barley and peas, rye and vetch, rye and peas, rye and clover, Kafir corn and peas, Kafir corn and clover, corn and millet, and corn and oats. There was an increase in nitrogen with the following combinations: barley and vetch, barley and clover, oats and vetch, oats and peas, oats and clover and Kafir corn and vetch.

The quantities of nitrate nitrogen remaining in the soil were comparatively low after harvesting millet, corn, Kafir corn and beets; and somewhat higher after clover, vetch, soy beans and peas; and still somewhat higher after oats, wheat, barley and rye.

*A Physiological Study of Certain Strains of Fusarium oxysporum and Fusarium trichothecioides in their Causal Relation to Tuber-rot and Wilt of Solanum tuberosum:* GEO. K. K. LINK.

Certain strains of *Fusarium oxysporum* and *Fusarium trichothecioides* can produce both tuber-rot and wilt of the Irish potato. The wilt is induced by destruction of the root system and by clogging of the xylem elements in the stem and is, in mild cases, marked by such symptoms as discoloration of leaves, curling and rolling of leaves, and production of aerial tubers. Under field and storage conditions *Fusarium oxysporum* is probably more responsible for wilt than is *Fusarium tricothecioides*, and *Fusarium trichothecioides* the more responsible for tuber-rotting. This may be explained in part by the fact that the optimum and maximum temperatures of *Fusarium oxysporum* are higher than those of *Fusarium trichothecioides*. *Fusarium trichothecioides*, however grows well at 8°–10° C., while *Fusarium oxysporum* does not. *Fusarium oxysporum* also has a more rapid, superficial and spreading habit of growth than has *Fusarium trichothecioides*. Both organisms possess a truly striking cosmopolitan ability to use the most diverse carbon materials as carbon sources in their metabolism. *Fusarium oxysporum*, however, is more cosmopolitan in its ability, and can utilize materials more readily than, though not so completely as, does *Fusarium trichothecioides*. *Fusarium oxysporum* also is less subject to inhibition in growth and intoxication than is *Fusarium trichothecioides*.

*Some Factors Determining the Presence of Fat as a Food Reserve in Woody Plants:* EDMUND W. SINNOTT.

Reserve fat occurs most abundantly in those woods where the rays and parenchyma cells are comparatively thin-walled and well provided with pits, and is particularly well developed in the cells immediately adjacent to the vessels. It is practically absent in species with thick-walled, slightly pitted parenchymatous tissue. These facts suggest that the occurrence of fat in wood and its distribution there may depend on the ease of diffusion of some fat-forming ferment from the vessels through the rays and parenchyma. Experiment shows the presence of a fat-splitting ferment in the leaves and bark, which varies greatly in amount according to species and season, but which is in general most abundant in the spring in those species where reserve fat was most abundant in winter. It is suggested that perhaps this fat-splitting ferment (lipase) may here be reversible in its action and that during the late summer and fall it may be diffused downward through the wood and bast, converting into fat the food reserves to which it has access.

*The Influence of the Medium upon the Orientation of Primary Roots:* RICHARD M. HOLMAN.

In this paper were considered the explanations offered by Hofmeister, Sachs, Elfving and Nemeč for the difference in behavior of primary roots growing in air and in earth when displaced from the normal perpendicular position. The author's experiment indicates that the failure of roots in air to bend downward after the autotropic flattening of the primary geotropic curvature is not due to absence of contact stimulus as Sachs suggested, nor to a change in the geotonus of the root as Nemeč's results seem to indicate. By the use of media whose resistance to penetration by the root tip could be widely varied, roots were caused to behave very nearly as in air or in the same manner as in earth, according as the medium was loose or considerably compressed. The authors' experiments indicate that the effect of the medium is primarily if not exclusively mechanical. The resistance offered by the medium to the advance of the downward curved tip of a root which has flattened its primary curvature tends to passively depress the root and in this manner the root is enabled to complete the geotropic reaction in media which offer appreciable resistance to the advance of the tip. *Vicia faba, Lupinus albus* and *Pisum sativum* were the principal species employed, although many other forms behaved similarly. Secondary roots of the three species men-

tioned behaved in a manner similar to the primary roots, reacting more promptly in media offering considerable resistance to penetration than in looser media. In the case of secondary roots the lack of complete permanent georeaction in moist air, as contrasted with prompt and complete curvature in earth, seems to be due to the mechanical cause mentioned above in connection with primary roots.

*On the Permeability of Certain Non-living Plant Membranes to Water:* F. E. DENNY.

A report of a series of experiments with plant membranes in which quantitative measurements were made of their permeability to water. Membranes used were seed coats of peanut, cycad, almond, English walnut, pumpkin, bulb-scale of onion, etc. Measurements were made in an osmometer so constructed as to detect the passage through the membrane of very small quantities of water, and to keep the physical factors such as temperature and concentration of solution constant. In each test the exact area of membrane used was known. Results are reported showing the temperature coefficient for a rise of 10° C., and showing the permeability of the membranes as affected by the concentration of the bathing medium, direction of flow through membrane, and as influenced by certain chemical constituents of the membrane.

*Influence of Temperature on the Moisture Intake of Seeds:* CHARLES A. SHULL.

A critical analysis of the data obtained as to the rate of moisture intake by seeds possessing semipermeable coats (*Xanthium*) at various temperatures from 5 degrees to 50 degrees C. shows that the curve of intake is by no means so simple as was assumed by Brown and Worley for barley seeds. The curves of intake are essentially the same in character in certain seeds used, whether semipermeable coats are present or not, but differ in steepness according to the kind of seed used. The temperature coefficient for the rate of intake is decidedly lower than the Van't Hoff coefficient for chemical processes, and considerably lower than the values obtained with barley seeds. Moreover, plotting the logarithms of hourly rate of intake against temperatures does not yield straight lines. It is evident, therefore, that the conclusions reached by Brown and Worley are not applicable generally.

*Some Experiments on Galvanotropism:* C. H. FARR. (Introduced by R. A. HARPER.)

*The Structure of the Bordered Pits of Conifers and Its Bearing upon the Tension Hypothesis of the Ascent of Sap in Plants:* I. W. BAILEY.

The tension hypothesis of the ascent of sap in plants, as interpreted by Dixon, postulates continuous columns of water that are entirely free from bubbles (0.02 mm. or more in diameter) of air or gas. However, even if continuous columns of water are present throughout the year, which has not been demonstrated conclusively, it remains to be shown how high tensions can arise and be maintained in the tracheids of tall trees. The pit membranes of Conifers are not entire septa, and are not impervious to undissolved gases and solids, as has previously been supposed to be the case. They are porous or sieve-like in structure, and the surface tension of the sap, in the sieve-like pit membranes of various Conifers, is not sufficiently great to prevent the penetration of air or gas, under the tensile strains that are supposed, by Dixon, to occur in tall trees.

H. H. BARTLETT,
*Secretary*

## SOCIETIES AND ACADEMIES

### THE BIOLOGICAL SOCIETY OF WASHINGTON

THE 546th meeting of the Society was held in the Assembly Hall of the Cosmos Club, Saturday, December 4, 1915, and called to order by President Bartsch at 8 P.M. with 55 persons present.

On recommendation of the council Dr. R. W. Shufeldt, Washington, D. C., and Arthur deC. Sowerby, Tien Tsin, were elected to active membership.

On recommendation of the council the following resolutions were read and adopted:

WHEREAS: Dr. George M. Sternberg, former Surgeon General of the U. S. Army, a distinguished worker in the biological sciences as applied to medicine, long time an active member of the Biological Society of Washington and its president during the years 1895 and 1896, has passed from this life, therefore be it

*Resolved*: That the Biological Society of Washington keenly regrets his death and offers its warmest sympathy to Mrs. Sternberg, and will always be grateful to his memory for the important part which he took in the affairs and discussions of the society and for the distinction which his eminent name adds to its list of past presidents.

Signed L. O. HOWARD,
FREDERICK V. COVILLE,
PAUL BARTSCH