are the ones in which the numerical results are most clearly traced, but they are also exceedingly rare. Those in which two unit characters are concerned are dihybrids. In these the combination series gives four different kinds of offspring. So there are trihybrids, giving eight possible combinations, tetrahybrids, and so on to polyhybrids; and in every succeeding grade the difficulties of statistical and comparative studies increase. Of how many characters is a plant composed?

### V. CONCLUSION.

Now, in conclusion, what are the great things that we have learned from these newer studies? (1) In the first place, we have been brought to a full stop in respect to our ways of thinking on these evolution subjects. (2) We are compelled to give up forever the taxonomic idea of species as a basis for studying the process of evolution. (3) The experimental method has finally been completely launched and set under way. Laboratory methods, comparative morphology, embryological recapitulation, life history studies, ecological investigations—all these means are likely to be overshadowed for a time by experiments in actually growing the things under conditions of control. (4) We must study great numbers of individuals and employ statistical methods of comparison. (5) The doctrine of discontinuous evolution is now clearly before us. (6) We are beginning to find a pathway through the bewildering maze of hybridization.

L. H. Bailey.
Cornell University.

## *THE SOCIETY FOR PLANT MORPHOLOGY AND PHYSIOLOGY.*

The sixth regular annual meeting of this society was held, in conjunction with the meetings of the American Society of Naturalists and the American Association for the Advancement of Science, at Washington, December 30 and 31, 1902, under the presidency of Professor Volney M. Spalding. A large part of the members were in attendance, and the meeting was in all ways most successful and pleasant. New members were elected as follows: Messrs. W. A. Cannon, of the New York Botanical Garden; Judson F. Clark, of Cornell University; G. P. Clinton, of the Connecticut Agricultural Experiment Station; W. C. Coker, of the University of North Carolina; C. C. Curtis, of Columbia University; E. J. Durand, of Cornell University; J. E. Kirkwood, of Syracuse University; W. A. Orton, of the United States Department of Agriculture, and K. M. Wiegand, of Cornell University. The following officers were elected for the ensuing year:

*President*—Roland Thaxter, of Harvard University.

*Vice-President*—Conway MacMillan, of the University of Minnesota.

*Secretary-Treasurer*—W. F. Ganong, of Smith College.

The chief item of business of general interest was the discussion upon the practicability and desirability of the new Central Bureau 'for the obtaining and distribution of material for investigation and demonstration' proposed by the Association Internationale des Botanistes. An expression of opinion taken after the discussion showed a unanimous opinion against the plan. Suggestions were formulated towards securing further improvements in the *Botanisches Centralblatt*, and a committee was appointed to draw up and publish in Science and elsewhere a statement to American botanists of the desirability of giving their full support to the *Centralblatt*, and of declining to support a competing journal.

The social features of the meeting were of unusual attractiveness. The society joined with the other societies in the vari-

ous public entertainments which had been arranged by the American Association, and in addition two notable courtesies were extended to the visiting members of the society by botanists of Washington—the first, a charming dinner at the Hotel Barton, given to the visiting members of the society and their wives by the Washington members and their wives on Tuesday evening, and a reception later the same evening given to all the visiting botanists by the Botanical Society of Washington.

The address of the president, Professor Volney M. Spalding, dealt with 'The Rise and Progress of Ecology,' and was delivered after the dinner at the Hotel Barton. It is believed to be the first presidential address to deal with this subject. It was published in full in this journal for February 6.

The society voted to extend its warmest thanks to the authorities of Columbian University, to its members resident in Washington and to the Botanical Society of Washington, for the many courtesies which had contributed to make the meeting so successful and enjoyable.

Following are abstracts of the papers actually presented in full before the society and thrown open for discussion, excluding those offered by title. The abstracts are by the authors. Certain papers appear by members of the new Association of Botanists of the Central States, the sessions being to some extent joint ones with that association.

*A Discussion of Mendel's Law and its Bearings:* Professor L. H. BAILEY, Cornell University, and Dr. HERBERT J. WEBBER, Department of Agriculture.

Professor Bailey's paper is published above. It is expected that Dr. Webber's paper will also be published in this journal.

*The Early Root Development of Tree Seedlings, an Important Factor in their Local Distribution:* Professor J. W. TOUMEY, Yale Forest School.

A series of twenty slides were shown of the initial root systems of various root types of seedlings of American trees, photographed in various stages of germination, and at different later periods until the species had grown well-developed initial root systems. All of the seedlings were grown at approximately the same time and under the same soil and atmospheric conditions.

From the study of the root systems of the various species, it appeared that the form of the initial root systems of the trees studied is surprisingly constant for the same species. In other words, there is an inherent tendency for each species to produce an initial root system that takes a definite form and direction. Early in the life of the seedling, this initial root system becomes more or less modified by its environment, particularly by the moisture and other soil factors. It was shown that there are great differences in the different species studied in the plasticity of the initial root system; that is, in the rapid and marked changes from its initial form and characteristics under the influence of environment. In some of the species shown, as in many hickories and oaks, the initial root system has remarkable fixity. The general form of the initial root persists, no matter upon what soil the species grows. It was pointed out that the species which show but little plasticity in the initial root system under the influence of environment, do not readily adapt themselves to variable soil moisture conditions.

In others of the species shown the initial root system is extremely plastic, rapidly changing under environmental influence, as illustrated in the red maple. In this species the initial root system consists of

the long tap-root and a few strong lateral roots very near the surface of the soil. In wet situations the tap-root soon disappears, and the plant becomes surface-rooted from the development of the lateral roots. In a dry situation the tap-root persists and the initial lateral roots disappear. Trees exhibiting this plasticity readily adapt themselves to a great diversity of situations as to soil and moisture. Thus we find the red maple grows in swamps, and also on dry rocky ridges.

It was further shown that the form and behavior of the initial root system, in its development prior to its becoming materially modified under the influence of environment, is directly correlated with the soil moisture conditions best suited to its growth and development. It appears possible to classify our woody plants into groups based upon differences in form and development of their initial root systems, and their plasticity under the influence of environment, and judge, with a fair degree of accuracy, the locality as to soil moisture best suited to each group.

*Observations on a Hitherto Unreported Bacterial Disease, the Cause of which enters the Plant through Ordinary Stomata:* Dr. ERWIN F. SMITH, Department of Agriculture.

A disease of Japanese plums of unusual interest has made its appearance in central Michigan. It is first visible in the form of numerous small water-soaked spots on the leaves and green fruits. The leaf disease ends in 'shot-holes'; the fruit disease ends in roundish, sunken, shallow black spots and in deep fissures which spoil the plums. The spots enlarge slowly, but may finally reach a diameter of one fourth to one half inch. The disease is due to a yellow bacterium, *Pseudomonas pruni* Smith, *which enters the uninjured plant through ordinary stomata.* In the earliest stage of the disease, visible only under the compound microscope in properly fixed and sectioned material, the bacteria are confined to the substomatic chamber. From this point they push into the deeper tissues, and by the time the spots have become large enough to be seen under a hand lens (as small water-soaked areas—one fifth to one half mm. in diameter), the bacteria have multiplied enormously in the depths, pushing up the epidermis and the cells immediately under it, and forming in the deeper tissues closed cavities of considerable size. Later, when the enlarged spots have begun to sink in and become brown, the bacteria reach the surface as numerous tiny, rounded, pale-yellow, gum-like masses, which ooze from the stomata lying over the closed bacterial cavity. The infections take place principally in May and June and no wounds are necessary. The shaded and west side of the fruits are most subject to infection, *i. e.,* those on which the rain drops or dew drops (necessary for infection) would persist longest because best protected from the morning sun. This is primarily a disease of the parenchyma, but the bundles are finally invaded.

The organism is distinctly yellow and grows readily in ordinary culture media, bouillon, milk, potato, agar, etc. It was easily obtained in pure culture from small spots. In agar plate cultures it looks much like *P. campestris,* but is readily distinguished by its feebler growth on potato and by its behavior in Uschinsky's solution, which is converted by it from a limpid fluid to one as viscid as egg albumen. The bacteria are small to medium size and occur singly, in pairs, or short chains. They are motile by means of one to several polar flagellæ. The thermal death point is approximately 51° C. Gelatin is not liquefied rapidly. Litmus in milk is reduced, but finally returns to its

former color. Casein is slowly precipitated and finally redissolved. No gas is produced from any medium.

The paper was illustrated by fifty lantern slides showing the location of the bacteria in the tissues and illustrating the morphology and cultural characters of the organism.

*Completed Proof that P. Stewarti is the Cause of the Sweet Corn Disease of Long Island:* Dr. ERWIN F. SMITH, Department of Agriculture.

In the winter of 1897–98, Stewart described a disease of sweet corn from Long Island which he attributed to a yellow bacterium that was very abundant in the vessels. This organism Smith subsequently named *P. Stewarti.* Stewart's infection experiments were inconclusive partly because made in a locality where the disease occurred naturally and soon appeared on the check plants, and partly because not made in the most natural way.

In the summer of 1902 the writer visited Long Island and obtained pure cultures of the organism. With these about 500 sweet corn plants of several varieties were inoculated, all during the seedling stage. Part of these plants were exposed to infection by placing the bacteria in drops of fluid oozing from the water-pores at the tip of the leaf, part by shaking up slant-agar cultures in sterile water and spraying this on the plants in a fine mist, during the period when they were extruding water from their leaf-tips. Both methods yielded good results. The first shriveling of tissue was at the tips of the inoculated leaves. Typical constitutional symptoms appeared in a few plants during the first month, but most of the cases developed the second and third month when the plants were several feet high. In such it was common to find the vascular system plugged with this yellow bacterium in practically pure culture all the way from the basal nodes to the top of the plant, four and one half feet in some cases. The nodes of such plants were browned inside very decidedly, especially the basal ones; the internodes within were generally white, with yellow bundles from which the bacteria oozed abundantly on cross-section. Frequently 150 or more bundles would be occupied. More than 300 typical cases of this disease were obtained, and many other plants would undoubtedly have shown symptoms had not the experiment been cut short by a frost. One of the first symptoms of this disease is the whitening and death of the male inflorescence. The leaf blades dry out one after another until all are dry, while the stem is still green. In this condition the affected plants look as if frosted, and the cause of the disease is not apparent until the plants are cut open.

This experiment, conducted in Washington, where the disease does not occur, shows conclusively that wounds are not necessary for infection, *and makes it reasonably certain that natural infections take place as a rule through the water-pores or ordinary stomata in the seedling stage of the plants.* The vascular system is the primary seat of the disease, but small cavities filled with the bright yellow slime finally appear in the parenchyma. The bacteria were not confined to the stem but passed out into the vascular system of the blades of the middle and upper leaves and into vessels of the husks and cobs. The paper was illustrated by lantern slides.

*Opportunities for Study at the Minnesota Seaside Station:* Professor CONWAY MACMILLAN, University of Minnesota.

The speaker gave an account of the surroundings of the station, the particularly rich marine flora, and the advantages offered for investigation in this compara-

tively new field, illustrating the subject fully by lantern slides.

*On the 'Blue' Color of Coniferous Timber:* Dr. Hermann von Schrenk, Missouri Botanical Garden.

Following an attack of the destructive pine bark beetle in South Dakota, the sapwood of the bull pine (*Pinus ponderosa*) turned blue. The color first appears at the base of the tree some months after the beetle attack, and gradually spreads up the trunk until it has reached the top. The color is evenly distributed throughout the sapwood, and is very permanent. Reference was made to the researches of Vuillemin on the 'green' color of wood, which he found due to a substance, *xylindeine,* formed by *Helotium aeruginascens.* The 'blue' color of pine wood is due to the growth in the wood of *Ceratostomella pilifera,* the fruiting bodies of which grow on the outside of affected wood. The life history of the fungus was described and cultures exhibited. No coloring matter could be extracted from 'blue' wood, and it is probable that the color is largely due to the blending of the brown color of the fungus present throughout the 'blue' wood, with the color of the wood itself. The 'blue' wood was shown to be as strong mechanically as green wood.

*The Development of the Prothallium in Pinus:* Dr. Margaret C. Ferguson, Wellesley College.

A few of the more important conclusions reached in a detailed study of the development of the prothallium in *Pinus* were given.

The ovules are not differentiated in the species of pines studied until about three weeks before pollination.

The macrospore-mother-cell may originate from a hypodermal cell as ordinarily stated, but in a study of the development of the ovule there is not the slightest evidence of such an origin.

The first division of the macrospore-mother-cell is heterotypical in nature and gives rise to the one half number of chromosomes. This division is quickly followed either in the lower cell only, or in both cells, by a homotypical division, thus giving rise to axial rows of three or four cells. The basal cell results from a true tetrad-division, and always forms the functional macrospore.

The macrospore passes through a period of growth lasting about six weeks. During this time the peripheral layer of cytoplasm is organized and the nucleus takes up a position in the wall-layer of cytoplasm near the micropylar end of the cell.

Thirty-two free nuclei are formed before the approach of winter, and more than two thousand nuclei have been counted at the time when cell-walls are laid down. In the later development of the prothallium, true 'alveoli' are not formed, but each cell divides several times before reaching the center of the prothallial cavity.

The 'spongy tissue' is not disintegrating tissue, as previously stated, but it forms a zone of physiological tissue which plays an important part in the nutrition and support of the developing gametophyte.

*Fertilization in Taxodium:* Professor W. G. Coker, University of North Carolina.

The male gametophyte of *Taxodium* is much like that of the Cupresseæ. No sterile prothallial cell is formed, and the pollen-tube reaches the archegonia before the division of the central cell occurs. This division takes place simultaneously with the ventral-canal division in the archegonium, and in a day or two fertilization is completed. The sperm-cells are of equal size, and, as a rule, each is instrumental in fertilizing an archegonium. In outline the sperm-cells resemble those of

the Cupresseæ and *Sequoia*. They are sharply separated from the protoplasm of the pollen-tube by a distinct hautschicht. Immediately around the nucleus is a thick layer of starch; next to this peripherally comes an imperfect layer of granular material staining red in saffranin which is probably of the same nature as the large masses found in the spermatozoids of *Ginkgo*. Between this layer and the hautschicht is a narrow zone of clear protoplasm without appreciable inclusions. In the Abieteæ the pollen-tube contains starch, but there is none in the sperm-cells themselves, while in *Taxodium*, on the contrary, the pollen-tube is free from starch and the sperm-cells are loaded with it.

The ventral-canal division in the archegonium does not produce a ventral-canal cell, separated from the egg, but simply cuts off a ventral-canal nucleus which, while closely pressed to the surface of the egg, is still included in its protoplasm. This nucleus is rarely cut off at the very tip of the egg, but is generally lateral in position and may even be half way down the side. It does not degenerate at once, but persists until after fertilization, and then generally divides amitotically.

In fertilization the entire sperm-cell enters the egg, passes through its protoplasm, and comes in contact with the egg nucleus, around which it folds. The starch is thus distributed evenly around the fusion nucleus and sinks to the base of the archegonium with it, to be included in the small amount of protoplasm cut off at the base of the egg as the proembryo. In *Taxodium*, then, almost the whole of the included food material and a considerable part of the protoplasm of the embryo are derived from the sperm-cell, while only a small part of the protoplasm of the egg is instrumental in embryo formation, the remainder being digested and absorbed by the young plant. Such a type of fertilization is known so far only in the group Taxodieæ.

*Stamens and Pistils are Sexual Organs:* Professor W. F. GANONG, Smith College.

The author contended that the current effort to restrict the sex-terminology to the gametophyte in the flowering plants is misdirected, for not only does the sex-terminology belong to stamens and pistils on the ground of priority, but also as a matter of physiological fact. The paper will appear in full in this journal.

*The Toxic Effects of Some Nutrient Salts on Certain Marine Algæ:* Professor BENJAMIN M. DUGGAR, University of Missouri.

Some work conducted in part at the Naples Marine Biological Laboratory and in part at Woods Holl was reported. In attempting some osmotic studies with solutions of cane sugar, potassium nitrate and sodium chloride, it was found that with isotonic solutions, either in sea water or in distilled water, the results were unusually inconsistent. It seemed probable that the explanation might be found to be connected with the toxic action of the salts used. Accordingly, an investigation was attempted of the toxic action of certain nutrient salts found in sea water when added to sea water, other chemical agents being also used for comparison. Seven algæ were employed, namely, *Chætomorpha linum, Cladophora gracilis, Dasya elegans, Pleonosporium coccinium, Grinnellia Americana, Griffithsia Schousberi* and *G. opuntioides*. It is desirable to employ for such studies algæ which change color as soon as killed, or those with which the plasmolytic test may be readily employed.

After the acids and some of the salts of the heavy metals, the potassium phosphates proved most toxic; and the latter are closely followed by the neutral salts of ammonium, among which the sulphate is

most injurious. The last-mentioned are followed by some salts of potassium and calcium in irregular order, although it is to be noted that potassium nitrate is about twice as poisonous as potassium chloride. The least toxic are the salts of sodium and magnesium. An average of the experiments shows magnesium sulphate to be the least toxic of all salts which have been used as sulphates, chlorides or nitrates. The low toxicity of the magnesium salts with relation to the marine algæ makes it evident that these plants are very notable exceptions to the rule which Loew and others found to hold for many phanerogams and fresh-water algæ.

The toxicity of the salts studied bore no close relation to the relative amounts of these salts normally present in sea water. The inconsistent results with potassium nitrate and other salts as plasmolytic agents may be partially explained by the toxic action of these salts on the marine algæ.

*The Nature and Function of the Pyrenoid:* Mr. H. G. TIMBERLAKE, University of Wisconsin.

Among the structures found in the cells of the green algæ the pyrenoid occupies a doubtful position. The question as to whether it is to be considered a true cell-organ or a mere mass of reserve material is partly, but not wholly, solved by its history in connection with the various phases of the life history of the cell and its relation to the process of starch formation. That the pyrenoid may be reproduced by division is shown in the cells of *Cladophora*, *Œdogonium* and other filamentous algæ, as also in *Chlamydomonas* among the unicellular forms. In this latter case the pyrenoid divides during the division of the cell. On the other hand, it is well established that under ordinary circumstances the pyrenoids entirely disappear prior to spore formation in *Hydrodictyon* and are afterward formed anew in the young cells.

The relation of the pyrenoid to starch formation in *Cladophora* and other forms studied is essentially the same as that already described by the author for *Hydrodictyon* (*Annals of Botany*, December, 1901). The following additional details are noted: The usual shape of the pyrenoid in the species of *Cladophora* studied is that of a biconvex lens. The differentiation of the pyrenoid into two parts takes place in such a way as to divide it by a plane passing through its longer axis. In many cases the pyrenoid is actually split into halves with a fairly broad cleft between them. Either of the halves so formed may be converted into a starch grain. In some instances the entire pyrenoid is converted into starch without previous cleavage. This is more apt to happen in *Œdogonium* and *Rhizoclonium* than in *Cladophora*.

The nature of the chemical processes involved in the formation of starch from a pyrenoid is now under investigation. That the process involves a conversion of a proteid substance (the pyrenoid) into a carbohydrate (starch) seems reasonably certain, but the unreliable character of various microchemical reactions makes the study of the details very difficult.

*Observations upon the Morphology of a Species of Osmunda from the Cretaceous Formation, and its Relation to Existing Species:* Professor D. P. PENHALLOW, McGill University.

In material from the Cretaceous of Skidegate Inlet, Queen Charlotte Islands, collected by Dr. C. F. Newcombe in 1895 and 1897, there were several fragments of plants representing the stipe, rhizome, fertile and sterile pinnules of a fern. Although not in actual connection, these fragments proved, upon examination, to belong to the same genus and undoubtedly

to the same species which has, therefore, been designated as *Osmundites skidegatensis*. From the material now at hand it is possible to effect a complete restoration of the plant with the exception of details relating to the sporangia, but as these structures differ but little in the Osmundaceæ, it would be possible to complete even this detail in a general way, from existing types. A close comparison with existing representatives of this family shows that it approaches the type of *Todea* in certain details of the phloem structure, as also in the absence of an endodermal layer. In all other respects it closely approaches the type of *Osmunda*, to which it is no doubt most closely related. A fact of very special interest is derived from a close comparison of the relative dimensions of the various structural regions and organs, from which it appears that the fossil must have been at least eight times larger than the modern *Osmundas* such as *O. claytoniana* or *O. cinnamomea*, and, with respect to the individual stem, much larger than *Todea barbara*. The general conclusions which these facts seem to indicate are that *Osmundites* represents a transitional form from which, or from a point near which, divergent lines of development arose, leading to the type of *Todea* on the one hand, and to the type of *Osmunda* on the other. It would also seem that *Osmundites* must have represented a period when the individual members of the family were much larger that at present, the existing species indicating, in their small size and diminished numbers, a tendency toward obliteration of this branch. The paper was fully illustrated by lantern slides.

*Ecological Conditions of Plant Growth in the Isle of Pines:* Professor W. W. ROWLEE, Cornell University.

The Isle of Pines has an area of nearly a thousand square miles. It is about one fifth as large as Jamaica and is as large as all the other islands that immediately surround Cuba would be if put together. It lies about thirty miles south of western Cuba, from which it is separated by a very shallow archipelago, the islands of which are small coral keys covered, for the most part, with a dense growth of mangrove. The island lies on the southern verge of the plateau, the northern part of which is the island of Cuba.

The northern and larger part of the island consists of a rolling table-land, in its highest parts scarcely more than 300 feet above tide. The most conspicuous physiographic features of this part of the island are the mountains which rise abruptly in isolated masses to a height of from 500 to 1,600 feet. The principal ones are Sierra Canada, Sierra Caballos and Sierra Casas.

The flora of the island, taken as a whole, is xerophytic in its tendency. Upon the mountains this tendency manifests itself most strikingly. Not only do plants grow upon the naked rocks, but many plants, such as bromelias, orchids and aroids, grow upon the trees and shrubs without any direct connection with terra firma. Among the trees here were species of *Clusia, Ficus* and *Cecropia*, as well as others not identified. On the rocks mingled with them were *Plumerias, Bilbergias, Fourcroyas* and cacti in great profusion. Palms were abundant, particularly on the perpendicular faces of the mountains, and were kept in constant motion by the sea breeze.

The flora of the mountains is very different from that of the plains, and strangely enough the pines are confined to the plains. To the ecologist the mountains afford a most interesting study, and there also remains much to be done before anything like a satisfactory list of the species can be written. The island is completely surrounded by a mangrove zone.

Here as elsewhere it is the plant that reclaims the sea. The ocean current and tide sweep through it, carrying the débris from other lands, and the roots of the mangrove retain it. It is practically a pure growth, as few other plants can exist under such conditions. It is limited inland by tide-water and is the favorite abode of the *cayman*, many of which may be seen from a ship in passing. Immediately behind the mangrove zone comes a belt of palms, among which are small savannahs in which grasses and sedges form a sward. Nowhere else in the trip were seen such numbers and varieties of palms growing. It reminded one of the palms of the Amazon. Some were palmetto-like, others bore pinnate leaves. Very few were in flower at the time of our visit (January) and the time at our disposal did not warrant our trying to identify them.

Three regions not sharply delimited may be distinguished in the interior of the northern part of the island, the savannahs, the pine lands and the stream banks.

The Malpais River is so named from the wet savannahs in the central part of the island through which it flows. The savannahs also extend to the uplands and have steadily increased in size as the natives have burned them over to improve the pasturage. Besides sedges and grasses there are many other herbaceous plants, especially species of Leguminosæ. They make up a thick sward. All show by their form and the texture and vesture of their leaves a decidedly xerophytic adaptation. Scattered everywhere through the savannahs are arborescent palms mostly of the palmetto type. One species with perfectly rotate leaves and fibrous sheathing bases to their petioles was everywhere seen. Its identity has not yet been determined. The sheaths enclosed one another on the stem, and when separated had the appearance of fibrous cornucopias. Thirty to fifty could be taken from one plant.

The pine lands resemble those of our own gulf region. The pine predominates over considerable areas. They are best developed on the higher ground. They have palms mingled with them everywhere, especially in the lower lands. The kinds of pine have been discussed by the writer in another place. There has been heretofore little done upon the study of their affinities, but in general they have been referred to *Pinus cubensis*. The natives distinguish several kinds and select certain ones for construction. In many of them are large black termites' nests. Not only does the termite infest the island, but ordinary ants are present in large numbers and build large mounds in the savannahs and pine lands. They are a serious obstacle to agricultural pursuits and have, beyond doubt, been an important factor in determining the character of the native vegetation.

Finally along the streams the vegetation shows the least xerophytic tendency, and closely approaches the conditions found in humid tropical regions. Several Scitamineæ occur here, also many ferns and orchids. The trees are mostly broad-leaved and large. Palms abound, also shrubs of many kinds. The soil is rich and very porous. If it were not for the overflow in the rainy season, its agricultural value would be very great.

In conclusion it may be said that the island presents the greatest diversity of conditions. The agriculture of the island, although in a primitive condition, shows this. Tomatoes, potatoes and other crops grown in the north grow well, and at the same time oranges, mammey, guava and all sorts of tropical fruits flourish. It may be truly said that here the vegetations of the temperate and tropical zones meet.

*Artificial Sea-water:* Dr. RODNEY H. TRUE, Department of Agriculture.

Two solutions were tested: (1) A synthetic solution made up with chemically pure chemicals and distilled water, and (2) a solution made by redissolving in a proper volume of distilled water sea salts that had been obtained by carefully evaporating sea water to dryness over a water-bath. The composition of the synthetic solution adopted was the average established by the *Challenger* analyses.

*Cladiphora gracilis* and *Enteromorpha intestinalis,* together with small scup, silversides and other marine fish and lower animals, were found to live and grow for part of the summer in both solutions. In view of certain unfavorable conditions under which these tests were made, these results make it seem very probable that artificial solutions may be used to replace sea water in some kinds of marine aquarium work.

*Notes on the Genus Herpomyces:* Professor ROLAND THAXTER, Harvard University.

The morphology and development of *Herpomyces* were described with the aid of diagrams. With the exception of certain species of *Dimeromyces* the genus is the only one among the Laboulbeniaceæ the members of which are parasitic on orthopterous insects, and is of interest from the fact that it adds another to the short list of genera in which the sexual organs are separated on different individuals, which, however, normally develop side by side in pairs corresponding to the spore pairs formed in the ascus. The germinating female spore forms a minute 'primary receptacle,' which gives rise to one or more fertile branches; and the latter, coming in contact with the substratum, form 'secondary receptacles,' which may creep more or less extensively, and, becoming independent of the primary receptacle, after perforating the integument of the host by means of clearly defined short haustoria, produce a variable number of perithecia. The primary receptacle of the male individual is similar to that of the female, and usually produces a variable number of simple antheridia directly; in one instance also producing in addition secondary receptacles as in the female, the perithecia being, however, replaced by tufts of antheridial branches. Although these plants occur on insects (Blattidæ) which are supposed to belong to one of the most ancient types, and are distinctly aberrant when compared with other Laboulbeniaceæ, they do not appear to represent as primitive a type of structure as is found in some other genera, nor do they seem to throw new light on the as yet obscure relationships of the group.

*The Contribution of Linnæus and his Students to Phytogeography:* Dr. HENRY C. COWLES, University of Chicago.

The path-breaking work of Linnæus in taxonomy is well recognized, but phytogeographers have commonly begun their science with Humboldt. As a matter of fact, Linnæus and his students presented a vast amount of material which should be more fully recognized. In his treatise entitled 'Om Växters Planteriog, grundet på Naturen,' published in the first volume of the transactions of the Royal Swedish Academy in 1739, Linnæus outlines a number of the fundamental principles of phytogeography, citing numerous illustrations. Ideas expressed here, as in his various travels and better-known taxonomic works, were worked over in detail by several of his students, and published in the *Amœnitates Academicæ.* Among the best of these treatises were Biberg's 'Œconomia Naturæ' (1749), Tornander's 'Herbationes Upsalienses' (1753), Hedenberg's 'Stationes Plantarum' (1754), and Åmanu's

'Flora Alpina' (1756). Hedenberg's analysis of plant habitats would be a credit to a modern student, and Åmanu's Alpine studies bring out much of value. A trace of the principle of succession of plant associations is found in Biberg, who pictures the changes on a rock surface from lichens to the forest.

*Some Notes on the Bending of the Inflorescence of Daucus Carota:* Dr. Henry Kraemer, Philadelphia College of Pharmacy.

It was observed that the bending of the peduncles of *Daucus Carota* at the close of the day was in inverse proportion to the age of the inflorescence, *i. e.*, this bending is most pronounced in peduncles bearing buds and very young flowers, and decreases with the development of the flowers, so that the oldest flowers show little or no bending of the peduncles. Furthermore, all of these stages were observed on a single plant.

An examination of the anatomy of the peduncles in different stages of the development of the inflorescence showed an increase in the development of mechanical tissues associated with the fibrovascular bundles, the amount of thickening and degree of lignification of the walls of the cells increasing with the age of the peduncles and being greatest in the lower portion and least in the upper part of the same peduncle, and entirely wanting in the peduncles of the buds.

Another observation was that on cool nights after cool days during both summer and fall, when the temperature was about 10° to 15° C., there was a marked diminution in the bending of the peduncles, even in the flower buds, the latter being erect in the majority of cases. On the other hand, this bending was most pronounced in the evening of a hot day when the temperature ranged from 27° to 37° C.

These observations, taken in connection with others, tend to show that the bending of the peduncles of *Daucus Carota* is not due to low temperatures, but that it appears to be influenced by the conditions affecting transpiration and is in the nature of a wilting, this being most pronounced in the young peduncles, which are deficient in mechanical tissues and in which transpiration is most active, and at the close of the day during which the conditions for transpiration have been most favorable.

*Studies upon the Cytohydrolytic Enzymes Produced by Soft Rot Bacteria:* Professor L. R. Jones, University of Vermont.

The account was based upon studies of *Bacillus carotovorus*, although related organisms were used in comparison. The enzyme was secured apart from the living organism by four methods, as follows: (1) By passing culture broths through porcelain filters, thus removing the organisms and leaving the enzyme in solution in the sterile liquid. (2) By heating broth cultures to 55° C. or slightly above. Since 51° is the thermal death point of this organism, sterility was thus secured, whereas the enzyme, although weakened at 58°, was not fully inhibited until about 62° was reached. (3) By adding the proper amounts of either phenol, thymol or formalin. Chloroform did not sterilize. (4) By precipitation with alcohol.

Detailed studies were made with the enzyme secured by the fourth method including the determination of the following points: (*a*) The relative activity of the enzyme as secured by fractional precipitation with increasing amounts of alcohol; (*b*) the relative activity from filtered as compared with unfiltered broths (porcelain filters); (*c*) the relation of composition of broth, and (*d*) of age of culture to enzyme production; (*e*) minimum, optimum and

maximum temperatures for cytohydrolytic action; (*f*) relative activity in the presence of varying amounts of sodium hydrate and of each of the following acids: hydrochloric, acetic, oxalic, formic, citric, malic, tartaric; (*g*) relative activity in the presence of the juices of the host plants of this bacillus (carrot, tomato, etc.); (*h*) relative activity in the presence of the products of growth of the organism. Practically no diastatic action occurred.

The full paper will soon be published.

*A New Key to the Phylogeny of the Monocotyledons:* Professor E. C. JEFFREY, Harvard University.

Recent extensive investigations of the anatomy of the higher plants, living and fossil, have established beyond question that anatomical features, especially in the case of the larger groups, are even more constant than those presented by the reproductive and floral organs. This being the case, it is not surprising that they should be used to an increasing extent in the elucidation of phylogeny. The intention of the present abstract is to call attention to the fact that there are certain anatomical features of the Monocotyledons which appear to be of considerable phylogenetic value.

It has long been known that the bundles of the aerial stem of the various monocotyledonous orders are of the closed collateral type, while those of rhizomes often present a curious concentric condition, in which the phloem, exactly reversing the arrangement found in the vascular cryptogams, is surrounded completely by xylem. The latter type of bundle has been called by Strasburger amphivasal, to distinguish it from the amphicribral concentric bundle, which is characteristic of the vascular cryptogams.

The author has found that the amphivasal type of concentric bundle is present not only in monocotyledonous rhizomes, but in the nodal regions of the reproductive axis as well. The amphivasal concentric bundles of the reproductive axis make their appearance at a varying distance below the nodes, and usually disappear entirely from the stem after the leaf-traces have passed off. The reproductive axis is consequently divided into a number of distinct phytomeres, which are characterized at their upper ends by the presence of the amphivasal concentric bundles just described. Sometimes in the extreme upper part of the floral axis, where the internodes become shortened, the amphivasal nodal segments of the axis are fused, so that the fibrovascular tissue becomes continuously concentric, just as is ordinarily the case in monocotyledonous rhizomes.

The occurrence of concentric bundles at the nodes of the reproductive axis has been made out by the author, in the Gramineæ (*Zizania, Phleum, Coix, Zea, Calamogrostis, Elymus,* etc.), Cyperaceæ (*Scirpus, Eriophoron, Cladium, Carex,* etc.), Juncaceæ and certain of the lower Liliaceæ. He believes that these facts furnish a valuable additional clue to the phylogeny of the Monocotyledons.

It is a well-established general principle, resulting from the study of the comparative anatomy of living and fossil gymnosperms, equisetales, etc., that ancestral anatomical conditions are extremely apt to persist in the reproductive axis. The occurrence of concentric bundles at the nodes of the reproductive stem in the above groups is consequently, in all probability, to be regarded as an ancestral feature. This view gains force from the fact that in *Potamogeton,* etc., and many grasses, the concentric bundles occur throughout the stem, but only at the nodes. Moreover, in the higher Liliaceæ, the Iridaceæ, the Orchidaceæ, the aroids, the palms and the Scitamineæ, etc., concentric bundles have

entirely disappeared from the nodes of the reproductive axis.

Briefly, the author's hypothesis is that the primitive monocotyledon was a segmented plant, composed of phytomeres, and characterized by the presence of concentric bundles at the nodes. Probably as the result of periodically recurring unfavorable conditions of existence, the primitive segmented type of stem became differentiated into vegetative and reproductive portions of very different structure. The vegetative part of the stem gradually became characterized by tufted leaves and short internodes, resulting finally in the fusion of the nodal segments, containing concentric bundles to form a continuous system. In the reproductive axis of the lower groups of Monocotyledons, on the other hand, the ancestral division of the stem into distinct phytomeres is retained, together with the recurring segments of concentric bundles. In the higher monocotyledons, however, the primitive organization disappears and concentric bundles are no longer found in the reproductive axis.

The hypothesis outlined above is based on the study of a considerable number of facts, and, further, seems to gain force from two considerations. In the first place, it agrees on the whole very well with the data supplied by a study of the floral organs. Secondly, a typical cambium has been found in the reproductive axis and seedlings of some of the lower monocotyledonous orders mentioned above. The latter feature is reserved for subsequent consideration, but it may be pointed out that this discovery lends support to the opinion recently expressed by Queva, in connection with his anatomical studies on the Uvulariaceæ, viz., that the Monocotyledones are derived from the Dicotyledones, or an equivalent stock, by the loss of a cambium and an increase in the number of leaf-traces.

W. F. Ganong,
*Secretary.*

## SCIENTIFIC BOOKS.

*Morphogenetische Studien.* Als Beitrag zur Methodologie Zoologischer Forschung. By Tad. Gabrowski. Gustav Fischer. 1903.

Gabrowski publishes under the above title a quarto monograph of which the first 24 pages deal with the structure of *Trichoplax adhærens,* 9 pages with the biology of this animal, and 141 pages of general discussion.

In regard to the structure of *Trichoplax* very little that is essentially new is added. The organism is disc-shaped and, as a rule, irregular in outline. It has an outer layer of ciliated ectoderm, and an internal spongy parenchyma. It lacks completely digestive tract, reproductive organs and nervous system. Some of the parenchyma cells, although not differentiated into muscles, are probably contractile, and cause the changes in the shape of the body.

*Trichoplax* moves slowly over solid bodies by means of the long cilia on its under surface. No food particles of any sort have ever been found in the body, and the author's only suggestion is that the food may be soluble organic matter absorbed from the surrounding water; but this is purely conjectural, and nothing new was discovered as to the probable source of food.

Reproduction is by division into two pieces; the body drawing away in two directions until the connecting part is finally broken. Gabrowski has also seen two, and even three, individuals come together and fuse into a single mass, for which process he suggests the use of the term concrescence—a term that has acquired a very different meaning, and it seems unfortunate to apply it to this process of fusion.

A long discussion of the affinities of *Trichoplax* leads the author nowhere, since no new facts of any significance have been added by his work and the speculation is not particularly illuminating. Even less impressive is the long, heavy discussion of the gastrula theory which is painfully dragged through