substituting one coil for another in the percentage bridge, which is less complicated than the Carey Foster commutator.

The most serious disadvantage of the percentage method is pointed out and a remedy suggested.

The percentage bridge is an instrument of great simplicity, great sensitiveness and relatively great range; and one in which the standard resistances are automatically protected from heavy currents. It is not only a very superior instrument for the comparison of standard resistances, but one which lends itself admirably to a variety of special purposes, such as calibrating rheostats, determining temperature coefficients, etc.

Priming Caused by Poor Circulation in a Boiler: D. S. JACOBUS, Stevens Institute of Technology. Section D.

Dual Degree for Engineering Courses: P. C. NUGENT, University of Syracuse. Section D.

Panama: Discussion of Present Conditions and the Prospect: F. L. WALDO. Section D.

Panama: A Sea-Level Canal: W. R. WARNER, Cleveland. Section D.

DAYTON C. MILLER,
Secretary.

THE SOCIETY FOR PLANT MORPHOLOGY AND PHYSIOLOGY.

THE ninth annual meeting of this society was held, in conjunction with the meetings of the Western Branch of the American Society of Naturalists and the Affiliated Scientific Societies, at the University of Michigan, Ann Arbor, Mich., December 27, 28, 29, 1905, under the presidency of Professor E. C. Jeffrey. Though small in point of numbers, the meeting was otherwise one of great profit and enjoyment. In effect it was a joint meeting with the Botanists of the Central States, for this society held sessions only in the mornings and the Botanists of the Central States only in the afternoons, each society attending the sessions of the other. The new members elected were Messrs. Mel. T. Cook, of the Agricultural Experiment Station of Cuba, Raymond H. Pond, of Northwestern University, and W. W. Stockberger, of the United States Department of Agriculture. The society voted to accept the constitution recommended by its committee on union of botanical societies in case it is accepted by the Botanical Society of America and the American Mycological Society, and on this basis to unite with those societies into a single new society to be called the Botanial Society of America. Pending the action of the other societies no new officers were elected, but the officers of this meeting were continued until the union of societies should be effected, or until the next annual meeting, with authority to perfect all details of the union. The address of the president, entitled 'Morphology and Phylogeny' has appeared in full in SCIENCE. The society expressed by a special vote its great appreciation and thanks for the gracious hospitality of the university, and for the admirable arrangements of the local committee, which contributed so much to the interest and success of the meeting.

Since the Ann Arbor meeting the Botanical Society of America and the American Mycological Society, at their meetings at New Orleans, have taken action with respect to a union of botanical societies similar to that taken by this society at Ann Arbor. Accordingly a union of these three societies into a single society of the widest scope has been agreed upon and is expected to be brought into effect during the present year. The Ann Arbor meeting, therefore, was the last to be held by this society separately; next year it will meet in New York, as part of the new society.

The papers presented before the meeting were the following. All were presented in full and discussed. The abstracts are by the authors.

The Induction of New Species: Dr. D. T. MacDougal, Carnegie Institution.

The author described some experimental researches by which forms, potentially new species, were secured as a result of chemical and osmotic action exerted on unfertilized ovules. Solutions were injected into the ovaries of *Raimannia* immediately previous to pollination and fertilization, which then apparently ensued in a normal manner. Among the seeds secured were a number which produced plantlets, differing from the normal, or typical of the species, notably in physiological qualities and general anatomy. Some of the atypical derivatives thus secured had come to maturity and produced seeds, and are to be considered as mutants of the parental type. The series of experiments demonstrates conclusively that factors external to the protoplast may exert a profound influence upon its hereditary characters, and call out qualities not hitherto exhibited externally by the line of descent affected.

The author had not yet succeeded in analyzing the manner in which the treatment described had influenced the normal activity of the embryonic cells, but suggested that the readiest explanation lay in the suggestion that the externally applied reagents had interfered with the normal course of the succession of the enzymes during the stages immediately preceding egg-formation, and also that the results were indicative of unequal influence upon individualized chromosomes.

Some Factors Concerned in Color Production in a Species of Fusarium: Dr. J. B. Pollock, University of Michigan.

The species of *Fusarium* used was obtained from the cut ends of Indian corn stubble, in autumn. One of its characters is the bright salmon-pink color usually found under natural conditions. This color also develops on many artificial media, under proper conditions. Among the conditions necessary for its development, direct sunlight, or at least strong light, is of primary importance. Diffuse light is scarcely any better than complete darkness. In absence of light only a pale cream color is produced, generally without the faintest tinge of red.

Cultures removed from diffuse light to direct sunlight showed a marked development of color within five hours.

Moisture also has a considerable influence on the development of color. The moister the medium the less the color shows, but even submerged in a liquid medium there may be some color produced in light. Besides light and moisture, the composition of the medium also influences the production of the red color. Under similar conditions of light and moisture, after seven days' growth, the red color was very pale on cornstarch, while on carrot, hubbard squash and cornmeal the color was between roseous and testaceous of Saccardo's color chart; on apple, onion and potato it was almost exactly ochraceous, on wheat flour it was slightly paler than orange, and on buckwheat flour it was darkest red, slightly redder than testaceous.

On raw dahlia tubers the growth becomes bright red, but if they are steamed in the autoclave almost no red color is produced even in the light. Also on steamed dahlia tubers the fungus produces a green color, and this was produced on no other medium used. All the soft tissue of the medium turns green, and on some cultures the fungus growth above the surface is green also. The green color is produced in both light and darkness.

The Traumatic Reactions of Living and Extinct Araucarians: Professor E. C. JEFFREY, Harvard University.

Among the Abietineæ *Abies* and its allies, although possessing normally no resin canals in the secondary wood, form traumatic resin canals as the result of injury. The presence of resin canals as a constant and normal feature of the first woody ring of the root in *Abies*, etc., as well as their occasional occurrence in the first annual ring of the vegetative and reproductive branches of the stem, leads to the inference that the traumatic resin canals of the abietoid Abietineæ are a reversionary feature. The examination of a considerable number of species of the living aracaurian genera *Dammara* (*Agathis*) and *Araucaria* has resulted in the conclusion that the living Araucarineæ do not produce traumatic resin canals. The present author has been able to extend this conclusion to certain extinct Araucarians from the Cretaceous beds genera *Dammara* (*Agathis*) and *Araucaria oxyla* of the Cretaceous beds of the eastern United States, however, show a very different wound reaction from that found in *Agathis* and *Araucaria,* for they form traumatic resin canals very abundantly as a result of injury. These occur in the usual tangential rows characteristic of traumatic canals and contain mucilage as well as resin, as is commonly the case in the cortical resin-canals of the living Araucarineæ. The *Araucarioxyla* which react in this way are characterized by the small size of their tracheids and the complete absence of the resin-containing elements, which are found in the wood of living Araucarineæ. There is good reason to believe that these *Araucarioxyla* are the wood of *Brachyphyllum* Brongniart, which thus takes its place among the Araucarineæ and in that most ancient group, which includes *Walchia, Ullmannia, Pagiophyllum,* etc. Traumatic resin canals have been found in araucarioxylous material from the Raritan formation of Staten Island, from Martha's Vineyard and from the much older deposits of the Potomac. The writer is of the opinion that these facts will turn out to be of considerable phylogenetic significance.

Some Experiments in the Control of Color in Plants: Dr. HENRY KRÆMER, Philadelphia College of Pharmacy.

In a paper presented to this society a year ago the author gave the results of some morphological and chemical studies on the color substances of plants. An examination of a large number of the unorganized or cell-sap color substances showed that they readily react with various chemicals, a marked change in color being produced in many instances. For example, the majority of plant-color substances turn green with calcium hydrate, deep red with organic acids, rich purple with potassium and aluminum sulphate, and blue with ferrous sulphate. While the color substances in plants are considered to be in the nature of metabolic products, still it is likely that the various tints and shades are due to certain associated substances, as organic acids, phosphates, calcium salts, etc.

It has been repeatedly observed in the study of certain chromogenic bacteria that the intensity of the pigment is dependent in great measure upon the nutrient media used. The addition of chemicals like magnesium sulphate, potassium phosphate and grape sugar, is found to be necessary for the development of the pigment. Overton found some years ago that by feeding certain plants with glucose there was an increase in the red coloration of the leaves. Katic has recently published some observations on this subject. He has fed plants with cane sugar, potassium, calcium and magnesium salts, and reports that he has obtained positive results. He, however, adds that other factors must be taken into consideration, as the presence of oxygen, exposure to light and the maintenance of a certain temperature.

Certain more or less fanciful notions have heretofore prevailed with regard to the influence of chemicals on the color of flowers. The blue-flowered form of *Viola lutea* has been supposed to owe its color to the presence of zinc in the soil. The blue color in flowers of hydrangea has been attributed to the presence of an excess of iron or alum in the soil, and it is a common practise among rose growers to treat the soil with a solution of ferrous sulphate for intensifying the color of red roses.

About November 1, 1904, through the courtesy of Dr. George T. Moore, the author began a series of experiments in the greenhouses of the U. S. Department of Agriculture at Washington, for the purpose of determining the effects of certain chemicals on the color principles of plants. The plants selected for study were carnations, roses and pansies. The following chemicals were used: Aluminum and potassium sulphate, aluminum phosphate, aluminum sulphate, aluminum and ammonium sulphate, iron and ammonium sulphate, iron citrate, iron salicylate, iron malate, iron succinate, ferrous sulphate, potassium cyanide, potassium hydrate, potassium nitrate, potassium iodide, water of ammonia, ammonium nitrate, acetic acid, citric acid, formic acid, malic acid, salicylic acid, phosphoric acid, sulphuric acid and iodine.

The work thus far must be regarded as more or less preliminary, as the experiments showed that it is necessary to establish control conditions in order to determine the effects of the chemicals supplied, apart from other factors. Some effects have already been noted, but these could perhaps be ascribed to other factors than the chemicals used. For instance, in the case of La France roses the petals became of a uniform pink color when the plants were supplied with iron citrate and citric acid. Maroon roses became dark red when the plants were supplied with phosphoric acid, iron and ammonium sulphate or sulphuric acid. In fact, the color of the maroon roses approached that of the crimson roses when treated with sulphuric acid, and they also tended to singleness.

Channels of Entrance and Types of Movement in Bacterial Diseases of Plants: Dr. ERWIN F. SMITH, United States Department of Agriculture.

Using the blackboard for purposes of illustration, the speaker discussed the various ways in which bacteria enter the living plant, viz., through wounds and through natural openings. The question whether there is ever any entrance of the bacteria except through tissues injured by other causes was also discussed. It is still, perhaps, a matter of doubt whether in case of certain stomatal infections which take place when drops of water stand on the plant for a long time, there may not be suffocation of a few cells in the substomatic chamber prior to the multiplication of the bacteria. Such, however, does not appear to be the case, and certainly in water-pores, where the tissues are accustomed to be bathed in excess of water an infection conditioned exclusively on preliminary suffocation would seem to be improbable. The writer obtained rather promptly, viz., within a few days, numerous small, round, dead spots on cotton leaves sprayed under tents with water and then with pure cultures of *Bacterium malvacearum*. But these spots, which he regards as genuine suffocation spots, did not enlarge much, did not contain any organisms, and bore no relation whatever to the genuine bacterial infection spots which appeared in great numbers some weeks later on these same plants, and passed through the typical stages of the angular leaf-spot. The author has since learned from Mr. W. A. Orton that similar sterile spots occur naturally on cottons in the field in rainy seasons. Attention was then called to the various mechanical obstacles which the bacteria meet with in the plant, and the methods by which these are overcome, to wit, by growth: (1) through vessels; (2) through parenchymatic tissues by way of the intercellular spaces, with the eventual formation of cavities; and (3) from cell to cell without the primary occupation of the intercellular spaces. The transpiration stream appears to have little to do directly with the movement of bacteria in the stems of diseased plants. It appears to be made out with reasonable certainty that in some cases bacteria pass from cell to cell through pits or thin places without crushing the cell-wall or dissolving any great portion of it. Such would seem to be the manner of movement of *Bacillus amylovorus* in some tissues of the pear. The writer spoke of the fact that new leaf-spot diseases due to bacteria are constantly turning up, the latest one being a disease of the Gloire de Loraine begonia, cultivated in hothouses for winter blooming. Some observations were also detailed respecting the curious distribution of starch in young potato tubers diseased by *Bacterium solanacearum*. This organism, as is well known, has very little diastasic action on potato starch. The irregular distribution of the starch in such tubers seems to point, therefore, not to a solution of starch grains already laid down in the amyliferous tissue, but to the paralysis or death (by enzymic action or otherwise) of considerable areas of tissue surrounding the bacterial foci, so that it is impossible for the plant to lay down starch in such cells. Sections of such tubers from paraffin infiltrated material show the starchless areas to be roughly proportionate to the size of the central bacterial focus; if this is large, *i. e.*, of some age, there will be a correspondingly large area of the surrounding tissue which is destitute of starch grains or which bears them only in occasional cells. If the bacterial focus is a small one, the area destitute of starch will be correspondingly reduced in size. In tubers infected after they have reached a greater age the starch grains are present, and even in the center of a bacterial focus remain undissolved, and, so far as can be determined microscopically, are not corroded even on their margins by the action of the organism.

Report from the Committee on the College Entrance Option: Presented by Professor W. F. GANONG, Smith College.

A committee of the Society for Plant Morphology and Physiology, the present members of which are Professors W. F. Ganong and F. E. Lloyd, was appointed in 1900 to formulate a college entrance option in botany. The committee has published three reports, well known to members; and the course there formulated, based upon earlier educational reports and the approval of a large number of the prominent teachers of botany throughout the country, has been adopted by the college entrance examination board and by a large number of schools. The committee had been continued as a standing committee of the society with instructions to keep the option in touch with educational advance, and from time to time to report such alterations as may seem desirable. In the present report the committee stated that it had been gathering evidence as far as possible upon the working of the option. The only serious criticism that has developed has been with reference to the number of topics, which has been found by most teachers to be too great for the time the option is supposed to take (one year). The committee accordingly recommended the omission of certain minor topics which will render it about one tenth shorter than at present, and improvements in certain minor details. These changes will soon be published in the *Plant World*, and will be laid before the college entrance examination board. The committee also called attention to the fact that although many schools now offer this full-year course in botany, comparatively few students take the college entrance board examination in that subject. This is obviously due to the fact that few colleges as yet include a year course of botany among their entrance options, and this, no doubt, largely because the existence of a definite highly-graded course in that subject has not yet been brought officially to the attention of the authorities. The recommendation was made by the committee that the members of the society who are teachers should at least make sure that the matter is not going by default in their own institutions.

The Formation of Tetraspores in Griffithsia: Professor D. S. JOHNSON and Mr. I. F. LEWIS, Johns Hopkins University.

The tetrasporangia are borne in whorls at the junction of two cells of the thallus. Each tetrasporangium rudiment arises as a papilla-like outgrowth from the apical region of the cell of the thallus. By a horizontal division this outgrowth gives rise to two cells, a basal stalk cell and a terminal tetrasporangium. The tetrasporangial cell increases in size and the nucleus divides into two, then into four, the nuclei lying peripherally in the cell. The nuclei then travel toward the center of the cell, and simultaneously partitions grow in from the periphery. The four nuclei lie in a central mass of rather dense cytoplasm, the partitions just reaching the outer border of the central mass. In this condition the tetrasporangium is shed, the actual separation of spores taking place in the water.

The Curly Top or Western Blight of the Sugar Beet: Dr. C. O. TOWNSEND, United States Department of Agriculture.

This paper consisted of a discussion of twenty-three theories that have been investigated during the past five years, relative to the cause of the curly top or western blight of the sugar beet. The theories discussed included parasites, unfavorable soil, climatic and cultural conditions, inherent tendencies in the plant toward the disease, and a weakened condition of the plant due to poor seed. None of the theories investigated gave positive results in regard to the cause of the disease under the conditions in which the experiments were conducted. The bacterial theory has probably received more attention than any other possible cause of this disease, but the results thus far indicate that none of the organisms isolated are the sole cause of curly top. In some localities the disease is accompanied by insects so persistently that at first sight they seem to be the cause of the trouble, but their almost total absence from other badly diseased fields throws considerable doubt on this theory. The fact that a parasitic fungus was found in the tissues of the roots in several microscopic sections cut from diseased plants, points to this theory as one that needs further investigation. However, inoculations made with this fungus in healthy plants in the field and in the greenhouse have not produced the disease under the conditions employed. It is possible that a combination of unfavorable conditions is necessary to produce the curly top. The most important practical result obtained so far in the study of the disease is the fact that it does not usually attack beets in the same locality or even in the same field two years in succession.

About twenty lantern slides were used to illustrate the paper.

Distribution of Upland Plants near Ann Arbor: Dr. G. P. BURNS, University of Michigan.

The physical features of the country around Ann Arbor are largely the result of glaciation. The region is made up of morainal ridges between which are numerous valleys. In some cases the depression forms a 'pot-hole.' These are filled with swamp or bog flora.

The soil conditions vary as much as the topography. The glacial deposits are different in various parts of the same section.

Large contour maps were made and on them the exact locations of the various plant societies plotted. These maps show that our hills are covered with hydrophytic and mesophytic as well as xerophytic plants.

The factor of greatest importance in determining the distribution of upland plants in this region is the position of the impervious layer.

Demonstration of the Geotropic Sensitiveness of the Elongating Zone of Roots: Professor F. C. NEWCOMBE, University of Michigan.

The well-known work of Czapek claimed to demonstrate the limitation of the perception of gravitation to the apical 1.5 mm. of the root-tip. The present report was divided into two parts, (1) arguing that Czapek had neglected to take account of the inherent tendency of roots to grow straight, and hence had failed to prove the localization of geotropic sensitiveness; and (2) exhibiting a preparation of twelve seedlings of *Vicia faba* that had just been removed from a centrifuge revolving for six hours with a speed about four times the acceleration of gravitation. From each root 3 mm. of the tip had been removed six hours before, and yet all but one of the roots showed distinct outward curves, the bends being within 2 to 4 mm. of the ends of the roots.

There seems no escape from the conclusion that the elongating zone is sensitive to gravitation.

On the Erroneous Physiology of Elementary Botanical Text-books: Professor W. F. GANONG, Smith College.

The author pointed out that the recent simplification of methods and appliances of plant physiology accompanying its extension into elementary education, while admirable in some respects, had often resulted in crude, slipshod and illogical apparatus manipulation and reasoning. Various examples of erroneous experiments current in the elementary text-books, especially connected with photosynthesis, root-absorption and transpiration, were described. These errors have arisen partly from a neglect of control experiment, partly from a too-great reverence for the authority of very fallible leaders in simplification. The remedy is to be found in the application to elementary experimenting of the same logical and control methods we should use for investigation, in concentration upon a few important experiments rather than in spreading over many of a more showy type, and in the use of more exact and workman-like apparatus which it is often more economical to buy than to make. The paper will soon appear in *School Science and Mathematics.*

The Growth-energy of Trees as Measured by the Bands of the Common Bagworm: Dr. HERMANN VON SCHRENK, United States Department of Agriculture.

The common bagworm (*Thyridopterix*

ephemeræformis) weaves a band of silk around the smaller twigs of many trees about the beginning of September. The cocoons remain on the trees over winter and in the great majority of cases drop to the ground in May or June of the following year, because the bands which hold them are torn as the twig increases in diameter. Now and then, however, the bands are so strong that they act as a ligature, causing the swelling of the tissues on one or both sides of the band. The swellings on the upper and lower sides usually join after several years, imbedding the band completely. Swellings were described and shown on soft maple, sycamore, red gum, oak, Virginia pine, sassafras, red cedar, arbor-vitæ, apple, robinia, deodar cedar, willow, cottonwood, cypress.

Several hundred bands were broken to test their strength, and the radial pressure which they exerted on the twig was calculated. As most of the bands are broken by the growth of the twigs every year, these bands were taken as a measure of the energy exerted by the twig. The pressure necessary to break them was determined to be about 35–45 atmospheres per square millimeter. Under pressures of 20–30 atmospheres the cambium still forms wood cells, which differ from the normal wood in having thicker walls, and a smaller lumen. A smaller number of vessels are formed. The results are considered as preliminary and more extended data were promised.

W. F. Ganong,
Secretary.

Northampton, Mass.

SCIENTIFIC BOOKS.

Allgemeine Biologie. Zweite Auflage des Lehrbuchs 'Die Zelle und die Gewebe.' Von Oscar Hertwig. Pp. 649, mit 371 Abbildungen im Text. Jena, Gustav Fischer. 1906.

This book is a second edition of 'Die Zelle und die Gewebe,' which originally appeared in two parts, the first dealing with the general morphology and physiology of the cell, in 1892, and the second dealing with the cell in heredity and development, in 1898. Since the publication of the first part fourteen years have elapsed, and eight years since the publication of part two. These have been very fruitful years in the history of the subjects with which Professor Hertwig deals; conceptions of the morphology and physiology of the cell, current at the time of the first edition, have in some cases been greatly enlarged by new discoveries, and in other cases entirely superseded. Facts and ideas of prime importance concerning the chemistry of protoplasm, the so-called tropisms, the phenomena of cell-division, of maturation, fertilization, the physiology of development and the origin of species, have been set forth by numerous writers. The value of the present book must, therefore, be measured largely by the author's assimilation of the new data and by their incorporation within his original system in a logical manner, or else by logical development of a new system rendered necessary by the new data.

Let us see to what extent the new edition measures up to these requirements: (1) The number of pages of the new edition is 649, and of the two parts of the first edition 610; the number of figures has been increased from 257 to 371. There has been, therefore, considerable expansion; in many places new matter has replaced the old, entire sections have been completely rewritten, new sections have been added and there has been a certain amount of rearrangement. The main additions are Chapter IV., dealing with the conception of causation as applied to biology, part of Chapter VIII., dealing with problems of karyokinesis, and most of Chapter XI., dealing with the maturation phenomena of ova and spermatozoa. (2) On the other hand, the author has not attempted to incorporate any of the results of the chemistry of proteids or of the applications of physical chemistry to the study of protoplasm, although there is a chapter on the chemistry of the cell; he has not availed himself of any of the literature