gal in the production of initial elementary structures and organs. But while making abundant provision for the life of the organism through the favored few, she has learned to turn an increasing number of the unfavored ones to good account. Acted upon by external agents and by internal forces, and a changing environment, advance is made step by step to higher, more stable and prolonged periods.

While we have not yet solved any one of these problems, the results of experimental morphology are sufficient to indicate the great importance of the subject and the need of fuller data from a much larger number of plants. If thus far the results of experiments have not been in all cases sufficient to overthrow the previous notions entertained touching the subjects involved, they at least show that there are good grounds for new thoughts and new interpretations, or for the amendment of the existing theories. While there is not time for detailing, even briefly, another line of experiment, viz, that upon leaf arrangement, I might simply call attention to the importance of the experiments conducted by Schumann and Weisse from the standpoint of Schwendener's mechanical theory of leaf arrangement ('78). Weisse ('94) shows that the validity of the so-called theory of the spiral arrangement of the leaves on the axis may be questioned, and that there are good grounds for the opening of the discussion again. It seems to me, therefore, that the final judgment upon either side of all these questions cannot now be given. It is for the purpose of bringing fresh to the minds of the working botanists the importance of the experimental method in dealing with these problems of nature that this discussion is presented as a short contribution to the subject of experimental morphology of plants.

Geo. F. Atkinson.

Cornell University.

PHYSIOLOGY AT THE BRITISH ASSOCIATION.

During the Toronto meeting of the British Association for the Advancement of Science the Section in Physiology held seven sessions under the presidency of Professor Michael Foster (Cambridge). The sessions were held in the Biological Building of the University of Toronto, and forty-one papers and demonstrations were presented. The proceedings began upon Thursday, August 19th, with the admirable address of the President, which will be printed in a future number of Science. The sectional papers of that day related in general to the subject of motion. Professor H. P. Bowditch (Harvard) discussed the rhythm of smooth muscles. Rings from the frog's stomach, when suspended, exhibit sooner or later spontaneous contractions, which continue for from forty-five minutes to twenty-four hours. The graphic curve of such contractions seems to be compound, being formed by the superposition of two waves, which represent two rhythmic contractions of different rates. Sets of contractions are also repeated rhythmically. Professor G. C. Huber (Michigan) gave the results of further researches on the innervation of motor tissues with especial reference to nerve-endings in the sensory muscle-spindles. The main points in this paper are given in Science, Vol. V., p. 908. Mr. O. F. F. Grünbaum (Cambridge) demonstrated by lantern slides the muscle-spindles in pathological conditions. Professor F. S. Lee (Columbia) discussed the ear and the lateral line in fishes. These two organs are equilibrative in function, and the former is probably the phylogenetic derivative of the latter. Audition in the customary sense of the word is wanting in fishes, and first appears with the change from an aquatic to a land existence. Professor W. P. Lombard (Michigan) spoke on the effect of the frequency of excitations on the contractility of muscles. Dr. J. H.

Kellogg reported the results of a dynamometric study of the strength of the several groups of muscles and the relation of the corresponding homologous groups of muscles in man.

The session of Friday morning, August 20th, was devoted mainly to the presentation of papers on the circulation. Professor G. N. Stewart (Western Reserve) gave a large number of measurements of the output of the mammalian heart examined by a new method. Professor W. T. Porter (Harvard) reported his observations on the mammalian heart concerning the cause of the heart-beat, fibrillary contractions, the influence of ventricular systole on the blood-flow through the heart-muscle, and the circulation through the veins of Thebesius. (See SCIENCE, p. 905, 906.) Professor Karl Hürthle (Breslau) discussed the resistance of the vascular channels. Resistance depends on two factors—the internal friction of the blood and the dimensions of the tubular system. Measurements of the former by the author's method give the result: internal friction of distilled water at 37°C.: that of blood : : 1 : 4.5 (dog), 4.1 (cat), 3.2 (rabbit). From this and certain other data, the author calculates the resistance expressed in terms of the dimensions of a tube through which, under the given conditions, the same quantity of blood could flow. The resistance through the several organs and over the entire vascular course is now being measured. Dr. W. H. Gaskell (Cambridge) gave a comparative résumé of the physiology of the cardiac branches of the vagus nerve in the five main divisions of the vertebrates. Professor A. R. Cushny (Michigan) discussed rythmical variations in the strength of the contractions of the mammalian heart. Professor W. H. Thompson (Belfast) presented a report upon the physiological effects of peptone and its precursors when introduced into the circulation. The research is in the hands of a committee consisting of Professors Schäfer, Sherrington, Boyce and Thompson, and the work of the past year has been carried on by Professor Thompson. The effects of Witte's peptone, pure peptone, anti-peptone and deutero-albumose were given in detail. Professor E. W. Reid (Dundee) presented the results of experiments on the absorption of serum in the intestine. Water and organic and inorganic solids are absorbed against an excess of hydrostatic pressure in the blood-vessels. The results seem to exclude explanation by osmosis, filtration into capillaries or lacteals, imbibition, electro-osmotic action, and aspiration by the blood-current.

In the afternoon of Friday Professor Anderson Stuart (Sidney) spoke upon a newly discovered function of the canal of Stilling in the vitreous humor in receiving lymph during the accommodation of the eye. Professor Stuart also described a number of simple pieces of physiological apparatus which he had found useful for demonstrative purposes. Dr. Noel Paton (Edinburgh) discussed the phosphorus metabolism of the salmon in fresh water, with especial reference to the diminution of phosphorus in the muscle and its increase in the reproductive organs. The loss of phosphorus from the muscle is barely sufficient to account for the gain in the ovary, and amply sufficient for the gain in the testis. But the phosphorus compounds—chiefly lecithin and ichthulin in the ovary and nuclein in the testis—must be formed synthetically. Lecithin is probably one of the first stages in the construction of nucleo-compounds. Professor J. Loeb (Chicago) demonstrated and discussed certain electrostatical stimulative effects upon nerves, which might be mistaken for electro-magnetic effects. Professor G. Lusk (Yale) gave the results of experiments on the gastric inversion of cane sugar by hydrochloric acid, which show that the acidity of the

gastric juice is sufficient to produce such inversion as takes place in the stomach.

The section held no session on Saturday, the majority of the members making the excursion to Niagara.

Monday forenoon was devoted to the subject of neurology. Professor Carl Huber (Michigan) gave an account of his study of the comparative histology of the cells of the sympathetic nervous system. (See Science, Vol. V., p. 132.) Dr. J. J. Mackenzie (Toronto) spoke on the microchemistry of nerve-cells. Mr. W. B. Warrington gave the details of an investigation of the changes in nerve-cells in various pathological conditions, the latter being caused by various organic poisons, anæmia, the division of peripheral nerves, and the division of the posterior roots. Professer A. Waller (London), who is a member of the committee previously appointed by the Association to investigate the changes which are associated with the functional activity of nerve-cells and their peripheral extensions, and who has been working upon the electro-physiology of isolated nerve, made an elaborate and valuable roport upon the action of acids, alkalies, carbonic acid, tetanization and temperature upon electrotonic currents in nerve. Such currents are physiological, as well as physical. Normally the anodic current (A) is greater than the kathodic (K), in the proportion of 4 or 5 to 1. Rise of temperature to 40° causes diminution of A and increase of K. K is favored by acidification and tetanization, disfavored by basification; alterations of A are less uniform and characteristic. Tetanization and CO_2 have similar effects upon the electrotonic currents. In Dr. Waller's opinion this proves that the tetanization of an isolated nerve gives rise to a production of CO_2. In view of the impossibility heretofore of obtaining any evidence whatever of metabolism in an acting nerve, this conclusion is most important and suggestive, as bearing upon the nature of the nerve impulse. During the presentation of Dr. Waller's paper Miss Welby demonstrated the method used in his laboratory of applying anæsthetics to isolated tissues, employing for the purpose cardiac muscle. Professor Charles Richet (Paris) announced his discovery of a refractory period in the cerebral and medullary nervous centers of the dog. If these be rhythmically stimulated they will respond to either every stimulus or only every other one, according to the temperature and rate of excitation. The duration of the period is 0.1″ at 30° C. Man has a refractory period, since he cannot think at a greater frequency than 10 to 12 per second. Hence the psychological unit of time, or the elementary period of consciousness, is about 0.1″, which, therefore, represents the duration of vibration of the nerve-center.

Monday afternoon was given up to demonstrations. Professor W. P. Lombard (Michigan) showed a cheap and simple chronograph. Professor C. S. Sherrington (Liverpool) demonstrated various new facts regarding visual contrast and flicker. Professor A. B. Macallum (Toronto) showed microscopic specimens illustrating the distribution of iron in cells, and Professors W. A. Herdman and R. Boyce (Liverpool) microscopic specimens illustrating the presence of copper in cells.

On Tuesday morning the Sections in Physiology and Botany held a combined meeting to discuss the chemistry and structure of the cell. This attracted a considerable audience and was one of the most interesting of the sessions. The discussion was opened by Professor R. Meldola (London), who spoke on the rationale of chemical synthesis. Comments were made by Professors J. R. Green (Cambridge), W. D. Halliburton (London), I. Remsen (Johns Hopkins), H. Marshall Ward (Cambridge), and H. E. Armstrong (London). Professor J. R. Green (Cambridge) presented experi-

mental evidence of the existence in yeast of an alcohol-producing enzyme. Professor A. B. Macallum (Toronto) presented certain new views on the significance of intracellular structures and organs. According to him the centrosphere is the oldest part of the cell. The nucleus and the cytoplasm are secondary structures. This explains the fact that in cell-division the division of the centrosome precedes that of the rest of the cell. These views were opposed by Mr. H. Wager (Leeds), who gave strong evidence for the presence of a nucleus in the yeast-cell, and by Professor J. B. Farmer (London).

The final session was held on Wednesday forenoon and was devoted to psychological and miscellaneous papers. Professor W. D. Halliburton (London), on behalf of himself and Dr. Mott, discussed the action of cholin, neurin and allied substances on the circulation, in connection with the discovery by them, in the cerebro-spinal fluid in certain forms of insanity, of a substance which appears identical with cholin and depresses blood-pressure by acting upon the heart. Professor R. Boyce (Liverpool), on behalf of himself and Professor W. A. Herdman (Liverpool), discussed the presence of copper in animal cells. Papers were read by Dr. T. W. G. McKay on intestinal absorption of hæmoglobin and ferratin, by Mr. R. R. Bensley (Toronto) on the morphology and physiology of gastric cells, and by Mr. O. F. F. Grünbaum (Cambridge) on visual reaction to intermittent stimulation. Professor Wesley Mills (McGill) discussed the functional development of the cerebral cortex in different groups of animals (see SCIENCE, Vol. V., p. 134), and the psychic development of young animals. In the latter paper he presented the results of a correlation of the psychic development of the dog, cat, rabbit, guinea-pig, rat, and bird with the development of the cortical centers. Professor C. Lloyd Morgan (Bristol) read a suggestive paper on the physiology of instinct. The essential part of the objective aspect of instinctive activity is the coordination of outgoing impulses. This activity is at first unconscious, but later, by the coming in of afferent impulses, consciousness may appear. Professor L. Witmer (Pennsylvania) discussed the nature and physical basis of pain. Pain is a sensation, the central organ of which consists of the sensori-motor centers; no special pain nerves exist.

On account of the full program comparatively little general discussion of the papers was possible, and this constituted the one drawback of the meeting. The sectional committee, the membership of which has already been printed in SCIENCE, p. 335, held daily sessions, and the usual grants for research were asked for.

FREDERIC S. LEE.
COLUMBIA UNIVERSITY.

THE PATAGONIAN EXPEDITION FROM PRINCETON UNIVERSITY.

THIS expedition, dispatched to Patagonia from Princeton University in February, 1896, returned during August. It was under the auspices of Professor W. B. Scott, of the Department of Geology, and had for its object the collecting of vertebrate fossils from the Tertiary deposits, and the skins and skeletons of recent birds and mammals. It was directly in charge of Mr. J. B. Hatcher and his assistant, Mr. O. A. Peterson.

The objective point was the Port of Gallegos, on the east coast of southern Patagonia, which was reached April 29, 1896. From this point investigations were conducted, first along the coast from Sandy Point, in the Straits of Magellan, to Port Desiré, on the north. In this region many interesting fossil forms were secured and a nearly complete series of living birds, mammals and plants. After spending several