probably due to some action related to the solvent properties of urea. All attempts at synthesis of urea by urease failed. Prof. Bayliss referred to the complexity of the process of hydrolysis of urea, and believes that the first action of urease on urea is to form ammonium cyanate. The change of ammonium carbamate to carbonate is not accelerated by urease. An interesting discussion of problems raised by the paper followed, in which Prof. Ramsden and Prof. Moore took part.

Dr. J. Tait gave a communication on capillary phenomena in blood cells, and on phagocytosis. He described the movement of the spindle-shaped cells of invertebrate blood in coagulation, and pointed out their analogies with blood platelets. Such cells are phagocytic, but not amœboid; their movement is irreversible and passes into cytolysis. Dr. Tait proposes the name "Thigmocyte" for this class of blood cell. If the thigmocyte is unstable for any substance it is phagocytic for that substance. The movement may be explained physically, and obeys the laws of capillary attraction. Leucocytes, on the other hand, may be stable on a foreign substance, and yet be capable of ingesting small fragments of that substance. Dr. Tait showed that this is not inconsistent with a physical explanation. He further proposed a physical explanation for various blood phenomena, amœboid movement, diapedesis, the relation between agglutinins and opsonins, and the coagulation of blood.

Dr. C. E. Lea showed lantern slides of electrocardiograph records from clinical cases of auricular fibrillation of the heart, and pointed out the value of this method as a mode of diagnosis. The action of drugs on the condition was also illustrated.

Dr. E. P. Poulton read a paper on the alleged acid intoxication of diabetic coma. He analysed a series of cases showing the amount of alveolar CO_2 and the hydrogen-ion in the blood. Dr. Poulton finds no evidence of acid intoxication in diabetic coma; the blood, indeed, shows no increase in H-ion concentration in this condition, and is less acid than in uræmia, or even after moderate exercise. He believes the coma of diabetes to be the direct action of some poison, possibly acetoacetic acid. The lowering of the alveolar CO_2 may be to some extent responsible, and is in itself a trustworthy index to the onset of the condition.

Prof. W. H. Thompson recorded some experiments upon arginine and the formation of creatine. He fed or injected dogs and ducks with arginine, and estimated the output of creatine. In nearly all cases there was an increase of the creatine-creatinine output, injection giving the higher result. Racemic arginine gave no greater effect than dextro-arginine.

Prof. Thompson also contributed a paper on the effects of tetanisation on the creatine and creatinine in the muscle of the cat. A decerebrate animal was used and the creatine estimated by Folin's method. There was an apparent decrease as the result of long-continued activity of the muscle, but Prof. Thompson did not believe there was any real alteration, the apparent decrease being explained by other factors.

On Friday Dr. C. Powell White described a test for copper sufficiently delicate to detect 1/100th of a milligram in 15 c.c. of fluid. The test is identical with Oliver's test for morphine. Dr. Powell White found copper in all the tissues of the body and in various foodstuffs, animal and vegetable. Quantitative measurements were made by the ferrocyanide method. The copper may possibly play an important part in the reactions taking place in the living cell.

Dr. Lamb and Mr. Holker reviewed a number of methods of differentiating fats and lipoids microchemically, and showed lantern slides of tissues thus treated.

Dr. Lamb also illustrated the appearances of the mucous membrane of the small intestine during fat absorption, and showed differences in the columnar cells according to the kind of fat that was administered.

Dr. Sarah M. Baker propounded a new theory of muscular contraction which she termed the "liquid pressure theory." The theory was arrived at in consequence of a similar explanation of the ascent of sap in trees. An aeropermeable membrane, impermeable to liquids but permeable to gases, is assumed to be present in muscle. Carbohydrate is oxidised in the muscle with the production of water and CO_2. The formation of water causes a liquid pressure which manifests itself as a contraction of the muscle. Relaxation is due to rapid evaporation of water through the membrane. The heat thus lost reduces the total energy of the oxidation process by about nine per cent. Dr. Baker cited a number of observations supporting various points in the theory. In the discussion that followed, Prof. Thompson and Prof. Herring criticised the application of this theory to muscle in several details, and Dr. Baker replied.

Dr. Tait and Dr. Harold Pringle then gave a paper on the elasticity of the strophanthinised heart. Tracings of an isolated frog ventricle in Schäfer's plethysmograph were exhibited by the lantern, and the action on it of strophanthin demonstrated. The amount of relaxation of the ventricle was shown to be directly proportional to the preceding contraction, and to be entirely due to the elasticity of the heart.

BOTANY AT THE BRITISH ASSOCIATION.

THE meeting this year was a busy and successful one, though the attendance was smaller than it would have been in happier circumstances, many members being prevented from attending by more urgent calls and duties.

The shadows cast over the meeting by the war were deepened for Section K by the news of the premature death of Prof. D. T. Gwynne-Vaughan, who had been for many years successively secretary and recorder of the section. On Wednesday morning the section adjourned as a mark of respect during the hour of the funeral. A new departure which proved of value scientifically was the setting apart of an afternoon in which readers of papers demonstrated their results, and others also gave demonstrations. It afforded an opportunity for informal discussion which was greatly appreciated. No sectional dinner or excursions were arranged.

The presidential address has already been given in an abridged form in these pages. It embodied a plea for the revival of the causal point of view in morphology, so long neglected in favour of the phyletic aim. Using the alternating generations of the fern, the seed and its embryo, and other examples, the president illustrated the application of distinctively morphological conceptions, such as specific substance, with "allotropic" forms, and the correlation or mutual influence of parts, to the study of form and structure, and emphasised the significance for causal morphology of "homologies of organisation," which have been the bugbear of phyletic morphology.

A feature of the meeting very appropriate in Manchester was a lecture by Mr. Lawrence Balls on the application of science to the cotton industry. Surveying the chief results of his experimental study of the cotton plant in Egypt, he showed how, by suitable sampling, trustworthy statistics could be obtained, from which the growth, flowering, and fruiting of an average plant under average conditions could be cal-

culated. Such data, graphically represented, showed in a striking way correlations between flowering, fruiting, and growth, which might enable an expert to issue at frequent intervals valuable reports and trustworthy forecasts that would have a steadying effect on the market. The lecturer also indicated how careful breeding and selection of pure strains could result in improved spinning quality. Pure strains yield more uniform lint, which will spin well even in cases where the expert grader would reject a sample at first sight as worthless. The need of closer co-ordination between the grower and spinner was emphasised, the chief desideratum being a common language, which might be provided by men of science, so that the spinner could make his requirements intelligible to the grower.

Cryptogams.

Prof. F. O. Bower gave an account of the progress which has been made since the publication of his "Origin of a Land Flora" in the study of the relationships of the Filicales, with special reference to the Dipterids and Pterideæ. While dealing with these in detail he gave a general account of the present state of knowledge with regard to the phylesis of the ferns as a whole. Members of the section appreciated the opportunity of learning the direction in which investigations still in progress at Glasgow were pointing.

Prof. T. G. B. Osborn sent a paper describing the morphology and structure of *Selaginella uliginosa*, which occurs in eastern Australia. It has a well-developed rhizome in which the vascular system is solenostelic, with ramular gaps, a second example of solenostely in the genus. In relation to this Mr. H. B. Speakman demonstrated the structure of the branching rhizome in *Selaginella lyallii*.

Prof. A. H. R. Buller described the discharge of spores from the basidia of Uredineæ and Hymenomycetes. The discharge is violent, a drop of fluid being previously excreted just below the spore, and discharged with it. In many cases the basidia are curved so as to direct the spores towards the open air. Dr. M. Wilson recorded the occurrence of the conidial stage of *Tuburcinia primulicola* on *Primula vulgaris* in Kent. The conidia appear as meal-like masses, partially filling the corolla tube and gluing the stamens together. Conidia may be found in all stages of conjugation by short connecting tubes. Germ tubes are afterwards produced, which probably develop the mycelium that bears the chlamydospores. These arise in groups from coiled masses of hyphæ, and when young contain conjugate nuclei which afterwards fuse. Finally, the whole ovary disintegrates, setting free the spores as a black powder. Mr. W. Robinson demonstrated germ tubes of certain Uredineæ, and abnormal spermogonia.

Fossil Botany.

Dr. Marie C. Stopes gave an account of the remarkable flora of the Lower Greensand deposits of Aptian age, represented by petrifactions, often beautifully preserved, as was amply demonstrated by lantern-slides and actual sections. The flora included Cycadophyta, Conifers, and woody Angiosperms. The wood gives evidence of well-marked seasons, pointing to a cool climate, in marked contrast to the "tropical climate" inferred to have existed at the time of the Wealden flora of southern England.

Prof. F. W. Oliver showed slides illustrating the structure of the seed Gnetopsis, which he has recently further elucidated, and dealt with some general problems of the seed and the flower. Prof. D. Ellis described fungal hyphæ occurring in ferruginous rocks of the Lower Lias, which were incrusted with ferric hydrate, unseptate, with branches, frequently in whorls, and spherical sporangia, each containing about four spores. Another similar fungus, from secondary rocks in north-west Scotland, had a hard black membrane and no sporangia. In fossilised putrefying animal remains were found two Bacilli, a Micrococcus and an Actinomyces-like form, consisting of a thick meshwork of minute threads.

A paper was contributed by Mrs. Edith M. Osborn describing an Australian Zygopteris, probably of Upper Devonian age. This new type is of extraordinary interest. It combines the main features of the *Ankyropteris grayi* type of stele, with the simple Clepsydropsoid type of petiolar structure. Axillary branches were not present. Miss N. Bancroft demonstrated sections showing the structure of the stem and petiole and the mode of branching of *Rachiopteris cylindrica*.

Physiology.

Miss T. L. Prankerd described observations, similar to those of Haberlandt and Nemec, on the coincidence in time and place of geotropic sensitivity and the occurrence of movable starch grains ("statoliths") in certain Liverworts and other plants, illustrated by good microphotographs. Movable starch was located in the top point of the curve of young circinnate fern fronds. In general the nuclei of the "statocytes" were larger than those of neighbouring cells, and in many cases were found among the starch grains at the bottom of the cells.

Dr. Sarah M. Baker directed attention to the enormous fund of energy represented by the total internal liquid pressure of water (corresponding to the pressure of a gas, due to molecular bombardments), which, according to Van der Waals and Stefan, reaches many thousands of atmospheres at low temperatures. Just as osmotic pressure becomes effective in presence of a semi-permeable membrane, so might liquid pressure theoretically become effective, given a membrane permeable to water vapour, but not to liquid water. Dr. Baker suggested that this liquid pressure might account for the ascent of water in tall trees, adducing as evidence of the existence, in the growing region of the root, of a membrane with the requisite properties, (1) that certain dyes do not enter this region, in contrast with the root-cap and root-hairs, and (2) that in a moist atmosphere acid drops of water exude from the root-hairs. The interpretation placed upon these facts was received with some scepticism; it was, moreover, objected that the relatively low values hitherto obtained for root-pressures and the existence of "negative" pressures in the trunks of trees during active transpiration make it abundantly evident that the pumping activity of the root, however it may be explained, is not adequate to the raising of water as fast as the shoot-system actually absorbs and transpires it. On the other hand, attention was directed to the desirability of more extended observations of root-pressures in relation to the heights reached by different species.

Dr. E. M. Delf gave a preliminary account of very careful experiments by a new method on the effect of temperature on the permeability of protoplasm. The rate of contraction (proportional to the rate of exosmosis of water) of strips of plant tissue was followed minutely, and the rate at a specified stage of the contraction was taken as a relative measure of the permeability to water. The results showed a much greater rate of increase at high temperatures than hitherto observed, the curve being logarithmic in form right up to 42°.

Mr. A. M. Smith dealt with the effect of drying on the respiration of plant organs. His experiments showed that with the removal of increasing percentages

of contained water the respiration increases regularly up to 25–30 per cent. loss, when it reached two or three times the respiration of similar undried material. Beyond this point drying had no further effect until 50–60 per cent. of the water had been removed, after which the respiration steadily diminished, not ceasing entirely so long as any water remained in the material.

Prof. W. B. Bottomley gave the results of relative determinations of growth-stimulating "auximones" by means of the bacterial scum formed in their presence on crude nitrifying culture solutions. The relative amounts in fresh and rotted manure and bacterised peat respectively were 1, 5, and 250. The formation of auximones during germination was demonstrated; excised embryos were found to flourish in culture solutions only if auximones were added. Culture experiments with *Lemna minor* showed that the purer fraction precipitated from extracts by silver nitrate stimulates growth more than the cruder phosphotungstic fraction.

Other Papers.

The only foreign guest of the section, Prof. Julius McLeod, of Ghent, demonstrated the possibility, in the case of certain mosses, of describing and determining species biometrically. Using the genus Mnium, as an example, the maximum, mean, and minimum values for the length, breadth, etc., of the leaves on successive portions of the fertile stem up to the longest leaf were tabulated. The results showed that the correlation between these measurements was characteristic of the species, so that by comparing the length, breadth, etc., of, for instance, the longest leaf of a given specimen with data for the longest leaves of the various species, it could be identified.

Dr. J. C. Willis put forward the view, based on a statistical study of the flora of Ceylon and India, that very local indigenous species are those of recent origin, while species widely distributed on the mainland as well, are those long established. He found no evidence of the elimination of species by "natural selection"; most of the widely distributed species are also common, few rare, while of the endemic species the majority are rare.

Dr. E. J. Salisbury described the influence of coppicing on the ground flora of Oak-Hornbeam woods on clay soils. Before coppicing, it comprises chiefly perennial herbs with storage organs which produce their leaves very early in the spring. After coppicing, species from the edges of the wood and paths invade the opened areas, accompanied by weeds of cultivation with good dispersal mechanisms. Some of the old occupants are enabled by the increased light to flower. The soil becomes more acid and drier. The gradual return of the ground flora to its original condition as the undergrowth thickens was described.

In addition to the contributions already mentioned, Mrs. M. G. Thoday demonstrated the structure of seeds of *Gnetum gnemon*, Miss E. M. Blackwell dealt with the occurrence of stomata on hypogeal cotyledons, and other smaller demonstrations were given.

Reports.

Reports on the work of committees of the section were submitted as follows:—By Prof. T. G. B. Osborn, on the cutting of sections of Australian fossil plants; and on Australian Cycadaceæ; by Prof. A. J. Ewart, on investigations of the influence of various atmospheric pressures upon geotropic and heliotropic irritability and curvature; by Mr. R. S. Adamson, on the vegetation of Ditcham Park, Hampshire; by Prof. R. H. Yapp, on the Cinchona Botanic Station in Jamaica; and by Mr. R. P. Gregory, on experimental studies in the physiology of heredity.

AGRICULTURE AT THE BRITISH ASSOCIATION.

ALL interest in agriculture centres at the present time in the economic problems involved in the desired increase of the scope and efficiency of British farming as measured by its output of foodstuffs. It was inevitable, therefore, that the programme of Section M. this year should be largely devoted to the consideration of the existing situation and of the economic factors which govern the introduction of changes in the direction of increased production.

The inaugural address of Mr. Rew, apart from its other merits, served to give the section at the very outset an admirable *résumé* of the existing situation as regards the share contributed by British agriculture to the national food supplies, and more particularly the extent to which it has assisted during the past year in making good the lack of supplies from sources cut off by the war that under normal conditions would have furnished us with some portion of our food. He was able to renew the assurance given by him three years ago at Dundee that, even in normal times, the share of British agriculture in the food supply of the nation is more considerable than is commonly realised. Further, he could demonstrate that this share has been substantially increased during the first year of war, whilst, thanks to the Navy, the total supplies which have reached our shores have been actually rather larger in time of war than in time of peace.

After the address, reports upon the present situation and outlook with reference to supplies of manures and feeding-stuffs were presented by Prof. Hendrick and Mr. E. T. Halnan. Prof. Hendrick directed attention to the difficulties that were likely to arise in connection with the supplies of phosphatic manures, especially "dissolved" manures, owing to the increased cost of imported raw materials and the difficulties of distribution. The loss of supplies of potash manures from Germany could be met only to a very slight extent from other sources, but much might be done to reduce existing waste of potash in the form of loss of liquid manure. The exploitation of seaweed as a source of potash and iodine was also worthy of attention. In a later paper Prof. Hendrick quoted numerous analyses of seaweeds, both Fucus and Laminaria, which showed that the latter contain appreciable quantities of potash, amounting in some cases to fully 12 per cent. of the dry matter.

Mr. Halnan dealt more particularly with the supply of feeding-stuffs, and summarised the results of tests made at different centres with materials new to the British market, such as dried yeast and palm-nut kernel cake.

A further contribution to this day's programme was made by Prof. Somerville, who gave the results of a series of pot-culture experiments which demonstrated clearly the accumulation of fertility in the grass-land of five selected farms as a result of the application of basic slag.

The second day's programme furnished a natural corollary to Mr. Rew's address in the shape of a discussion of various aspects of the present and future agricultural situation as affected by the war. For the purposes of this discussion Mr. T. H. Middleton, Permanent Under-Secretary of the Board of Agriculture and Fisheries, opened the day's programme with an interesting comparison of the efficiency for the production of food of different systems of farming. By ingenious methods of computation he was led to the conclusion that, whereas grazing at its best produces probably not more per acre than sixty-seven days' supply of protein, or 140 days' total supply of energy for a man, and, at its worst, produces no