THE STORY OF A GRASS.[1]

GRASSES form one of the largest and most widespread families, adapted to very different conditions of soil and climate, but with a remarkably uniform plan of structure. Wherever conditions allow of plant-life on land, there, almost without exception, the family is represented. In number of species the grass family falls short of other great families of flowering plants, Compositæ, Leguminosæ, or Orchids, but in the aggregation of many individuals of one and the same or a few species, either growing alone or densely scattered through a mixed herbage covering large areas, it forms a pre-eminent type of the earth's vegetation—as, for instance, in the grass-carpets forming the meadows or pastures of temperate or cold climates, or the coarser growth prevalent over vast areas, as in steppe or prairie vegetation.

These sociable grasses play an important part in the general scheme of plant-life; they protect the soil from too great evaporation of water, and cover up other plants in the resting stage, such as bulbs, tubers, etc., during the cold or dry season. The penetrating effect of the roots and underground stems helps to break up a stiff soil and fit it for other plants. Examples of the great variety of habitat in which grasses thrive are seen in the short turf which covers limestone areas, where the soil is too dry and thin to support trees or shrubs; in the luxuriant growth of meadow-land where it thrives together with a variety of other herbs; in the reed-grasses which are associated with water; in the coastal mud-flats in Hampshire and Sussex, which are being rapidly reclaimed by the growth of *Spartina Townsendi,* a vigorous-growing hybrid which has spread over large areas during recent years; or the sand-dune grasses, which bind and fix the sand dunes and prepare the way for a more varied and permanent type of vegetation.

The adaptation necessary to accommodate the plant to widely differing conditions of life does not involve changes in general plan of structure; for instance, in hot, dry, or exposed areas, where excessive loss of water by the plant must be avoided, this is effected by narrowing the leaf-surface, or rolling it over from margin to margin to protect the upper face on which are the water-transpiring stomata. The structure of the stem, a slender, hollow cylinder, strengthened by a band of supporting fibres beneath the outer layer, or strips accompanying the water-conducting tissue, gives sufficient strength, with the greatest economy of material, for the purpose required, namely, to carry up into the light and air the leaves, flowers, and fruits for the short period of active life, and to allow of the swaying motion which favours the processes of nutrition, of transfer of pollen, and of distribution of the mature fruits.

The mode of development of the branches at the base of the stem determines the habit; a tufted growth results from the upward growth of the buds in the interior of the leaf-sheath, as seen, for instance, in the "tillering" of cereals; while the turf- or sod-formation is due to the penetration of the sheath-base by the young shoot and its lateral development in the soil. Branching from the upper part of the stem is rare in grasses of the temperate zone, but occurs in tropical genera, and is characteristic of the bamboos, in which the woody stem often attains tree-like proportions.

Points of interest in the structure of the grasses are the mode of growth in length of the stem by a zone of growth above the place of insertion of each leaf, the rigidity of the stem at this tender-growing zone being maintained by the stiff, encircling leaf-sheath; the swollen "node" round the base of each leaf-sheath, which is able by a geotropic growth response to an alteration in its position to raise again to a vertical position a stem which has been laid; and the short prolongation of the leaf-sheath above the line of its union with the leaf-blade to form the membranous "ligule" which protects the entrance to the tube formed by the sheath.

The grass-flower and the association of flowers to form the inflorescence are very characteristic. The unit is the spikelet which contains one to several, sometimes many, flowers. The character of the spikelet is determined by the bracts or glumes, the green membranous or papery scale-leaves which enclose the single flower and overlap each other in a double row when several flowers are present in a spikelet. The bract-leaf is a general method of protecting the flower-bud; in the iris, for example, each flower-bud is enveloped by a pair of bracts—the outer, farther from the main stalk, green and leaf-like, the inner, between the bud and the main stalk, thin and hyaline with a double keel on the back. In the iris the bracts wither as the flower opens, in the grass the bracts remain as the character-giving feature during flowering and fruiting, the flower itself being reduced to those organs which are directly concerned in the setting of the fruit. The pollen is distributed by means of air-currents, and the petals are represented merely by a pair of minute fleshy scales (lodicules) at the base of the flower, which, by absorbing water, swell and cause the bracts to separate, and thus allow the thread-like stamens to grow out and expose the delicately hung anthers, from which the light dusty pollen is scattered by the wind; the feathery stigmas protrude later to catch the pollen-grains. In the great majority of grasses there are three stamens, as in the Iris family, and a single ovary bearing a pair of long, feathery stigmas and containing a single egg. The remarkable variety in the form of the spikelet and the inflorescence is achieved by variety in the form, size, and number of the glumes which constitute the spikelet and the degree of branching of the inflorescence. The colour of the inflorescence is due to the colour of the pendulous anthers, and disappears when these drop after shedding the pollen. Fertilisation of the ovule succeeds pollination of the stigma, and the ovule becomes the seed, which, except in a few genera, is permanently enclosed in and inseparable from the fruit. The fruit also generally remains enclosed in one or more of the glumes, which fall with it and by their light, papery consistency help in its distribution by wind. Frequently the outer glume bears a stiff awn on the back or tip, which is an effective aid to distribution, as it will cling to the coat or plumage of an animal or bird. In the steppe grasses of the genus Stipa the awn is sometimes very long and feathered, forming an admirable device for distribution by wind. The stiff awn is frequently spirally coiled in its lower portion and hygroscopic, and its coiling or uncoiling with the varying degree of moisture in the atmosphere is arranged so as to drive the pointed end of the glume, in which the fruit is enclosed, into the ground.

The seed contains the embryo at the lower part of one side; the rest consists of a food store of starch and gluten to nourish the embryo on germination. The embryo has a well-developed stem-bud or plumule and root; the plumule is enveloped by a sheath (coleoptile), which appears above ground in germination as the slender pointed green seed-leaf from which the true leaves successively break. The food store in

[1] Abstract of a discourse delivered at the Royal Institution on May 17 by Dr. A. B. Rendle, F.R.S.

the seed is rendered soluble and absorbed by a flat sucker (scutellum), which is attached to the base of the coleoptile, and together with it represents the single cotyledon characteristic of the division of flowering plants, Monocotyledons, to which the grass family belongs.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—Sir William Ashley, Dean of the faculty of commerce, has been invited to become Vice-Principal in succession to Dr. R. S. Heath, whose resignation takes effect at the end of the current session. The post of registrar, hitherto occupied by Dr. Heath, is to be filled by Prof. Alfred Hughes, Dean of the faculty of arts.

CAMBRIDGE.—The governing body of Emmanuel College offers two exhibitions, each of the value of 50*l.* and tenable for two years, to research students commencing residence at the college in October, 1918. The governing body may also make additional grants to students whose means are insufficient to cover the expense of residence at Cambridge or whose course of research may entail any considerable outlay in the provision of apparatus or materials.

OXFORD.—Prof. Horace Lamb, professor of mathematics in the University of Manchester, has been appointed Halley lecturer for next year.

THE *Times* correspondent at Toronto states that a prominent citizen, whose name is not yet disclosed, will give from 100,000*l.* to 600,000*l.* to endow chairs in the faculty of medicine at the University of Toronto.

BY the will of Sir G. H. Philipson, the sum of 2000*l.* has been left to the University of Durham College of Medicine, Newcastle-upon-Tyne, for the foundation of two Philipson scholarships to be awarded to the undergraduate of the college obtaining the highest marks at the M.B. final examination.

THE sum of 2500*l.* has been given to the Armstrong College, Newcastle-upon-Tyne, by Miss Stephenson, for the endowment of a studentship in the faculty of arts, in memory of her late father, Sir W. H. Stephenson; and Messrs. Cochrane, Ltd., of Middlesbrough, have given 3000*l.* to the same institution for the foundation of scholarships, primarily for residents of Middlesbrough and New Brancepeth.

THE Regulations for Secondary Schools for 1918–19 (Cd. 9076, price 2*d.*), now published by the Board of Education, are in substance the same as those for the present year. The definition of advanced courses for pupils remaining in secondary schools until eighteen years of age has been revised and modified. It will be remembered that the Board's circular of 1913 on the curricula of secondary schools pointed out that the legitimate requirements of the great majority of pupils would be met by the provision of three different types of advanced course, viz. (*a*) science and mathematics, (*b*) classics, and (*c*) modern humanistic studies. The requirement that the work of an advanced course in group (*a*) must include both science and mathematics has now been relaxed. In schools, especially girls' schools, where biology occupies a prominent place in the curriculum, it is not always possible without risk of serious overstrain to require the inclusion both of mathematics and of the auxiliary sciences of chemistry and physics. The Board has therefore reserved discretionary power to dispense with the requirement of mathematics in such cases. It is expected that chemistry will always be continued in the advanced course in connection with biology, and that physics will also be continued unless it has previously been carried to an adequate standard. The claims of geography for recognition as an advanced course are discussed in an explanatory note to the regulations, and it is stated that the Board is prepared to give sympathetic consideration to any practicable proposals made by suitable schools for advanced courses in which geography is made a predominant subject.

ONE chapter of the recently published report of the Board of Education for the year 1916–17 (Cd. 9045) is concerned with the work of universities and university colleges. It includes a section dealing with the gifts and bequests received during the year under review by the university institutions which come within the scope of the report. The majority of the foundations were directed to promoting the study of subjects the importance of which has been emphasised by the war. Among the gifts recorded the following may be mentioned:—A legacy to the University of Birmingham of 5000*l.* from the late Sir Charles Holcroft, the income of which is to be devoted to research work in science and engineering; a bequest of 10,000*l.* from the estate of Miss Craddock for the purpose of founding a chair of commerce at the University of Liverpool; 25,000*l.* under the will of Sir George Franklin for the foundation of chairs at the University of Sheffield; 30,000*l.* contributed to the Ramsay Memorial Fund; some 30,000*l.* given towards the erection of new science buildings at Bangor University College; 20,000*l.* promised by anonymous donors to Aberystwyth College for buildings required by the Agricultural Department; and at Cardiff 25,000*l.* received from Sir W. J. Tatem towards the provision of new chemical laboratories, a bequest of 20,000*l.* to the Medical Department, and a sum of 30,000*l.* from Miss Emily Talbot to endow a chair of preventive medicine. Altogether, well over 200,000*l.* was found by private donors for the improvement and development of higher education, in addition to the gifts of land, like the site of nine acres in the heart of Bristol given to the University there by Mr. Henry Wills, part of which is marked out for the erection of a department of physics. The benefactions to universities and colleges in the United States exceed 5,000,000*l.* annually, or twenty-five times more than the gifts to similar institutions in Great Britain.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 6.—Sir J. J. Thomson, president, in the chair.—N. B. **Dreyer** and Prof. C. S. **Sherrington**: Brevity, frequence of rhythm, and amount of reflex nervous discharge as indicated by reflex contraction. A single momentary stimulus of moderate intensity, *e.g.* a break-shock, even though not far above threshold value of stimulation, applied to the afferent nerve of a spinal reflex-centre, evokes from that centre not uncommonly a repetitive series of volleys of motor impulses. It tends to do so more as the stimulus, within limits, is increased in intensity, but the state of the reflex-centre at the time is also a decisive factor. The rhythm of repetition of volley-discharges from the spinal reflex-centre was traced, by the ordinary mechanical method, to be of synchronous rate with that of stimulation of the afferent nerve up to a frequence of 55 per sec., and by a mechanical resonance method up to a frequence of 65 per sec. By a "doubling frequency" method it