

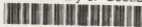
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BUTE BOTANICAL SOCIETY.



BRITISH GRASSES:
A LECTURE

DELIVERED BY

MR NORMAN LAMONT, YR. OF KNOCKDOW,

BEFORE THE MEMBERS OF

THE BUTE BOTANICAL SOCIETY,

IN

SAINT PAUL'S HALL, ROTHESAY,

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ESPLANADE.

BRITISH GRASSES.

It was not without considerable trepidation that I accepted the invitation of the Bute Botanical Society, to deliver a lecture upon British grasses. I was, it is true, prizeman in botany at the Agricultural College of Downton in 1890; and had carried off the trophy for the best collection of grasses there, in 1888; but I have not had much opportunity since then of keeping myself up-to-date in botanical progress; and, indeed, I feel that in some respects my botanical knowledge is decidedly rusty.

However, I am not so presumptuous as to think that in any case I could teach the Bute Botanical Society anything; and I shall be fully satisfied if, in the course of the following address, I can persuade any of you to specialise your investigations upon what is perhaps the most interesting, and certainly the most valuable, of all the natural orders of plants.

The Order of Gramineæ belongs to the Class of monocotyledons, and contains 46

British genera, which themselves include from 105 (Hayward) to 133 species (Parnell). It is distributed over all the portions of the earth's surface, from the polar regions to the equator, and apart from the very wide distribution of this order the amazing variety in size of some of its genera is very remarkable, as well as the great variety of uses to which different grasses are put.

In point of size our British grasses may be said to range from *Aira præcox* and *Agrostis vulgaris*, var. *pumila*, with a height of two or three inches, up to *Bromus asper* and *Glyceria aquatica* which attain six feet, and *Arundo Phragmites* which reaches even ten feet. But what are these compared to the giant bamboo of the tropics, with the girth of a small tree, and a height of fifty or sixty feet?

With regard to the different uses to which grasses are put, these are so various and so important that it would not be too much to say that we could more easily dispense with all the other natural orders of plants put together, than with the Gramineæ. Their most obvious use is "to build up starches, sugars, and other plant-substances which are then consumed, and turned into flesh by our cattle and sheep," and so to furnish us with meat. But they or their products are also consumed directly as human food, for wheat, barley, oats,

and rye all belong to this order ; as do maize, sorghum, rice, and the sugar-cane, though not grown in the United Kingdom. And not only human food, but human drink, is obtained from them, as beer, whisky, and rum are all obtained from some one or more of the plants I have enumerated. Then the straw of several of these plants is used for thatching purposes, to say nothing of the manufacture of hats. And several grasses are used as sand-binders, to consolidate shores liable to be carried away by the winds or the waves. A hundred other uses could easily be mentioned, but I am dealing with British grasses only, and their principal value is for pasture and for hay.

There is only one other order of plants which is likely to be mistaken for grasses, and that is the order of Cyperaceæ, or sedges. It may be useful to give at the outset a rough list of the distinctions between the two:—

CYPERACEÆ.		GRAMINEÆ.
Triangular, solid.	Stem.	Round, usually hollow.
Entire.	Leaf sheath.	„ split.
Absent.	Ligule.	Present.
Entire at apex, innate.	Anther.	Notched at apex, versatile.
Three, simple.	Stigmas.	Two, feathery.
None.	Lodicules.	Usually two.

While they have in many respects very highly adapted themselves to the conditions of their existence, grass-flowers are conspicuous instances of degeneration. At one

period of their existence there is little doubt that grasses had acquired calyx and corolla in order to attract bees or other insects, but they have now abandoned them, and reverted to the more ancient method of fertilisation by wind. The same reason that has led grasses to abandon colour has caused them to dispense with odour. The only British grass that has any strong odour is the sweet vernal (*Anthoxanthum odoratum*), which has, when growing, when freshly cut, or even after having been kept for many years, a perfume of new mown hay. And it has a taste (which is not always the case) exactly corresponding to the smell. This sweet-scented ether is known by the name of coumarin, and occurs in several other plants, notably woodruff (*Asperula*).

I shall now turn to the vegetative character of grasses. Their roots are generally thin and fibrous and adventitious from the nodes, frequently forming radiating crowns round the base, which are easily pulled up, and usually broken in the process. In some moor grasses, such as *Molinia* and *Nardus*, the roots are tough and stringy, and resist breakage. Some grasses are stoloniferous—that is, they have creeping or running underground stems, which send down roots at intervals. The stoloniferous variety of *Agrostis alba* (florin, as it is called) is perhaps the most typical of this habit, which

enables a grass to cover a large area very rapidly. Then some grasses are liable to a curious swelling of the bottom of the stem, which forms a sort of tuber, and is apt to be mistaken for a root. The common "timothy" (*Ph. pratense*) is very liable to this on dry soils, and a still more striking example is *Arrhenatherum avenaceum*, var. *bulbosum*, which forms long strings or bunches of these swollen stolons, whereby it propagates itself very swiftly. It is very difficult to eradicate completely, and is known to the farmer as "onion couch," one of the worst weeds of the corn-field.

The stem of a grass is botanically known as the haulm or culm, and is hollow except at the nodes. The leaf of a grass consists of the lamina or blade, which passes direct into the leaf-sheath, without any petiole, or leaf-stalk. This sheath is, as a rule, obviously split, and rolled round the stem till it overlaps. At the junction of the blade with the leaf-sheath, there is a delicate membranous growth, generally whitish, and semi-transparent, which is of the very greatest value in the identification of species: this is the ligule. It may be long or short, blunt or pointed, jagged, or even entirely absent, as in sheep's fescue. By its means, for instance, one can readily distinguish *Poa trivialis* from *P. pratensis*, which are otherwise very similar grasses. The former has a long pointed, the latter a short, blunt ligule.

The flowers of grasses always form spikelets. There may be one or more florets on a common rachis or stalk, contained within (usually) two empty glumes, but the whole forms one spikelet. Each individual floret consists of (to begin at the base) two lodicules or tiny scales, three hypogynous stamens, with large two-lobed versatile anthers dangling from the ends of the filaments, and an ovary with a feathery two-plumed stigma. Each such floret is enclosed within a pair of pales or paleæ, called the lower and upper palea, and these, again, within the pair of glumes. The genera of *Hordeum*, *Phleum*, *Agrostis* have only one perfect floret in each spikelet—*Avena*, *Dactylis*, *Briza* have two florets; *Festuca*, *Poa*, and *Lolium* have three or more.†

All our grasses have the two glumes, except *Lolium* and *Nardus*, which have only one to each spikelet. The glumes are boat-like in shape, generally with a distinct keel. This keel or midrib is occasionally prolonged into a stiff bristle or awn, but this is quite exceptional. The paleæ are also generally boat-shaped, and more delicate than the glumes. The outer pale is usually stouter than the inner, and more frequently armed with an awn, which may spring either

† In wheat there are sometimes 5 or 6 ripened florets in each spikelet, when it is known as 5 or 6 chested wheat.

from the tip or from the back of the pale. Poa, Glyceria, Melica, and several other genera have no true awn at all, while in Avena, Hordeum, Arrhenatherum it is very conspicuous indeed, and in the rare Stipa pennata the awn is feathery and nearly a foot long. It cannot be too frequently pointed out that these glumes and paleæ bear no relation whatever to the sepals and petals of an ordinary flower. The glumes are really bracts which enclose the spikelet. Similarly, the paleæ are bracteoles, which, before flowering, completely enclose the flower. It has, however, been suggested with some reason that the two little lodicules, which lie directly above the lower pale, represent the obsolete perianth. In sweet-vernal and meadow-foxtail they are entirely absent. But where present, they perform an interesting function. Their normal condition is that of two minute scales, but when the plant is about to flower, they fill with water, swell, and become fleshy, thus driving the valve-like paleæ apart. The stamens are thus released; the weight of the anthers causes the filaments to bend outwards and downwards; then the anthers open and allow the pollen to escape. At the same time, the stigmas spread out right and left between the paleæ, and are ready to receive pollen. After flowering (which only lasts from 15 minutes to 2 hours) the lodicules shrink and the paleæ consequently

close, covering up the fertilised ovule.

It is interesting to observe that in those species having no lodicules (*Anthoxanthum odoratum* and *Alopecurus pratensis*) the process of flowering is different. The paleæ scarcely open, but the stamens and stigmas protrude from a tiny opening at the tip of the spikelet. A third method is pursued by some very modest grasses, e.g., *Leersia*, whose stamens never protrude at all, and whose fertilisation is conducted privately within closed pales.

The "fruit" of a grass is a caryopsis. That is to say, it is a one-seeded, dry, indehiscent fruit, with the seed adhering to the pericarp, or ovary wall. In some genera, such as *Briza*, the paleæ remain attached to the fruit, expanding like wings, to catch the wind, and help in the dissemination of the seed. In other genera, *Holcus*, for instance, this function is performed by the glumes, which remain attached to the caryopsis, together with a small portion of the rachis, called the rachilla.

Ward remarks that "In *Stipa pennata* we have the most complex of all such adaptations: the exceedingly long awn terminating the palea is plumose at the upper end, and twisted below, and the hard, sharp rachilla at the base of the fruit is furnished with stiff, short hairs directed upwards. The plumed awn serves as a wind-surface, the whole fruit flying like an arrow through the

air. The stiff hairs below serve to fix the lower end between particles of soil, and by the alternate drying and wetting, the warping of these, and of the twisting and untwisting awn, drives the sharp base into the soil." *Stipa pennata* is an exceedingly rare grass, and I do not suppose that any of you are likely ever to find it growing wild, but it is often cultivated, and well repays botanical examination. And you may observe the driving power of the twisted awn, in *Avena* (oats); while it is known to every school-child that an ear of barley (*Hordeum*) will creep up the sleeve. This action is due to the reflexed asperities on the awns.

All grasses do not possess such elaborate contrivances to disseminate their seed. *Agrostis*, for instance, relies entirely on the wind to scatter its small, light seeds, while *Arundo* and *Aira* depend on the soft, silky hairs upon the persistent rachilla to offer a surface to the breeze, and distribute their seed far and wide.

Having thus given a very rough description of the different parts of a grass, in the course of which I have purposely avoided troubling you

WITH MANY EXCEPTIONS,

it may now be useful if I point out how all the differences in these various structures may be used to identify the different species. On finding a grass with which he

is unacquainted, the student should investigate the following points:—

- 1.—The inflorescence. This may be either a simple spike, as in rye grass; a compound spike, as in *Digitaria*; a simple panicle, as in *Festuca pratensis*; a compound panicle, as in *Festuca elatior*, *Milium effusum*, and many others; or, fifthly, a spike-like panicle, as in fox-tail, timothy, and sweet vernal. The spike, of course, has sessile, the panicle stalked, spikelets.
- 2.—Spikelets. Number of florets in each spikelet.
- 3.—Glumes. Number, and whether awned. Almost all our grasses have two glumes, but *Lolium* and *Nardus* have only one, while *Anthoxanthum* has four.
- 4.—Presence or absence of an awn on the palea. If present, its exact position there; and its shape, whether straight, or twisted as in *Avena*, or kneed as in *Arrhenatherum*.

From these characters the student should be able to identify, with the aid of a good flora, almost any grass. But grasses are not always in flower, and for his botanical knowledge to be of any practical agricultural use, it is necessary that he should be equally able to identify them at any time of the year, whether they are in flower or not. He should, therefore, carefully examine the various vegetative organs:—

- 1.—The stem or culm. Look whether it is plain, bulbous, or stoloniferous at the base; whether the internodes are straight or geniculate (kneed at the joint); smooth or downy.

- 2.—The leaf-sheath. Whether entire, split, or slit only a short way down. Whether rough or smooth (pubescent or glabrous). Colour is also a useful character, especially in winter. The red, downy leaf-sheaths of Yorkshire fog, for example, enable one to identify this grass with certainty at any time of year.
- 3.—The ligule. Whether long or short; whether pointed, jagged, or blunt. It is hardly necessary to point out minute botanical differences to enable anyone to distinguish wheat, barley, and oats. But the differences in their respective ligules form so good an object lesson that I cannot refrain from mentioning them. Wheat has a hairy ligule, not quite surrounding the culm. Oats have a smooth ligule, not quite surrounding the culm, and barley has a ligule either smooth or hairy, but so completely surrounding the culm, that its ends slightly overlap.
- 4.—The lamina, or leaf blade. Whether lanceolate, linear, or setaceous. Whether flat, or conduplicate (folded on itself.)

Let me give one

EXAMPLE OF IDENTIFICATION.

The student finds a grass with stalked spikelets in an open panicle. Examination shows that the spikelets each consist of two florets, the lower floret (that is, that nearest the stem) is perfect, but unawned. The upper floret, on the other hand, has an awn, but is imperfect, being provided with stamens only. This points to the genus *Holcus*, which consists of two rather similar species. Both are about the same

size; both flower early in July, and both frequent meadows. *H. mollis* may be known, however, by its awn being exerted beyond the glumes, while in *H. lanatus* the awn is weak, and bent over within the glumes ("included," as it is called), so as to appear at first sight as though it had no awn at all. Further, *H. mollis* is a much scarcer grass, is inclined to prefer the shady spots of meadows, is of a green colour throughout, and is of a smooth or glabrous character, except at the nodes. *H. lanatus*, on the other hand, has no objection to the full glare of the sun, and acquires in consequence a characteristic complexion of ruddiness, which renders both its inflorescence and its leaves singularly beautiful. And the whole plant is of a downy and pubescent description, that helps to render its soft, spongy herbage even more unpalatable to stock (especially to horses) than its un-nutritious quality would already warrant.

It will be seen that it is necessary that the student should attend, not only to structural differences, but also to certain, somewhat obvious, natural aids to identification. Size and colour speak for themselves. Then the time of flowering is important. Sweet vernal, as its name implies, is one of the earliest grasses, and flowers in the middle of April; soft brome in May; *Poa pratensis* and *Lolium perenne* early in

June; *Briza media*, later in the leafy month; Yorkshire fog early in July; *Molinia caerulea* about the third week in July; while the giant *Arundo Phragmites* only comes into flower in August. Of course, this period of flowering is affected by latitude and altitude, as well as by the weather. It must, therefore, not be forgotten that a grass which flowers in the first week of June in the valleys of the south of England, will not probably bloom until the third week in central Scotland, or in the mountainous parts of the north of England.

Then the habitat of grasses is of great importance to their identification. No one, of course, would expect to find an Alpine grass in a water-meadow, or a sand-binder in a beech forest. But grasses are true to their habitats to a much greater extent than this. The following are moor-grasses: — *Nardus*, *Molinia*, *Koeleria*, *Triodia*, *Aira flexuosa*, *Agrostis vulgaris*, and *Festuca ovina*. Then the following are maritime grasses:—*Anemophila*, *Triticum junceum*, *Elymus*, and *Phleum arenarium*. These have been of enormous value in binding the loose sands on the coasts of France and Holland, and may be found performing a similar useful function at many places

ON OUR OWN COAST.

Others affect woods, preferring the shade;

for instance, *Melica uniflora*, a beautiful grass, interesting as being one of the very few plants which will grow under beech-trees, and as bearing a seed of which pheasants are very fond. *Milium effusum*, whose seeds are eaten greedily by small birds; *Bromus asper* and *giganteus*, *Triticum caninum*, *Brachypodium sylvaticum*, and *Poa nemoralis*, a fine-leaved grass, whose compact growth makes it valuable for lawns and bowling-greens.

Several grasses prefer marshes and river-banks, for example, *Phalaris arundinacea*, *Arundo Phragmites*, and *Glyceria aquatica*. These are our three largest grasses. Also *G. fluitans* and *Alopecurus geniculatus* are of aquatic inclinations, and the sweet-tasted *Catabrosa aquatica*.

Another contingent is addicted to the rigorous climate of the mountain tops. Among these may be mentioned *Sesleria*, *Poa alpina*, *Phleum alpinum*, *Alopecurus alpinus*.

Some grasses thrive best on the chalk downs of the south of England—*Avena pubescens* and *flavescens*, and *Koeleria cristata*. There is a number of grasses that can only be included in the category of weeds. A weed has been defined as "a plant out of place," but these grasses are always out of place. Some of them affect good society, and thrive on the best pasturage or meadow-land, among the good

grasses. They are to be

CLASSED AS WEEDS,

because they are not readily eaten by any class of stock, or if eaten, have little nutritive value. Of such are *Briza media*, *Bromus mollis*, *racemosus*, and *sterilis*, *Agrostis vulgaris* and *canina*, *Holcus lanatus* and *mollis*, *Hordeum pratense*, and *Aira caespitosa*.

Other grass-weeds pay their unwelcome attentions rather to arable land: for example, *Avena fatua* (the wild oat), *Arrhenatherum bulbosum* (onion couch), *Alopecurus agrestis* (black bent), and *Triticum repens* (twitch or couch). One other must not be omitted, though fortunately it is not of such common occurrence as the four I have just mentioned. I mean *Lolium temulentum*, or darnel, which has the evil reputation of being the only poisonous British grass. Parnell says of it:—"This grass is found principally in cultivated fields, especially among corn, where it is a noxious weed. The seeds, it is said when eaten, produce vomiting, purging, violent colic, and death; and Linnaeus states that the seeds when mixed with bread produce but little effect, unless when eaten hot; but if malted with barley, the ale soon occasions intoxication." Lowe also mentions its poisonous properties. This dangerous grass is a good object-lesson in the value of botanical knowledge, for it

resembles very closely its congener, *Lolium italicum*, Italian rye-grass, and might be mistaken for it at first sight, even by a botanist. A closer examination, however, would show him that the poisonous darnel has the glumes markedly longer than the spikelets, while in Italian rye-grass, they are shorter.

There is another class of useless grasses, which hardly deserve to be called weeds, because they do not displace useful plants, but merely devote their attention to adorning the earth's waste-places. Hedge-rows, waysides, old quarries, railway embankments, are their homes. This company includes *Aira caryophyllea*, perhaps our most delicate, graceful species, and its kinsman, *Aira præcox*, notable as the smallest British grass. It never attains a height of over four inches, and sometimes does not exceed one inch. Then there is *Schlerochloa rigida*, an exquisite, fern-like grass, frequenting old chalk-pits in the Down districts. An old wall is the favourite haunt of *Hordeum murinum* and *Festuca myurus*, but while the barley clusters at the base, the fescue perches on the summit. *Poa annua*, like the poor, is with you always, and is the insignificant little species which constitutes so large a portion of the grass-carpet of our London parks.

An imported grass, which has apparently

come to stay, is the handsome *Phalaris canariensis*. It was introduced a long time ago from the Canary Isles, and it is still cultivated sparingly in Essex for its seed, which is the Canary seed of commerce. I cannot say I have seen it growing wild myself, but it is said to be naturalised in Nottinghamshire. Some otherwise

USELESS GRASSES

are highly valued for purposes of decoration, and last for a long time in vases, when they have been gathered before the ripening of the seed. *Stipa pennata* is cultivated expressly in gardens, and its wonderful awns make it a great favourite; so is a variety of *Phalaris arundinacea* with variegated green and white leaves. *Lagurus ovatus*, the hare's-tail grass, with its soft, downy, spike-like panicle, is very decorative. It has a curiously close superficial resemblance to the cottongrass of our moors, which is, of course, not a grass at all, but an *Eriophorum*. I am not sure that "ornamental" is the right word to apply to brilliantly-dyed specimens of the exotic *Briza maxima*; but it is quite certain that they are considered so, by the numerous householders who decorate their mantel-pieces with vases of these flaming scarlet or vivid green monstrosities. Those of quieter taste prefer the simpler beauty of our native quaking-grass in its natural russet tint; while the waving plumes of

Arundo phragmites in late autumn are at least as beautiful as those of the South American pampas-grass.

Practically all our

VALUABLE GRASSES

are perennial. Among the rare exceptions are Italian and common rye-grass, and even these may become perennial. About ten of the unimportant species are annual, the best known being *Poa annua*. It is generally easy to tell an annual from a perennial grass by examining the shoots. If all the shoots have flowering stems in them, and are evidently of the current year, the plant is annual. If any shoots have leaves only, it is perennial. The rhizome or root-stock of a perennial grass is continued by means of buds branching from the lowermost joints of the flowering shoots. It is when these buds burst through the leaf-sheaths, that they may develop as extravaginal shoots and run horizontally underground as stolons; grasses of such habit must not be confused with those which creep above ground by means of runners, like Yorkshire fog.

Certain grasses are liable to a very curious variation, known as vivipary. Ward says of this: "A curious phenomenon is observed in some

GRASSES GROWING IN HIGH LATITUDES

or mountainous regions, or in moist situa-

tions. The flowers, or even entire spikelets, grow out into minute leafy buds, with rudimentary roots at the base, and fall off like the bulbils of other monocotyledons, taking root directly in the damp soil. The phenomenon must be looked upon as a case of apogamy, since the development of sexual organs is entirely passed over—the parts which would normally have become ovary and stamens being transformed into leaves. In some species or varieties, for example, *Poa alpina*, *Festuca ovina*, this viviparous condition may co-exist with normal flowers and spikelets; in others, for example, *Poa laxa*, var. *stricta*, only the viviparous state occurs.”

I suppose it is because this district fulfils all the three conditions of high latitude, mountainous region, and moist situation, that the phenomenon is in the West Highlands of such very frequent occurrence as almost to cease to be a phenomenon at all. Also *Festuca ovina* is our dominant grass, and *Festuca ovina* is particularly liable to this variation. At any rate, you cannot inspect a score of specimens of this grass on the Cowal Hills during August or September, without coming on one or more viviparous ones. I have also in my collection a specimen, from Knockdow, of a viviparous variety of *Dactylis glomerata*, the common cock's foot: though I have not found it men-

tioned in any book that this species is liable to this extraordinary variation. Out of the hundred and odd grasses native to this country, not more than 15 are reckoned as "good" grasses—that is, of

HIGH AGRICULTURAL VALUE,

either for permanent or temporary pasture, or else for meadow-hay. These are:

- 1 *Dactylis glomerata* (cock's foot.)
- 2 *Festuca pratensis* (meadow fescue.)
- 3 *Festuca elatior* (tall fescue.)
- 4 *Phleum pratense* (timothy.)
- 5 *Alopecurus pratensis* (meadow foxtail.)
- 6 *Anthoxanthum odoratum* (sweet vernal.)
- 7 *Arrhenatherum avenaceum* (false oat grass.)
- 8 *Avena flavescens* (golden oat grass.)
- 9 *Cynosurus cristatus* (dog's tail.)
- 10 *Festuca ovina* (sheep's fescue.)
- 11 *Poa pratensis* (smooth-stalked meadow-grass.)
- 12 *Poa trivialis* (rough do.)
- 13 *Lolium italicum* (Italian ryegrass.)
- 14 *Lolium perenne* (perennial ryegrass.)
- 15 *Agrostis stolonifera* (fiorin.)

Now, of these, false oat-grass has, unhappily, not yet obtained among British agriculturists the popularity it enjoys on the Continent, while sweet vernal, smooth-stalked meadow-grass, and perennial ryegrass no longer stand where they did, and are all declining in favour owing to recent botanical research; so the list might be still further reduced to eleven.

Mr Faunce de Laune, one of the highest authorities on British grasses, stated his

opinion that "the grasses, valuable beyond all others for permanent pasture, are cock's foot, meadow fescue, and its ally tall fescue, timothy, and meadow fox-tail. These five grasses should form the bulk of all pastures on good soil, either for sheep or cattle." Now, the agricultural value of grasses depends not only on the weight per acre produced, but upon the nutritive properties of the food. The following is a rough standard. Of 100 lbs. of hay, containing 14 per cent. of water, a really good grass should contain 80 lbs. of organic matter, of which at least 9 lbs. should be albumen. Perennial rye-grass, meadow fescue, foxtail, *Poa pratensis*, have all been found to contain 10 per cent. of albumen; Italian rye-grass, cock's foot, false oat-grass, 11 per cent.; sheep's fescue, 13.7 per cent.; and dog's tail 14.3 per cent. But analyses such as these cannot be held to have universal application; and, in any case, the high nutritive value of the two last-mentioned grasses is considerably modified by the fact of their being far from prolific croppers. Take it for all in all, that is, both for pasture and meadow purposes, I should be inclined to give the palm to cock's-foot, as

BEST OF ALL THE BRITISH GRASSES.

I am quite aware of its tendency to become harsh and coarse after flowering, but against this must be set its rapid growth,

its abundant yield, its adaptability to almost any soil or climate, its nutritive quality, and, above all, its wonderful power of producing a rich, leafy, aftermath. No other grass recovers so quickly from the effects of the scythe—in fact, the more it is grazed or cut, the better it grows. A final advantage claimed for it is that it is less exhausting to the soil than rye-grass.

The two fescues, *F. elatior* and *pratensis*, mentioned by Mr de Laune, I will treat together, as they are, botanically, very closely allied. They flower quite three weeks later than cock's-foot, which is of advantage, because it is, of course, desirable that the grasses of a pasture should go on flowering in succession for as long a period as possible. For meadow-hay it is expedient that all should flower at once. The only difference between *elatior* and *pratensis* is that the former is a very much larger plant, and that its inflorescence is a compound panicle, while that of *pratensis* is simple. Both are essential for permanent pasture, on account of their tender, succulent herbage, which is much liked by cattle, and which never forms rank tufts.

TIMOTHY GRASS,

or cat's-tail (*Phleum pratense*) takes its name from a Mr Timothy Hanson, who cultivated it largely in North America about 1760. It is a very valuable grass, and gives

a very heavy crop of culms, which are more nutritious than is the case with most grasses. It is indispensable for pasture, and even for hay, though the aftermath is scanty, and very slow in "coming away." Another excellent grass is meadow fox-tail. Except the much over-rated sweet vernal, this is the earliest of all our grasses, and flowers at the end of April. It succeeds remarkably well under trees, probably because it starts growing before their leaves are out, to intercept the light. It is thus a good grass for parks. It is not harmed by late frosts. Contrary to the habits of most grasses, and the reason again probably being its early flowering, it produces a larger growth of leaves after flowering than before. It goes on increasing its yield for four years after sowing, and is therefore more suitable for permanent than for temporary pasture. Although Mr de Laune rightly does not include

SHEEP'S FESCUE

among his five best grasses, for ordinary low-ground pastures, it is undoubtedly more important than any of them to the Highland sheep-farmer. The genus *Festuca* is certainly the most difficult, from a botanical point of view, of any in the Gramineæ. Nature herself does not seem to have yet completed her labours upon it. The result is that the species run into each other

in a most puzzling manner. Botanists have as yet come to no final agreement as to what to label species, what permanent varieties, and what sub-varieties; the result is that every writer re-arranges the classification and the nomenclature to suit his individual prepossessions. *Festuca ovina* is doubtless the most difficult species of a difficult genus. It has great power of adaptability, and is consequently liable to extreme variation. Some authors recognise as many as nine or ten distinct varieties, while others sub-divide it into several species called *F. rubra*, *F. tennifolia*, *F. duriuscula*, etc. It is certainly the most catholic in its tastes of any grass we possess, and evolves a variety to suit every sort of locality. Parnell says of it, or rather of the main variety, *Festuca ovina* proper, that "it grows naturally on rather dry, sandy soils, frequently at an elevation of 4000 feet above the sea, and forms the greater part of the sheep pasture-grounds in the Highlands. It is the favourite food of sheep; they prefer it to all other grasses, for although small, it is very nutritious. Linnaeus states that sheep have no relish for heaths and hills that are destitute of this grass." And it would not be too much to say that it is by their exclusive pasturage on this excellent little vegetable that the blackfaced sheep of Scotland and the small Welsh mountain sheep produce mutton of that fine

flavour, which is so much appreciated at the dinner table.

Fiorin (*Agrostis alba*, var. *stolonifera*) is a grass whose merits have been rather tardily recognised. I mentioned it before as a typical instance of the stoloniferous habit or growth, that is the production of long trailing underground shoots, such as those of the strawberry. Now, these shoots are produced during the autumn and winter months, and afford a welcome little crop of herbage, when other grasses are dormant. It therefore extends the period of productiveness of a pasture; and it thrives on any soils that are not too dry. It is a true permanent variety of *Agrostis alba*, which is a tufted grass and propagates itself by seed. *Stolonifera*, on the other hand, has come to rely for reproduction upon its stolons alone, and its seed seems to be infertile. In order to propagate it, the best method is to chop up the stolons, and scatter them over the pasture. It is distinguished from *Agrostis vulgaris* by its long, pointed ligule.

I will not weary you by taking you at length through the other pasture-grasses, but it would be wrong to omit the rye-grasses, so important in alternate husbandry.

ITALIAN RYE-GRASS

(*Lolium italicum*) is, as its name implies, not a native British grass. It was intro-

duced in the reign of King William IV., from Lombardy, by Mr Charles Lawson, the celebrated Edinburgh seedsman, and has proved an invaluable addition to our native grasses. It is a very heavy cropper, and on sewage-farms as many as five cuts have been obtained from it in a single season, while it occasionally attains a height of 4, 5, and even 6 feet. As it has now been cultivated continuously in this country for seventy years, and may occasionally be found growing wild, it may fairly claim to be a naturalised British subject. Only within the last few years, however, has it been fully recognised how very superior this biennial is to our native species, perennial rye-grass, alike in nutritive value, earliness, productiveness, and rapidity of the growth of its aftermath. These great advantages render it probable that, in spite of its seed costing threepence a pound as against $2\frac{1}{2}d$ for that of "perennial," "Italian" will gradually altogether supersede its poorer rival, from which it is distinguished botanically by its awned florets.

About 15 to 20 years ago, there was a keen controversy as to whether common rye-grass was actually entitled to its name of "perennial," and whether, therefore, it were really a useful plant for

PERMANENT PASTURE.

Mr Faunce de Laune attacked it. Dr. Fream, on the other hand, asserted that

it was perennial, and constituted from 50 per cent. to 75 per cent. of every famous English pasture. It is now, however, pretty well established that it is an annual grass, which may become perennial, and that it deteriorates rapidly, both in quantity and quality after the first year. In forming new pastures, therefore, it is advisable to sow grasses more certain in duration, more productive even at first, and less liable to fall off afterwards, than *Lolium perenne*. For one year's pasture and meadow, a bushel of Italian rye-grass is often sown per acre with no other admixture than that of 14 lbs. of red clover. But if the crop is intended to hold the land for two or three years, it is advisable to reduce the quantity of rye-grass somewhat, and add 4 lbs. each of cock's-foot, timothy, and tall fescue.

For permanent pasture a good mixture is the following:—7 lbs. of meadow fescue, 6 of cock's-foot, 4 each of tall fescue, timothy, and Italian rye-grass, 3 each of fox-tail and rough-stalked meadow grass—that is, 31 lbs. per acre of the seeds of seven different grasses, with 2 lbs. each of red, white, and alsike clover, and $\frac{1}{2}$ lb. of yarrow. The object of the rye-grass and red clover is to get a good crop in the first year, after which they will diminish as the others increase their yield.

I do not intend to discuss the thorny

question of whether the ordinary Scottish method of winning hay is that best calculated to conserve the natural nutriment contained in the grasses, but certainly one of the

COMMONEST FAULTS IN FARMING

in the West of Scotland is, that during the summer many a low-ground pasture or park is stocked with about half the number of sheep or cattle that it ought to carry. The idea is, I suppose, to leave grass for the autumn and winter. But this is quite a mistake. The closer a pasture is cropped, the faster the grass will grow, and not only will the total yield be actually greater in the long run, but the grass will be both better and sweeter. But if the park is under-stocked, the beasts will naturally select the best grasses, and the worst grasses will be left untouched to seed themselves; and, so reinforced, will encroach every year more and more upon their nutritious rivals. In the West of Scotland Yorkshire fog and the worthless Bent (*Agrostis*) very rapidly

DISPLACE GOOD GRASSES,

unless the whole pasture is kept close-cropped during the summer months. And, not only this, but even some GOOD grasses are apt to become very rank if left long after flowering. Cock's-foot, for instance, forms great harsh tufts, or tussocks, of

coarse, unpalatable herbage. In Denmark, the difficulty is overcome by tethering all cattle on pasture, by which means the herbage is kept evenly and closely cropped. If, however, the farmer's reason for understocking is that he has not enough sheep or cattle to graze the whole field properly, it would be far better to divide it with a temporary fence or with hurdles; graze one half thoroughly, and, with regard to the other half, either mow it or let it stand, for then, at anyrate, the inferior grasses would gain no undue predominance. Indeed, it is by no means bad agricultural practice to let the grass on a permanent pasture occasionally stand till the winter. It re-seeds the pasture, it exterminates moss, and the herbage forms a winter fodder which is not to be despised. Arthur Young, who wrote at the end of the eighteenth century, mentions this practice, which is still largely in vogue in South Wales, where it is termed "fogging" the land. An interesting observation, bearing somewhat on what I have been saying, I find on record in the "Statistical Account for Scotland," published in 1793. It is remarked by the Rev. Hugh MacTavish, minister of Inverchaolain, that "the rage for sheep-stocks has banished the practice of rearing black cattle, though some judicious farmers think a few on the hills along with the sheep would pasture on those

grasses which the sheep do not like, and which are otherwise entirely lost." There is much sound theory in this observation, but in practice I do not think that it would hold good, at any rate so far as grasses are concerned, for the reason that there is on the hill pastures practically only one grass — sheep's fescue—which is palatable either to sheep or to cattle. Black cattle would therefore be more likely to compete with sheep for the fescue, than to eat other grasses. Sheep's fescue has an immensely strong, natural growth on these hill pastures, and is therefore in a different position from the more or less artificial growth of good grasses on the low-ground pastures of which I have been speaking, and it is probably this that has enabled it to hold its own against Aira, Molinia, Agrostis, and other valueless moor-grasses. But certainly Mr MacTavish's observation would be true as regards bracken. Unless black cattle or horses are introduced to eat down the young bracken-shoots in early summer, or some very drastic measures adopted to war against it, it certainly looks as though this plant would succeed, within a measurable space of time, in absolutely ousting both sheep's fescue and heather from our hill pastures.

Some interesting experiments are now being conducted under the auspices of the West of Scotland Agricultural College with

a view to discover how those poor, rough, high-lying pastures, which are sometimes called "white lands," may be economically improved by the application of manures, and the feeding on of cake. One of these experiments is being conducted on the farm of Auchenskeoch, near Tighnabruaich. Basic slag, burnt lime, sulphate of potash, and superphosphates, are the fertilisers being used, and the by-fodder is undecorticated cotton cake. It has, of course, long been recognised that, on the whole,

PHOSPHATIC MANURES ARE THE BEST

for improving pasture, and that of these basic slag has been the most economical and effective. On light soils potassic manures (as kainit and sulphate of potash) are good, as improving the quality of the herbage, and developing leguminous plants. Lime and common salt have not usually been effective; and nitrate of soda actually does considerable damage, for though it increases the bulk considerably the first year, it makes the pasture coarser, and afterwards the increase of bulk is lost, while the coarseness remains.

Another method of improving poor pasture is to scarify the turf with a toothed harrow, top dress, and sow on 12 or 14 lbs. of the best permanent pasture seeds, and then roll the surface well. I myself believe this method to be the best, for it is

obviously futile to apply costly fertilisers to a pasture composed only of worthless grasses. Basic slag will increase the yield either of good grasses or of bad ones. But it will not convert poor species into nutritive species. The philosopher's stone itself, if applied as a top-dressing, would not turn *Aira flexuosa* into *Festuca ovina*. Nor will basic slag cause nutritive grasses to grow, except where their seeds are present.

Far too little attention is generally bestowed on the treatment of permanent pasture. An immense amount of nutriment is annually removed from the soil in the form of beef and mutton, yet it is but rarely that anything is returned to it, either by the feeding-on of cake, or the application of artificial manures. And yet the pasture is expected to maintain its fertility! It is indisputable that a good dressing of 10 cwt. of basic slag per acre, every four or five years would be both beneficial to the pasture, and profitable to the farmer.

If I am not becoming too agricultural, I should like to refer very briefly to the practice of "long-term pasture, short-term tillage," which is being so ably advocated by Mr R. H. Elliot. The term almost explains itself, and means laying down land to pasture for from four to six years, during which period sufficient fertility is stored up by the agency of

DEEP-ROOTING PLANTS

for a very successful four-year arable rotation, after which the process is repeated. The deep-rooting plants recommended by Mr Elliot are chicory and burnet, and he adds to his mixture of grass-seeds 3 lbs. of the former and 8 lbs. of the latter. Both plants yield very valuable fodder themselves, especially burnet, which has the admirable quality of remaining green, and growing throughout the winter. The main object, however, of including them is that their deep roots may so till and aerate the subsoil, and so manure it with decaying vegetable matter, that the application of chemical fertilisers becomes superfluous, except with the turnip crops, which are taken in the first and third years of the rotation. Mr Elliot's little book "Agricultural Changes, and Laying Down Land to Grass" (Rutherford, Kelso), only costs 2s 6d, and should be in the hands of every farmer.

In no department has the botanist rendered greater service to the agriculturist than in the improvement of species. Sufficient proof of this assertion is to be found in the world-famous achievements of Messrs Garton of Warrington, in the hybridisation of wheat, which has enabled them to produce varieties with an enlarged grain and a stiffened straw. The botanist can also give important assistance in connection with

GRASS SEEDS.

He can tell him whether samples of the "seeds" which he intends sowing, either for a temporary ley, or for permanent pasture are pure and of good quality; or whether the seedsmen have either neglected to separate from them the seeds of useless grasses, or have purposely adulterated them with foreign substances. He must also verify the seedsman's "guaranteed percentage of germination," as the germinative power of seeds bears a direct ratio to their value. Much of the work of identification of grasses requires to be done with the assistance of a good hand-lens or magnifying glass, and this is especially true in connection with the identification of their caryopses, or "seeds," as they are commercially called. It is, of course, impossible to do more than to glance at this part of the subject at this hour of the night. But a knowledge of it is indispensable, if the student intends to make his botany of any value in practical application. I will give one instance—the seed of the valuable *Alopecurus pratensis*. The "seed" here consists of the two glumes, connate below and hairy on the keel and ribs, enclosing the caryopsis enveloped in the single palea with a dorsal awn. The whole "seed" is comparatively large—5 millimetres in length—and if really ripe should be of a greyish-brown colour, but it is

frequently collected unripe by

UNSCRUPULOUS "SEEDSMEN"

in order to obtain a heavier crop, as the ripened fruits easily fall off and are lost. Naturally the seed gathered unripe has less germinating power, but it can be told by its beautiful silvery lustre, which it loses on reaching maturity. This seed is frequently adulterated with the seed of its congener, *Alopecurus agrestis*, the worthless "black bent." This seed can be distinguished by its glumes, which are smoother, harder, and broader than in *pratensis*, and their edges appear to the naked eye to be quite free from hairs. It is also adulterated with the seeds of *Aircaespitosa* (which is much smaller and has hairs only on the rachilla), and of *Holcus lanatus* (which is easily distinguished, as the "seed" consists of the glumes enclosing the generic two-flowered spikelet, with the upper floret, only, awned).

In conclusion, perhaps a few words on the bibliography of the grasses. There is a considerable amount of

LITERATURE ON THE SUBJECT,

some of it very highly specialised. I shall content myself with mentioning a few of the books which I myself have found most useful, and which I can therefore confidently recommend to the intending student. First of all in importance comes Parnell's

monumental work, "The Grasses of Scotland," published in 1842, and supplemented three years later by his "Grasses of Britain." Parnell is incomparable alike in the accuracy of his botanical descriptions, the wonderful interest he infuses into his account of the history and habits of each grass, and in the beauty and value of his engravings of the grasses, and of their spikelets. This book is now unfortunately very scarce, and a good copy cannot readily be obtained. Lowe's "British Grasses" is also good in its way, and those who like to be able to recognise their grasses from a coloured picture rather than work them out from a "flora," will find it a remarkably good guinea's worth. It was published by Bell of London in 1871. Sir Joseph Hooker's "Flora" is always useful to the botanist. And for field work, there is nothing to equal Hayward's "Botanist's Pocket-book," though as regards grasses, too little attention is directed to the leaves, culms, etc., as opposed to the inflorescence. No one studying grasses from the agricultural point of view can afford to be without Stebler and Schröter's "Best Forage Plants," of which the English translation was published by Nutt of London in 1889. The authors are the directors of the Seed Control Station of Zurich, Switzerland, where extremely valuable and accurate scientific investigations are conducted. The

book I have mentioned contains monographs upon all the more important grasses, containing all conceivable information. Lastly, I should like to mention an admirable little book, which I have quoted several times to-night. It was issued last year by the Cambridge University Press. It is by Professor Ward, is entitled merely "Grasses," and costs, I think, only six shillings. It is packed with useful matter, but is perhaps more suited to the advanced botanist than to the beginner.

A WORD OF ADVICE

before I sit down. I should recommend everyone studying grasses to make a collection of them. Not only will he have the dried specimens always by him for reference, but in searching for the grasses in their natural habitats, he will learn much about them that mere book-knowledge or study of someone else's specimens can never teach. It adds enormously to the interest of a country walk; it is very little trouble, and practically no expense. Personally, I have always found common blotting-paper to be far preferable for drying specimens than the so-called "botanical drying-papers." In like manner, two or three bricks are quite as effective as the most elaborate drying-press. Out of the 105 British species mentioned in "Hayward," I succeeded during the summer of 1888, in collecting 65,

within the radius of a long walk of the Downton College of Agriculture. That being situated in a river-valley between the Downs and the New Forest, is an extraordinarily favourable locality for the botanist, as there are practically three distinct flora. One single field in the water-meadows, I remember, produced twenty-four different species. But although this northern latitude is not so prodigal, in some respects, of botanical treasures, yet I have no doubt that careful research would reveal at least 55 or 60 species in the island of Bute.

I had last summer the honour of opening a flower show at Millport. I was delighted to observe that a prize was given for the best collection of grasses by school-children. And some very nice collections there were, tied up into bouquets, or arranged upon cardboard. Only one thing was wanting—that the specimens should be named. If it is your pleasure, ladies and gentlemen, I shall be very happy to mark this occasion by placing at the disposal of the Bute Botanical Society, a copy of Lowe's "British Grasses," to be competed for at the forthcoming annual Rothesay Flower Show by the schoolchildren of Bute, the prize to be awarded to the exhibitor of the best collection of named grasses found in this island.







