BRITISH GRASSES

BUCKMAN.

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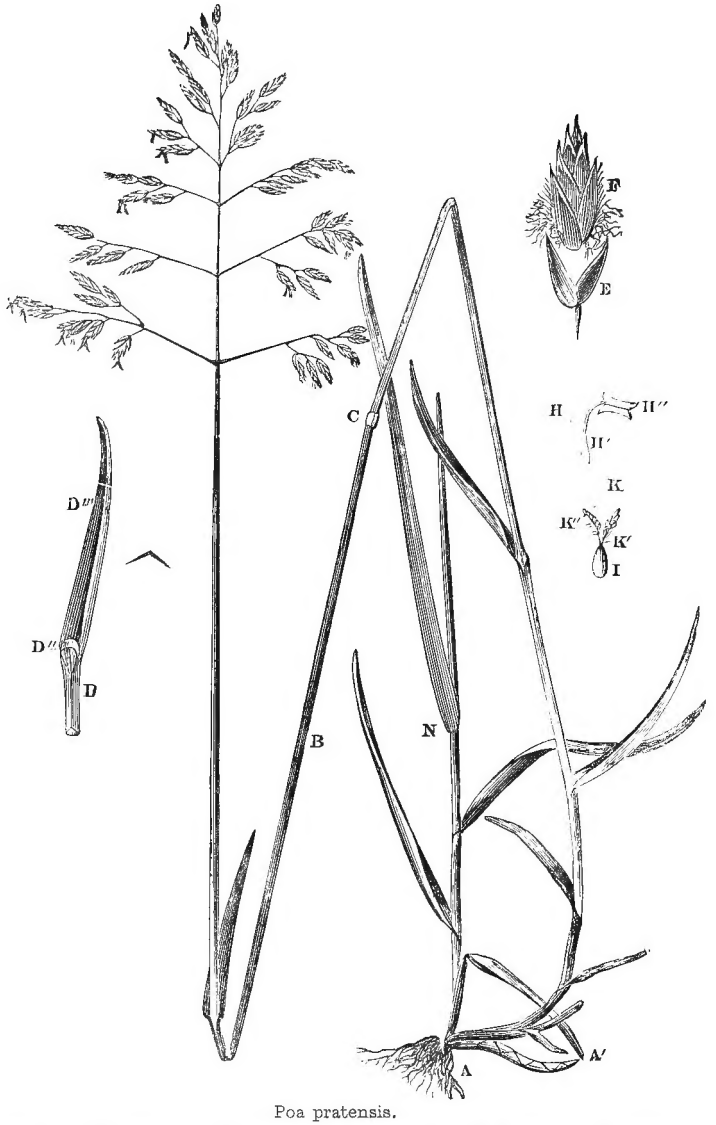

Poa pratensis.

A. Fibres.
A'. Rhizome.
B. Culm.
Joint.
C. Node
D'. Sheath.
D''. Ligule.
D'''. Blade.
E. Glumes.
F. Glumels.
H. Pollen.
H'. Filament.
H''. Anther.
I. Seeds.
K'. Style.
K''. Stigma.
N. Barren Shoot.

THE

NATURAL HISTORY

OF

BRITISH MEADOW AND PASTURE GRASSES,

WITH AN ACCOUNT OF THEIR

ECONOMY AND AGRICULTURAL INDICATIONS.

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PREFACE.

THE following pages, it is hoped, may contain such information upon the useful tribe of plants to which they refer as may be of use in directing a larger share of attention to the subject of meadows.

The notes herein contained are mostly the result of direct observation and attention to individual species, both in their wild state and in cultivation, to which has been added Notes upon the Agricultural qualities or indications of the species commented upon.

As regards descriptions of species, it must be confessed that, after all, these can seldom be rendered quite intelligible without specimens or drawings; but as this little volume is meant principally as an indicator of the value of a study of Grasses to the Agricultural Student and the observant Farmer, it is hoped that specimens will be collected by them, and such drawings made of them when in a fresh state, as may assist in this interesting study.

The Author has made portraits of nearly all British species, from which his observations are mainly drawn; and for examples of some of the rarer ones he tenders his best thanks to H. C. WATSON, Esq.: he also confesses his obligations to the Council of the Royal Agricultural Society, for their permission to use the two drawings with which the book is now illustrated, as well as the matter which formed part of a series of papers to the Society's Journal by

THE AUTHOR.

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Chapter I.

NATURAL HISTORY OF BRITISH GRASSES.

The importance to the agriculturist of a knowledge of the pasture or meadow grasses which are everywhere found in our fields is now so generally recognised that little need be said to enforce its value, especially when it is considered how much of the land of this country is still in natural pasture, and even that under tillage may at some time or another be required to be laid down in pasture of a permanent form, or be employed from time to time in the cultivation of grasses as a shifting crop. But however much a knowledge of this useful tribe of plants may have been desired by the student, yet he has been mostly repelled from its pursuit by the difficulties ever attendant upon distinguishing genera and species of large vegetable families, without which little progress can be made; and this is the more felt, the more natural the groups and the closer their affinities, and more especially so in the grasses, as the whole tribe is a highly natural one, the same principles of structure prevailing in all; so that distinctive characters have to be sought for in the differences presented by minute details: the more obvious parts, as leaves, have the same uniform type in all the species—they may be longer, narrower, broader, smooth, rough, hairy, and the like, but they have ever the same general outline; but if we compare the leaves of another family of plants, as, for example, the *Leguminosæ*, or Pea tribe—also a very natural group—these show at a glance the broad distinctive characters of *bifoliate*, *trifoliate*, *pinnate*, and others, all of which point to differences readily apprehended by even the most casual observation in the field, and, as a consequence, greatly lessen the labour of

studying descriptions in the different botanical and agricultural works devoted to them.

But again, the facts above glanced at show that it is almost impossible to study the grasses with that celerity requisite to engage the attention of the non-botanical inquirer without engravings of many of the species; and this, in the form in which it has hitherto been done, renders works upon them too expensive for general use, and even when obtained they will be found rather to present botanical than agricultural matter; these, however, have to a considerable extent been admirably combined in *Sinclair's Graminea Woburnensis*. But as in the present day additional knowledge has been obtained upon grasses, the combined results of experiments and observations by the cultivator, the chemist, and the botanist, it seems desirable to claim attention for some notes upon the subject in a manner which may come the more immediately before the eye of the intelligent farmer and the general student; and in the accomplishment of this object it is intended to offer a series of notices having reference to the following subjects:—

1. General observations on the Natural History of Grasses.

2. The Structure and Anatomy of Grasses, and the Classification founded thereon.

3. Descriptions of Genera and Species, with notices of their qualities and distribution.

1. *General Observations on the Natural History of the British Grasses.*—Grasses, as they appear over the surface of the globe, naturally divide themselves into two sections —*Cereal* or cultivated corn-grasses, and *Natural* or wild grasses.

Now, the first do not appear to grow anywhere as wild plants, but may in all cases be deemed as *derivatives* obtained from wild examples by cultivation through a long series of years, and hence the varieties—not species—which will be found to abound in all of them. These variations maintain a great permanency of form if the circumstances

of cultivation be strictly maintained, but left to themselves they would either die out altogether, or revert once again to some original wild type.

The natural grasses, which it is the object of these papers to illustrate, may, for convenience, be divided into the following groups :—

1. *Jungle*, or Bush Grasses.
2. *Aquatic*, or Water Grasses.
3. *Marine*, or Seaside Grasses.
4. *Meadow*, or Pasture Grasses.
5. *Agrarian*, or fallow Grasses.

1. *Jungle grasses* are those which for the most part have a tendency to grow in a distinctive and separate manner, assuming in some tropical examples, where they reach their maximum, the height of 50 or 60 feet, presenting more the aspect of trees than the lowly herbs of our northern species.

In our own country, though we fall far short in size, yet many of our species have the same disposition of growing in distinct bunches, having no inclination to form a matted turf, but mix with shrubs, or grow as separate plants beneath tall trees, or maintain a distinctive form even in meadows. Of these the following may be appealed to as examples :—

Aira cæspitosa—Turfy hair-grass (hassock-grass of farmers).

Avena pratensis—Narrow-leaved oat-grass.

Brachipodium pinnatum—Heath false brome-grass.

„ *sylvaticum*—Slender false brome-grass.

Elymus Europæus—Wood lyme-grass.

Festuca elatior—Tall fescue-grass.

There are other grasses which, if cultivated by themselves, assume the same distinctive, and even cushion form of growth, as

*Festuca ovina**—Sheep's fescue.

* This is almost the only grass which will grow beneath the tall beech groves of the Cotteswolds, though never in a matted turf, but always in distinct *hassocks*. It grows the same in my experimental plot in the Botanical Garden of the Royal Agricultural College.

Festuca duriuscula—Hard fescue.
Dactylis glomerata—Cocksfoot.

These always grow in tufts when sown thin for permanent pasture, if the land be poor, but is soon prevented by depasturing, bush, or fine-tine harrowing and rolling: these operations take away all mosses and dying grasses which have a tendency to rot, and thus form a humus soil around the roots—a circumstance prejudicial to the growth of good turf. Rolling presses the whole together, and makes the soil firmer, a matter of great consequence in maintaining a pasture. Indeed, fertilizers and mechanical processes may be looked upon as the means which, after all, keep meadows in the form we now see them; as in truly wild nature, there would be a greater tendency to a distinctive mode of growth than to the formation of a matted turf, as even simply depasturing supplies to a considerable extent, all the requisites I have adverted to, as necessary for the prevention of the jungle mode of growth, in many even of our meadow grasses.

2. *Aquatic or Water Grasses* are those which elect to grow by the margins of rivers, in brooks and ditches, or around the edges of ponds. These are not very numerous, nor are they generally of any agricultural value; at the same time, as they may sometimes be seen, especially in summer, without the contiguity of surface water, they afford excellent indications of a swampy and wet soil; and as some of them prefer stagnant water, when they occur in ditches, or in the open meadow, these should at once inform us that our drainage is imperfect, and point to the necessity of draining if not previously done, or if already drained to the cleaning out of ditches, and looking more particularly to their levels. The following are amongst some of our more common water-grasses:—

Arundo Phragmites—Common reed.
Phalaris arundinacea—Reed canary-grass.
Glyceria aquatica (Poa)—Reed meadow-grass.
Poa fluitans—Floating meadow-grass.

Catabrosa aquatica—Water whorl-grass.
Alopecurus geniculatus—Floating foxtail-grass.
Molinia cærulea (Melica)—Purple melic-grass.
Aira cæspitosa—Hassock-grass.

Of these, the four first mostly grow in water. The first, however, frequently occurs in damp meadows, especially in their hedge-rows; the four last may be found on oozy mud banks, thus often directing to a watershed or *spring*. The two last more especially affect furrows, and the neighbourhood of a defective drain.

3. *Marine or Sea-side Grasses.*—Under this head we may just glance at a list of grasses which particularly affect the sea-coast; the contiguity of salt-water, and banks of sand or marine mud, being requisite for their growth in a natural state. Of these, the following may serve as examples:—

Ammophila arundinacea—Sea-reed or matweed.
Elymus arenarius—Upright sea-lyme-grass.
Spartina stricta—Twin-spiked cord-grass.
„ *alternifolia*—Many-spiked cord-grass.
Poa procumbens—Procumbent sea meadow-grass.

Marine grasses are for the most part exceedingly harsh, so that cattle cannot eat them; but some of them have their uses in keeping together the loose sands of the sea-shore. This they do by their creeping *rhizome** (underground stem), which, running in every direction, forms a thick matting in the sand. It is on this account that the two first of the above-named are carefully preserved, not only on our own shores, but those of Holland, as a good natural safeguard against the encroachments of the sea.

4. *Meadow Grasses.*—By far the greater number of our British grasses may be arranged under this head. They are those which supply us with the hay store, as also pasture for cattle; and as pastures occur over the country under the widely differing circumstances of *climate, eleva-*

* A specimen of the rhizome (erroneously called the root) of Ammophila arundinacea, upwards of 30 feet in length, was communicated to me by my friend and pupil, Mr. George Maw.

tion, soil, and modes of farming, a due and attentive study of the tribe should, upon examination of a district, enable us to arrive at facts with regard to the nature and value of any tract of ground with almost as much certainty as though we had resided upon the soil for some time, and had drawn our conclusions from what is called "practical experience;" and yet after all, though one is termed "scientific" and the other "practical," they are equally the results of observation, and both constitute knowledge of a practical kind.

But besides this, it becomes necessary to study the meadow-grasses, in order to enable us to bring about those changes which may result in the amelioration of property, and as we know the influence exercised by the circumstances just noted, so we may be enabled to decide as to the kinds of grasses to use in such cases as the laying down of new pastures; and the method of ameliorative, or other culture to be adopted in that which already exists. Indeed this is just as important in farming, unless it be empirical, as the understanding the anatomy of the animal frame before attempting to prescribe for its treatment under the many conditions in which it may be placed.

Now, in order to enforce this argument, it will be well to glance at the distribution of our more common meadow-grasses under the following heads:—

a. Upland pastures, thin soils.

b. Poor stiff soils, "hungry clays."

c. Rich deep loams.

d. Meadows on the banks of rivers subject to periodical floods.

e. Irrigated meadows, in which the water can be entirely controlled.

In the Table (p. 10), therefore, are arranged twenty species; in it the first and second columns are devoted to the botanical and trivial names of the grasses tabulated. The columns, 3, 4, 5, 6, and 7, have reference to their distribution, the figures in these columns representing the *propor-*

tionals of each species in their respective situations; and as this latter point is one which is exceedingly difficult to ascertain with perfect exactitude, it may be stated that the results have been arrived at by long observation and great pains-taking; and if only approximating to truth, they will equally serve the object now in view, namely, that of showing the preference of some grasses for one set of circumstances before another.

The facts noted in the Table are mostly derived from observations made in the upland or Cotteswold district, and the vale or lowland part of Gloucestershire, and, therefore, not perhaps strictly true for all parts of England; yet I do not doubt but that they are correct as to their more general principles.

Now, from this Table we learn that the kinds of soils noted have not only diferent species of grasses, but when the same do occur in lands of an opposite character, they are mostly very much altered in their proportionals.

The differences between good, as compared with bad pastures, are in many cases the result of attention and good cultivation. Let us, for instance, suppose a poor clay ameliorated. We must not then expect that its list of grasses will remain the same, or in the same proportions as are here tabulated; on the contrary bad grasses, which are ever present to a greater or less extent in every pasture, will nearly all die out, or if not so they greatly improve in quality, whilst many good ones, of which scarcely an example could be found before, rapidly increase.

And, again, the many herbaceous plants distinct from grasses—such as *Plantago media*, broad-leafed plantain; *Bellis perennis*, common daisy; and *Ranunculus bulbosus*, bulbous crowfoot; and many others—give place to a growth of grasses.

This may be the more particularly observed in lands set apart for irrigation, as in such cases the changes are often very rapid; hence observations of these cases are very instructive. Take the following example of a meadow in the

TABLE I.—*Showing the Relative Growth of Grasses in different Situations.*

1. Botanical Name.	2. Trivial Name.	PROPORTIONAL. 3. Upland Pastures, thin Soils.	4. Poor Clays.	5. Rich Loams.	6. Flooded Meadows.	7. Irrigated Meadows.	REMARKS.
1. Alopecurus pratensis	Meadow foxtail... ...	...	1	2	2	3	Very variable in growth, increasing rapidly as the soil becomes better.
2. Phleum pratense ...	Timothy grass	...	2	2	1	2	In poor land only about 9 in. high, 2 feet in good soil.
3. Agrostis stolonifera	Marsh bent	2	...	...	1	2	Occurs in all poor uplands, where it is generally refused by cattle. Spreads rapidly under irrigation, when it becomes a good grass.
4. Arrhenatherum avenaceum.	Oatlike grass	...	3	1	...	...	Never abundant, except in poor soils either of clays or sands.
5. Poa pratensis ...	Field meadow-grass ..	1	1	2	1	3	In most meadows.
6. ,, trivialis ...	Roughish meadow-gras.	...	...	...	2	1	Increases quickly in stagnant meadows; decreases under perfect irrigation.
7. Briza media ...	Quaking-grass	1	2	...	...	...	Only in poor soils.
8. Avena pubescens ...	Soft oat-grass	1	...	1	1	1	Tolerably constant in meadows.
9. ,, flavescens ...	Yellow oat-grass ...	...	...	1	1	2	Most abundant in good soils.
10. ,, pratensis...	Narrow leaved oat-gras.	1	2	...	...	...	Often abundant in poor heathy land.
11. Holcus lanatus ...	Meadow soft-grass ...	1	1	...	2	...	Increases rapidly in stagnant or marshy meadows, not usual in good pastures.
12. Festuca ovina ...	Sheep's fescue	4	..	...	...	...	Almost entirely an upland grass.
13. ,, duriuscula	Hard fescue	2	1	1	...	1	Also an upland form, but occurs more or less in most places.
14. ,, rubra (var.)	Creeping fescue... ...	...	...	2	...	...	A form, though not frequent, in rich meadows; also in sandy pastures near the sea.
15. ,, pratensis ...	Meadow fescue	...	...	2	1	1	Abounds in good pastures.
16. ,, loliacea ...	Spiked fescue	...	...	1	2	2	Very fine in floods way, on the banks of the Isis, at Oxford, and on the Churn, near Cirencester.
17. Bromus erectus ...	Upright brome-grass ...	1	...	...	...	...	Belongs peculiarly to calcareous uplands.
18. Dactylis glomerata	Cocksfoot.grass	...	1	2	3	3	Of general occurrence; increases rapidly in good soils.
19. Hordeum pratense	Field barley-grass ...	1	1	2	2	2	Often in patches in the richer parts of uplands. Very abundant in the hay fields, in the valley of the Churn.
20. Lolium perenne ...	Perennial rye-grass ...	1	1	3	2	2	In most pastures. In uplands it seldom attains to 6 in. high; it is double that in good deep pastures.
Amount of hay per acre	Average	...	10	15	25	30 to 40	
Rent per acre	Average	10	15	25	30	40 to 100	

neighbourhood of Cirencester, a part of which is now under irrigation.

The meadow observed upon is one on the banks of the Churn, and from its slope only half of it could be covered with water. It has a subsoil of oolitic gravel, so that although vale land, its produce was that of a thin upland pasture. How much it has changed will be seen from the annexed Table, which is designed to supply information on the following points:—

1. The names of the grasses observed.
2. The proportions of these observed in the meadow before irrigation.*
3. The changes effected in two years.
4. Those on the fourth year.

TABLE II.

Representing the Changes of Grasses under Irrigation.

Botanical Names.	Trivial Names.	Proportionals.		
		Before Irrigation.	After 2 years' Irrigation.	After 4 years' Irrigation.
Alopecurus pratensis	Meadow foxtail-grass	1	2	4
Poa pratensis	Field meadow-grass..	2	3	4
„ trivialis	Roughish meadow-grs	1	2	1
Briza media	Quaking-grass	2	..	..
Cynosurus cristatus	Dogstail-grass	2	1	..
Aira cæspitosa ..	Hassock-grass	1	..	..
Agrostis stolonifera	Marsh bent grass ..	1	2	3
Dactylis glomerata..	Cocksfoot-grass.. ..	1	2	3
Avena flavescens ..	Yellow oat-grass ..	2	3	3
„ pubescens ..	Soft oat-grass	1	1	1
Hordeum pratense ..	Meadow barley-grass	1	2	2
Lolium perenne ..	Perennial rye-grass ..	2	4	6

This field has trebled in value in four years.

This Table shows us that all the better grasses have increased, if we except the *Poa trivialis* and *Hordeum pratense*, in which cases there has been an increase in grasses

* The whole meadow is now improved, as it has been much depastured: and cattle have ranged the unirrigated as well as the irrigated portion: thus irrigating half a meadow tends to improve the whole.

not possessing the best character. Now, with respect to the first of these, it should be noted that though it increased rapidly up till the third year, it is now declining. This is explained on the supposition that the drainage of the irrigated part was at first imperfect, and the water was consequently left in a partially stagnant state: this is often the case with such meadows on their first formation, but ultimately the water conduits become better managed, and they act more perfectly. And again, these changes become more evident where there is a gravelly subsoil: stiff clays, without a stratum of lighter matter, seldom succeed so well under irrigation.

So much, therefore, for the changes which take place in the grasses: now if we take into consideration the same set of facts, as presented by herbs of other families, the alteration is still more striking, as attested by the following Table:—

TABLE III.

Representing the changes of Herbs found with the Grasses.

Botanical Names.	Trivial Names.	Proportionals.		
		Before Irrigation.	After 2 years' Irrigation.	After 4 years' Irrigation.
Ranunculus acris ..	Upright meadow crowfoot	1	3	1
,, bulbosus	Bulbous crowfoot .. .	3	1	..
Plantago lanceolata	Narrow-leaved plantain	3	1	1
,, media ..	Broad-leaved plantain ..	3	..	..
Trifolium repens ..	Dutch clover	2	..	..
,, pratense ..	Broad clover	1	2	2
Anthriscus vulgaris	Common beaked parsley	1	2	1

Now this Table points out the important fact that large and innutritious herbs in pasture are destroyed by irrigation, and the previous one makes it clear that their places are supplied by the grasses. However, the beaked parsley sometimes increases at first, and though it soon gets less, it is not entirely eradicated without pulling; this should be done, as it takes up much room, and is of little use itself.

Docks, too, such as *Rumex crispus* (curled dock), and *Rumex pratensis* (meadow dock), often greatly increase by irrigation; these, however, are soon destroyed, and if not allowed to seed give but little trouble.

5. *Agrarian Grasses* are more properly those which occur in land under tillage; they are not a large list, nevertheless they will be found worthy careful study, as all of them are weeds and many of them great pests. Some, as the couch grasses, are troublesome, for their creeping *underground* stems as well as growth of herbage. The wild oat occupies the ground with a larger plant than the cereal with which it usually grows, whilst others are sure indicators of a low state of fertility, and often of bad farming. The following is a list of the Agrarian Grasses:—

Avena fatua—Wild oat.
„ *strigosa*—Bristle-pointed oat.
Alopecurus agrestis—Slender foxtail-grass.
Bromus mollis—Soft brome-grass.
„ *secalinus*—Smooth rye brome-grass.
„ *sterilis*—Barren brome-grass.
Lolium tremulentum—Bearded darnel.
Poa trivialis—Roughish meadow-grass.
„ *annua*—Annual meadow-grass.
„ *compressa*—Flat-stemmed creeping meadow-grass.
Triticum repens—Couch-grass.
Agrostis stolonifera—Creeping bent-grass.

Of these, the most mischievous—for all are weeds in arable—are the couch tribe. These the farmer knows well how to cope with, and as this is the case, it is somewhat surprising that there is so much couch to be got rid of everywhere; this too often arises from the work being behind-hand, in which case the seed has often to be sown before the land is clean, and with couch a blade left here and there is quite sufficient to spread over a field in a short time.

In the Cotteswold district, where all three of the creeping grasses are in abundance, a distinction is made in them

by the farmer. For instance the *Triticum repens* is called *Couch (cooch)*, whilst the *Agrostis stolonifera*, and *Poa compressa*, are indifferently named *Squitch*, or small couch. The two latter are held in such detestation by the farmer, that it is not at all uncommon to hear him say that he would rather have "fine healthy couch to deal with," meaning *T. repens*, "than the nasty benty squitch."

The *Alopecurus agrestis* is well known by the name of "black bent," and is sometimes a very troublesome weed, more especially in stiff infertile clays. The Lias Shales, in the Vale of Gloucester, where unameliorated by drifts, are often full of it. The Forest Marble on the higher Cotteswolds has also a great abundance. It is in all cases an evidence of poor plastic soil, and soon disappears with draining and good tillage.

The *Avena fatua* is very common in the stiff lias clays in the Vale of Gloucester, and it is curious that an objection urged by the Vale farmer against the sowing of oats, is that, in his opinion, the scattered grain degenerates into wild oats. This is a question I shall not discuss at present, but that wild oats should be dreaded is not wonderful, as in some instances they completely smother the intended crop, growing higher than wheat; and as they shed their seeds before the wheat is ripe, a continued succession is maintained. However, even wild oats soon disappear under good tillage and judicious cropping.

The *Lolium temulentum* (darnel) is the only other species that need now be commented upon. This grass has large seeds, which are reputed to possess highly intoxicating properties, but as it occurs in such small quantities, I have had no opportunities of testing these qualities, but from the nature of the case I incline to think that their effects have been much overrated.

Having now dwelt upon the natural history of grasses as they occur in the more wild state, it seems proper to note that some of them are cultivated as *shifting crops*, and come in in a regular course of *rotation;* and though up to the

present time only a few sorts have been so employed, yet it seems desirable so study the habits of grasses more carefully, with a view of increasing this list. For though a number of plants—not grasses—are cultivated as "seeds" or "artificial grasses," it is quite unnecessary to remark that these are altogether distinct from the true grasses. Of the latter, only one species is used to any extent in seeds, namely, the *Lolium perenne* (perennial rye-grass). Of this there are several varieties derived from cultivation, the best of which is the *Italian Rye Grass*. Now these two varieties, namely, *Lolium perenne* (common rye-grass), and *Lolium perenne, var. Italicum* (Italian rye-grass), possess highly valuable properties; they yield nutritive food, and have an upright mode of growth, so that, while adding greatly to the weight of the hay, they interfere less than most other species with the surrounding herbage; but as they are now universally grown from cultivated seeds, there is in them a tendency to changes which are not for the better. This may be shown by attention to the habits of the *Lolium perenne*. In wild nature we see that this grass is entirely perennial in habit, hence, in depasturing its green herbage, it stools out very considerably; in cultivation, however, it grows straight, upright, coarser culms, which when flowered are cut down for hay. It then has a less tendency to "tiller," or "stool," and much consequently dies for the want of living shoots to keep up its vitality. Now this is a tendency that increases, and must increase, until this plant becomes more of an annual than a perennial, and indeed in some districts it is even at present next to impossible to get a crop the second year. This, however, may in a great measure be prevented by early cutting of the grass when for hay, and here it is proper to remark that there can be no greater injury done to a grass crop, whether *natural* or *artificial*, than the letting it get too ripe before cutting.

In all herbaceous vegetation, there is the tendency to die wholly, or in part, on the production of seed. Thus annuals

die at once when they have attained the end of their growth, namely, seed for the reproduction of their species; and in many of them their duration of life can be delayed for an indefinite period by preventing this consummation: thus I have made the annual *Reseda odorata* (mignonette), by constantly pulling off its flowerbuds, grow for three years, and assume the form of a woody plant, dying, however, on the fourth year, on their being allowed to seed.

In October, 1849, I planted a patch of wheat in one of my experimental plots of five yards square; this I kept constantly cut down during the summer of 1850, and it stood the winter of 1850-51, and became a tolerable crop in the summer of 1851, though much of it had died in the mean time. Oats and barley treated the same quite died out.

Now, these experiments show, that not allowing seeding in due season has a tendency to prolong the duration of life of plants; it is upon this principle in depasturing, that our meadows maintain their position, as continuous patches of herbage. Constant haymaking would inevitably promote the dying out of good grasses, and this the more readily the older the grass be before being cut, so that in all cases it is the greatest possible mistake not to make hay early. Otherwise what is gained in quantity is mostly prejudiced in quality, and the after consequences are always unfavourable, circumstances arising not solely from the impoverishing of the soil.

The Italian rye-grass will be found to throw out more barren shoots in cultivation than the common form, and this renders it a valuable *variety:* indeed, varieties—not merely species—of all agricultural plants should be carefully attended to, as derivative specimens always alter their properties in the course of years. By some it is thought that new forms take the place of old ones in estimation, merely from fashion and caprice, but I am inclined to think that they are more generally resorted to from the necessity of trying something else, because of the previous failure of the old sorts, which is ever the case, even with careful

change of seed, in course of time. The Italian rye is comparatively new: and though it is perhaps not so great a favourite as it was in some districts, yet it may be worth a trial in most cases where the common rye-grass has been kept up in the rotation for an ofttimes repeated series.

It was with these facts in view that I was induced to experiment on a few grasses which I thought might be serviceable for seed-crops, and in 1849 I tried patches of the following: —

1. *Anthoxanthum odoratum*—Sweet vernal grass.
2. *Alopecurus pratensis*—Meadow foxtail.
3. *Phleum pratense*—Timothy grass.
4. *Dactylis glomerata*—Cocksfoot grass; and by the side of these, by way of comparison—
5. *Lolium perenne*—Perennial rye-grass.
6. „ „ *var. Italicum*—Italian rye-grass.

My plots are on a band of stiff marl, resting on the *great oolite freestone*, and are never manured: the grasses are cut down yearly, and thus the following observations upon them made this summer may be of interest in this part of the inquiry:—

This year, 1853, all of them were cut with the scythe in July, at which time No. 1 had seeded: at present it is rapidly dying out as it has but few barren shoots.

Nos. 2, 3, and 4 stooled well, and increased in culms and barren shoots from year to year: they increase in quantity, and all of them have even sent up many culms for a second crop, and all show a large quantity of *aftermath*.

Nos. 5 and 6 have nearly disappeared.

We see from these data that, in as far as yield and permanency are concerned, Nos, 2, 3, and 4 may be used advantageously: No. 2 is considerably earlier than 3 and 4, which in some cases may be much in its favour. From these circumstances I am induced to think that these grasses would be well worthy a trial on a greater scale than has yet been accorded them in artificial pastures.

Diseases of Grasses.—Under this head it seems desirable

to point out some of those affections of a fungoid form to which grasses seem more particularly liable: those which more commonly attack cereals have been explained before the Society by Mr. Sydney in his usual felicitous manner, under the names of *Red Robin*, *Mildew*, *Smut*, and *Bunt*, with others of this class, all of which are more or less common to the grass tribe in general, though perhaps not to so great an extent in the wild grasses as in the cereals.

The smut *(Uredo segetum)* is constantly found attacking the grass-flowers, but oftener, perhaps, on the flowers of *Arrhenatherum avenaceum* than on any other species. I have seen whole patches of this grass covered with the black efflorescence of the fungus; here, however, as the object is not grain, it produces but little mischief, though the attacked grass is always stunted in its growth.

The greatest mischief done by fungi to grasses is that occasioned by the agaric, or mushroom tribe; and more especially by those which form the circles in meadows, known as fairy rings. These often make a turf look very dissightly; and though it has been said that they manure the grass, as evidenced from the circle of greener grass where they have decayed, yet we must remember that this ring of green is always surrounded by another of brown withered herbage, consisting of nearly dead grasses; and, indeed, it is in the decay of these that the phosphatic salts which Professor Way has shown to exist so abundantly in this tribe of fungi are supplied.

It may be here stated, that the fungus upon which the Professor experimented, and upon which his paper was founded, is the *Agaricus prunulus*, a plant which is abundant in all poor upland pastures in Gloucestershire, and consequently the fairy-rings which are formed by them are at all seasons of the year a good criterion of the value of a field. This fungus is remarkable for growing in the month of May, on which account it can be distinguished from its congeners, as other fairy-ring agarics do not appear until the autumn, and then frequently in the same rings as those

Uredo segetum on Arrhenatherum avenaceum.

a. The smutted flowers. *b*. The spores of the fungus magnified 200 diameters.

of the *A. prunulus*. This plant is worthy of notice, as furnishing a delicious article of food; I think far superior to our mushroom: indeed, this is the French "*Mousseron*," from which our name has been derived; and attached to the *Agaricus campestris*, and according to Dr. Badham, it is the favourite species all over the Continent; and to show the esteem in which it is held in Italy, the learned Doctor says that little baskets of it are sent as presents to lawyers, and fees to medical men, &c.*

The physiology of the growth of fungi in the grasses on which they feed is a curious question, and one which it would take too long to discuss here; suffice it to explain that it is easily prevented, as whatever tends to improve the pasture soon destroys the rings; thus on a field in front of the Royal Agricultural College, where in about eight acres were as many as seventy rings, was applied some years since, a dressing of bones and guano, and the fungus crop was for a time nearly destroyed.

Fairy-ring agarics are great pests in lawns, arising from the grass being impoverished by constant cutting: these and mosses are soon kept under by a fine-toothed rake, and using guano highly diluted with sand or fine ashes, or watering with guano water. This treatment will make the grass coarser for a time; but in many cases it is a question of treatment of this description, or the destruction of the turf altogether.

It now remains to point out a disease to which all kinds of grass seem liable, both the cereals and those of the meadow, namely the *Secale cornutum* (ergot of rye); this, until recently, was supposed to be a fungus, but closer examination has shown that the ergot is an altered condition of the seed of the grass; still ergot itself is liable to be attacked by a fungus, which has been named *Ergotetia*.

Ergot has long been known as prevailing to a considerable extent in the rye of the Continent; and it is principally from this corn that the ergot of rye used in medicine has

* See Dr. Badham's book on Esculent Funguses.

been obtained, and the terrific effects of its presence in rye-bread have been pointed out by various medical authors. Amongst other diseases incidental to its prolonged use, even in small quantities, is that of *Gangrene*: its more immediate operation upon gravid animals appears to be the procuring of abortion; and as one of the grasses in which it occurs in great quantity is the *Lolium perenne* (rye grass), a prevailing grass in all good pastures, it often becomes a matter of great importance to look well to a meadow in autumn before turning in cows. Some years since, the late Earl Ducie suffered considerably from the dropping of the calves of some of his most valuable stock. At this time a quantity of ergotized rye-grass was gathered in the field where these accidents took place; and from the report given me of the general state of the meadow, I have little doubt but that this diseased grass was the cause of the accidents which occurred.

The quantity of ergot in some low damp meadows is quite astonishing; however, it is lessened by good draining. Uplands are much less affected: in the Cotteswold district the bands of oolitic clays are often clearly made out by the quantity of ergotized grass.

I have gathered ergot from almost every species of grass; but it occurs to a very inconsiderable extent in other grasses of the pasture—the *Poa fluitans*, a water grass, and *Bromus asper*, perhaps are next to the rye-grass; but these, from their quality and position, can have no effect of a baneful kind.

Chapter II.

THE STRUCTURE AND ARRANGEMENT OF BRITISH GRASSES.

In giving descriptions of grasses, it may be well to set out with the acknowledgment that these plants form an exceedingly natural group, which at once supposes that, although they have such differences that species can be recognised by careful analysis, they have yet such agreement in common that the most casual observation is usually sufficient to determine one of the family to be a "grass," or at least to enable us to refer it to the *Graminaceæ*, as the natural order of plants to which it belongs.

Here, then, we see that there must be a great similarity of parts in species of grasses, and, as these parts are often minute, it follows that in order to understand descriptions so as to enable us to distinguish one species from another, or to *analyse* them, great care must first be taken to master the minute distinctive characters which such parts may present. This done, the student of grasses may soon know them tolerably well, whereas, if neglected, he may attain to the knowledge of *names*, but it will only be in a traditionary manner, and therefore with a constant liability to error, according as his informer is well or ill acquainted with his subject.

This Chapter is intended to illustrate the following subjects:—

1st. An account of the structure of grasses; and

2nd. To offer a system of classification or arrangement dependent thereupon.

1. *Structure of Grasses.*—In grasses we meet with the following parts, all of which, though tolerably constant in

form in individuals of each species, yet in their variations *in species* make up the sum of those distinctive characters which enable the botanist to separate one species from another. Such are—

The Root, or descending axis, consisting of root-fibres and rhizome.

Culm, or ascending axis, consisting of stem, with its nodes and joints.

Leaves, the appendages of the axis, consisting of sheath, ligule, lamina.

Flowers, or *reproductive organs*, consisting of floral envelopes, stamens, and pistils.

Seeds, or *Fruit*, consisting of grains of various forms and sizes.

The roots of grasses usually consist of small fibres, which, in starting from the seed, burst through the radicle, or seed-root, like the inner valve of a telescope from the outer; this, which is called by botanists *Endorhizal*, from two Greek words signifying *within a sheath*, may be well observed in the germination of such large grasses as are presented in the cereals, as wheat, barley, &c. Roots are sometimes hard and wiry, especially in such species as grow in damp and boggy places; whilst in others they are exceedingly flexile, the main roots often creeping great distances in search of food, and then branching off into innumerable *fibrils*, or *rootlets*, the ends of which, consisting of the newest cells or growth, form the *spongioles*, or suckers, by which nutriment is taken from the soil into the plant system. It is hence necessary, in the cultivation of grasses, that the soil for the reception of the seed should be of good *tilth*, and especially that its mechanical consistency should be such as that it will not greatly expand in moisture, and so push the plants out of place,—or crack in drought, in which case the rootlets, or active parts in life and increase, are broken away just at the period when they are most required. Roots are without buds, from which it will be seen that all the parts of a grass which grow beneath the

surface are not always true roots, such, for instance, as the runners in the common couch *(Triticum repens)*. These receive the name of *Rhizome*, or underground stems, and it is by means of these that the couch tribe of grasses so quickly spread from a common and small centre into large patches; as, though they creep for a considerable distance, yet their points ultimately rise to the surface and then expand new leaves, and, in fact, form distinct and perfect individuals, which, if separated from the parent, all the more rapidly give rise to independent colonies, and indeed these scions do as their parent did before them.

Several species of grasses have this tendency, and consequently when it occurs it forms a good distinctive character. Hence though the *Triticum repens* has a rhizome, the *T. caninum* is only furnished with a fibrous root; some of the *Poas*, as *Poa pratensis* and *P. compressa*, have rhizomes, whilst *Poa annua* and *P. trivialis* are without any tendency to a creeping habit of growth.

Agriculturally it is necessary to distinguish the different forms of couch, as the species of one district may be absent from another; and as even the rhizome will vary in being large or small, so will its eradication much depend upon its difference in form and habit. However, we shall hereafter see that several species of grass become useful from this very structure in keeping together banks of sea-coast, canals and the like; and it is a matter worthy of serious consideration and careful experiment whether they could not be made available in consolidating the slopes of railway cuttings, which give so much trouble and cause such constant yearly outlay on some lines.

Culm—Stem.—The stems of grasses are usually hollow *(fistular)*, to which, however, the *Molinia cærulea* (purple molinia) of wet places offers an exception in its solid stem. It is rounded, except in *Poa compressa* (flat-stemmed meadow-grass), in which the trivial name has been given from the oval form on a transverse section, as though it had been subject to compression.

The stem is separated into long or short lengths, called *joints*, by the intervention of *nodes* (knots), which are solid and tend much to strengthen the structure of the plant, to which end they will be found to be closer at the base, where the strain would be greatest on account of these light plants swaying forwards and backwards in the wind, and more remote upwards in the culm, from which are suspended the newer and more active leaves.

Stems may vary in being quite *smooth*, *ribbed*, armed with hairs—which may be long or short—*bristly* or *downy*, in proportion as this kind of *armature* may be *coarse* or *harsh*, or *fine* and *soft*.

The nodes again may be of a different colour from the culm, or, like it, may be smooth or armed in a similar manner.

The leaves consist of the following parts:—

The sheath, = *petiole*, or leaf-stalk of other plants.

The ligule, or tongue.

The lamina, = blade, or flat part of the leaf.

The sheath is the footstalk of the leaf. This takes its rise from the nodes, one from each, arranged on alternate sides of the culm. The whole length of the sheath, which is variable, is folded around the culm, from which it can be loosened by unwinding without fracture, a circumstance which serves to distinguish the grasses from the sedges (*Carex*), as the sheath of the latter is a continuous tube, in which the solid and often triangular culm is *inserted*, not folded. This is a distinctive character of great importance to observe, inasmuch as grasses and sedges are outwardly much alike—indeed some species of the latter are called *Carnation Grass*—but greatly different in quality; grasses being for the most part highly nutritious plants, whilst sedges are not only usually innutritious, but, from the harshness of their herbage, are often a source of injury and annoyance to the creatures that from starvation are sometimes doomed to eat of them.

The blade—lamina—is the expanded part of the leaf. It

is sometimes large and drooping, as in the larger or flag-like grasses, but occasionally it is very minute, especially when compared with the sheath, as in the *Avena pubescens* (soft oat-grass). In some species the blade is long and the sheath short. The blade is traversed by longitudinal parallel lines, which are called the *leaf-veins* or *nervures:* these may be *broad, narrow, rigid, soft, armed with rough hairs,* and so on, all of which are not only points of distinction in species, but aid in making up the sum of those differences which will ever be found in good and bad pasture grasses: as, for instance, grasses in which the herbage is covered with long downy hairs are mostly poor and innutritious in quality; on the other hand those of a harsh and rigid structure, with serrated leaves, whose edges act as a saw and whose flat blades perform the office of a file, even if nutritious, would nevertheless be refused by cattle on account of their mechanical inconvenience.

The ligule.—At the point where the sheath ends and the blade begins occurs a thin and usually white semi-transparent membrane, termed the *ligule,* or tongue. This, as it varies so much in size and form, will be frequently referred to in diagnosis by some such terms as the following:—

Short, in *Poa pratensis,* smooth-stalked meadow-grass.

Pointed, in *Poa trivialis,* rough-stalked ditto.

Notched, in *Bromus mollis,* soft brome or lop grass.

In pairs, in *Ammophila arundinacea,* common sea-reed.

Its value as a distinctive character may be drawn from an examination of *Poa pratensis* and *P. trivialis,* as it assists at a glance to distinguish two grasses, much alike in appearance, though very distinct in habit and general properties.

The use which this part of the leaf subserves would appear to be that of more securely fastening the upper part of the sheath to the culm, as without it the wind would tear the leaves downwards, in which case their functions would become much disturbed, and they would soon wither and die. The flower in grasses consists of the elements of an

entire plant, each bunch or *locusta* of flowers being but a grass in minature, consisting of a central axis or stem with its alternately arranged leaves, the stamens, pistils, and seeds in the axils of which are but buds; this fact may at once be seen in *viviparous* specimens, such as are often found in the *Lolium perenne* (perennial rye-grass) and *Cynosurus cristatus* (crested dog's-tail), in which, instead of flowers, we have complete buds, which we have indeed detached and grown as distinct plants of their respective species.

Now, in these examples the case is very different from that of germination in the ear which takes place in laid and damp wheat, as in the latter the seeds have been perfected, and germination takes place from heat and moisture in the usual manner; but in *viviparous growth* the envelopes and their organs, instead of growing seeds on the principle of arrested development, go on growing into branches, and no seed is consequently perfected.

Flowers consist of the following parts:—

Glume = outer chaff-scales
Glumel = inner chaff-scales
} Floral envelopes.

Stamens
Pistils
} Fertilizing organs.

Seeds = grain = reproductive organs.

Floral envelopes, upon the theory just enunciated, consist of metamorphosed leaves; they are arranged in pairs, and *each* scale starts from an opposite side of the central axis, but not from the same point. The outer pair subserves the same use as the *calyx* in other plants, and receives the name of *calyx-glume*; the inner pair, or pairs—for sometimes several occur in a single glume—is termed *glumel*, and the pieces of which either are formed obtain the name of valves, the lower one being the outer and the upper one the inner of each respectively.

The glumes differ in shape, and in the presence or absence of longitudinal lines or *ribs;* it may be large enough to *include* or *conceal* the *glumel*, or it may be considerably

smaller than the latter. Again, the outer and inner valve may vary in size and shape, and, indeed, present many differences which will be explained in simple language in the descriptions of species.

The glumel,—*corolla*, is subject to like differences in form and proportions, facts which can only be well explained with a specimen in one's hand; and it should not be forgotten that in grasses we have to deal with plants which, though simple in their structure, present such minute differences that the eye must become by use accustomed to examine and trace them, and as so many characters are necessarily derived from such important organs as the flowers, which are often small, even a pocket lens will frequently be required to assist the ordinary vision.*

The glumel is often found to be armed by a projecting spine or beard; this is of greater or less length, and is termed the *awn*,† and may be well observed in bearded wheat and in both wild and cultivated barleys. This organ, when long and stiff, and armed as it is sometimes with projecting *spiculæ*, renders grasses where they occur exceedingly objectionable, especially for hay, though the grass may be good if kept from flowering by constant depasturing; such are the species of *Hordeum* (wild barley).

The fertilizing organs consist of the stamens; which possess the following parts:—

a. The filament, or thread which supports
b. The anther, or case in which is secreted
c. The pollen, or fecundating dust.

The filament, by reason of its length, may cause the anther to be *exserted* or standing out from the flower, or from its shortness to be *inserted* or included in its valves, the anther may be varied in its colour as follows:—‡

* For this purpose a lens of ordinary power will suffice, such as may be purchased at the optician's for about 9*d*.

† The awn, when present, may represent the blade of a leaf, whilst the glume and glumel are the representatives of the sheath.

‡ The colour differs much in the same species, some being more liable to variation than others.

Colourless, *Poa annua*, annual meadow-grass.
Flesh colour, *Phleum pratense*, Timothy grass.
Rose in *Alopecurus pratensis*, meadow foxtail.
Purple in *Aira cæspitosa*, hassock grass.
Yellow, *Bromus mollis*, soft brome, and most grasses.
Orange, *Bromus erectus*, upright brome.

The pollen is usually of a light straw colour, but as it cannot be well examined without a tolerably good microscope, and even then would offer but doubtful specific characters, it need not be further mentioned here. In our British species of grasses we find three stamens, with but very few exceptions, to each floret, and hence grasses belong to the Linnæan class *Triandria*.

The *Pistil* consists of a style, which is in one or as it were split into two parts, each surmounted by a *stigma* either pointed or feathery; they are mostly very pale in colour, but occasionally highly tinted. As our British grasses, with but one exception in *Nardus stricta*, heath grass, possess two *stigmata*, so they belong to the Linnæan order *Digynia*.

Seeds are sometimes loose in the chaff-scales, as in the wheat; in others the glumel is adherent, as in barley;—a circumstance which may explain how readily wheat grain is shed when "dead ripe," as the attachment of the seeds to the chaff-scales is much less firm than that of the flower to the flower-stalk: these facts fully justify the process of reaping, as involving more care, for the former, and of the rougher method of mowing for the latter; this, however, is now calculated as a matter of expense, and not one of mere waste.

For the sake of perspicuity the following resumé of parts is added, which should be studied with a grass in flower:—

Root.....	Fibres	...The true root fibres.
	Rhizome.	.Creeping underground stem.
Stem	Culm	....The whole aboveground stem.
	Joint	....A single length from node to node.
	Node	....The hard knot between the joints.

- Leaf
  - Sheath . . . The folding portion of a leaf.
  - Ligule . . . The tongue of the leaf.
  - Blade . . . . The lamina, or free part of leaf.
- Floral Envelopes
  - Glumes . . The outer chaff-scales, in pairs.
  - Glumels . . The inner chaff-scales, ditto.
- Fertilizing Organs.
  - Stamen . . .
    - Filament . The thread supporting the anther.
    - Anther . . . The pouch containing the pollen.
    - Pollen . . . The fertilizing dust.
  - Pistil . . . . .
    - Style . . . . The support of the stigma.
    - Stigma . . . The receptacle for the pollen.
- Seeds . . . . The reproductive organ.

A barren shoot . . . . A flowerless branch.

Inflorescence—Thus far we have described the separate parts of the structure of grasses; we have now to point out the terms used to designate these in aggregation, which will be briefly considered under the following heads:—

a. *Herbage*, that is the leaf portion, principally concerned in pasture.

b. *Culms*, or parts which grow upright, and make up so much of the bulk and weight of hay.

c. *Heads of flowers*, the various forms which they assume.

a. The quality of grasses depends so much upon the quantity and physical character of the herbage, that for agricultural purposes these should always be noted with great care; hence, if for hay, both bulk and quality is much influenced by luxuriant leafage, a character in which grasses will be found to differ in a remarkable degree; if however this be rough and unpalatable, that is, the "sour grass" of the farmer, no matter how great its quantity, such should be discouraged. Again, if for depasturing, it will be necessary to note such facts as *longevity*, and how the species succeeds in sending up herbage under continual mutilation by feeding off.

Most grass meadows are sometimes mown for hay and then depastured in the shape of *aftermath*, whilst in some years no hay crop is taken, so that it is necessary to encourage the growth of all such species as will be found

adapted to our soil, and will there yield us the best return in both hay and herbage. Connected with this part of the subject we must not omit *duration;* as for permanent pasture *perennial grasses* are absolutely necessary, annual species having nothing to recommend them.

b. The *Culms* of grasses, whether *hard* and *wiry*, or soft and pliable, *bitter* or *saccharine*, *scanty* or *abundant*, should also receive attention, as hay, both in quality and bulk, will much depend upon these circumstances.

c. Heads of flowers.—These are aggregated from single *locustæ*, spikelets, or smaller bunches or bundles of flowers which may vary in the following manner:—

a. A single glumel to each pair of glume-valves.

b. Two glumels and sets of flowers to a pair of glumes.

c. Three or more glumels to each pair of glume-valves.

Each flower, or *locusta* of flowers, as *b* and *c* would be termed, may be attached to the stem in various ways:

a. On short upright footstalks (pedicels), in which the flowers unite into a compact head, called a *spike* —example, Foxtail grasses.

b. On longer upright footstalks (pedicels) forming an upright panicle, as in Bromus mollis, soft brome.

c. On long and flexile footstalks (pedicels) a drooping panicle, as *Bromus asper*, rough-stalked brome.

2. *Classification.*—In a large group of plants, like the grasses, their study necessitates their arrangement into smaller groups or bundles in order to facilitate their analysis, to which end various characters, more or less minute, have been dwelt upon by different authors. We here choose the method of arrangement that appears to us as the most simple, making use of the foregoing descriptions and terminology as our guide.

A.—STAMENS, 2. STYLES, 2.

1. *Anthoxanthum*—panicle spicate.
2. *Hierochloe*—panicle lax.

B.—STAMENS, 3. STYLE, 1.

3. Nardus—spike unilateral.

C.—Stamens, 3. Styles, 2.

* *Spikelets single flowered.*

† *Flowers spiked.*

4. *Leersia*—glumes absent.
5. *Alopecurus*—spicate, glumes connected at the base, spike compact.
6. *Phleum*—spicate, glumes distinct, spike compact.
7. *Ammophila*—spicate, glumes pointed, with a tuft of hairs at the base, spike compact.
8. *Lagurus*—spicate, glumes with long bristly points, spike short and compact.
9. *Phalaris*—spicate, glumes broad, glistening seeds, smooth, spike less compact.
10. —*Gastridium*—spicate, glumes swelling at the base, spike less compact.
11. —*Polypogon*—spicate, outer glume awned, spike less compact.

†† Flowers paniculate, more or less lax.

12. *Milium*—panicle spreading, glumes herbaceous.
13. *Stipa*—panicle erect, glumes coming out to a fine point, inner glumel with an awn ten times the length of the flower.
14. *Calamagrostis*—panicle loose, glumes surrounded by silky hairs.
15. *Agrostis*—panicle loose, glumes lancet-shaped, nearly equal.

††† Flowers spicate, arranged on two sides.

16. *Rottbolia*—spikelets alternate, glumes equal.

†††† Spikelets arranged unilaterally.

17. *Spartina*—spikelets unilateral, glumes unequal.
18. *Cynodon*—spikelets in alternate pairs on one side, glumes very unequal.
19. *Digitaria*—spikes branched, spikelets alternate on one side, glumes very unequal.

** Spikelets with one or two perfect florets, sometimes with one or additional florets, which are imperfect.

†† Fertile flowers, one; imperfect flowers, one or two.

20. *Setaria*—panicle spicate, flowers surrounded by bristles.
21. *Panicum*—panicle spicate, spike-branched glumels, with short hairs.
22. *Molinia*—panicle contracted but not spicate, glumes acute.
23. *Melica*—panicle lax, glumes rounded.
24. *Catabrosa*—panicle spreading, glumes obtuse
25. *Aira*—panicle spreading, glumes unequal in size.
26. *Triodia*—panicle of few *locustæ*, which are large and tumid.
27. *Holcus*—panicle lax, florets soft, with downy hairs.

28. *Arrhenatherum*—panicle lax, glumes and glumels with bifid or notched points.
29. *Sesleria*—panicle spicate, glumes with trifid, glumels with bifid points.
30. *Cynosurus*—panicle spicate, flowers hidden in a comb-like shield, *involucre* of botanists.

*** Spikelets (*locusta*), with three or more perfect flowers.

† Spikelets forming bilateral spikes.

31. *Elymus*—spikelets (*l.*) in twos or threes, both valves of the glumes on one side of the spikelet.
32. *Hordeum*—spikelets (*l.*) in threes, of which only the central one is perfect.
33. *Triticum*—spikelets (*l.*) alternate on the *central axis* (*rachis*), glumes transverse to it.
34. *Brachipodium*—spikelets (*l.*) alternate on the central axis (*rachis*), glumes transverse to it.
35. *Lolium*—spikelets (*l.*) alternate, not transverse, each with a single glume.
36. *Glyceria*—panicle slightly branched, outer glumel with 5-7 strong ribs.

†† Flowers paniculate, panicle more or less *lax*.

37. *Poa*—panicle lax, glumes unequal valves, the inner glumel notched at the extremity.
38. *Briza*—panicle lax, glumes equal, tumid.
39. *Dactylis*—panicle somewhat compact, glumes pointed, glumels awnless.
40. *Festuca*—panicle lax, glumes finely pointed, glumel with a short awn.
41. *Bromus*—panicle lax, glumes more or less rounded, outer glumel with a long awn, inner one edged with fine hairs.
42. *Avena*—panicle more or less lax, glumes thin, transparent membrane, glumels adherent to the seed.
43. *Phragmites*—panicle more or less compact, glumes and glumels finely pointed, the latter very unequal.

Now, in the foregoing Table, we have arranged 43 genera, which will be found to include about 125 species. Of these however only about 20 genera, containing not more than 40 species, will be found to possess any particular interest in an agricultural point of view; only these therefore will be fully described in the next Chapter, and their properties and capabilities pointed out, whilst sufficient reference will be made to the remaining species to enable the student to refer them to their proper places.

Chapter III.

THE AGRICULTURAL ECONOMY OF BRITISH GRASSES.

The following description of meadow grasses is meant to apply for the most part to such species as are of importance to the farmer, from making up a part of the ordinary pasture in different soils and situations; at the same time remarks will not be wanting on those species which either from their bad qualities as pasture grasses may be considered as pastoral weeds, or from occurring to a considerable extent under tillage may be denominated agrarian weeds.

As regards the relative value of the pasture grasses, there must always be some difference of opinion, arising from difference of soil, climate, and other external causes, which certainly exercise great influence, and cause a wide diversity of result. We can therefore only say, on behalf of our own observations, that they are the result of many years' study of this useful tribe of plants, which we have pursued not only as a botanist, but as thoroughly alive to their agricultural bearing and importance. Not only have we carried on this study in the field, but have also kept most of the species in cultivation for many years, and made them the subjects of practical experiments in reference to their growth, yield, and some of the chemical details connected with them.

It should be remarked that this Book has not been burdened with descriptions of all the grasses, as many of them, though curious in a botanical point of view, are yet without agricultural interest, and their consideration would have too greatly increased the length.

REFERENCES.—A refers to an *annual* grass, or such as dies when it has produced its first crop of flowers.
B, *biennial*, such as flower two years, and then die.
P, *perennial*, such as flower for several years.

A.—STAMENS, 2. STYLES, 2.

ANTHOXANTHUM—*panicle* spicate, *glumes* unequal, *glumel* double, outer one with short awns.—P.

A. odoratum—sweet vernal grass—is the only agricultural species in this division; it is a very early grass, being one of the first to flower, and is well known for its peculiar fragrant odour, which is more apparent in the dried than in the green specimens: it is the presence of this grass which imparts most of the grateful smell and flavour to meadow-hay, and which in all probability renders it not only more palatable but also more nutritious than "seeds" or artificial hay.

Its bulk is small, so that it adds but little weight to the rick, and its short leaves are incapable of affording much *aftermath;* still its fragrance entitles it to a place in all mixtures of grasses in laying down permanent pasture.

B.—STAMENS, 3. STYLE, 1.

NARDUS—*glume* absent, *glumel* of two valves, *spike* unilateral.—P.

N. stricta—heath grass—occurs on damp heaths or marshy places, and is readily distinguished by its slender unilateral spike with flowers all pointing one way. Of no agricultural value, except as indicating the nature of its soil.

C.—STAMENS, 3. STYLES, 2.

† *Flowers spiked.*

ALOPECURUS—*glumes* nearly equal, united at the base; *glumel* of a single valve, awned from below; *spike* compact.

1. *A. pratensis*—meadow foxtail—spike cylindrical, blunt at the apex, about 2 inches in length.—P.

2. *A. agrestis*—taper foxtail—spike cylindrical, pointed at the apex, from 2 to 3 inches long.—A.

3. *A. geniculatus*—floating foxtail—spike cylindrical, blunt at the apex, about half the size of A. pratensis.—P.

The Alopecurus pratensis is a common native grass, especially in moist meadows and in deep rich pastures, for which situations it is admirably adapted, as it yields a large proportion of hay and a quick growth of aftermath; it should always form part of the grass for irrigated meadows, as it is very early and bears cropping well, sending up culms and a plentiful supply of herbage for the second or hay crop, after the first depasturing by sheep.

As a grass for self-cultivation, it may be stated that it grows fast even on a medium soil and in exposed situations, and its upright habit would point it out as no bad species to mix with rye-grass in "seeds," whilst in laying down land for permanent pasture it should always take a place with other grasses.

The Alopecurus agrestis is sometimes called the *black-bent*, at others *hunger-weed*, terms expressive of the low estimation in which it is held, and the poor agrarian land in which it delights to grow. Sinclair says, "the appearance of the black-bent among wheat is a certain sign that the crop will be worthless." It is seldom found in the open meadow, but is mostly an accompaniment of strong heavy land which has been badly tilled and is much out of condition; its presence therefore denotes a want of drainage and liberal manuring, which treatment, as we have frequently witnessed, will eradicate it even in a single season.

A. geniculatus is here noted as a denizen of wet places, where, if cattle can get at it, they invariably keep it well cropped down. In some situations it appears in a stunted condition, apparently on dry soil, but this is only after drought, as, if it be not surrounded by water for a great part of the year, it soon dies out; under such circumstances, therefore, it is an indicator of some value.

PHLEUM—*spike* compact, *glumes* distinct, *glumel* of two equal awnless valves.

P. pratense—timothy or catstail grass—glumes equal, much truncated, with long produced points, each valve ciliated with a row of stiff hairs on the back.—P.

This grass, under the name of catstail, is a common native, found everywhere in tolerably good pastures. It has been introduced among most others of our British pasture grasses to the American continent, where it appears to have attracted the attention of one Mr. Timothy Hanson, who probably first brought it out as a self-grass, in which cultivated form it has become associated with his Christian name; and hence the idea that some entertain that we got the species from America is erroneous, as it is not indigenous to that country, though it is quite true that we import from the States and Canada most of our seed under its name of timothy-grass.

As a meadow-grass, it is to be recommended for the mass of its nutritive culms, which are anything but coarse with us, and especially in our hay season, as it is a late species; it however yields comparatively little aftermath.

As a self-grass, its cultivation has never been carried out to any extent in Britain. In the United States, however, and Canada, hundreds of acres may be seen occupied with the cultivated form—timothy-grass; and on the alluvial flats of the Ohio, and the broad alluvial lands left by the contraction of the American lakes, this grass yields enormous crops, with spikes of flowers sometimes as much as six inches in length.

It is a grass easy of cultivation, and particularly well adapted for growth on river flats or estuarine warp-land, on which it will yield much larger crops than any other grass, and, though somewhat harsh and coarse in such places, will yet be found to contain highly nutritive qualities, and is peculiarly adapted for admixture in chaff.

There are several other species, but they have no particular agricultural value.

AMMOPHILA—*spike* compact, *glumes* of nearly equal pointed valves, with a tuft of hairs at the base, including the *glumel*.—P.

A. arundinacea—sea-reed, mat-grass—remarkable for its creeping rhizome, which we have obtained of as much as 30 feet in length. It is a common denizen of the sea-side, and, from its peculiar growth, it operates very beneficially in keeping together the sands of the coast, on which account it is carefully looked after and preserved by Act of Parliament. It may be worth a trial in some of the deep railway cuttings, especially where these occur in sandy clay, which renders them peculiarly liable to give way either from the rain of the wet season or the cracking which succeeds from the drought of summer. It is readily cultivated by joints or cuttings of the rhizome.

It is of no agricultural value, as its coarse, rigid, sapless herbage is untouched by cattle.

PHALARIS—*glumes* of erect equal keeled valves, including the *glumel*, which adheres to and becomes part of the seed.

P. canariensis—canary-grass—flowers in an oval spike—an annual grass, occurring in waste places and about the homestead, and probably introduced from its use as a food for canaries and other small birds, on which account it is cultivated in the neighbourhood of London and some of our larger towns for its seed. Its cultivation is exceedingly easy, a light soil with a fine "tilth" being almost the only condition required. We have seen good crops on both elevated and low lands, as it is a grass which endures great variations of climate.

P. arundinacea—reed canary-grass—flowers more or less densely paniculate. A perennial species, usually growing in water, in which it extends rapidly by its thick rhizome. Its occurrence in hedge-rows and meadows is a sign of great damp, which would be improved by drainage, when the species soon dies out. It is of no agricultural use; its

rhizome, however, occasionally renders it of value in keeping up river-banks; but it is oftener injurious, as spreading into watercourses, and thus vitiating a system of drainage by arresting the equable flow in the main or trunk channels.

†† *Flowers paniculate, more or less lax.*

AGROSTIS—*glumes* of two unequal valves longer than the *glumel*, the inner valve of which is sometimes absent, the outer either awned or awnless.

Agricultural forms.—Fine bent:—

1. *A. vulgaris*—head of flowers spreading, exceedingly light and elegant; *stolons* more or less creeping, whole plant smooth. Hab., upland meadows and pastures.—P.

2. *A. vulgaris var. alba*—marsh-bent—head of flowers larger and more compact; culms rooting at the lower nodes, and sending out *stolons;* whole plant more or less rough, and stouter than the preceding. Hab., ditches and wet places.—P.

3. *A. vulgaris, var. stolonifera*—agrarian bent—head of flowers much congested; stolons above, rhizomes creeping below, the ground. Hab., stony places; mostly an accompaniment of agrarian conditions,—P.

These three forms are proved to belong to the same species, as from cultivation we have obtained the following results:—

A plot of A. vulgaris, sown in 1855, presents the usual delicate form of this grass, with a tolerable admixture of both *stolonifera* and *alba*.

A plot of A. stolonifera. The general plant is A. vulgaris, having a few *stolonifera* intermixed, which latter present more of the true *alba* form than the congested flowers and stolon growth of its proper type. These experiments, though they tend to confirm their specific identity, by no means confound the different agricultural value of the three forms; and indeed, agriculturally, varieties themselves are of equal value with true species.

These varieties mark different agricultural conditions; and though neither of them are of great use as pasture-grasses under ordinary circumstances, yet the peculiar method of growth of the *A. stolonifera*, united with the fact of the great increase both in quantity and quality of its herbage under irrigation, point it out as a grass well adapted to form part of the produce of an irrigated meadow. As an agrarian, however, it is usually known by the name of *squitch;* and its small wiry rhizome renders it exceedingly difficult to eradicate, especially from brashy land, which is its favourite habitat, and in which it spreads so fast, that a summer fallow becomes so literally choked up with it as almost to exclude every other form of weed, if we except Triticum repens—common couch—which is its usual congener.

** *Spikelets with mostly two perfect florets.*

MOLINIA—*panicle* contracted, not spicate; *glumes* acute.

M. cærulea—purple melic-grass. A species remarkable for its solid stem and few nodes; it has long wiry roots, by which it mats together the humus soils of peats and moors; it is of no value in pasture, but is always an index of want of draining and general amelioration, under which it immediately disappears.—P.

CATABROSA—*panicle* spreading; *glume* of two obtuse valves, including the two or three florets; *glumel* truncated, awnless.

C. aquatica—water-whorl-grass. It is a perennial water-grass, and its only British species will be found in ditches, water-courses, and ponds, where it frequently grows very luxuriantly, and is remarkable for a peculiarly sweet licorice flavour, on which account cattle crop it down very closely whenever they can reach it; it is, however, so purely aquatic—refusing to grow away from water—that nothing can be done in its cultivation. A dwarf variety will frequently be found on mud-banks; but here it is an evidence of their wetness.—P.

AIRA—*glume* of two unequal valves, including two perfect florets, which are usually awned from near their base.

A. cæspitosa—turfy hair-grass—hassock or tussac grass. Of this genus there are several species, but only this one will need description here: it is distinguished by its tall stem, panicle spreading; flowers numerous on slender pedicels, having their outer glumel awned; leaves long and pointed, with serrated margins and roughened ribs, which makes this grass very rigid and objectionable to cattle, on which account, and from its possessing but little nutritive matter, they commonly object to eat it unless when quite young. It is found constant to two positions—moist damp woods, under the trees, where it forms an excellent covert for game. Its more objectionable habitat is in undrained meadows, or where there is a chance of water stagnating; and hence it is interesting as marking want of drainage, the stoppage of a drain, of a grip not well opened, or a want of free exit for the water in any part of a water-meadow. If any of these conditions continue for a length of time—sometimes incredibly short—this grass soon assumes its large cushion-like growth, from which it has attained the country names of hassock or tussac grass, bullpates, &c. It establishes itself in separate masses, like the larger jungle grasses of the tropics, which soon overpower all other species. Where present a meadow can never be perfect; if in irrigation, the wet "swag" must be relieved by an additional grip or channel into the exit-drain. In the meadows, with proper draining, its disappearance is equally rapid with its former growth.

HOLCUS—*panicle* lax, florets soft with downy hairs; *glumes* of two nearly equal two-flowered valves; upper floret awned, lower one awnless.

H. lanatus—meadow soft grass; awn short and curved backwards, so that it is seldom exserted beyond the glumes; its upper end only is rough; plant not creeping.—P.

H. mollis — creeping soft grass; awn nearly straight, always exserted, rough along its whole length; plant creeping on the surface of the ground.—P.

The first of these is usually found growing in damp meadows near rivers, being a general grass under flooding, but not so under proper systematic irrigation. It is quite useless, possessing neither flavour nor nutritive qualities, and much deteriorates meadows in which it abounds. The best method for its eradication will be found in the adoption of such farming as will suit better species; the law of extermination of the weaker by the stronger being nowhere so apparent as in the grass meadow; for if the circumstances prevail which suit those of a good kind, any bad ones either die out or linger on in a wretched and abject state; but a return to poverty, or a starved condition of the soil, soon causes the bad ones to obtain the ascendancy, and drive out those of a better quality.

The H. mollis is almost confined to sandy soils, such land as is formed from the disintegration of the conglomerates of the old red, and the more arid tracks on the new red sandstones, and the grits accompanying coal-measures are peculiarly liable to it. It spreads in most dissightly tufts in the meadows on such soils, and, from being of no value itself, it is a great pest in the meadows. It is best kept under by well harrowing it from the rest, and following this process with marling and manuring, which may be done with any substance tending to fertility, as it is a grass unknown in rich pastures. Johnston, in his *Natural History of the Eastern Borders*, remarks that, "when a field of light shallow soil, after being cultivated for a few seasons, is again laid down for grass, an abundant and unlooked-for crop of this grass will often appear. It is one of those cases in which we are left to wonder how the seed came there."—(p. 212) But we need not wonder how this or its congener spreads and gets into cultivation, seeing that each in its own locality is ever found about the homestead, and one plant seeding is enough to stock a wide space of ground.

The sweepings of waste places, when they are thus cared for, find their way to the muck-heap; and from this, agrarian grasses and other weeds are continually being very industriously and equally spread over the land.

ARRHENATHERUM—*panicle* lax, *glumes* of two valves, and two florets, the lowest of which has a long twisted awn, the upper one a short bristle on the outer glumel, lower floret with stamens only, upper one perfect, *i.e.* with stamens and pistils.

A. avenaceum—oat-like grass—a tall species, growing much after the manner of the oat, to which its trivial name of oat-like has reference; both its culms and aftermath are usually produced in abundance; but it possesses an exceedingly bitter taste; and though Sinclair says "it is eaten by all sorts of cattle," yet we have uniformly noticed that cows and sheep refuse it unless starved to it by want of something better. "It contains too large a proportion of bitter extractive and saline matter to warrant its cultivation without a considerable admixture of different grasses; and the same objection extends to its cultivation in permanent pasture," according to the author just quoted; but as he finds it "always present in the composition of the best natural meadows," so he concludes that it should have a place in the list of species for the laying down of permanent pastures. However, from a long observation of this grass, both in separate plots and in the meadow, we are inclined to think that it would be better to discourage its growth; it may indeed be seen in the good meadow, but it is best grown in the worst parts thereof; and, from the peculiarity of its constitution, it is capable of adapting itself to a wide range of circumstances, and hence the universality of its occurrence. We have two distinct forms, and under constant conditions, permanent varieties, namely, the typical *A. avenaceum* in deep and moist soils, and the curious variety *bulbosum* in sandy lands. The former of these has a swelling at its lower node; but as in its locality there is

always sufficient and regularly supplied sustenance and moisture, there is no need for the nodular growth assumed by the var *bulbosum* when growing in sands, and provided as a storehouse of food for its living on in those periods of drought with which arid sands are mostly affected at some season or other.

These bulbs, which are the ordinary *nodes* of the grass much enlarged, look like a string of onions on a small scale, which has given rise to its popular name of *onion couch;* and upon the sand-beds upon which rest a great part of the towns of Gloucester and Cheltenham, and on the broken-down sandstone of the new red about Worcester, or the silicious drifts and soils of other districts, it sometimes forms a most troublesome weed, as each node is capable of growing a distinct plant, and so succulent are these that heat and dryness have even less chance of killing it than the common couch; the only way to get rid of it is to hand-pick it after repeated ploughing and harrowing.

It may be supposed that the var. *bulbosum* would be a useful grass on sands; but as its propensity is to increase by roots, and it sends up no second growth of culm, as does the *A. avenaceum,* its yield of herbage is not half that of the true species; its bulbous growth, however, is large and rapid, and its knotted onion-like traces are much in the way of any crop with which it may be intermixed.

The very bitter taste of the nodular masses would almost point it out as of medicinal use, but we have never heard of its so employment.

CYNOSURUS—*panicle* spicate, flowers hidden in a comb-like shield, (*involucre* of botanists)—*glumes,* equal awned, inner valve of *glumel* with or without an awn.

Cynosurus cristatus—head of flowers forming a narrow spike, florets with a short awn.—P.

Cynosurus echinatus—head of flowers broadly ovate, florets with a rather long awn.—A.

The comb-like shield by which the *locustæ* of flowers are

separated from each other in this genus is sufficient to distinguish it from all others.

Of our two British species only the first needs attention here, which we shall accord it, not so much because of the character of "a valuable grass" which Hooker gives it, perhaps following Sinclair, but in order to give our own independent observations upon a grass which is so abundant, and which, as we think, has been overmuch cultivated.

Probably much of the error which we conceive attaches to this species has arisen from the company in which it is usually found in its favourite upland localities, and hence such grasses as *Festuca ovina*, sheep's fescue, *F. duriuscula*, hard fescue, *Lolium perenne*, perennial rye-grass, and *Poa pratensis* common meadow-grass, which in such places yield an unusually sweet herbage, have been robbed of much of that character which has been erroneously attributed to *Cynosurus*.

Sinclair says, "In some parts of Woburn Park this grass constitutes the principal part of the herbage on which the deer and Southdown sheep chiefly browse, while another part of the park, which consists chiefly of the *Agrostis vulgaris fasciculari*s, Agrostis vulgaris tennifolia, Festuca ovina, Festuca duriuscula, &c., is seldom touched by them; but the Welsh breed of sheep almost constantly browse on these, and almost entirely neglect the Cynosurus cristatus, Lolium perenne, and Poa trivialis."

Now, in opposition to this, we beg to offer our observations, of some eight years, upon this grass, as it occurs in the park of Earl Bathurst, at Cirencester.

This park, which is very extensive, rests on the stonebrash of the great oolite, with some of the higher ridges just capped with forest marble clay; all parts of this, and especially the portion called the Deer Park, is full of the *Cynosurus cristatus*, which grows equally well on the brash and the clay, and the thickness of the grass may be estimated from the fact that scarcely six inches of space occurs without its occupants of one or more of the *dry sapless culms* of

the C. cristatus. Now this park is *constantly* stocked with deer, Southdown sheep, horses, and oxen, by which the general turf is kept well cropped down, and yet no dead culms of any other grass will, as a rule, be found to prevail. Let it therefore be borne in mind that this is different from a meadow where the culms may become hard and woody before cattle are turned into it: they are always here, and keep every other grass from flowering but the one in question; it is therefore quite evident that here at least the *C. cristatus* is not a favourite with deer or Southdowns.

Perhaps, however, it was Sinclair's very observation of the quantity of culms in Woburn Park that led him to conclude that it formed so great a mass of the herbage; but if we bear in mind how very small and wiry these culms usually are, and how short in the leaf are the tufts of grass by which they are accompanied, we shall have reason to conclude that after all *C. cristatus* may there form but a small proportion of the herbage: at all events, we may safely determine that, if the grass in its young state was so favourite a pasture, it would, like others, be kept from growing culms by constant depasturing, but the grass in question seems all the more, because even the young shoots are never cropped. From these observations we feel bound to conclude that the *C. cristatus* is both a poor hay and pasture grass, and neither in quantity nor quality of either, worthy a place in a good meadow; and though it is true that it improves vastly under liberal treatment, yet the culms are left even in the lowlands on depasturing, and it fortunately happens that improvement of a pasture will cause the dying out of the greater portion of the grass in question, as it is essentially one of the poor pasture which cannot maintain its ground on the advance of other and more important species. The culms are gathered in quantity for straw-plaits, for which they are well adapted both from their fineness and strength of fibre.

*** *Spikelets (locustæ) with three or more perfect flowers.*

† *Spikelets forming bilateral spikes.*

HORDEUM—*florets* in threes, of which the central one is fertile, the lateral ones usually imperfect; *glumel* incorporated with the seed.

1. *H. sylvaticum*—wood lyme-grass—wood barley; spike smooth, upright; spikelets three-flowered; florets with a long awn; leaves flat and drooping.—P.

2. *H. murinum*—wall barley; spike about two inches long; spikelets three-flowered; central perfect; lateral ones imperfect; all with long awns.—A.

3. *H. pratense*—meadow barley; spike smaller than in the preceding; lateral florets with short awns; central one with an awn twice the length.—P.

The first of these, *H. sylvaticum*, is usually named *Elymus Europæus*, but its position is perhaps more natural with the barley, though it would appear to have a greater affinity with the cereal than the meadow types of the genus. It is essentially a wood grass, with broad flat drooping leaves, but as yet we know nothing of its character in cultivation; but, having this year collected a lot of seed for our garden, we shall hope soon to be able to add some facts to its natural history.

As regards the *H. murinum*, this is confined to sandy soils, in which it is a sad weed, especially in corn fields, banks, and hedge-rows—the tertiary sands of Suffolk, the marine sands in the old Severn strait, decomposed sandstones, and indeed a perfectly sandy soil anywhere is peculiarly liable to it: it is not strictly a grass of the meadow, choosing the margins of fields, edges of pathways, mounds, and hedge-banks. Its plentiful green herbage grows very early, and is not deficient in nutritive properties, so that it may be grown for soiling, but care should be taken not to let it advance to flowering, as the long rough serrated awns are most obnoxious to cattle, sticking about the mouth and causing great irritation; from this cause hay is much deteriorated by its presence, so that corners of fields in which it may occur should not be mown with the crop, but be cut earlier so as to prevent its seeding.

H. pratense—much smaller than the former and decidedly pastoral in its habits, growing in good grass-fields and especially such as are liable to inundations, and also occupying a place in irrigated meadows—its herbage is of good quality, and all kinds of cattle graze and do well where it is abundant; but though its awns are not so long or so stiff as those of the *H. murinum*, they are still highly objectionable in the hay crop.

The presence of this grass is a good indication of condition, as it always occurs to a greater or less extent in good meadows, but uniformly refuses to grow even in small quantity either on poor heath or sour undrained clays.

TRITICUM—*locustæ* flat, alternate on the sides of the central axis (*rachis*); *glumes* transverse; external *glumel* either pointed or awned.

The only species that need be here described are the following, which are distinguished from the rest of the genus by their creeping roots:—

Triticum repens—creeping wheat or couch grass; *glumes* ribbed; *locustæ* of from four to eight florets; the *glumels* mostly awned, leaves broad and flat; *rhizome* much creeping.—P.

T. junceum.—Rushy sea wheat-grass; *glumes* obtuse, with many ribs; *locustæ* of from four to five florets, without awns; leaves *involute* (folded); *rhizome* creeping.—P.

The first of these constitutes the detested couch of the farmer, and is a grass more catholic in its tastes and habits than almost any other; so much so indeed, that hedge-rows, road-sides, the pasture-field, and waste places, no less than arable lands, all upon every kind of soil, will be occupied by it to a greater or less extent; and as lands in which it is allowed to increase are considered *par excellence* as "foul," the removal of couch is a matter in which all farmers are occupied and interested. Considering, therefore, the perpetual warfare that is waging against this grass, it is surprising how much of it still remains, even in some well-

cultivated districts. Much of this may be accounted for in the unploughed spaces under hedges or stone walls, in which it seeds and thus forms a nursery for the fields; and besides, the *rhizomes* are cut off by the plough and become scattered by the operation of the harrow, and thus a centre is formed in the field, from which it spreads in like manner, so that a quantity of couch has always to be got rid of.

Much of the evils arising from this grass may be prevented by the timely use of the fork, which should always be brought into requisition upon every couch centre that may be detected, and that before ploughing for any and every crop, as this instrument is capable of following the plant in its depth as well as breadth, while the plough only cuts it off for the depth limited by its operations. This method, it is true, adds a little to the first expense of tillage, but it saves much after trouble, and is far cheaper in the end.

The same circumstance which renders the plant just described so great a pest to the farmer, namely its creeping habit of growth, should impel us to preserve the *T. junceum*, as it is confined to sandy sea-shores, which its long, tough, and flexile rhizome assists in so matting together as to prevent the encroachment of the sea-water on the coast.

BRACHIPODIUM—*locustæ* cylindrical, on short *pedicels* alternate on the central axis; *glumes* unequal, transverse.

B. pinnatum—heath false brome-grass—*locustæ* of from eight to twelve smooth florets; *awns* half the length of the florets; spike and leaves upright.—P.

B. sylvaticum—slender false brome-grass—*locustæ* of from eight to ten florets; florets hairy; *awn* longer than florets; *spike* drooping; *leaves* bent downwards.—P.

The habits of these two species are very different—the former preferring poor open heaths and down lands, particularly on limestone soils; the latter growing in hedgerows and beneath woods and in shaded places. Agriculturally

they are both of them useless; but the former is well worthy of study for its indication of soil and its condition.

The B. pinnatum will be found partially intermixed with the grass of most poor upland pastures on limestone, to which small isolated specimens it is confined under a constant system of depasturing; but if left wild or only occasionally stocked, it is astonishing how quickly the least bits spread into rounded patches, often of several yards in diameter, which, if cattle be turned into in the summer, they leave wholly untouched, and so it seeds, besides spreading by short rhizomes until the greater part of a pasture may be taken possession of by this useless and distasteful grass.

The best way to get it under is to fold sheep on a portion at a time, especially through the early spring, feeding them with corn, hay, and a few turnips; in which case the dead grass is trodden into manure, and the sheep manuring so encourages the growth of the sprinkling of better species, which before were thin and isolated, that the enemy is subdued in an incredibly short space of time; even one season being enough to destroy the greater portion, and reclaim a pasture that was before going fast to waste.

The B. pinnatum is also a great pest in hedgerows and on mounds, especially on the Cotteswolds, where it is a constant denizen. It should be carefully forked from the former, and before it has seeded, especially in the young state of the fence, as, from its upright and close method of growth, much injury results to the quick from being smothered, besides the exhausting powers which it possesses.

The B. sylvaticum is usually refused by all kinds of animals, but, from the readiness with which it grows under wood, it affords a tolerable covert for game.

LOLIUM—*glume* of one valve to the lateral (not transverse), *locustæ*, two to the terminal one; *glumels* sometimes awned.

Lolium perenne—perennial rye-grass—*locustæ* of from

six to eight florets, awnless; leaves mostly upright, of a dark-green hue; of this there are several varieties.—P.

Lolium Italicum—locustæ of from six to eight awned florets; leaves broad drooping, of a light green colour.—B.

L. temulentum—locustæ equal in length with the glumes. —A.

The *L. perenne* in its usual form is found almost every where, but more especially in good pastures: brought under cultivation as "seeds," it is liable to a great number of variations, especially in size and in a disposition to a greater or less permanency of growth, and hence arise the many names which its varieties are known by in the seed-market. The properties of the true *L. perenne* are such as to render it very valuable to the farmer, as it soon arrives at maturity, yields a good weight to the rick, and in the meadow stands depasturing to any extent, yielding a perennial supply of good succulent leaves, which are readily eaten by stock of all kinds. In arable culture, however, its permanency is most uncertain, as it generally begins to die out, especially after the first hay crop; and this all the sooner and the more certain in proportion to the longer time the grass is left before being cut.

The *L. Italicum*, which is perhaps after all only a variety of the *L. perenne*, has been much recommended as a self-grass, and particularly for soiling: the reports of its yield under watering with sewage manure are almost fabulous: however, on limestone soils, and on light lands in general, it is now sown as a separate crop, in which case it comes in for pasture in the following spring, in which state it may be continued for one or two years according to circumstances, though it seems to be, strictly speaking, a biennial form.

These varieties of rye-grass are the only ones usually employed in seeds in this country, and they are either sown by themselves or in company with different trefoils, such as Trifolium pratense, T. medium, T. repens, Medicago lupulina, and others. The principal reasons for its preference, as stated by Sinclair, are the quantity of seed which it

produces, the readiness with which this can be collected, and the facility with which it vegetates under circumstances of different management.

L. temulentum—darnel—is an agrarian weed, now of comparative rarity, and fortunately so, if the following character of it be true: Sinclair says, "it has from the earliest ages borne the name of *drunken darnel*, and there can be no doubt of its deleterious qualities, whether in meat or drink." Parnell gives a modified opinion hereupon: he remarks, "the seeds, *it is said*, when eaten, produce vomiting, purging, violent colic, and death." Linnæus' opinion was, that the seeds, when mixed with bread, produced but little effect unless when eaten hot; but if malted with barley, the ale soon occasions intoxication. Sir J. E. Smith, in his *English Flora*, says, "the seeds are of very evil report, for causing intoxication in men, beasts, and birds, and bringing on fatal convulsions." Haller mentions them as "communicating these properties to beer." Vol. i. p. 175. Hooker and all botanists follow in the same strain, but merely quoting from each other, as none of them seem to have any personal knowledge of its qualities. Of late years it has been confined in its range, and so limited in quantity, that we have never been enabled to procure sufficient to follow out an investigation into this interesting matter; at present, however, we confess to the belief that its injurious qualities have been much overrated, if indeed the tales about it are not altogether fabulous.

Foreign seeds, flax more especially, are almost sure to yield a little of the plant on sowing.

†† *Flowers paniculate, flowers more or less lax.*

POA—*panicle* lax; *locustæ* of from five to ten florets; *glume* of unequal valves, the inner *glumel* notched at the extremity; part of the genus sometimes referred to *Glyceria*.

1. *Poa annua*—*locustæ* of about five florets, not webbed. —A.

2. *P. trivialis—locustæ* of about three acute webbed florets; leaves with a rough sheath, ligule pointed.—P.
3. *P. pratensis—locustæ* of about four acute flowers, with a web; culm and herbage smooth; ligule short and blunt; rhizome creeping.—P.
4. *P. compressa*—culms flat, oval on a transverse section, rhizome creeping.—P.
5. *P. nemoralis—locustæ* of three flowers, slightly webbed; ligule short; culms slightly compressed; rhizome indicated.—P.
6. *P. fluitans—locustæ* of from seven to eight florets obtuse, leaves broad and floating on the water.—P.

1. This grass is found about mud-banks, road-sides, ditches, and dirty places, a life for which its chemical analysis shows it to be well adapted, as, according to Mr. Way, it contains a large quantity of water and less ash, both in the dried and undried grass, than any other species upon which he operated; and upon this he remarks, that "the specimen of annual meadow grass, *Poa annua*, differs from all the others with which it is associated, both in the low percentage of silica and the corresponding decrease in the proportion of potash, which, whether calculated on the natural or dry specimen, is peculiarly low;" and to this is appended the following note, "Annual meadow grass is said (see *Lowe's Agriculture*) to be the most productive of all the grasses: Is this in any degree to be attributed to its more moderate mineral requirements?" In an agricultural point of view, this grass may be considered as a weed, as it has scarcely any feeding properties; and though it sometimes presents an apparently green turf over alluvial flats, and anywhere with a muddy subsoil, such grass affords, as the farmers say, "no heart"—"no proof" in it. On some land of Lord de Mauley's, celebrated for scouring cattle, this grass was a prevailing one. It is a great pest in garden-walks, increasing rapidly where allowed to seed. Salt has been recommended for the prevention of its growth,

which it does for a time, but requires a constant renewal of the dressing to quite keep it under.

2. *Poa trivialis* — rough-stalked meadow-grass. — This species is mostly confined to low and damp situations, often forming a great part of the bulk of hay in river-side meadows, but growing in the greatest abundance in irrigated pastures, especially in such parts as though not stagnant are always moist. Under the most perfect irrigation-system, it is by no means abundant. As an upland grass it is never met with in nature, and if employed in a mixture for such situations it usually disappears in a few years. In its favourite habitat it yields a large bulk of hay, but is usually very late in its growth, and this is followed by a good bite of aftermath; but our observations confirm us in the opinion that it is very watery in its composition, and its herbage is by no means of the sweet quality that belongs to the best species. Sinclair, however, speaks very highly of its properties, and in this he is followed by Parnell; he says, "the superior produce of this *Poa* over many other species,* its highly nutritive qualities, seasons in which it arrives at perfection, and the marked partiality which horses, oxen, and sheep have for it, are merits which distinguish it as one of the most valuable of those grasses which affect rich soil and sheltered situations."—*Hort. Gram. Woburn.*, p. 88.

Now, we cannot say that we have observed any partiality of cattle for this grass, and feel inclined to the belief that the following circumstances have contributed not a little to an over estimation of its qualities in this respect. If we examine its progress we shall find that it is nearly a month later than the general mass of the meadow grasses; so that it is no wonder that cattle should choose the green leaves of this species at a time when its congeners are in culm; but this is no argument for its superior value; on the contrary, we are constantly being told, in the language of the farmer, that hay from such situations has not the

* Here he does not mean of Poa, but other species of grasses.

"proof" in it of that of the good sound meadow—a circumstance which may, no doubt, in part be attributed to the quantity of water it contains, as shown by Mr. Way, in his *Fourth Report on the Analysis of the Ashes of Plants*, to which we have been greatly indebted for some valuable information, and from which we extract the following table, showing the percentage of water in three species of Poa compared with *Phleum pratense*.

Grass.	Date of Collection.	Water per Cent.	Nature of soil.
Poa annua	May 28	79.14	Loam, with gravelly subsoil.
„ *pratensis*	June 11	67.14	Dry calcareous loam.
„ *trivialis*	June 18	73.60	Calcareous loam.
Phleum pratensis .	July 11	57.21	Ditto.

From this, no less than long observations of its history and general characteristics, we should feel disposed to rank *Poa trivialis* as a very inferior grass to *Poa pratensis*, holding indeed, as far as the value of its hay and herbage is concerned, an intermediate position between the latter and *Poa annua*. As a weed, the *Poa trivialis* is often exceedingly annoying, especially on poor damp clays. We have seen it in some of the stretches of the fuller's-earth, choking even the scanty crop of grain which this stratum will grow when ill drained or otherwise unmitigated: it is however easily got rid of by thorough-draining, and letting light and air into this stubborn soil.

3. *Poa pratensis* — smooth-stalked meadow grass — is very constant in pastures, and especially in those of the best quality; it yields a good bulk for the rick, and sends up a quantity of herbage for the aftermath, which is less injured by cold and other climatal changes than almost any other species; its range is very wide, being found on dry uplands, in deep loams, and in both flooded and irrigated meadows, and should always be largely intermixed with seeds in the laying down of permanent pasture. Thus it will be seen that our experience of this species is quite at variance with that of the *Hortus Gramineus Woburnensis*,

in which it is stated, that "upon the whole it is an inferior grass; its strong creeping roots exhaust the soil; its growth after mowing is slow; and its spring growth, though early, is inconsiderable; and upon the whole it is unfit to be introduced among the superior sorts."

Now, as regards the creeping roots, these are never strong in the pasture; if, however, the grass be employed in turf-walks in the garden, it then spreads strong rhizomes into the plots in contact, on which account it should never be brought to such situations; but how rhizomes could exhaust the soil except by producing grass, we cannot make out; the truth is, that all good grasses exhaust the soil if taken off in the shape of hay, and this one especially by reason of its good crops; but such should be invigorated by manuring and good cultivation, for which this species amply repays.

4. *Poa compressa*—flat-stalked meadow grass—can only be looked upon as a weed, and its thin wiry rhizomes make it very troublesome in some of the brashes of the inferior and great oolite limestone rocks; the Gloucestershire farmer distinguishes it by the name of squitch, whilst the stronger rhizomes of *Triticum repens* are termed couch. This weed is very difficult to get rid of, as it creeps beneath the stones, so that the plough has but little chance with it, and where it once takes root it is too rapid in its spread to be mastered by the fork. The plan we have seen as most effective is to sow white mustard in the wheat stubbles in which it prevails, and, when eaten off by the sheep, apply a dressing of decomposed farmyard manure, and plough up for a winter fallow. In spring prepare for the turnip crop, which should be sown on the ridge; by such means the soil becomes deeper and better in quality—two circumstances which, besides want of rest, are highly prejudicial to the growth of squitch.

5. *Poa nemoralis*—wood meadow-grass—though early, yet yields so small a quantity of light culms and delicate leaves as to render it scarcely worth cultivation; at the same time, if cut early, it sends up a second crop of flowers;

and its habits point it out as well adapted for glades in parks, and under trees. Its herbage, though not of great amount, is of good quality, and we have observed that cattle eat it greedily.

6. *Poa fluitans*—floating meadow-grass. In this species we have a form at first sight so distinct from Poa as almost to entitle it to another generic name, which indeed by some botanists has been given, in that of *Glyceria*, a separation which we should at once adopt, both from its structure and habit, were this the only species in the group; but its congeners, *P. maritima*, *P. distans*, *P. procumbens*, sufficiently unite it to the true Poas for all practical purposes. This grass, with its evergreen leaves, will be constantly found floating on the water of the pool or the stream; in the summer it sends up some upright culms, which are more or less branched, and, with the whole herbage, very sweet in flavour, on which account cattle prefer it when young to almost any other species; it is, however, remarkably liable to become ergotised—a circumstance which would appear to render it highly injurious to cattle which are obliged to partake of it, arising either from the ill effects of the ergot itself, or the damp circumstances under which the grass grows, or perhaps both causes combined. In some cases which have come before us, abortion in cows has been frequent in low meadows traversed by watercourses and wet stretches in which this grass has been abundant.

We may here refer to another species in the *Poa (Glyceria) aquatica*, which is a constant denizen of rivers, ditches, and watercourses, where it frequently grows in thick masses of large upright leaves and culms, while its creeping rhizome assists in keeping up the mud and dirt, so that this plant often becomes a serious obstruction in watercourses, in flat countries especially, vitiating a whole system of draining from keeping up the water. From such positions it should be removed with as great care as weeds from a crop, and indeed it may here not be out of place to state that several species, not only of grasses but other plants, act prejudically

to the farm in general by being allowed in watercourses, and no farm can be kept in good order without efforts are used to destroy them.

The Poa aquatica and P. fluitans may now also be referred to as having been subjects of some interesting experiments in the garden of the Royal Agricultural College. Here, some two years since, we sowed a plot of each of these grasses which soon came up very well but did not flower until the second year, when, to our astonishment, the crops of the two beds were entirely alike in all their details of leaves and flowers; the new plants however being so entirely distinct from either of the originals, and from every other known British grass, as to present a matter of interest for further investigation; and in order to this we have this year endeavoured to collect wild seed of the two forms in question, but as regards the *Poa aquatica* entirely without success, as though a wide district has been carefully examined, in no instance have we succeeded in finding any fertile seeds. Plants therefore of the two forms have been obtained from the Cirencester Canal and planted in our experimental plots; and if it should be ultimately proved by repeated and varied experiments that a change of habitat from a residence in water to one on dry land is capable of producing so great an alteration in specific details, it will afford another interesting proof of the curious physiological facts which are to be elicited from experiments in the cultivation of grasses.

BRIZA—*panicle* lax; *locustæ* of from six to eight very tumid florets; *glumes* equal, rounded, and with the whole flower quite smooth.

Briza media—quaking grass—is so called from the restlessness of its pendulous flowers, which are comparatively heavy, and balanced on delicate rounded *pedicels*. Though a beautiful species, it is of no use agriculturally; however, as it grows for the most part in poor, stiff, undrained clays, it may always serve by its presence or absence as an indication of condition. If present in quantity, we may predicate

a stiff unmitigated clay, such as is found in the Lias shales, Oxford clay, Forest marble, and London clays, and especially where not visited by local deposits, undrained, or otherwise badly cultivated; these formations will be found to afford too much of this species, and far too little of those of a better quality. If, however, the soil be merely wet, and not of a decidedly stiff description, less of the quaking-grass will occur, but the specimens will be far larger in size, and equally useless as food.

This grass is not touched by cattle, and, therefore, its culms may be observed late in the season, usually accompanied by those of the Cynosurus cristatus. At any time it yields little to even the scanty bulk of the hay from its favourite habitats, and its short leaves render it useless for pasture.

> DACTYLIS—*panicle* with the primary branches long; *pedicels* short, so that the flowers are clustered in bunches; *glume* of two unequal valves arranged obliquely; *glumel* pointed, almost awned.—P.

Dactylis glomerata—cocksfoot—is too well known to need further description, especially as we have but a single native species to consider; its agricultural capabilities render it an important one to the farmer, as it yields a very large bulk both of culms and long leaves to the hay crop, and a no less proportion of aftermath; and though somewhat rough, coarse, and woody in its culms, especially if left too long before cutting, yet it presents for the most part a highly nutritious and bountiful supply to the rick; it is, moreover, remarkable for its quickness of growth after mowing, as in a few days its light-green succulent leaves will be seen considerably overtopping the surrounding turf; and if at this time cattle be turned into the field, they invariably make a first attack upon the young cocksfoot.

Sinclair, in speaking of this grass, says, "By various tests to which the leaves and stems were submitted at different periods of their growth, the author found that the stems,

when full grown, contain more nutriment than the leaves at any time;" and his general conclusions respecting this grass are, that "it is more valuable for pasture than for hay, and, for the latter purpose, is superior to rye-grass and many others." "If constantly kept closely grazed, it yields a greater profit than used in any other way, merely because the leaves grow rapidly, and give a full bite." This, though appearing at first as somewhat paradoxical, is quite in accordance with our own observations, which lead us to conclude that, in all its stages, this is a highly valuable grass. This view, again, is confirmed by Mr. Way's analysis, which determines it to belong to the best agricultural species. It has the merit of growing in almost any soil, and enduring a great range of climatal difference; it attains to maturity, or at least to as great a bulk as any other species, comparatively soon, and is, therefore, good for admixture in the laying down of permanent pasture, and might, we think be profitably employed in a mixture with rye-grass in seeds. Its more robust and faster growth than most other species should prevent its being used for lawns; and the admirers of cricket should take care to have it expunged from their field—a consummation indeed which will soon result, even when present, from plenty of practice of the 'noble sport.'

There is a variety in the seed-market known as giant cocksfoot; it is not different from the usual grass when in cultivation, which indeed sometimes attains gigantic proportions.

FESTUCA—*panicle* lax; *glumes* unequal; finely pointed outer *glumel*, with a short *awn* or bristle at the summit.

In this genus, so far as the farmer is concerned, we have two types, which may be coveniently tabulated as follows:—

a. *Leaves more or less setaceous (hairlike).*

1. *Festuca ovina*—sheep's fescue—leaves setaceous; panicle diffuse; rhizome absent.—P.

Festuca ovina, var. duriuscula — hard fescue — leaves nearly plane on the culm, those of the root inclining to setaceous ; rhizome absent.—P.

Festuca ovina, var. rubra—creeping fescue—leaves involute (rolled inwards at the edges), thus often appearing setaceous; panicle inclining to one side; rhizome more or less creeping.—P.

b. *Leaves plane.*

2. *Festuca loliacea*—spiked fescue—panicle spiked in two rows, like Lolium perenne ; leaves long, broad, and drooping.—P.

Festuca loliacea, var. pratensis—meadow fescue—panicle diffuse, inclining to one side ; leaves upright and succulent.—P.

Festuca loliacea, var. elatior—tall fescue—panicle large; much branched ; leaves harsh and rigid.—P.

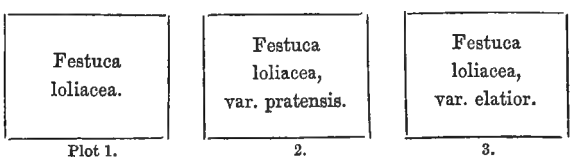
On comparing our nomenclature with that of botanical authors, it will be seen that it differs materially from all of them ; our reasons for this course will be made apparent from the following observations and experiments :—

Six years since we sowed separate plots of the three first forms with seed from the Messrs. Gibbs ; these came up well, and soon established themselves in the separate tuft method so peculiar to this group when unmixed with other species. The first two years they were tolerably distinct, now, however, the following facts are observable :—*F. ovina, duriuscula,* and *rubra,* scarcely distinguishable in size or details, while the creeping habit of root of the latter is entirely lost. It may be remarked that the *F. rubra* is not amongst our wild forms at Cirencester, but we have occasionally met with specimens of *F. duriuscula* in the road-dirt with which the tops of our stone walls are frequently capped, having a decidedly creeping habit, which, if shown as a tendency in the "light sandy pastures near the sea," which is given by Hooker as the habitat of the *F. rubra,*

may account for ovina taking on the rubra form in such a locality.

As respects *ovina* and *duriuscula*, it may be remarked that poor uplands present the first, the bushes and hedgerows of these the second, which is sure to prevail in good upland meadows; but seldom are they greatly intermixed, which perhaps may be taken as an argument that the variety is induced by the difference of circumstances. From long observation of these, we can only consider them as varieties of the same species, and had we choice of names should choose for it *F. duriuscula*, as the departure seems to be from that type, of which the *ovina* is the mountain form and the *rubra* a sea-side one.

Festuca loliacea varieties.—At the same time as the above, were sown the three forms tabulated below in the following order:—



These plots the first year of flowering presented the following appearances:—

Plot 1. *F. loliacea*—most of the plants were of the true spicate type, but were sparingly intermixed with paniculate flowers; the herbage of all was of the rich green which characterises the true type.

Plot 2. *F. loliacea, var. pratensis*—all came true, but with a tendency to a rigidity of leaf.

Plot 3. *F. loliacea, var. elatior*—scarcely distinguishable from plot 2.

In three years great changes had been wrought, as under:—

Plot 1. No spicate flowers in the whole plot.

Plot 2. More rigid and larger; in fact, none of the true type.

Plot 3. A little larger, but otherwise not distinguishable from plot 2.

Now in the sixth year the *F. elatior* form prevails in all the plots. Here, then, we think that it is satisfactorily proved that these three forms are all referrable to a single species, as the change has taken place, not by hybridisation, but in individuals; at the same time they may maintain their distinctive characters under the following circumstances:—

1. In meadows by the side of rivers, especially where subjected to occasional floods—as the Isis at Oxford, or irrigated meadows on the banks of the Churn at Cirencester. The *F. loliacea* is constant, and is a most valuable grass for hay or pasture.

2. In rich meadow flats, as in the vale of Berkeley, the celebrated locality for the production of double Gloucester cheese, the *F. loliacea, var. pratensis,* is a common and valuable denizen, and any meadow where it maintains its characteristics may be considered as good in quality.

3. On the alluvial sandy clay banks by the seaside, or poor silicious clays inland, the variety *elatior* rears its tall coarse form. In the county of Gloucester the warp mud on the banks of the Severn estuary is always occupied by this grass, which we look upon only as the extension of the *pratensis* from the rich flats within the sea-wall boundary.

The *F. pratensis* is a grass which is always recommended for admixture in forming new pastures, on which account there can be but little doubt that it was used in the glades laid down within the last few years at the entrance of Oakley Park, the seat of the Earl Bathurst. When first sown it came up true enough, though with a disposition to harshness; the last three years it has become *elatior* in all its features, and is now in such large coarse *tussacs,* or *hassocks* as they are technically called, as to make the spot dissightly as a lawn and much impaired for hay or pasture. The secret here appears to be that the soil consists of sandy clays of the Forest marble rock, the texture of which

is very similar to that in the favourite habitats of this form of grass.

Here, then, we see in these forms of fescue, plants which assume what have been taken as specific differences, not only from change of circumstance giving rise to varieties which are maintained from seed, but assuming a varied form from the same seed, and absolutely becoming *pratensis*, and afterwards *elatior*, from a typical form of loliacea; and so certain has been this occurrence in our own experimental garden, that the result of twice sowing the three forms of seed from different seedsmen has been the negative of *loliacea* and *pratensis* and the permanent establishment of *elatior* on all the plots.

As therefore *F. elatior* seems to be the more perfect state of the grass, this name should more properly be attached to the group.

In an agricultural point of view, the fescues afford widely useful varieties, each of which is valuable under certain distinct circumstances, and, indeed, under them keep their typical forms, thus :—

F. ovina is essentially a grass of the thin soils resting on rocky uplands, as on the mountain limestone, the oolites of the stony Cotteswolds, and most mountain ranges.

F., var. duriuscula—in the valleys between such hills, and in the more sheltered pastures in upland districts.

F., var. rubra—in sandy loams of the lowland meadow, and by the sea-shore.

F. loliacea—rich meadows, on river-banks, or under irrigation.

F., var. pratensis—best lowland pastures not liable to floods.

F., var. elatior—on sandy clays, or other stiff or strong land, especially on warped sea-shores.

In each of these situations the peculiar form is well adapted for yielding, under the circumstances, as good a crop and of as good quality as any other species. There can be no objection to their encouragement in the habitats

indicated. The last, however, is exceedingly coarse, and would thus only be adapted for the grazing of such cattle as may occasionally be enabled to rough it.

BROMUS — *panicle* lax; *glumes* more or less tumid; outer *glumel* with a long awn from near its middle, inner one *ciliated*, edged with fine hairs.

Of this genus there are several species which are of little moment to the farmer; and indeed those in which he is interested are, for the most part, rather enemies than friends. Of these the following may serve as a synopsis :—

a. *Annual.*

1. *Bromus mollis* — soft brome, "lop" of the farmer— *locustæ* ovate, of from six to ten florets, upright, on short pedicles; flowers and whole plant hairy.
2. *B. mollis, var. racemosus*—smooth brome—the same as the preceding, only that the flowers are smooth and glistening.
3. *B. mollis, var. commutatus*—field brome—*locustæ* of from ten to twelve smooth florets, more or less drooping, upon long and slender pedicles.
4. *B. secalinus* — *locustæ* of from eight to ten florets, which are usually smooth, but in the sub-variety *velutinus* are hairy; much drooping in seed, when the florets are more distinct and separated than in the other forms.

b. *Perennial.*

5. *B. erectus*—*locustæ* upright, on short pedicles; florets lanceolate, smooth; anthers bright orange.

The two first of these may practically be taken together, as the *racemosus* can only be considered as a smooth form of *mollis*, and by which the latter is but sparingly accompanied, being produced from the same sample of seed. It is known by the farmer under the name of "*lop*," and is a detestable weed, especially in seeds, where it sometimes

prevails to such an extent as to form a greater part of the hay-crop. In this case it is difficult of eradication, because it is much earlier than the rest of the grass; and if the hay be cut early, to prevent its seeding, there are always some unflowered stems left behind, which will shoot up and seed in the aftercrop. On this account it has been recommended to be cut often, but, after all, this is a method of cure which would frequently render a crop of seeds of comparatively little use to the farmer. "Prevention, therefore," says Sinclair, "is most to be recommended," and this is to be achieved by judicious cropping and liberal treatment, and more especially as this grass is mostly a denizen of poor exhausted soils. But, above all, we should be particular not to sow this grass with our crop—a process by which its continuance is constantly ensured without proper care, and which results in the following manner.

A dishonest farmer has a crop of seeds which may be very foul, especially with the prevalence of lop. In this case he knows it will be not only a short but a poor crop of hay and grass; he therefore seeds it, and the lop and the rye-grass thus become inseparable, and the superior weight of the former makes up a tolerable weight of seed, which, even if sold at a reduced price because it is not of the best quality, pays better than by any other mode of dealing with it; and thus, as long as men are rogues enough to seed foul patches, and others are so foolish as to buy the cheapened produce, so long will this be a source of weeds. Yet, so far as clean farming is concerned, we cannot consider any as entitled to that name unless as well as destroying weeds it also provides against sowing them. "Prevention" is indeed better than cure, as weeding, however judiciously performed, is sure to leave enough of prolific enemies to continue the pest, so that it is the best, and safest, and, we think, the cheapest cure. We have been thus hard upon the lop, as it can only be considered a weed, being an annual grass; and, notwithstanding the high position in which my friend Dr. Voelcker has placed it in Chemistry of Food, in respect

to its feeding properties, which places it among grasses of superior quality, yet cattle will not eat it if they can possibly avoid doing so, and hay is always poor in which it occurs, which is not to be wondered at when the lop, for the most part, elects to grow in the most impoverished soils.

Bromus commutatus we can only view as a variety of *B. mollis*. Its situation is that of low damp irrigated meadows, in which the *mollis* is quite exceptional, though, when it does occur, it assumes the drooping habit of the *commutatus*, and offers many intermediate states. Now, as we have watched the laying out of poor pastures as irrigated meadows, we have observed that two or three years is often capable of changing the *B. mollis*, which was before alone, into *commutatus*. Of course it may be considered that this was in virtue of that law of substitution of one species for another which universally occurs on a change of soil, but we incline to think that much of this where it occurs is due not merely to this cause, but to real change of form, as the result of an alteration of condition and circumstance; and, as regards the grass under consideration, our chain of evidence is nearly complete in establishing this position, when it is stated that the *B. commutatus*, from the irrigated meadows, most certainly in cultivation in my experimental garden, has resulted in some fine examples of *B. seculinus*, a form not before known there, and therefore not liable to have led me into error, as might be the case where the different varieties are wild natives.

That *B. arvensis*, and perhaps other forms, may by cultivation be shown to be varieties of an annual grass, of which *B. mollis* is the common type, is an idea which seems to be countenanced by the protean forms of *mollis* and its congeners.

B. erectus is a perennial brome, very partial to limestone soils, and is one of the commonest grasses on the poor thin oolite brashes, extending along the whole of the Cotteswold chain of hills, from Bath to Chipping Campden; it is no

less prevalent on the chalk range, and the quantity of lime which its ash contains may have something to do with this preference. The per centage of this product (lime) in B. erectus, when compared with some other species, is interesting: we therefore copy it from Mr. Way's *Fourth Report on the Analyses of the Ashes of Plants*:—

	Per centage of Lime in Ash.
Festuca duriuscula (a common chalk species)	10·31
Bromus erectus (upright brome)	10·38
Dactylis glomerata (cocksfoot)	5·82
Alopecurus pratensis (meadow foxtail)	3·90

Indeed as regards lime, out of sixteen species the B. erectus is only exceeded by the following:—

	Per centage of Lime,
Poa annua (annual meadow)	11·69
Phleum pratense (Timothy grass)	14·94

—the first of these always succeeding best on road-scrapings from limestone road-metal, as Bristol limestone, and the latter on alluvial mud-banks from rivers, which is always full of shells. These are facts which, while they show the general correctness of Mr. Way's analyses, at the same time point out their value and importance.

The B. erectus is usually refused by cattle; it is a tall grass, but from growing few culms and long leaves it appears much more productive than it really is. Whatever tends to the improvement of the pasture contributes to its disappearance, and its presence in quantity may be held as a sure sign of poverty of soil, as well as an evidence of its calcareous nature.

AVENA—*panicle* more or less lax; *glumes* thin and membranaceous; *glumels* pointed, adherent to the seed.

In this genus we have two divisions, one of which contains strictly agrarian species, which are doubtful natives, and are perhaps only derived from degenerated corn-oats. The other contains very distinct plants, exclusively belonging to the meadow.

a. *Agrarian oats.*

1.—*Avena fatua*—wild oat—*locustæ* of three florets; *glumels* hairy all over, outer one with a long stout awn bent at right angles, the lower half twisted when ripe.—A.

2. *A. strigosa*—bristle-pointed oat—*locustæ* of two perfect flowers; *glumels* with two long bristly points awned.—A.

b. *Meadow Oats.*

3. *A. pratensis*—*locustæ* of from three to five florets; leaves not hairy, finely serrated; whole plant rigid.

4. *A. pubescens*—*locustæ* of three florets; outer glumel jagged; leaves flat, more or less downy; plants soft and hairy.

5. *A. flavescens*—*locustæ* of three florets, flowers small, yellow, very numerous.

Avena fatua is a grass which almost universally accompanies agrarian circumstances, that is to say, it seldom if ever occurs in a truly wild aboriginal state, but is an attendant upon tillage, and in some soils is a most common and detested weed in various crops, but more especially amid grain, whether of wheat, barley, or oats; sometimes too with beans or seeding vetches, or indeed in any crop which is of sufficient duration to allow it to ripen, and from which it is not eradicated in weeding by the hoe.

It is a tall grass, rivalling the height of the finest cultivated oat, from some forms of which, and especially those with a lax panicle, it is at a first glance not readily distinguishable; however a more careful examination and comparison with the so-called *Avena sativa* enables us to make out the following differences:—

Avena fatua—Wild Oat.

Florets usually three, each armed with a stiff awn, which is bent in the middle, the lower part twisted when ripe; covered, more particularly at the base, with straight harsh bristles; seed small and worthless.

Avena sativa—Cultivated Oat.

Florets usually two, either with or without awns, but straight and less rigid when present than in A. fatua; quite smooth externally, and somewhat tumid from its enlarged seed or grain for which the plant is cultivated.

The experiments about to be detailed were performed with the *Avena fatua*. In the autumn of 1851 we collected some seed of the wild oat, putting it aside for spring planting, and in the spring of 1852 drilled a plot of $2\frac{1}{2}$ yards square with the seed that had been kept during the winter —a fact to be carefully noted, as it forms a first and most important link in our chain of evidence, thus constituting what we shall hereafter revert to as a *cultivative process*. The seed came up well, the plants on ripening were tall and robust, and the grains presented a scarcely appreciable difference from the wild examples, but if anything there might have been a slight tendency to increase in the quantity of flour. The seeds again collected and preserved through the winter were sown in a patch of similar size in a different part of the garden in the spring of the following years 1853-54-55, with little alteration from year to year, though in some examples the following tendencies seemed from the first to be gaining strength :—

1. A Gradual decrease in the quantity of hairs on the florets.

2. A more tumid grain, in which the covering "skin" was less coarse and the awn less stout and straighter.

3. A gradually increased development of kernel or flour.

The seeds of 1855, without selection, were treated through the winter the same as before, and sown in the spring of the present year, the resulting crop, gathered in the latter end of August, presenting the following curious variations :—

	Proportion of each.
1st. Avena fatua, wild oat of the true type, with large loose panicles of flowers, thin hairy florets, with the bent awn twisted at the base	5
2nd. Avena fatua, var. sativa, with loose panicles of flowers, florets quite smooth and tumid, with or without *straight* awns, some few examples slightly hairy towards the base. This is near the potato-oat type	6
3rd. Avena fatua, var. sativa. Panicles more compact, flowers inclining to one side, grains more tumid than 2, quite devoid of hairs, awn straight. These present the type of the white Tartarian oat ..	12

Each of these forms is now separately saved for further experiment, whilst the shed seeds of the plot are left to grow as they would do in nature, with the view of demonstrating the downward progress by the reverse methods to those adopted in the cultivated ones.

We may add here, that in the article *Avena* in *Morton's Cyclopædia of Agriculture*, Dr. Lindley referred to the probability of the wild origin thus demonstrated, suggesting that the cultivated oat is "a domesticated variety of some wild species, and may be not improbably referred to *Avena strigosa*, the bristle-pointed oat, which would become the common oat by a slight alteration of the form and division of its pales and the loss of one of its awns—changes much less considerable than are known to have taken place in other cultivated plants."

The experiments, as far as they have now gone, show us in the clearest possible manner that the *Avena fatua* is the parent of our cultivated oat, and that not only of one but of more forms or varieties produced in the same space of time and by the same series of operations,—conclusions which cannot be other than interesting to the botanist, whilst to the farmer they offer considerations no less curious in theory than important in a practical point of view.

If we can produce the cultivated from the wild weed oat, it follows that the weed may result from a degeneracy of the cultivated form; and this will serve to show how true the instincts of the old-fashioned farmer not unfrequently were, as we remember that some years since a main objection to the growth of oats on stiff lias clays was, that they left behind them wild oats; and all who have had to deal with them as a weed, as not unfrequently occurs on the stiffer lands of the lias, Forest marble, or Oxford clays, may well dread any cause of its increase. As a botanical notion this was never well received, but viewed as impossible by the species-maker; however, actual experiment has at length demonstrated its truth, and it may just be mentioned that a confirmation of this has in the mean time been arrived at

by a different process, which we can now only shortly detail.

On the examination of stray plants of oats from shed seeds, where the year before oats had been the crop, examples are not uncommon with a few hairs at the base of the floret, whilst the awn will be mostly stiffer than those in the crop; and this on thin soils, where wild oat is not usual as a weed. Again on stiff clays, in which the weed prevails, many intermediate forms or degrees of wildness will be observable, perhaps derivable from the cultivated oats brought to the soil in manures.

But further, if we examine oats grown on good oat-lands, we are aware of the following characteristics—a greater weight to the bushel, and a more plump grain with a finer coat and the awns scarcely more than bristles; and, as we know from observation, these qualities are immediately reversed if we sow good oats from a favourable oat-soil in a district unfavourable to the growth of this corn.

Here, then, the result of our experiments and observations is to show that the wild oat by cultivation will yield different sorts of a cultivated or crop oat; so that new varieties, and that direct from the original source, are easily attainable; and also that the cultivated oat may degenerate into the wild form from which it has sprung, and in some soils in a very short space of time.*

A. strigosa, like *fatua*, is in all probability derived from some cultivated form, or, as Professor Lindley has hinted, it may be the wild form from which some cultivated examples have been derived; it is only found as an agrarian, and that very rarely, being more common in Scotland than in England, its place with us being supplied by the *A. fatua*.

Avena pratensis, in the stiff untractable land in which it delights to grow, can only be considered as a pasture weed, which, however, can soon be got rid of by draining and better cultivation; in short, whatever tends to the ameliora-

* In this Report several curious botanical changes which took place as the experiment progressed have not been noticed, as they would unnecessarily burden the subject for the general reader.

tion of the soil will quickly cause it to die out. It is too harsh to be eaten by cattle, so that it is fortunate that it is seldom to be met with in large quantities, being by far the rarer form of the meadow species.

A. pubescens.—Besides its general hairiness, this is well distinguished from the preceding by its very short upper leaves, which, when compared with *A. pratensis*, may be estimated as follows:—

	Proportions of Leaf-blade.	Proportions of Sheath.	Proportions of Leaves of base.
Avena pubescens	1	20	10
„ pratensis	10	25	40

Its habitat is that of light upland pasture, in which it often forms a conspicuous feature, affording, however, but a small weight to the crop from the exceeding lightness of the culms and flowers, and its short after-leaves produce but little to the pasturage; it is, however, a sweet grass in all its stages, and one which is well kept down by depasturing at all seasons. A small proportion in laying down permanent pasture in the upland meadow will hence be not without advantage.

A. flavescens is, for the most part, a denizen of calcareous soils, on which it thrives remarkably well, being, though small, equal in point of produce to most other grasses by which it is surrounded, arising from the weak growth of some commoner and larger species on thin brashes. On this account it is a grass of great importance for admixture in light upland or limestone pastures, as it affords some sweet hay and no less good herbage for grazing—a circumstance which, as Sinclair justly remarks, recommends it to form part of even richer meadows, "and more especially if the land be elevated and without good shelter, as it thrives better under such circumstances than any other;" and animals are very fond of it.

PHRAGMITES—*Panicle* more or less compact; *glumes* and *glumels* finely pointed, the latter very unequal,

Phragmites communis (*Arundo phragmites*) — common reed—is too well known to need description; it grows in abundance on the margins of rivers and pools, and is made available for thatching purposes. In hedgerows and damp places, on clay soil, it will often be found on badly managed parts of the farm, where its great size and stout rhizomes make it a troublesome weed. Draining, however, is an effectual remedy, to which end this and kindred species are often useful, as directing attention to the state of affairs, not only as regards broad extent but in isolated patches.

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