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NEW ZEALAND PRACTICAL HANDBOOKS.

# PASTURE PLANTS AND PASTURES

OF  
NEW ZEALAND



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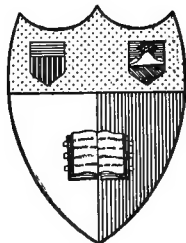
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NEW ZEALAND PRACTICAL HANDBOOKS.

PASTURE PLANTS  
AND  
PASTURES OF NEW ZEALAND

BY

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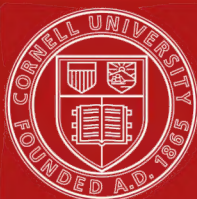
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## PREFACE.

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**T**HIS little volume is published in the hope that it may prove useful to both farmers and students. No other crop approaches grass in importance, and yet in many parts of the country no other crop is so little studied. A good deal of attention has been devoted in the following pages to the means of recognising the various grasses, as it is considered that the ability to recognise the different varieties is the surest way to induce a study of their habits and capabilities. On this study depends the solution of the most important of all problems facing the New Zealand farmer, namely: "What is the best grass mixture to sow on my land?"

F.W.H.

LINCOLN, 1918.

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# PASTURE PLANTS AND PASTURES OF NEW ZEALAND.

## CHAPTER I.

### THE COMMON PASTURE GRASSES.

The majority of the pastures in New Zealand will be found clothed with only some four or five grasses, but in exceptional circumstances some dozen additional species may be found. It is the design of this chapter to describe these grasses so that they may be recognised and named, to discuss their value as fodder, and their suitability to different classes of soils.

In the description of a grass, the leafage is of most importance because that is to be found all the year round, while the flowers can be found for only a short period. The following terms are used in describing the leafy portion of a grass :—The *sheath* is the part in which all the leaves are folded together to make a kind of a stem from which the blades of the leaf spring. The *ligule* is a transparent membranous flap standing up at the junction of the sheath and the blade. Its presence or absence and its shape when

present are very important points in identifying grasses. It can be very plainly seen in Cocksfoot and Prairie Grass for example. The *ears* are a pair of hooked structures springing from the base of the leaf blade and more or less enfolding the sheath. They are very well developed in barley. A *rhizome* is an underground creeping stem, giving off roots downwards and frequently leaves upwards at

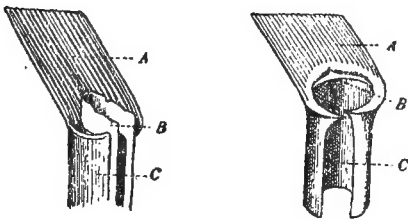


Fig. 1.—A : Base of blade. B : Ligule. C : Sheath.  
Note pointed ears between B and C in the right-hand specimen (after Ward).

or less enfolding the sheath. They are very well developed in barley. A *rhizome* is an underground creeping stem, giving off roots downwards and frequently leaves upwards at

each knot. All grasses with rhizomes are called "Twitches." A *stolon* is an overground creeping stem rooting where the knots touch the ground. A common example is found in the Strawberry, and among grasses, stolons are often found in Creeping Bent. A *spikelet* is one of the small clusters in which the flowers of grasses are arranged. They are familiar objects in the Rye grasses, being the structures on which children count "Tinker, Tailor, etc." In most grasses they are smaller and more crowded together than in the Rye grasses. An *awn* is a hair-like projection from part of the spikelet. Awns are well seen in Italian Rye.

The habits of growth of grasses in New Zealand are often very different from their habits in England, and English books are therefore often misleading in estimating the value of a grass for local conditions.

The following grasses are those commonly or occasionally sown in New Zealand pastures.

**Cocksfoot** (*Dactylis glomerata*). — A strong-growing, broad-leaved, perfectly hairless grass, with a bluish tinge on the leaves. The sheath is strongly compressed so as to have almost cutting edges. Ligule fairly developed and somewhat pointed. Upper surface of the blade practically ribless but with a rather deep groove. Blade gradually tapering to the tip.

This is one of the most valuable grasses used in New Zealand. It is quite permanent, and produces a very large amount of palatable fodder. It can be profitably sown on every class of ground. The only real disadvantage it suffers from is that it dies down almost entirely in winter, at any rate in the South, and starts into growth late in spring. It has, besides this, several fancied disadvantages, which are almost universally held to limit its usefulness. These are that it always grows in tufts, leaving bare ground between the tufts, and that it takes about three years to establish itself, so



that it is useless for temporary pastures. Both of these disadvantages are due, not to the character of the grass, but to the manner of treating it. Cocksfoot is very commonly sown at the rate of three or four pounds to the acre, in a mixture containing 20 or 25 pounds of Perennial Rye. It is no wonder that the Cocksfoot grows in tufts. If a sufficient seeding were applied it would form a turf at least as good as that provided by Perennial Rye. The fact that Cocksfoot usually takes two to three years to establish itself is again due to the thin seeding of this grass in a mixture. The Rye Grass develops earlier in summer and runs to seed. It thus becomes less palatable and the sheep leave it and feed almost exclusively on the Cocksfoot, worrying the life out of the few scattered plants. The wonder is that the Cocksfoot ever becomes established. If it is sown pure (or with Dogstail) at the rate of 14 or 15 pounds per acre, and grazed in the least degree reasonably it will establish itself in the first season. It is not intended by these remarks to advocate the sowing of Cocksfoot pure, but to show that its chief reputed disadvantages belong not to the grass itself but to the method of sowing it. This at least is true, that Cocksfoot is used far too sparingly. Three or four pounds to the acre leads to a waste of money—much more does the sowing of one pound such as one often sees. About 10 to 12

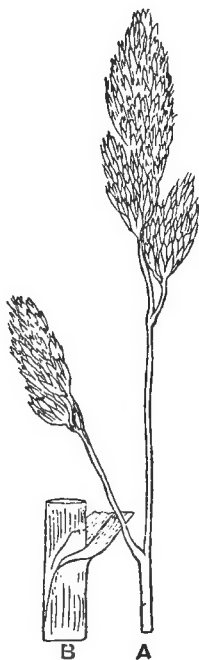


Fig. 2.—Cocksfoot.

A : Flower Head.  
B : Base of blade.  
(after Percival).

pounds to the acre, mixed with Rye Grasses and Dogstail, will give a permanent pasture of great value, but this matter will be referred to more fully under the heading of "Grass Mixtures."

Cocksfoot seed is harvested with the sickle and flail on Banks Peninsula and elsewhere in very large quantities, the average area saved for seed during the last ten years having been 30,000 acres. The seed varies in weight from 12 to 17 pounds per measured bushel, and the price varies accordingly. An average in normal years is about 7½d. per pound. This and all other quotations in this chapter refer to the price of dressed seed as sold by seed merchants to farmers, and no notice is taken of rise in price induced by war and drought.

**Perennial Rye** (*Lolium perenne*).—A rather small grass, distinctly red at the base of the leaf sheath, just below where it enters the ground. Blade and sheath hairless. Sheath



Fig. 3.—Perennial Rye Grass.  
(after Fream).

just underneath the leaves distinctly compressed into an oval shape. This fact is most easily distinguished by gently rolling the sheath between the fingers. Ligule very short and cut off square. Small clasping ears. Upper surface of blade distinctly ridged, lower side shiny.

This is the most popular grass in England and New Zealand, and one of the most valuable. It produces a large amount of feed of high palatability and nutritive value. It thrives

extraordinarily under the trampling of stock, and on roadsides may be seen occupying the land next to the metal, while Cocksfoot thrives nearer the fences, where the trampling of stock is less severe. Rye grass remains green all the winter, and starts growth very early in Spring, being much superior to Cocksfoot in these respects. This long list of good qualities, together with the cheapness of its seed, have led to the very extensive use of this grass, and perhaps it would not be too much to say that 70 to 80 per cent. of the grass seed sown in New Zealand is Perennial Rye. The wide range of utility of this grass cannot be denied, and yet it is quite certain that it is used too widely and without sufficient discrimination. From the list of its virtues given above that of permanence is absent. It is shallow rooted, and on light land with a rainfall of under 30 inches its life is very short, often little exceeding two or three years. Even within this period it becomes thin and patchy, and a paddock is often unprofitable for many months before it is ploughed up. Again, on the heaviest lands, although Rye Grass is permanent there, other grasses such as Timothy and Foxtail will give a much greater bulk of feed. In making up mixtures for the lightest and heaviest lands, then, Perennial Rye should be very much reduced in amount, and perhaps it would be a good thing if it were somewhat reduced in the great majority of the mixtures used in New Zealand. In the Clifton Park system of grassing to which reference will be made later, this grass is entirely rejected on account of its short life and shallow-root system. On heavy lands, and in wet seasons, Perennial Rye tends to be attacked by rust, which causes considerable scouring in stock.

Rye Grass seed is gathered in all the agricultural districts either by means of the reaper and binder, or very frequently by strippers, an average of 50,000 acres of this grass and Italian Rye having been annually saved for seed during the

past ten years. Seed from old pastures is preferred by buyers, as this tends to ensure that the seed has been saved from plants of a truly perennial nature. Poverty Bay seed is in great demand because of this factor. Other named strains are Pacey's, and Devonshire Evergreen, but their vogue in New Zealand is only slight. The seed from old plants tends to be small and shotty, and so the weight per measured bushel is an indication of the age of the plant whence the seed was gathered. Good seed runs about 29 pounds to the bushel, and an average price is 4s. 9d. per bushel of 20 pounds.

**Italian Rye** (*Lolium italicum*).—A stronger growing grass than Perennial Rye. It is similar in all its botanical characters except that the sheath just underneath the blades is round instead of compressed. In the flowering stage a noticeable difference occurs in that the flowers of Italian Rye have the hair-like projections called "awns," which are absent from Perennial Rye.



Fig. 4.—Italian Rye Grass.  
(after Frearm).

Italian Rye produces much more feed than does Perennial, and is very well liked by stock of all kinds. It, however, lasts only one or two years, except on the very heaviest and richest ground when it may become almost permanent. It is sometimes used alone (at about 40 pounds per acre) or with Red Clover, for sowing in Autumn to obtain a

large amount of fresh grass in the Spring, and given a moist and warm Autumn is very successful when so used. It is chiefly employed however, in mixtures, at the rate of about five to ten pounds per acre to give feed during the early part of a pasture's first season, with the idea that as it dies out, more permanent grasses will develop and occupy the space it leaves. About five pounds per acre is usually quite enough. More seed does not produce very much more feed, and is apt to leave the pasture patchy.

The numerous varieties of Italian Rye that have appeared of late years have been only a qualified success. Giant Italian proves a giant only where given good land and plenty of moisture, but is certainly a better strain than some others on the market. Perennialized Italian has no claims to its name, as it lasts little longer than the common strain and is probably less productive. Westernwolph's is certainly a vigorous grower in its first season, and is of great value when it is sown to last only a single season, but its life is too short to allow it to be used in mixtures, for under many conditions it becomes almost strictly an annual.

The seed, like that of Perennial Rye, is gathered with the binder, or occasionally with the stripper. In favourable circumstances yields of 50 to 60 bushels are not uncommon, and the crop then becomes more profitable than wheat. The life of the pasture is, however, always shortened by cutting a crop of seed. Many of the "awns" are knocked off in threshing, and the best of samples do not usually show more than 80 per cent. of awned seeds, while the usual run of seeds has probably less than 50 per cent. of seeds with awns. Such seed is difficult to distinguish accurately from that of Perennial Rye. The average price of the seed is 4s. 9d. per bushel of 20 pounds.

**Timothy** (*Phleum pratense*). — A strong growing grass with a bluish tinge on the leaf. At the base of the leaf sheath under the ground, and just above the roots, is a single or at most two bulb-like swellings. This is very characteristic. The leaf sheath is round and the ligule conspicuous. There are no ears.

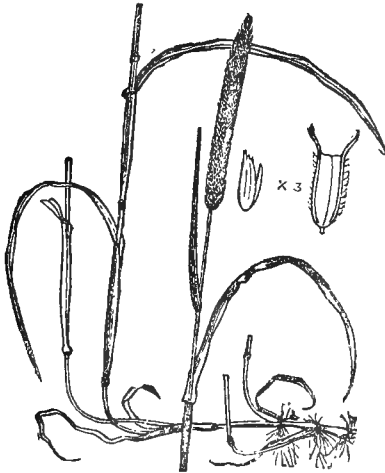


Fig. 5.—Timothy. (after Fream).

Timothy will last for six years or longer depending on the nature of the soil. It thrives best on heavy lands, and will succeed on wet clays where other grasses often fail, or on medium lands with a rainfall of about 30 inches. It is quite unsuited for light soils or dry districts. Under suitable conditions the abundance of feed it produces is hardly excelled by that of any other

grass in cultivation. The fodder is of the greatest palatability especially to cattle and horses. In general it is more a cattle than a sheep grass, just because it thrives best on the heavier soils. It is very economical to sow for several reasons. The seed is small, and there are about 1,100,000 of them to the pound, while in Perennial Rye for instance 240,000 seeds go to the pound. Thus if 28 pounds of Ryegrass is sufficient for an acre, about 6½ pounds of Timothy should be sufficient also. But the seed is rounded and solid, and so is very easily covered too deeply

in the soil. For this reason eight pounds per acre are used when Timothy is sown pure. More usually four or five pounds are sown in mixtures, and this quantity gives a considerable bulk of feed. A striking result often occurs in such mixtures. The Timothy appears to have failed, owing to its great palatability. It is grazed more closely than the other grasses, and therefore escapes notice, until by accident or design a piece of the field is protected from stock. The high productivity of Timothy, its palatability, the cheapness of its seeding, and its relatively long life make this one of our most valuable grasses. On any lands the least inclined to be heavy, or on medium lands with over 30 inches of rainfall, Timothy should replace a large quantity of the Perennial Rye usually shown. The seed costs about 6½d. per pound.

**Crested Dogstail** (*Cynosurus cristatus*). — Dogstail is rather a small grass, much like Perennial Rye in growth. It usually has a faint, but unmistakable yellow tinge at the base of the sheath, just under the ground, and this colour is sometimes more distinctly seen when the outer dead sheaths are stripped off. For the rest it is much like Rye Grass in the ears, ligule and ribs.

Dogstail is a strictly permanent grass on practically all classes of land. The amount of feed produced is rather small—distinctly less than in the case of Rye Grass, and while fairly palatable it is



Fig. 6.—Crested Dogstail (after Frearm).

also highly nutritious. It grows low and dense, and is useful for forming a close turf and filling up spaces between other grasses. While it, of course, thrives best on the heavier soils, it will hold its own indefinitely on all soils but the very lightest, and is therefore of great value in securing permanent pastures on such land. The seed stalks are very wiry, and are unanimously rejected by stock. A very important result of this is that Dogstail ripens its seed even while the paddock is being depastured, unless, of course, the stocking is unusually heavy. Thus the seed is scattered so that new plants occupy all vacant spaces. If a field then is designed for a permanent pasture only a little Dogstail need be sown at first, and it will spread and occupy the spaces left by the shorter lived grasses as the latter die out. For instance a field sown in a mixture containing only half a pound of Dogstail to the acre was found in nine years to be clothed with that grass almost entirely. A pound or so per acre of Dogstail should always be mixed with Cocksfoot in mixtures for permanent pastures for second class lands, as it tends to lessen the bad effect of the tufty nature of that grass under the usual conditions of sowing. Its close growth and turfy habit make it a valuable constituent of lawn mixtures. It is useless for temporary leys as it is somewhat slow in maturing, and as mentioned before of only moderate growth. Growing Dogstail for seed is a feature of the district near Palmerston North. Colonial seed is better than English, which frequently contains dog daisy as an impurity. The normal price of the seed in recent seasons has been about 1s. 4d. per pound.

**Meadow Fescue** (*Festuca pratensis*).—A grass of robust growth, with coarse, stiff, and rather pale green leaves. At the base of the sheath there is a distinct red colouration. The sheath is rounded, but the ears and ligule are



as in Rye Grass. The chief distinguishing character of this grass is the distinct roughness of the upper surface and edges of the blade when it is drawn from tip to base over the tongue or lip. This test needs to be made carefully or blood will flow.

Meadow Fescue is a perfectly permanent grass, suited to medium heavy soils. It produces a considerable quantity of fodder, and is well liked by stock in spite of the coarseness of its leaf. These features make it one of the most admired grasses in England, but in New Zealand it has not proved itself of great utility. It establishes its full growth but slowly, and does not yield its maximum return until two or three years after sowing. When

once established, however, it appears to hold its place long after many other grasses have disappeared. This feature and its excellent English reputation justify wider trials of this grass in different localities where permanent pasture is desired on land of fair quality or with good rainfall. Its past performances in New Zealand, however, do not warrant its being sown in more than experimental quantities. A seeding of about 15 pounds per acre in a mixture should be tried on a small area, rather than a very light seeding on a larger area. The seed is almost entirely of American origin, and costs about 11d. per pound.

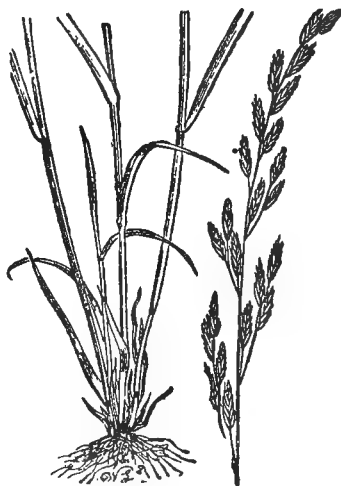


Fig. 7.—Meadow Fescue.  
(after Frearn).

**Tall Fescue** (*Festuca elatior*).—In leaf characters this grass is merely a coarse and robust form of Meadow Fescue, although the two grasses are very different in general appearance. It grows most freely on swampy land where it will form great clumps five feet in height.

As a pasturegrass Tall Fescue is little used. In swamps it is now generally looked upon as a nuisance, though it has done much good in carrying a certain quantity of stock until the swamps were drained. Sown upon hills in districts of sufficient rainfall it grows well, and then assumes much the habit of Meadow Fescue. Its extended use cannot be recommended.

**Chewings Fescue** (*Festuca saburicola*).—

Of all the species similar in growth to Sheep's Fescue, Chewings is the only one at all largely used here, and it will be taken to serve as a type of the whole group. It is a very small, low growing grass, its leaves rarely exceeding 6 inches in length, while they are often shorter, even when fully grown. There is frequently a slight red colouration at the base of the sheath. The leaf is very narrow, and is rolled towards the middle so that it becomes quite like a bristle or a pine needle. The ligule is very small, and is often barely visible. There are two rounded shoulder-like ears, not enfolding the stem, and these give one of the best identification marks of the species (v. fig. 9, p. 17).



Fig. 8.—Chewings Fescue.

- A: Section of bristle-like blade.  
 B: Base of leaf showing shoulder-like ears.  
 C: Flower head.  
 (after Frearn).

Chewings Fescue is an absolutely permanent grass that grows on every class of soil, even the lightest and driest. Here indeed, it appears to thrive better than on better soils, since in the latter case it has

to stand the competition of numerous other grasses, while on dry shingle it reigns alone. This is its chief, if not its only virtue. The bulk of feed produced is very small, and what there is, has a distinctly low palatability. When turned on to plots of various grasses, sheep will, if hard pressed, positively paw up the creeping stems of white clover before they will touch Chewings Fescue. On arable ground it forms a close growing twitch, which ploughs up into solid sods very difficult to work down into a tilth. For these reasons one cannot recommend the sowing of Chewings Fescue except on the very poorest and lightest soils, where nothing else will thrive. Even in such localities it is open to question whether one of the *Danthonias* would not be more profitable, especially if an occasional crop is contemplated; though it is true that the Chewings Fescue will come again after the crop without sowing any seed.



Fig 9.—Base of blade of Chewings Fescue, showing shoulder-like ears B—enlarged. (after Ward).

For lawns, however, Chewings Fescue cannot be excelled. It is fine leaved, dark green, slow growing, forms a close turf that tends to prevent the ingress of weeds, and suffers very little from the ravages of grass grub. The seed is cheap enough to be applied at the rate of 150 lbs. per acre without undue expense, and if this grass is sown pure it will give an infinitely better lawn than many of the elaborate and expensive mixtures usually sold. Of course it has disadvantages. It is somewhat slow to establish itself, and it turns brown unless watered in the height of summer. For the rough sort of lawn that is rarely if ever mowed this grass is quite unequalled.

Chewings Fescue is largely grown in Southland, where it was first accidentally introduced and afterwards separated out by Mr. Chewing. It is extensively saved for seed, which in

normal seasons is sold at about 6½d. per pound. The seed is apt to lose a large proportion of its germination capacity after the first season.

**Prairie Grass** (*Bromus unioloides*). A very strong growing grass, with broad, light green leaves. The sheath is compressed into an oval shape, and is covered with velvety hairs, while the blade is usually quite hairless.

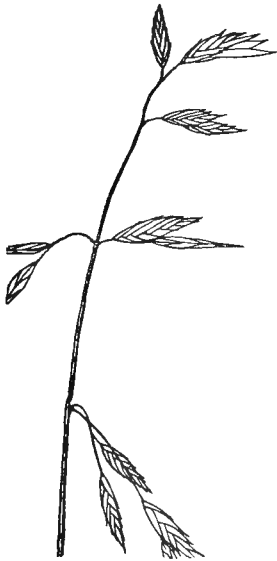


Fig. 10.—Prairie Grass.

Prairie grass produces a great wealth of foliage of the highest palatability to cattle, horses and sheep alike. It starts into growth extremely early in the season, if, indeed, one should not rather say extremely late, for it often produces a great deal of feed in early winter. It has, however, the grave disadvantage that when sown in mixtures it is immediately eaten out. How far this is due to the nature of the grass, and how far to the small amount introduced in the mixture one is not prepared to say. It is true, however, that the grass appears to be permanent along hedges and ditches where the stock cannot easily reach it (though this may be largely due to

self-seeding), and that in one or two districts it is sown pure, and then appears to survive stocking perfectly. If it is sown pure, the stock can be removed when the Prairie Grass is nearly bare ; but if sown in a mixture, it will, owing to its great palatability, be eaten right out while there is still abundance of feed in the paddock. It would, therefore,

seem to be a grass well worth giving a trial under favourable conditions of stocking, especially where winter grass is of great importance.

The seed is very large, and therefore a considerable weight, say 40 pounds, should be sown per acre. Owing to the difficulty of covering the seed when it is broadcast, it should be drilled in 7 in. rows, and then cross-drilled, sowing half the seed at each operation. Some seed is grown locally, and it is always better than the imported article, which often produces plants that suffer from smut. At Mounahaki Experimental Farm a pure strain was isolated by Mr. W. S. Hill, and this has given very satisfactory results from the point of view of increased yield. The seed averages in price 5s. 3d. per bushel of 20 lbs.

**Meadow Foxtail** (*Alopecurus pratensis*).

A strong growing grass with bluish-green leaves growing only on damp land or in moist climates. From the main plant go off rhizomes a couple of inches in length, and the ends of these are upturned and produce leaves. The sheath is round, the ligule short and obtuse, the ribs on the upper surface of the blade are noticeably flat, not sharp. The whole plant is hairless and the leaf has a tendency to roll up on hot days. The dead sheaths at the base have a purplish tinge in their brown.

Foxtail is a permanent grass producing a great wealth of feed. It starts into growth very early in spring. It is highly palatable and improves under stocking, there being several pastures over 40 years old even in so new a country as New Zealand.



Fig. 11.  
Foxtail.

The small rhizomes, while never forming anything like a twitch, enable the grass to obtain a good hold on the ground and to spread slightly as it reaches its full growth. The three striking disadvantages of this grass, that prevent its being more widely sown are as follows: (1) It is suited only to lands where there is always sufficient moisture without water-logging. A heavy rainfall is not essential if the soil has a high water retaining capacity, and on the other hand it will succeed on medium soils with a rainfall approaching 60 inches. The grass is quite useless in light or medium soils where the rainfall is under 40 inches. (2) It takes a year or two to establish its full growth, and therefore is useful for only permanent pastures. (3) The seed is light and fluffy, difficult to sow, and of very low germinating capacity, as a rule not over 50 per cent., and sometimes as low as 10 per cent. Thus many attempts at using this grass profitably have failed. But it is clear that Meadow Foxtail has a distinct sphere of great usefulness, and indeed it is regarded in England as absolutely the best grass for permanent pasture in heavy land—such as drained swamps. In mixtures for such soils Foxtail should always be included, as there are numerous examples of its great success in both Islands of New Zealand.

Seed was formerly largely imported but is now harvested, chiefly by hand, in the Manawatu District. Although this seed is better than that imported from Europe, yet its germination is uncertain, and it should always be tested before purchase. Samples germinating 60 per cent. are good. The seed is bulky, weighing about 10 pounds per bushel, and an average price is 1s. 4d. per pound. European seed is often adulterated, and Colonial seed impure, so that a sharp look out should be kept for worthless admixtures.

**Creeping Bent, Fiorin or Brown Top.**—(*Agrostis alba* and other species).—An exceedingly variable grass, which,

beside the above names, has the following applied to it, viz., Black Bent, Red Top, Waipu Brown Top, and Water Twitch. The grass, as the last name implies, produces creeping stems which in some varieties are subterranean, and in others sprawl over the ground, and strike roots wherever a knot comes in contact with the soil. The sheath is round, the ligule distinct, and the blade tapers regularly from base to tip. There are acute and prominent ribs on the upper side of the blade, and no groove along its middle line. But all these characters are somewhat obscure (except the tapering blade), and while there is no grass easier to recognise, there is none for which it is harder to detail diagnostic characters.

Creeping Bent is a perfectly permanent grass producing a rather small amount of feed which is fairly well liked by sheep—and this seems truer of Brown Top than of the other varieties. It is thought in the North Island to have poor fattening qualities, but this is not at all a universal experience. It thrives best on very wet or swampy soils, but does very well on light soils with a rainfall of 50 inches or over. It becomes established in its first season from seed, but starts into growth rather late in each season. Owing

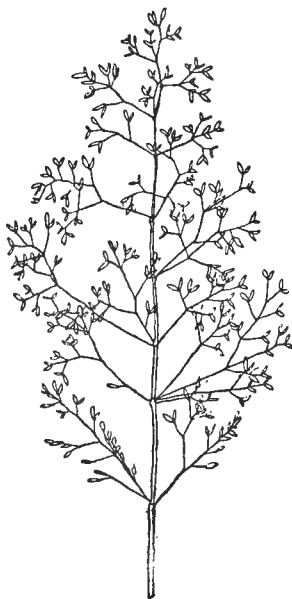


Fig. 12.—Flower head of Creeping Bent. (after Percival).

to its twitchy habit it is never sown in arable land, though it often becomes a serious weed there; on unploughable land of the better quality the twitchy habit tends to cause Creeping Bent to crowd out other grasses and to become sod-bound itself. But on really poor land with a good rainfall this grass is one of the most valuable, and along the foothills of Canterbury its spontaneous spread into the tussock is responsible for greatly increased sheep carrying capacity. In swamps, too, Creeping Bent is of great value as in some circumstances it thrives better than any other grass.

There are a very large number of strains or varieties recognisable, and a useful piece of work could be done in isolating the best of these for varying conditions. The variety known as Waipu Brown Top has a distinct and possibly deserved vogue in some districts. This name, and the American one of Red Top refer to the brownish pink tinge that is very striking when masses of the grass are in flower. Creeping Bent makes a very useful lawn grass, standing a good deal of wear, and making a fine turf not liable to be injured by grass grub. It is therefore almost universally included in lawn mixtures, and could profitably be used in larger proportions.

Some seed is saved in the north and east of the North Island, but nearly all is imported. It is very small and light, and six pounds are sufficient to sow an acre completely. An average price of the seed is 1s. 4d. per pound.

**Poa Pratensis or Kentucky Blue Grass** (*Poa pratensis*).—This grass is usually called by its botanical name in New Zealand, but is often called merely “twitch”—a most indefinite term. It is rather low and creeping, has very distinct rhizomes well developed, a compressed sheath, and leaves of the characteristic “poa” build. That is, they are flat and ribless, but have a pair of fine narrow lines like tram lines running in a shallow depression along



the top of the midrib ; the sides of the blade are parallel to near their top, and then rapidly contract to a point, so that the blade has usually a canoe-shaped tip.

*Poa pratensis* is quite permanent, and produces a close compact turf. The amount of feed it gives is only moderate, but its palatability is high. It is never sown on land intended for cropping, where indeed it forms one of the best known twitches. Though the grass has the very highest reputation in America for permanent pasture—forming the famous Kentucky Blue Grass,

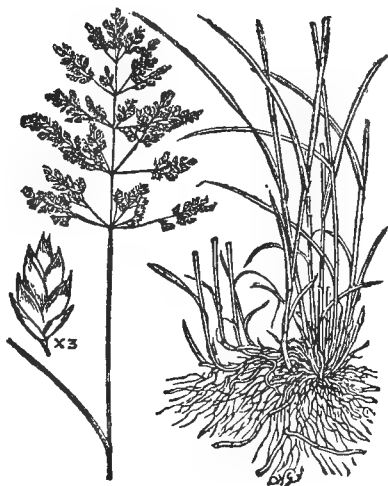


Fig. 13.—*Poa pratensis*, (after Fream).

yet it has here not a wide sphere of usefulness. On light dry lands it does not thrive, and in places where there is much moisture it can be replaced with Creeping Bent ; between these two extremes, however, is a large area of land where *Poa pratensis* might be employed for pastures which are intended to lie down permanently, but this is just the class of land where Cocksfoot thrives. Despite American practice, then, *Poa pratensis* should be used in only small quantities, say half a pound per acre, to form a turf between Cocksfoot tufts. It is a question, however, whether Dogstail cannot do all that *Poa pratensis* can, and at the same time give more feed, and less prospect of subsequent trouble.

The seed is very small and light, and its germination is usually very poor. Any test of its germination capacity should, however, be conducted with the seeds exposed to light. The seed is mostly of American origin.

**Poa Trivialis or Rough Stalked Meadow Grass** (*Poa trivialis*).—This grass is very much like the former in all points regarding its leafy parts, but it never produces rhizomes, and therefore is not a twitch.

It is permanent, but produces only a moderate amount of feed which, however, is of fair quality. It succeeds best in warm moist climates on rather good soil. Here it makes a close sole of grass, and for this reason is more or less regularly used in Taranaki and northern parts of Wellington Districts. It is useful in the same way as Dogstail is, that is, for forming a close turf among taller growing grasses; but while Dogstail combines best with Cocksfoot, *Poa trivialis* finds its best companion in Foxtail.

The seed is still smaller and lighter than that of *Poa pratensis* and its germination better. Seven pounds will completely sow an acre, and therefore it must be sparingly used (about half-a-pound) in mixtures. An average price of the seed is 1s. 5d. per pound.

**Paspalum** (*Paspalum dilatatum*). — This grass also is known by its botanical name. It is of very robust growth, and is practically confined to the northern half of Auckland Province. It has very strong rhizomes, a compressed sheath, and the edges of the ensheathing part of the leaves are fringed with long spiky silken hairs. There is a large ligule with a sparse fringe of long hairs behind it, and the blade of the leaf is cigar-shaped, that is, distinctly broader in the middle than at either end.

*Paspalum* is a permanent grass producing a large quantity of fodder on suitable soils. It thrives only in the warmest portions of the Dominion, since in other

parts it takes most of the summer to recover from the unfavourable effects of the winter, and so produces feed only in Autumn. Even in Auckland this objection holds to a considerable degree, so that *Paspalum* is purely a summer grass.

Rich and heavy swampy soils are most suited to its growth, and in pure swamps it effects a wonderful transformation in a few years, solidifying and binding them, and covering them with a luxuriant growth. Its very strong rhizomes, however, make it quite unsuitable for land which is likely to come under the plough, and the fear has been expressed that there is by far too much *Paspalum* in North Auckland. Foxtail or Cocksfoot would be much more profitable.

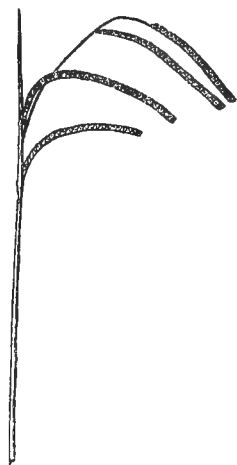


Fig. 14.  
*Paspalum dilatatum*.

The seed is largely imported from Victoria, and owing to its irregular ripening is often of very low germinating capacity. Seed shaken out, not cut, is much better, but of course more expensive. The rhizomes are sometimes planted instead of sowing seed, but the planting method is applicable to only very small areas. Seed sown in Autumn very often lies dormant till next summer, but then germinates quite satisfactorily. The average price is about 1s. 1d. per pound.

**Danthonia** (*Danthonia semiannularis* and *D. pilosa*).—The above two species, which are natives of New Zealand, are confused under the name *Danthonia*, and from the farmer's point of view one description will apply to

both. The grass is low growing, and is of a greyish green colour. It has usually some sparse hairs on the sheath and blade, but its most notable character is a tuft



Fig. 15.—*Danthonia*  
*semiannularis*.

of long silky hairs round the base of the blade near where the ligule appears in most grasses. There is no lateral expansion of the base of the blade suggesting ears, and this last point is necessary to differentiate it from *Microloena*.

*Danthonia* is a perfectly permanent grass, producing a small amount of feed of rather low palatability. In the South Island, therefore, it is usually looked upon as a weed to be burned or ploughed out so as to make room for better grasses. This is especially the case where of recent years *Danthonia* has shown a tendency to spread into pastures whence it was

banished by the plough when the tussock was first broken up. It is there thought to be killing out the English grasses, whereas it is probably only filling up bare spaces caused by the death of the plants unsuitable for permanent pastures. The seed is easily carried in the wool of sheep. *Danthonia* is commonest on dry, clay hills, or stony flats, and has the great merit of being able to thrive in districts too dry to support almost any other grass. *Chewings Fescue* is its only rival in this respect, and of the two *Danthonia* is the less unpalatable, and has the advantage of being easily got rid of if it is desired to bring the land again under the plough.

In the North Island, on the other hand, *Danthonia* is often looked upon as a valuable pasture grass, and is sown either broadcast, or by buying sheep in autumn off *Danthonia* country such as Nelson. On the hills north of Wellington *Danthonia* country is reported to have a carrying capacity of two ewes per acre.

*Danthonia* seed is saved to some extent in New Zealand. It is very light and fluffy, and difficult to sow by hand or machine. The two varieties are mixed in most samples purchased. Where it is possible to buy them separate *D. pilosa* is very much the better variety. An average price of the seed is about 1s. 2d. per pound, but it varies considerably from year to year.

**Rice Grass or Microloena** (*Microloena stipoides*).—This is another native grass. It is rather low growing, has rounded sheaths, and a noticeable tuft of hairs in the position of the ligule. There are sometimes seen properly formed ears, but always at the base of the blade are two expansions different in colour from the blade, and suggesting the bases of ears. The leaf is broad and of a rather light green colour.

*Microloena* is a permanent grass occurring chiefly in the Auckland Districts. It is useful only for poor lands, and indeed is usually sown for only one particular purpose. In some cases manuka when cut and burnt comes up again so thickly as to choke out all the grasses usually sown. It is then that *Microloena* is used, and it is found to resist the manuka to a greater degree than any other grass available. The seed sells at about 1s. 3d. per lb.

**Tall Oat Grass** (*Arrhenatherum avenaceum*).—A tall growing dark-green grass with long and wide but thin and papery leaves. On the upper surface of the leaves the hairs are disposed in lines, as can be seen if the leaf is held with an end in each hand and then looked at lengthways with one eye closed and the other at a level with the blade.



Fig. 16.  
Flower-head of  
Tall Oat Grass  
(unexpanded).  
(after Percival).

Tall Oat Grass has a certain popularity in parts of Europe. In England it is called "French Rye Grass." It grows very quickly and produces a considerable amount of fodder. Further it will withstand the very driest conditions, but it is apparently unpalatable to the highest degree. A horse confined in a paddock of less than one tenth of an acre every day for several years had bared all the ground except that occupied by a few tufts of tall oat grass, which were left to grow in full vigour, and several similar examples might be quoted. However, when forming a constituent of a mixture sheep will eat it, but it is probable that if it were introduced into a mixture in sufficiently large proportions to be of any importance, its unpalatability would make itself apparent in the falling-off in condition of the sheep. Even in France and Switzerland where the grass is largely used, it is recognised that cattle will not eat it green, but when mixed up in hay it is not rejected.

All the seed used in New Zealand is imported. It has long twisted awns like that of wild oats. The price is about 1s. 3d. per pound.

**Canary Grass** (*Phalaris bulbosa*).—A very tall, strong growing perennial grass, with one or more swellings less than the size of a pea, above the roots. From these swellings very numerous branches are given out. The blade is broad, and flat, and bluish, and the ligule one of the longest in our farm grasses, being almost as long as the leaf is wide.

Phalaris is a somewhat recent introduction. It grows very luxuriantly, and makes its chief growth in the winter. During its first season stock eat it greedily, but from the second season onwards so many seed stalks are produced that the grass is less relished. Still it produces a large amount of fodder that is sufficiently palatable. It is often said that Phalaris is difficult to eradicate after being down some years. It is true that if the land is ploughed and only slightly worked the Phalaris will come up again, and the same is true to a certain extent of Cocksfoot. The roots of any strong growing grass will require a good deal of working down before the land is ready to sow again, and incorporating the copious sod of Phalaris with the soil will in many cases be a considerable advantage. It seems therefore that anyone wishing to assist the production of winter feed in permanent pastures should try Phalaris.

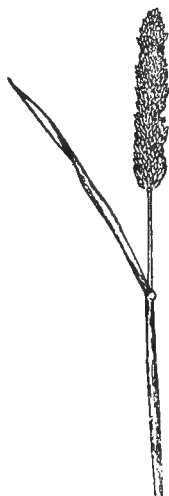


Fig. 17.  
*Phalaris bulbosa*.

The seed is now becoming more plentiful, and sells at about 1s. 6d. per pound.

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#### REFERENCES.

The general characters of the agricultural grasses as grown in England are well described in "Agricultural Botany" by John Percival.

For characteristics of growth of grasses in New Zealand see Cockayne, Journal N.Z. Department of Agriculture, March, 1914.

Elaborate descriptions and beautiful plates of grasses will be found in "The Best Forage Plants," by Stebler and Schroeter, translated by McAlpine.

For the identification of common grasses by the leaves, etc., the best book available is "Grasses," by Marshall Ward (Cambridge Press, at about 5s.)

For Native Grasses Buchanan's "Grasses of New Zealand" is valuable because of its plates.



## CHAPTER II.

### WEED GRASSES AND NATIVE GRASSES.

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#### SECTION I. WEEDS.

It is very difficult to say what grasses are weeds, for what is regarded as a valuable plant under some circumstances becomes a noxious weed elsewhere. A weed is a plant growing out of place, and any grass, no matter how good it is, is a weed if it is occupying ground that would support some better grass. On the other hand, grasses almost universally regarded as weeds become of great utility under special circumstances, and therefore at once lose their objectionable distinction. Several of the grasses mentioned in the last chapter, *e.g.*, Chewings Fescue, *Poa pratensis*, Creeping Bent and *Danthonia* are often regarded as weeds, while some to be mentioned here among the weeds, *e.g.*, *Agropyrum repens*, have a distinct sphere of utility. The terms "weed" and "pasture grass" are therefore only relative to the condition under which the grasses are found.

Occasionally grasses and other plants that are not of sufficient value to sow, come up spontaneously, and occupying spaces that would otherwise be vacant, provide valuable fodder. Such plants are then hardly weeds, but are known as *volunteers*. Examples are *Poa annua* and *Trifolium minus*.

**Twitch or Couch** is a name that is given to any grass with a rhizome or creeping underground stem. Such a grass, once it is in the ground, is very hard to get out, for the instruments of cultivation break and scatter the rhizomes, and each piece becomes a new plant. There are some six or seven twitches common in New Zealand, and frequently

the one that is prevalent in a district is called "Twitch," without any further distinction. This leads to considerable confusion, for different men are calling different grasses by the same name. The following case that occurred within the last two years will emphasise this point:—A prospective buyer of a farm found the land covered with a certain grass. He asked the seller "Is that Twitch?" "Oh no," was the reply, "that's not Twitch, that's Chewings Fescue. There is a patch of Twitch on the place, I'll show it to you," and the buyer was led to a small patch of *Poa pratensis*. An agreement to buy the farm was therefore signed, but on being informed by a friend that the commonest grass on the farm was Twitch after all, the buyer repudiated the agreement, and the seller sought damages therefor, the buyer finally paying several hundred pounds to escape from his bargain. The seller thought of *Poa pratensis* as twitch and the purchaser's friend thought of Chewings Fescue under that name. Hence the trouble. Since the various twitches differ in feeding value, habits of growth, and difficulty of eradication, it is advisable to be able to identify them, and to give them distinctive names. The following seven are the commonest:—

(1) ***Agropyrum repens***.—Twitch or Couch, sometimes called long twitch or white twitch. The rhizomes are very thick and of great length. They will easily penetrate potato tubers. The sheath and blade of the leaf are often but not invariably hairy. There is a pair of clasping ears. No other twitch common in this country has ears. The flower heads are superficially a good deal like those of Perennial Rye, but observation will disclose that while the spikelets of Ryegrass are set edgewise to the stem, those of *Agropyrum* are set broadside on. The general height of the stems is 1 foot or 18 inches, but when growing in a crop of wheat or oats they may reach a height of 3 ft. 6 in. or 4 ft.

This is without doubt one of the most difficult twitches to eradicate on arable land. The great length of the rhizomes makes them very difficult to remove entire from the ground, and when they are dragged to the surface their great vitality makes it very difficult to secure their destruction. On a certain Canterbury farm whose records have been well kept, there is an instance of one side of a particular paddock being worked for twitch in 1886, and intermittently on till 1916—a period of 30 years. In another instance this twitch had been worked out of the ground, raked into heaps and set fire to. After the fires had got a good hold rainy weather set in, and there was to be seen the curious sight of the heaps burning in the middle and on the outside producing a vigorous crop of green blades.



Fig. 18.  
*Agropyrum repens.*  
 Flower head and ears at base of blade. (after Percival)

As with many weeds this grass has some good points. It is undoubtedly relished by stock, as patches of it in a grass paddock are always closely grazed. Then there are two circumstances in which it is advantageous to introduce *Agropyrum*, and both these are cases where an unbreakable turf is the chief requisite in the grassy covering of the soil. On grassed sandhills, where stock are apt to break through the turf and expose the sand,

thus forming holes which the wind may indefinitely enlarge, Dr. L. Cockayne recommends this twitch. Again on race-courses where the hoofs of the galloping horses tend to destroy the turf, *Agropyrum* would undoubtedly give good results. The seed is however almost unprocurable, as even where it occurs, it is very commonly either quite infertile or else destroyed by ergot. The

best way to introduce the grass would be to secure a supply of rhizomes, chop them up and harrow or trample them into the soil.

(2) **Poa pratensis**.—This is also a common twitch: It is described on page 22.

(3) **Festuca saburicola**.—Chewings Fescue is another twitch. It is described on page 16.

(4) **Agrostis alba** is often called Water Twitch, but is better known under the names of Creeping Bent, Fiorin, Red Top, etc. It is described on page 20.

(5) **Holcus mollis**.—Creeping Fog, is one of the worst Twitches we have, but fortunately it is not very common in most districts. It is very like Yorkshire Fog in its over-ground parts, having the same velvety leaf, red and white leaf sheath, and pinkish feathery flower head. Underground, however, it displays thick and strong creeping stems that are very difficult to kill. The leaves are disliked by stock wherever better grasses are available, and on the whole this twitch seems to have no merit of any kind.

(6) **Avena bulbosa**.—Onion rooted twitch. This grass is, above ground, much like Tall Oat Grass (v. p. 27). Below ground, however, it displays a very characteristic structure. There is a string of 6 or 8 onion-like swellings. These are really knots, and vary in size from that of a pea to that of a hazel nut. Each knot is capable of independent growth when broken off from the parent stem. The grass is not really a twitch because it has no rhizomes, and it will not spread at all if it is not disturbed. Ploughs and harrows, however, break up the strings of knots and scatter them far and wide, so that in arable land the grass soon takes possession. It is very difficult to eradicate, for harrows cannot drag the knots to the surface in the same way as they do ordinary long rhizomes. The only way is to continuously cultivate the ground where it occurs, destroying the green

shoots as often as they appear, so as to finally exhaust the plant food stored in the knots. In the circumstances in which it occurs scattered among other grasses *Avena bulbosa* seems quite palatable to sheep, for it never flowers in a pasture, while in a cereal crop its feathery heads may be seen as high as the those of wheat or oats.

(7) ***Paspalum dilatatum***, usually called by its botanical name, is a most decided twitch, and in the northern-most parts of New Zealand is considered practically ineradicable. It is described on page 24.

Beside the twitches, the following eleven grasses are commonly found in pastures and are usually regarded as weeds owing to their low palatability :—

(1) **Yorkshire Fog** (*Holcus lanatus*).—Both blade and sheath are clothed with velvety hairs, and distinct red and white veins are to be seen at the bottom of the sheath. The flower head is pinkish and feathery. This grass is one of the best known, as it occurs in practically all situations. It is, however, chiefly found in moist localities, and in wet land or in damp climates it often becomes the dominant grass in old pastures. Its seed is a common impurity in that of Cocksfoot, and may occur with the husks on, when it appears as a rather broad flat “seed,” or with the husks threshed off, when it is a good deal smaller, light grey and shiny.

Yorkshire Fog is generally considered highly unpalatable and it is certain that it is avoided where Rye Grass, Timothy, or Cocksfoot are available. Still Fog is eaten to a certain extent, and it probably provides more fodder than it is usually credited with.

(2) **Sweet Vernal Grass** (*Anthoxanthum odoratum*).—A rather low-growing grass with a fairly close seed head growing about a foot high. The leaves and sheath are somewhat hairy, and there is a noticeable ring of hairs



Fig. 19.  
Sweet Vernal.  
A: Flower head.  
B: Base of blade.

round the conspicuous ligule. The flower heads are formed so early in spring that this is usually the first grass to be noticed in flower, its only rival in this respect being Meadow Foxtail. The whole plant when cut smells strongly of coumarin, the essential oil to which the smell of new mown hay is due. The hay like smell can usually be observed by chewing the grass, and this often forms a means of identification.

This worthless weed is very widely distributed in the agricultural areas and those near by. Owing to its unpalatability, its early seeding, and its twisted awns it is easily spread by sheep, and seems almost ineradicable without ploughing. It is said that in England Sweet Vernal is sometimes mixed with hay to improve the aroma, but the grass has no utility in New Zealand.

(3) **Goose Grass** (*Bromus hor-  
daceus*).—The name "Goose Grass"

appears to be purely Colonial. In England the common name is Soft Brome, while the term "Goose Grass" is applied



Fig. 20.  
Soft Brome or Goose Grass.  
(after Percival)

to a straggling and climbing road-side weed. *Bromus hordaceus* has a velvety leaf similar to that of Fog but has no red and white veins at the base of the sheath. As it is an annual the flower heads can usually be found either exposed or hidden in the sheath. The flowers have their husks or glumes fringed with white, and are provided with awns that are shorter than the flowers. The grass is almost never eaten by stock, and is universally regarded as a worthless weed. Its seeds are a common impurity of Italian Rye Grass, as the awns on both grasses are of about equal length, but its seed is easily distinguished from that of the Rye Grass by its greater breadth and boat-like shape.

(4) **Hair Grass** (*Festuca bromoides*). — This is again a Colonial name and is applied to a different grass from that bearing the same name in England. Colonial Hair Grass is a fescue with very fine leaves like those of Sheep's or Chewings Fescue. The flower heads stand about a foot high in ordinary circumstances and have narrow seeds with long awns. The excessively fine leaves give almost no feed so that the grass is quite worthless. It is commonest on medium to light soil, and is very widely distributed. When the land is not well packed in the ploughing Hair Grass may actually beat the cereal crops, and will then grow three or more feet high. Its seed, too, is not uncommon as an impurity in that of Italian Rye, and is to be distinguished by being much narrower and longer.

(5) **English Hair Grass** (*Aira caryophyllea*). — This is the grass called Hair Grass in England. Like Colonial Hair Grass it has leaves so fine as to be almost unnoticeable. The flower stalks are only three or four inches high and the heads are pinkish and feathery. The grass usually grows in a mass in old pasture on light land. It is quite worthless.

(6) **Barley Grass** (*Hordeum murinum*). A very well-known weed with hairy leaves distinguished by large clasping ears at the base of the blade. The flower heads stand



Fig. 20A.  
Barley Grass.

about 8 inches high and have very long straight awns like those of cultivated barley. The grass is very widely spread and at mid-summer can be seen to occupy many thousands of acres in a block. It is not troublesome on land under the plough, but thrives in old thin neglected pastures. Its seed possesses remarkable burrowing power, and is used by boys to put up their fellows' sleeves, when the seed or seed heads will travel to the shoulder. In the same way seed getting between the locks of sheep's wool will penetrate the pelt and must cause extreme irritation, while occasionally they may get in between a dog's toes, and piercing the skin, travel upwards through the muscle until they emerge at the elbow. Dogs on barley grass country

should therefore have their feet examined at frequent intervals. That the grass is freely carried by sheep is plainly seen from its prevalence on sheep camps, but it is only very rarely nibbled by stock.

(7) **Barren Brome** (*Bromus sterilis*). — An annual, with drooping heads and very long awns. The blades frequently, and the expansions at the bottom of the blade always, are coloured purple, and the leaves are covered with long hairs. This is a worthless weed common on roadsides or on sandy pastures.

(8) **Floating Sweet Grass** (*Glyceria fluitans*). — This grass occurs only in slow running or standing water, where it may often quite hide the water with its broad light



green leaves. These have almost the "Poa" shape described on p. 22, and are very palatable to cattle, which will often wade up to their girths to reach them. The heads bear a few sausage-shaped spikelets. Regarded as choking up water-courses this grass is a weed; where the free flow of the stream is not important it is a valuable volunteer (v. p. 31.)



Fig. 21.—*Bromis sterilis*  
(after Frearn).

(9) **Annual Poa** (*Poa annua*).—A small annual

grass growing 6 or 8 inches high. It has a distinct poa blade with many of the leaves transversely crinkled. The heads are sometimes feathery. This is perhaps the commonest weed grass occurring in gateways and by roadsides, and also occupying bare spaces in pasture land and lawns. It is much liked by stock and is a valuable volunteer. It is never sown owing to its very short life, which may, at the height of summer, be over in six or eight weeks from the germination of the seed. Its commonness is accounted for by its prolific seeding practically all the year round. In winter time it may often be found providing feed for sparrows and goldfinches.

(10) **Ratstail** (*Sporobolus indicus*).—A perennial, growing almost as a native from Marlborough northwards: sheath slightly compressed; ligule reduced to a ring of hairs; blade tough, finely ribbed, somewhat downwards rough,

hairless except for about half-an-inch at the base where silky hairs occur on the edges ; leaves about 12 in. high ; flower heads 2 feet high, producing a very narrow and long spike like a rat's tail 6 inches long ; the reddish seeds escaping freely

from the husks. This grass is distinctly a weed : owing to the harshness of its blades it is not liked by stock, and when forced to eat it sheep are found to have their teeth rapidly worn out. The grass is still sown in some quantity on the East Coast of the North Island, but that is a practice that should be rigorously discouraged.

(11) **Indian Doab** (*Cynodon dactylon*).—This weed is also called Bermuda Grass. It is common in the warmer parts of the South Island and all over the North occurring as a

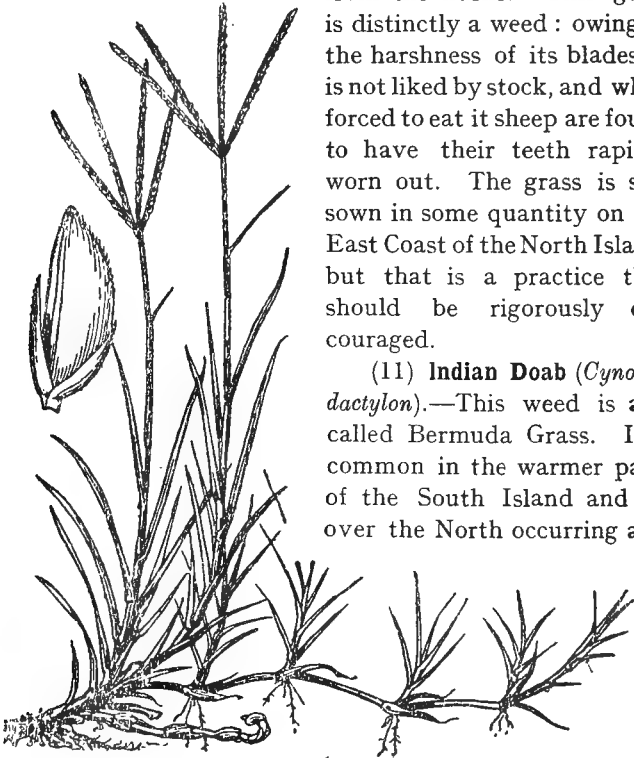


Fig. 21A—Indian Doab.

weed of pastures and roadsides, as well as being purposely included in lawns. It is perennial, deep-rooting, drought resisting, and has long rhizomes or stolons that root profusely. Leaves about 1 inch long but sometimes up to

3 inches ; flat with long taper from base to tip ; downwards rough ; ligule not seen, being replaced by a very strong ring of hairs—the only hairs on the plant ; flower stalks up to 18 inches high, ending in 4 or 5 stiff spikes one to two inches long, on which the spikelets are closely arranged.

This grass is usually a weed, but its drought resistance accounts for its occasional inclusion in lawn mixtures in dry and warm districts.

## SECTION 2. NATIVE GRASSES.

Some of the most important native grasses have been mentioned in Chapter I., but a few others have a certain feeding value and occupy vast areas of land, so that they merit a brief description. The chief ones are as follows :—

- (1) **Danthonia** spp., see page 25.
- (2) **Microloena stipoides**, see p. 27.

(3) **Tussock or Silver Tussock** (*Festuca novae zealandiae* and *Poa caespitosa*).—These tussocks are estimated to cover six million acres of land, or one seventh of all the occupied country in New Zealand. Their yellowbristly leaves are about 18 inches high, and as the name implies, they grow in tufts. The two species are hardly ever separated by the grazier, but the *Festuca* grows on higher country and the flowers have awns, while the *Poa* belongs chiefly to the plains and the flowers are broader and awnless. It seems to be agreed that sheep never eat silver tussock except immediately after it is burnt. Cattle, however, eat it freely, and pull much more than they eat, so that if closely grazed by cattle the tussock is in time exterminated. Rabbits, too, will eat Tussock, but for sheep country, the only suggested use of this grass when unburnt is to shelter other and better grasses. The question of burning Tussock land is dealt with by Cockayne (see reference at end of Chapter V.) and some suggestions for the improvement of Tussock land will be found near the end of this work.

(4) **Blue Tussock** (*Poa Colensoi*).—This is a fine-leaved grass growing either in Tussocks or as a turf among the Silver Tussock. It has a bluish tinge, and its leaves grow about 8 inches high. It is usually considered good sheep feed, but a close examination of the Blue Tussock on land fairly heavily stocked shows that this grass is little liked by sheep. It is nibbled here and there, or may be found closely grazed in patches, but on the whole it is neglected in favour of what one usually regarded as worthless weeds, e.g., Cat's Ear or Cape Weed (*Hypochaeris*).

(5) **Blue Wheat Grass** (*Agropyrum scabrum*). — This grass has broad bluish leaves that attain a height of 12 to 18 inches. The flower head is taller and is distinguished by the spikelets being set broadwise on to the stem and by having long, stiff, gently curved awns. It chiefly grows among the Silver Tussocks and is a valuable sheep feed where it occurs in any quantity.

(6) **Snow Grass** (*Danthonia raoulii*). — This is another Tussock, growing 4 to 6 feet high. It has broad leaves shining below, and feathery oat-like heads. It is found only in high country, though at the southern extremity of New Zealand it may descend to near sea level. Its presence in quantity frequently marks the limit above which it is not safe to carry sheep in winter, and therefore it is almost purely a summer country grass, as indeed its popular name of Snow Grass would indicate. Considering its great size it is freely browsed upon by sheep, and horses are inordinately fond of the seed heads.

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#### REFERENCES,

For Weed Grasses consult Percival and Ward, as mentioned at end of Chapter I.

For Native grasses Buchanan is still the best authority available

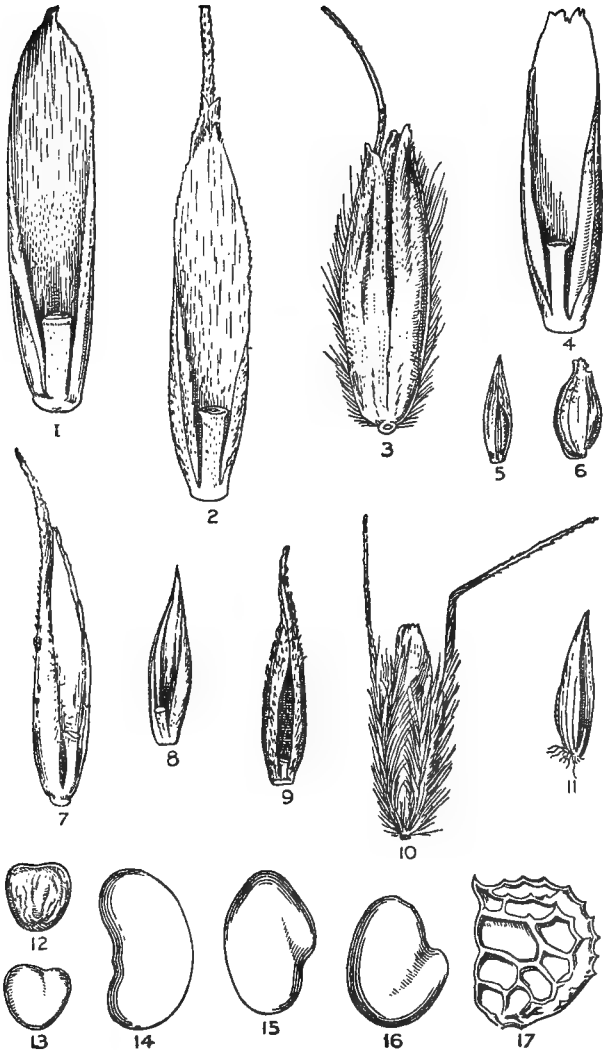


Fig. 22.—Seeds of various grasses and clovers :—1 Perennial Rye ; 2 Italian Rye ; 3 Meadow Foxtail ; 4 Meadow Fescue ; 5 Creeping Bent ; 6 Timothy ; 7 Cocksfoot ; 8 Sheep's Fescue ; 9 Crested Dogtail ; 10 Sweet Vernal ; 11 *Poa trivialis* ; 12 Alsike ; 13 White Clover ; 14 Lucerne ; 15 Another Lucerne ; 16 Red Clover ; 17 Sainfoin. Diagram No. 17 is four times natural size, and all the others ten times. (after Percival).

## CHAPTER III.

### KEY FOR THE IDENTIFICATION OF COMMON GRASSES.

Grasses are scientifically distinguished chiefly by their flowers. However, since the flowers are present for only a month or so in each year, the following key has been constructed to assist in the identification of the common grasses by their roots, stems, and leaves alone, and the recognition of grasses by their flowers has been left to the figures scattered through the preceding pages. In the case of annual grasses, however, the flower characters are used for identification, since the flower can nearly always be found either exposed or wrapped in the sheath. To use the following key it is necessary first to have complete specimens, including a good portion of the root, and next it is necessary to make careful observations, not on a single leaf but on several, before deciding that any particular structure is absent.

Under each of the figures on the left hand of the page in the following scheme will be found two alternatives. Within one or other of these alternatives every grass must fall. When close examination has determined within which of the alternatives the specimen under study is included, follow that line out to the right hand side of the page, where there will be found either the name of the grass, or the figure under which (when appearing on the left of the page) the investigation must be pursued. For instance take Cocksfoot. It has no hairs, no rhizome, no colouration at the base, but it has a strongly compressed sheath. Now turn to the key. Under figure 1 on the left Cocksfoot falls within the second alternative, hairless—and so we run out to figure 14 on the right of the page. Now find 14

on the left of the page and consider the two alternatives. No rhizomes takes us to 19. Here no colouration takes us to 22. At 22 no yellow colouring takes us to 23. Here no swellings at the base leads us to 25. Leaf sheath is compressed so go to 26. Not a "Poa" blade so go to 27, where the total absence of hairs finally identifies the grass as Cocksfoot.

- |  |                      |
|--|----------------------|
| 1. Hairy on leaf, or sheath, or both, or only round ligule   | 2                    |
| Hairless   | 14                   |
| 2. Hairs at least as conspicuous on leaf as on sheath,<br>or chiefly near ligule   | 3                    |
| Hairs long and numerous on sheath; much less con-<br>spicuous on blade   | <b>Prairie Grass</b> |
| 3. Hairs long and silky round ligule, shorter or absent<br>elsewhere   | 4                    |
| Hairs not chiefly round ligule   | 7                    |
| 4. Ligule very small if present at all (see note)  | 5                    |
| Ligule quite obvious, with hairs in front of or behind it.   | 6                    |
| 5. Thick ring or tuft of hairs round mouth of blade.<br>Blade rather narrow, sometimes hairy. No<br>clasping ears                                    | <b>Danthonia</b>     |
| Thin ring of hairs; blade broad and light green;<br>distinct though not large clasping ears  | <b>Microloena</b>    |
| (see note)   |                      |
| 6. Very large ligule; hairs long and silky behind it;<br>strong rhizomes; often a few scattered silky hairs<br>on edges of sheathing parts of leaves | <b>Paspalum</b>      |
| Moderate ligule; hairs round mouth of blade;<br>often hairy elsewhere; no rhizomes; taste<br>suggesting smell of hay.                                | <b>Sweet Vernal</b>  |
| 7. Distinct red and white veins at base of sheath, best<br>seen when sheath stripped backwards   | 8                    |

---

NOTE.—Ratstail and Indian Doab both fall here, as well as *Microloena* and *Danthonia*. See detailed descriptions on pp. 39-40.

- |   |                             |    |
|---|-----------------------------|----|
| No distinct red and white veins   |                             | 9  |
| 8. No rhizomes  | <b>Yorkshire Fog</b>        |    |
| Strong rhizomes—a serious twitch  | <b>Creeping Fog</b>         |    |
| 9. With distinct clasping ears  |                             | 10 |
| With no sign of clasping ears, though there may be present unmistakable rounded shoulder-like projections (v. fig. 9 p. 17)   |                             | 11 |
| 10. With strong rhizomes—a serious twitch   | <b>Agropyrum repens</b>     |    |
| Without rhizomes (an annual, with a barley-like head, usually visible or enwrapped in the leaves)   | <b>Barley Grass</b>         |    |
| 11. Hairs on the blade short and in distinct lines (usually only to be seen by method described on p. 27)   |                             | 12 |
| Hairs long, often velvety, and always quite obvious   |                             | 13 |
| 12. With a string of 3–8 onion-like swellings about the size of peas at the base of the plant   | <b>Onion Twitch</b>         |    |
| With no string of onion-like swellings  | <b>Tall Oat Grass</b>       |    |
| 13. With purple colouring over blade, or at least on the ear-like expansions at base of blade ; an annual ; waste land only. Spikelets with awns about one inch in length | <b>Barren Brome</b>         |    |
| With no purple colouring at ears ; an annual on waste land or in old pastures ; awns about quarter of an inch long  | <b>Goose Grass</b>          |    |
| 14. With distinct rhizomes or sometimes stolons   |                             | 15 |
| No rhizomes or stolons  |                             | 19 |
| 15. With clasping ears  | <b>Agropyrum repens</b>     |    |
| Without clasping ears   |                             | 16 |
| 16. Growing almost exclusively in slow running water ; broad soft blade ; compressed sheath   | <b>Floating Sweet Grass</b> |    |
| Growing on dry land   |                             | 17 |



17. Very fine bristle-like blade ; rounded shoulder-like ears (v. fig. 9 p. 17) **Chewings Fescue**  
Blades of ordinary width 18
18. With Poa blade (v. p. 22) **Poa Pratensis**  
Blade with distinct ribs and tapering from base to tip **Creeping Bent**
19. Distinct red colour on underground part of sheath ; colour brighter when dead sheaths stripped off 20  
No red colouration 22
20. Sheath distinctly compressed just below base of leaves **Perennial Rye**  
Sheath just below base of leaves virtually round 21
21. Upper surface edges of leaves when rubbed downward on lip distinctly cutting **Tall Fescue or Meadow Fescue**  
Leaf only rough, not cutting **Italian Rye**
22. Underground part of sheath with faint but unmistakable yellow colour, both on withered sheaths and on the fresh ones underneath (many specimens may need examination to see this) **Crested Dogtail**  
Sheaths not yellow at the base 23
23. With one or at most two distinct swellings about the size of a pea, at base of sheath 24  
With no swellings at the base 25
24. With one or at most two swellings ; length of ligule less than half the width of the blade **Timothy**  
With one swelling ; ligule almost as long as the blade is wide **Phalaris bulbosa**
25. With leaf sheath compressed 26  
With leaf sheath round 31
26. With Poa blade (v. p. 22) 28  
Without Poa blade 27

27. Quite hairless ; leaf sheath so strongly compressed  
as to have almost cutting edges ; no rhizome  
**Cocksfoot**  
A few spiky, silky hairs behind ligule ; strong  
rhizomes **Paspalum**
28. With Rhizomes 30  
Without rhizomes 29
29. An annual, usually only on waste land ; usually  
flowers all the year round ; about 50 per cent. of  
the leaves transversely crinkled **Poa annua**  
A perennial in pastures ; flowers only in summer ;  
few or none of the leaves transversely crinkled  
**Poa trivialis**
30. Growing on dry land, blades rather narrow **Poa pratensis**  
Found only near slow running water ; broad soft  
blades **Floating Sweet Grass**
31. Blades very narrow, often bristle-like 32  
Blades broad 34
32. An annual, often growing in tufts or waste ground  
or among crops ; awned spikelets nearly always  
exposed or enwrapped in sheaths **Hair Grass**  
Perennials forming a turf in pastures 33
33. With rhizomes which are often weak, but forming a  
very dense mat **Chewings Fescue**  
Without rhizomes **Sheep's Fescue or Hard Fescue**
34. Ridges high and sharp ; no sign of medial groove  
on upper side of blade ; stolons or rhizomes  
present **Creeping Bent**  
Medial groove, if present, very shallow ; no stolons  
or rhizomes 35
35. Dead sheaths at base of plant dark purplish brown ;  
ribs flat ; a broad, shallow medial groove on  
upper side of leaf always present but often indis-  
tinct ; on damp heavy land **Foxtail**

Base of sheaths white or light grey ; thin papery leaf ; medial groove frequently absent ; almost ribless ; examination of numerous leaves usually discloses short hairs in lines on upper side of leaf

**Tall Oat Grass**

---

The common cereals may be identified by the following simple key :—

- |  |               |
|--|---------------|
| 1. With ears   | 2             |
| Without ears   | <b>Oats</b>   |
| 2. With moderate-sized ears, bearing scattered long<br>silky hairs | <b>Wheat</b>  |
| Large ears bearing no hairs  | <b>Barley</b> |

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## CHAPTER IV.

### CLOVERS AND OTHER PASTURE PLANTS.

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#### SECTION I.—CLOVERS AND ALLIED PLANTS.

Besides the grasses treated of in the preceding chapters, there are several other important pasture plants, chiefly various members of the order Leguminosæ or the clover family. Most of these plants have flowers similar in structure to that of the Sweet Pea, although the individual flowers

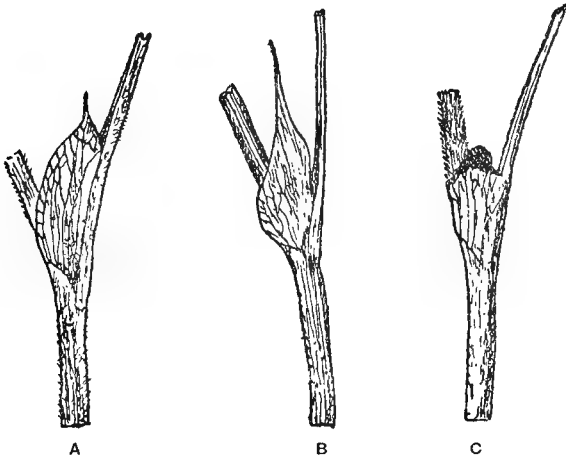


Fig. 23.—Stipules in different varieties of Clovers. (after Percival),

A : Red Clover ; B : Alsike ; C : Crimson Clover.

may be small and crowded together in a head, as in Red and White Clover. The fruit is a pod which may contain many seeds, as in Lucerne, or only one, as in Red Clover, etc. The leaves are divided into leaflets, each leaflet with its

own little stalk. If there are only three leaflets the leaf is said to be trifoliate, and this character is so general among the clovers that their botanical name is *Trifolium*. In other plants of the order there may be five or a dozen leaflets. At the base of the leaf stalk, where it joins the main stem are a pair of structures hitherto unmentioned in this work. They are membranous or leaf-like expansions, always paired, and are called *stipules*. Differences among the stipules are the easiest way of distinguishing between certain clovers when only their leaves are present.

One of the chief characters of plants of the order Leguminosæ is the possession of nodules on their roots. These nodules are usually about the size of Turnip seeds, and may occur singly or in groups up to the size of a hazel nut or larger. The nodules are the result of the action of certain bacteria living in the roots of the plants. These bacteria have the power of causing the free nitrogen gas of the air to combine with other substances to form proteids, which are stored up during the life of the bacterium and remain in the nodules when the bacterium goes into its resting stage. These compounds now form the very kind of food that the clover needs in large quantities, and so they are seized on by the clover, which thus indirectly uses the nitrogen of the air. As an accompaniment of the plentiful and direct supply of available nitrogen, the

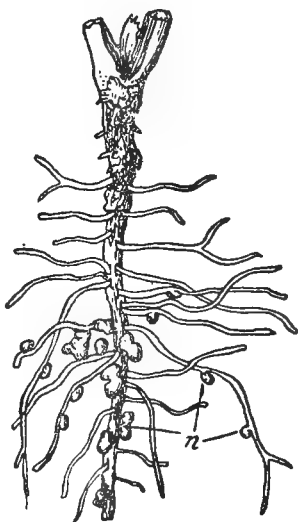


Fig. 24.—Nodules on root of bean.  
(after Percival)

Leguminosæ have acquired the peculiarity of containing in their stems and leaves a much higher proportion of nitrogen compounds than the grasses or the other pasture plants contain. Thus when a clover plant is ploughed into the soil, it actually enriches the soil in nitrogen compounds, seeing that it puts into the soil nitrogen which was originally drawn from the air, and of course the same is true if only the stubble of the clover is ploughed in, or if the clover is returned to the soil as the excrement of animals. Since nitrogen in compounds suitable for food for all other kinds of plants is one of the substances in which soil is very frequently lacking, and since it is most easily supplied by growing clovers and other leguminosæ, this order of plants is of the highest importance. A mixture, or an alternation, of clovers and grasses will allow more grasses to be grown than if the clovers were omitted, and we have at the same time the added feed from the clovers as well. Further the clovers with their higher nitrogen content form a particularly nutritious food for stock, and for all these reasons the plants of this order deserve detailed study in order, if possible, to extend their culture.

The following are those most commonly used :—

**Red Clover** (*Trifolium pratense*). — A strong growing clover ; leaves with three leaflets ; stems ascending, not creeping ; leaves and stems hairy ; stipules terminating in two long points that are usually hairy.

This is one of the most useful clovers. The amount of feed it produces is very large, even its first season, and it is in the highest degree palatable and nutritious. It is largely used for hay, and makes an article of the highest quality. It has deep penetrating tap-roots which work their way down into the stiffest sub-soils, and so have a largely increased space from which to draw food stuffs, especially

water. Red Clover starts into growth fairly early in the season, though it does not grow at all during winter. Its chief weak point is that it usually lasts only about two years and then quite dies out. It is stated, however, that when stocked exclusively with cattle, its life is longer, and that there is distinct evidence that if it were sown pure and grazed judiciously it would last for several years even when grazed by sheep.

Seed is harvested in all the agricultural districts, but the supply is not equal to the New Zealand demand. Much seed comes from Europe, and this is very frequently of a somewhat low grade. The price in normal seasons averages 11d. per pound.

**Cow Grass** (*Trifolium pratense perenne*).—Cowgrass differs from ordinary Red Clover only in that it flowers later in the season, produces its bulk of feed later, and so affords, when mown, only one cut in the season, and in that it will last for six years instead of two. The two varieties cannot be distinguished by the hollowness of the stem or by the number of hairs, as these characters are very variable. True Cow Grass is not obtainable from colonial seed, nor indeed from any one except professional seed growers, because under farming conditions bees cross-fertilize Red Clover and Cow Grass and the result is a hybrid. It follows then that it is not advisable to spend extra money on a sample of seed merely because it is called Cow Grass by the vendor. If, on the other hand, seed were guaranteed to come from a pasture that had been sown say six years that had never been allowed to flower until the season of harvesting, the seed submitted for sale then would be worth much more money than usual, because it would be practically certain to produce a long-lived plant. Such conditions as these are, however, practically never realized.

**White Clover** (*Trifolium repens*).—White Clover has hairless leaves and stems, and the stems are stolons—that is they creep along the ground and root at each node. The leaflets are heart-shaped.

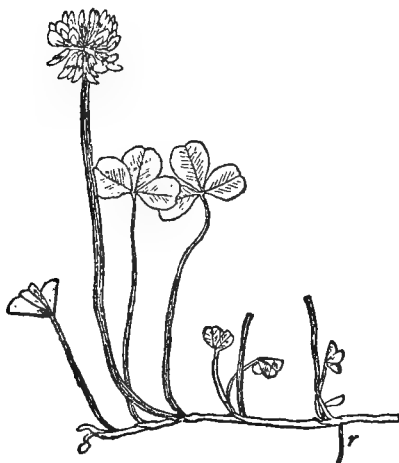


Fig. 25.—White Clover, showing stolon and root (r). (after Percival).

White Clover is one of the most valuable pasture plants we have. Its palatability is of the highest order, though the amount of feed produced is only moderate. White Clover is not strictly perennial, as the original plant dies out in a year or two, but the new plants formed by the stolons carry on its life, and besides this the numerous seeds

produced from new plants wherever there is a vacant space. The seeds have extraordinary vitality, and will pass through cattle uninjured and germinate freely in the dung. Fields that have not borne white clover for many years will produce an abundance of plants if they happen to be under a fallow crop or a late sown cereal crop in a moist spring. In fields, on light or medium lands, where White Clover has once thriven it is quite unnecessary to sow it again, at least for a great number of years, and the custom of sowing a pound or two of White Clover every time a field is laid down to temporary pasture doubtless leads to much waste. For permanent pasture one or two pounds are usually sown. In districts where White Clover thrives very well so that an



occasional crop of seed can be obtained, it pays to sow four or five pounds of seed with practically all mixtures in the hope of getting so thick a strike as to produce a seed crop. Few crops pay so well as White Clover seed if a yield of anything like a sack to the acre can be secured.

Seed is harvested in all the agricultural districts, but much is still imported. An average price charged to farmers is 1s. 2d. per pound.

**Alsike** (*Trifolium hybridum*).—Leaves and stem hairless, stems ascending, not creeping like those of White Clover, flowers pink.

Alsike produces an amount of feed midway between the product of Red and White Clovers. In the heaviest and dampest soils ploughed for pasture it is practically permanent or at least seeds itself, and so may always be found in the herbage. Its palatability is high, and in all respects Alsike ranks as one of the most valuable of our clovers. It is, however, quite impatient of medium or dry soils, and does not last more than two years in such situations. Thus it lasts no longer than Red Clover, and does not give so much feed. But in heavy damp land it flourishes, and should always be included in mixtures for such soils. Where Timothy and Foxtail thrive Alsike thrives too.

The seed is mostly imported, large quantities coming from Canada. It very frequently contains Californian Thistle as an impurity. The cost of seed to farmers averages 1s. per pound.

**Little Trefoil or Suckling Clover** (*Trifolium minus*).—An annual, with slender trailing stems, not stolons; leaflets



Fig. 26.—Little Trefoil and pod.  
(after Fream).

small, heart-shaped ; the midrib not produced into a spike sticking from the niche of the heart ; flowers in small heads, yellow.

Although rarely sown this is a very valuable Clover, often forming the bottom of thin pastures on dry land, and affording one of our best examples of a "volunteer." It seeds itself with great freedom and the seed will pass through sheep uninjured, so that once in a field this plant will recur whenever the weather conditions are favourable. It gives a fair bite in Spring and Autumn, dying down in Winter and in the heat of Summer. It is almost universally distributed where grasses and clovers have been sown, because its seed occurs as a common impurity in that of White Clover. Wherever Little Trefoil is found to be absent from permanent pastures on poor and light land, such as that of the sheep runs of the South Island, it should be surface sown. Two to four ounces per acre would be enough. The seed is on the market, and in normal times sells at about 4d. per pound.

**Strawberry Clover** (*Trifolium fragiferum*). — Much like White Clover in leaves and habit of growth, but the leaflets are a true oval instead of being heart-shaped or narrower at the base. It has the same kind of stolons as White Clover has. When in seed the heads become swollen and compact, then looking much like a strawberry.

Strawberry Clover is quite as valuable as White Clover, and indeed may be depended upon to retain its position in a pasture much more constantly than White Clover will. It has, however, the great disadvantage that its seed is very difficult to harvest and thresh, and is therefore seldom on the market. When it can be obtained by purchase or by hand picking it should be used for permanent pasture on medium lands.

**Subterranean Clover** (*Trifolium subterraneum*).—A rather small prostrate annual, clothed with long spreading hairs ;

stipules broad; the flowers white or pale pink; after flowering the flower stalks turn down and press against or into the soil where the seeds germinate.

This clover is one of the class of volunteers. It produces a certain amount of palatable food and grows even on dry gravelly soils. Its habit of burying its seed secures its permanence in any land it occurs in, and it often becomes a valuable constituent of thin dry pastures. In some places in the Auckland Province it is said to take possession of pastures. The seed is not usually on the market owing to the difficulty of gathering it, but a little of it could be with advantage sown on poor land in permanent pasture.

**Crimson Clover** (*Trifolium incarnatum*).—An erect hairy annual, with broad stipules, red or green veined and not ending in a long point (see fig. 23, p. 50). Flowers bright scarlet on a long rather thin head.

This Clover, while commonly used in Europe and America, is very little sown here. It grows quickly, and in warm climates can be drilled directly on the stubbles of cereal crops to give Autumn feed, or to be ploughed in. In Canterbury where it might be of much use it can hardly be grown because of the uncertainty of Autumn rains. It should never be sown in pastures of even temporary character because its place could be more profitably taken by Red Clover in almost all circumstances.

**Lucerne** is sometimes used as a pasture plant, but is usually employed for forage. Its use in pasture is outlined on p. 78.



Fig. 27.—Crimson Clover.  
(after Fream).

**Black Medick, Non-Such Clover or English Trefoil** (*Medicago lupulina*).—An annual with trailing stems, more or less clothed with short, soft hairs. Leaflets heart-shaped and



Fig. 28.—Lucerne (Note twisted pods).  
(after Fream).



Fig. 29.  
Black Medick (Note spike from end  
of leaflet. (after Fream).

with the midrib produced into a little spike protruding from the niche of the heart. The flowers are bright yellow, and the little one-seeded pods are quite black when ripe.

Black Medick is occasionally sown as a pasture plant in temporary leys. The amount of feed it produces is, however, small, and its self-seeding is not very prolific. Money spent on it would be much better devoted to Red Clover in most cases. On limestone soils, however, Black Medick flourishes, and is one of the best indicators of soils lying on limestone. On permanent pasture in such country Black Medick could be broadcast very profitably if it does not occur already.

**Burr Clover** (*Medicago denticulata*). — An annual with spreading stems, usually quite hairless. Stipules bordered with fine teeth. The pod is spirally twisted, and is edged with two rows of hooked or curved prickles—the whole forming a burr.

This is a volunteer, occurring in scattered localities. The burrs cause little or no inconvenience in New Zealand, while the foliage gives good feed in Spring and Autumn. It is never sown.

**Spotted Burr Clover** (*Medicago maculata*).—Very much like the preceding species

except that the pod is more compact and globular in shape, and that there is usually a dark spot in the middle of each leaflet. It also is a volunteer.

**Sainfoin** (*Onobrychis viciæfolia*).—A perennial of a few years' duration with stems 1 to 2 feet high; stipules brown, thin, finely pointed; leaflets a dozen or more; flowers bright pink.



Fig. 30.—Burr Clover.

(From N.Z. Department of Agriculture, Leaflet 6).

This plant has been largely used in England and the Continent of Europe both as a pasture and a forage plant. It



Fig. 31.—Sainfoin. (after Frearm).

succeeds only on limestone country. Many trials of it in New Zealand have convinced growers that it is not worth bothering about.

**Birds-foot Trefoil** (*Lotus corniculatus*, *L. major*, *L. angustissimus*, and *L. hispidus*).

—These four species may be dealt with together as they have but one common name. They are slender branching plants with bright green leaves of three leaflets. The stipules, however, are broad and like the leaflets, so that at first glance the

leaves appear to have fine leaflets and no stipules. The flowers are large and bright yellow, and the slender pods spread out like the toes of a bird's foot.

*Lotus corniculatus* is a perennial, and establishes very deep and firm roots, which penetrate deep into the sub-soil. The feed produced is plentiful, practically equal to that provided by Red Clover. It is fairly palatable and nutritious. The plant will stand dry conditions excellently, and there is little doubt that it should be given a thorough trial in permanent pastures in medium to very dry soils.

*Lotus major* is also a perennial, but it grows well only in damp, shady situations. It again is fairly palatable, and produces a large amount of feed. Its importance, however, is not so great as that of *L. corniculatus*, because there are many plants that will do well in the only positions suitable

to *L. major*. It might, however, be broadcasted in small quantities in creek beds and gullies, and is somewhat intensively used for bush burns.

*Lotus angustissimus* and *L. hispidus* are annuals with flowers about half the size of those of the perennial species. They have also only about two to four flowers to the head, instead of from five to ten or more. It would seem that these two plants being annuals would not be suitable for permanent pastures, yet they are said to be increasingly popular in the North Island.

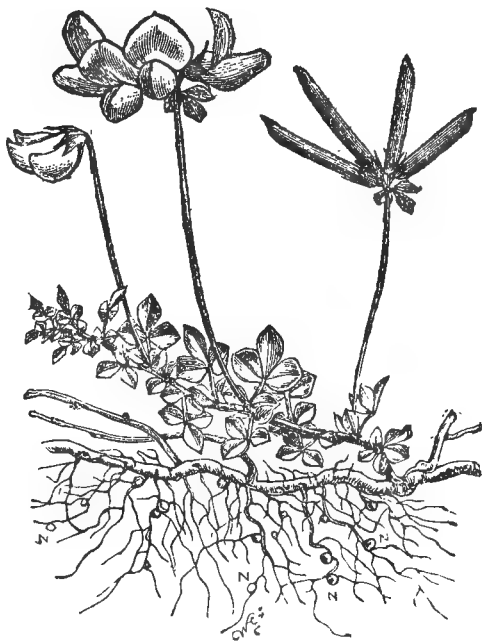


Fig. 32.—*Lotus corniculatus*.  
Common Birds-foot Trefoil. (after Fream.)

**Kidney Vetch** (*Anthyllis vulneraria*) is sometimes recommended for pastures on account of its deep root system. It is, however, practically valueless from either a fodder producing or a sub-soiling point of view.

For figures of certain Clover Seeds see p. 43.

## SECTION II.—OTHER PASTURE PLANTS.

Besides the Leguminosæ there are a few other plants used in conjunction with the grasses to form pastures. It must be remembered that all the Leguminosæ are more important than they look, in that they feed the soil, as well as feeding the stock. This added importance does not belong to the plants about to be mentioned.

**Yarrow** (*Achillea millefolium*).—A well-known perennial plant, with a creeping underground stem, so that it is usually regarded as a troublesome twitch. The leaves are large and are divided into very fine segments, so that they are almost fern-like. When crushed the leaves have a distinctive aroma usually considered pleasant. The flower stalks are two or three feet high, and the clustered flowers are white, pink, or scarlet.

As mentioned above Yarrow is, when it occurs on arable land, considered a twitch. In permanent pasture on second-class land, however, it becomes a somewhat valuable constituent of the herbage. It produces a moderate amount of feed, is quite permanent, tends to fill up vacant spaces, and is highly palatable to sheep. This last fact often leads to its importance being over-



Fig. 33.—Yarrow. (after Fream).

looked. On certain lands then which are unploughable and tend to become bare in dry seasons, so as to be occupied



by worthless weeds, Yarrow can be sown to advantage. The seed is very small, and so a little goes a long way. Its cost is about 3s. 6d. per pound.

**Chicory** (*Cichorium intybus*).—The root is thick, white and somewhat like a parsnip, except that it has no transverse crinkles. The leaf is large, tender, green, and slightly like the leaf of dock. The flower stalks when ungrazed are about three feet or three feet six inches high, and the flower the size of a florin, with a light blue colour.

Chicory is a perennial, chiefly grown for its roots, which are dug and ground to mix with coffee. For this purpose the plant is sown in drills and inter-cultivated, but

two or three hundred acres is all that the Dominion grows each year. As a pasture plant Chicory produces a rather small amount of feed, which is, however, distinctly palatable. The great virtue of the plant lies in the penetrating power of its tap-root. This grows to a depth of two feet six inches or more, and will burst its way straight through the stiffest clays, so that it opens up the subsoil, making its food stuffs and water available to the grasses and other weaker rooted plants. The seed costs about 2s. per pound.



Fig. 34.—Sheep's Burnet.  
(after Fream).

**Sheep's Burnet** (*Poterium sanguisorba*).—A perennial with strong tap-root. The leaves are long and consist of many leaflets, 9 to 19 to each leaf. The leaflets are oval and coarsely toothed. When crushed they smell strongly of cucumber. The

flowers are small, green, and crowded together in a rounded head a good deal like that of the native Piri Piri or bidi-bid.

Sheep's Burnet has been recommended for inclusion in pastures, because it provides a certain amount of palatable feed, and because it has a deep penetrating tap-root that will break up the sub-soil. The penetrating power of its root is, however, not great, and stiff clay pans will turn the root so that it runs along the surface of the pan instead of going through it. In this case Burnet has nothing left to recommend it.

The seed is large and four winged ; each so called "seed" contains several seeds, so that its germination exceeds 100 per cent. Its cost is about 1s. 3d. per pound.

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#### KEY FOR IDENTIFICATION OF CLOVER-LIKE PLANTS.

[An identification should never be made on a single leaf or stem, but these should be examined from several parts of the same plant, or if possible from different plants. For instructions for using this kind of key see p. 44.]

- |  |                          |
|--|--------------------------|
| 1. Plants practically hairless   | 2                        |
| . Plants—stems and leaves hairy  | 11                       |
| 2. Creeping stems rooting at the joints                                  | 3                        |
| Stems upright or spreading, but not rooting                              | 4                        |
| 3. Leaflets round or heart-shaped  | <b>White Clover</b>      |
| Leaflets long, oval in shape   | <b>Strawberry Clover</b> |
| 4. Leaflets 5, or 3 and the stipules shaped exactly like<br>the leaflets | 5                        |
| Leaflets 3, and the stipules quite unlike the leaflets                   | 6                        |

5. Spreading stems—growing in dry situations  
**Lotus Corniculatus**  
 Almost upright stems—growing in damp and shady  
 places **L. Major**
6. Stipules transparent and membranous, veined with  
 green, or at most green over less than half their area 7  
 Stipules membranous only at tip; more than half  
 their area leafy green 8
7. Stalks of the 3 leaflets almost or quite equal in  
 length; leaflets large, growing in damp places;  
 stems ascending; flowers pink **Alsike**  
 Stalk of terminal leaflet three times as long as stalks  
 of basal leaflets; leaflets small; stems ascending;  
 flowers small and yellow **Little Trefoil**
8. With dark spot in middle of each leaflet  
**Spotted Burr Clover**  
 With no dark spot in middle of each leaflet 9
9. Leaflets large and long, oval in shape; toothed on  
 edge in upper half, midrib carried on one-tenth  
 inch to one-quarter inch past bases of lower  
 leaflets **Lucerne**  
 Leaflets heart-shaped or round. Projections of  
 midrib past basal leaflets not nearly so marked 10
10. Pods dense black—as big as a wheat grain  
**Black Medick**  
 Pods yellowish—as big as a hazel nut and spirally  
 twisted **Burr Clover**
11. Leaflets 5, or 3 with the stipules shaped exactly  
 like the leaflets  
**Lotus angustissimus and Lotus hispidus**  
 Leaflet 3, with stipules quite unlike leaflets 12
12. Small spike protruding from niche at end of  
 leaflets **Black Medick**  
 No spike protruding from end of leaflet 13

13. Stalk of terminal leaflet three times as long as the stalks of the basal pair ; hairs usually few ; a spreading yellow-flowered annual **Little Trefoil**  
Stalks of all leaflets nearly equal in length 14
14. Stipules ending in distinct long points 15  
Stipules hairy, but with no long points ; a downy annual with upright stems **Crimson Clover**
15. Plant downy ; annual ; prostrate stems ; flowers turning into the ground **Subterranean Clover**  
Stems upright ; perennial ; flowers purplish red  
**Red Clover**
- 

Some of the Clover-like plants are difficult to identify by the leaves alone, and these may vary in a single species in different conditions, or may be practically similar in different species. Thus at 10 in the above key, identification by leaves breaks down, and the characters of the pods have been resorted to. This matters little in the particular case of the annuals described under 10, as in these cases pods are to be found at almost all times that the plants are above ground.

The following points may assist in some identifications :

**Trifolium**—Stipules usually membranous and transparent over most of their area ; veined or tipped with red, green or purple.

Leaflets with stalks practically all of the same length, except in *T. minus*, where the terminal leaflet has the longest stalk, and so is distant from the basal pair.

**Medicago**.—Stipules usually green and leaf-like over most or the whole of their area.

Leaflets with the terminal one distinct from the basal pair. This is due, not to the extra length of the stalk of

the terminal leaflet, but to the fact that the main midrib of the leaf is carried on past the basal leaflets, and to its end the terminal leaflet is joined by a short leaf stalk.

**Lotus.**—The stipules are like leaflets, so that the leaf appears to have five leaflets, the basal pair being slightly separated from the upper pair.

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#### REFERENCES.

Stebler and Schrøeter, mentioned at the end of Chapter I., deal as fully with Clovers as with Grasses. Percival's "Agricultural Botany" is again useful, and for botanical descriptions Hooker's "British Flora," or Kirk's Students' "Flora of New Zealand" are convenient for beginners

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## CHAPTER V.

### MANAGEMENT OF PASTURES.

Animal products are as a rule more highly concentrated and therefore more valuable than vegetable products, so that while meat may cost sixpence per pound and butter a shilling, wheat costs less than a penny per pound. In an agricultural country, then, far from its markets, so that the cost of carriage is considerable, animal products are likely to be the chief form of agricultural produce. Grass is the cheapest form of animal food, so that we might have expected that in New Zealand with its generally abundant rainfall and mild winters, pastures would occupy a very important place. This expectation is borne out to a striking degree in the following figures :—

TABLE I.

Acreage in grasses and other crops (1910-11):

	North Island	South Island	Total
Natural Grasses ... ..	7,159,558	16,812,678	23,972,236
Grasses Surface Sown ... ..	7,444,191	1,774,324	9,218,515
Grasses Sown after Ploughing	1,728,356	3,271,860	5,000,216
Total Grasses ... ..	16,332,105	21,858,862	38,190,967
Total Crops other than Grasses	441,055	1,606,104	2,047,159
Total Land in Occupation ...	16,773,160	23,464,966	40,238,126

The largely preponderating area under grass, and the further consideration that a grass crop is intended to occupy the ground for at least three or four years, makes

it clear that care in choosing the seed and in sowing the crop is of much more importance than in the case of cereals, or of annual forage crops. In many cases, however, as after bush burns, grass is sown down once for all, and, owing to the unploughable nature of the land no further opportunity will ever occur of renewing the pasture; in this case a right choice of grasses becomes by far the most important problem that the landholder is confronted with. The difficulty of making a right choice of grasses is very great; of two mixtures one may give much more feed than another, but owing to the lack of keeping accurate records of the stock carried, definite information for the guidance of other farmers is not available. Even where accurate records are kept the length of time over which the crop remains in the ground makes the information very slowly available. In the cases of cereals, root crops, or ordinary manures, the trials are very simple. The experiments are in most cases concluded in a single season, and the product of variety or manurial trials can be accurately weighed. Yet in these cases we have often arrived at no definite conclusion as to what is the best variety of wheat, or oats, or turnips, or what is the best manure to use with these crops, in any particular district. What wonder is it, then, that definite information in the matter of choice of seed and treatment of the land in the case of grasses, is almost entirely lacking. Each district follows some established custom, and there is little doubt that in many cases the most profitable grass is not used. One of the most valuable lines of experiment that could be embarked upon would be the sowing down of fields in different districts in different mixtures of grasses, and keeping a record of the stock carried by each plot. The plots, of course, would have to be duplicated to avoid experimental error; each would have to be separately fenced so as to prevent stock from

injuring the grasses by over feeding, and the trial would have to be continued for many years. This kind of thing has been done at Ruakura Farm of Instruction in the case of top-dressing pastures, and the results have given information of the greatest value.

**Temporary and Permanent Pastures.**—Grass seed is sown with the object of producing either a temporary pasture to last from two to six years, or a permanent pasture to last ten years or longer. In the grazing districts, of course, permanent pastures are always aimed at, but in the agricultural areas, it is often considered more profitable to sow mixtures that will last only a few years, but which will give a large bulk of rapidly growing palatable feed; then when the pasture weakens, it is ploughed up, roots or cereals are taken from the land, and a new crop of grass sown. There is little doubt that where mixed farming is possible, this system of short grass leys is the most profitable, though, of course, even here it is advisable to have a certain number of paddocks in permanent pasture, if only because the fields laid down permanently are off one's hands, so that more care and time can be given to securing the best returns from the rest of the farm. The temporary pasture does, if the varieties are wisely selected, give feed that is greater in quantity and higher in nutritive value than would be produced by a permanent pasture during the same season. But a proper selection of grasses to be sown needs considerable knowledge and experience. The peculiar advantage of a temporary pasture is lost if any slow maturing grasses are sown in the mixture, and the chances of securing a successful permanent pasture are much reduced by the inclusion of any considerable proportion of short-lived grasses. To secure the best results it is necessary to make a sharp distinction between the two types of grass land. This is contrary to the prevailing practice in our agricultural



areas where it may be stated, with a rough approximation to the truth, that fields are usually laid down in pasture to stay in this condition as long as they will do so, and then they are put in root crops and cereals largely as a preparation for a new grass crop. Therefore the mixtures usually sown are such as will give a high yield of fodder in the first two seasons, and other grasses are included in less amount on the chance that they may establish themselves and so persist for five or six years. It is contended here that this is unsound practice, that in the first year or two the slow maturing grasses are occupying the land unprofitably, and that in the later years, the bare spaces left by the short-lived grasses are pure waste. A field laid down in :—

Italian Rye	6 pounds
Perennial Rye	8 „
Cocksfoot	2 „
Timothy	6 „
Meadow Fescue	4 „
Red Clover	2 „
White Clover	1 „

and thus containing long and short-lived grasses in about equal proportions, was found three years from the date of sowing to contain 39 per cent. of bare land, all the Italian Rye and Red Clover, and much of the Perennial Rye having died out. In this field 39 per cent. of the rent and taxes, cost of maintenance, and initial cultivation were all being lost. If no Cocksfoot, Timothy, or Fescue had been sown the pasture would certainly have been ploughed after its second year and a new sole of grass provided for. In the adjacent half of the same field 14 pounds of Cocksfoot were sown and both Rye Grasses were left out, and in this part of the field there were only 16 per cent. of bare spaces. A seed mixture designed to produce the advantages of both temporary and permanent pasture rarely gives economical results.

The chief weakness of temporary pastures has been pointed out in the preceding paragraph, namely that they tend to become thin and unprofitable before they are ploughed up. This weakness is particularly serious where cows are kept, for the stock loses condition during the Winter so that they are unable to take advantage of the flush of feed provided in the Spring and Summer. If the system of sowing short-lived grasses is to realize its full profit one must keep the plough going hard, as is done specially in some parts of the Waikato, where Italian Rye or Westernwolths is sown definitely for a single season, and then the land reploughed.

**Sowing Pure or in Mixtures.**—The question of sowing grasses pure or in mixtures is one of the greatest importance. In Europe and New Zealand the sowing of mixtures more or less elaborate has been the almost universal custom. For instance, in England, for permanent pastures at least a dozen species are sown together, and in many cases in sowing New Zealand bush burn, as many as eight or nine grasses and clovers are mixed. In the United States, on the other hand, grasses are sown practically pure. Both customs have strong and weak points. In mixtures there can be included plants that mature in their first year, and then die out, giving place to the more vigorous growth of the perennial species. There can be included grasses providing a large amount of food early in Spring, and others that come on later in Summer. There can be included strong growing tufted grasses, and others with turf-forming habits to fill the spaces between the tufts. Thus in ideal conditions the pasture will provide feed in all the years of its existence, at all seasons of the year, and the ground will be completely covered. Further, the mixture of grasses and clovers allows for more vigorous growth for each, and at the same time provides more palatable feed for stock. On the other hand pastures laid down on these lines

require much more careful treatment than our customs favour. If sheep are put on the field in its first year, our almost universal custom, the slower growing grasses are trampled out, and the more palatable ones are eaten out. If on the other hand cattle are put on, the ground being soft becomes poached. Such pastures should be shut up for hay until the ground is firm, then grazed by cattle so that only the rankest grasses are eaten off, and not until the slowest grasses are well established should sheep be put on the land. This treatment is almost impossible under our system of farming, and as a result we lose from our mixtures the grasses slowest to mature, and especially those that are most palatable. The grasses slowest to establish themselves are usually those of permanent habit, and thus the best grasses are lost from the mixture, and after the short-lived grasses are gone, we get a field more or less occupied by bare patches, or inferior grasses, or sundry weeds. This is largely the explanation of the failure of Cocksfoot to establish itself when there is sown say three pounds of Cocksfoot with twenty pounds of Perennial Rye, and of the failure of Prairie Grass to stand stocking. It may be taken as certain that it is waste of money to include a small quantity of a highly palatable grass with a large quantity of one less palatable. Such a field will appear to have plenty of feed, because of the quantity of the less liked grass present, and so the stock will be left on it, while in reality the more palatable grass is being eaten so bare that it will never recover. It is often the case that the less of a grass there is obvious in a field sown down in a mixture, the better that grass is. Instances of this are common. In a mixture of Chewings Fescue and Cocksfoot the Cocksfoot will be eaten right out and the Chewings Fescue left to occupy the land, or in a mixture of Timothy and Ryegrass the Timothy will be hardly apparent except upon the closest investigation. In fields sown in mixtures

it is often a wise plan to enclose a patch of land in a triangle of wire netting, say two or three yards on the side, so that the grasses that are growing best may be observed. Where grasses are sown pure none of these difficulties is encountered. Grasses that mature in their first year may be put in one field and those that mature later on in another field ; winter grasses in one field and summer grasses in another, and so on. In fact the mixture of grasses is on the farm, and not in each paddock. The total product of grass will be greater, and the management of each field much easier. It is not meant to suggest by this that one variety should be sown strictly by itself, but that grasses of only one habit should be sown together. For instance Italian Rye and Red Clover might be mixed, but to mix a little Foxtail with a large quantity of Italian Rye would in many cases be to waste the Foxtail. The plan here suggested is of course suitable only to those farms that are divided into suitable paddocks.

Whatever may be thought of the relative merits of sowing seeds pure and in mixtures, it cannot be denied that to sow the same mixtures in all classes of ground in any district is unwise. And yet that is an exceedingly common practice. Where land runs from light shingle to heavy swamp in the same district one finds the same mixtures used on both soils. And in surface sowing bush burns the same mixture is often sown on the dry sunny faces and in the dark damp gullies. Much study of the behaviour of the different grasses under different conditions is still needed, and the information we require cannot be obtained until careful experiments are made on the lines suggested earlier in this Chapter. In the meantime it is well to note that the grass that does best on any land is the best grass for that land. This may seem a truism, but it is one whose teaching is often neglected. If the headlands and roadsides run to Cocksfoot or Rye Grass, or *Danthonia* or Timothy, then that is the grass that will succeed best if sown down for permanent pasture.

**Cost of Seed.**—The cost of grass seed for various mixtures is very often given a place of too much importance in deciding upon the mixtures to be used. If one mixture cost 10s. per acre and another cost 20s. per acre, the resultant feed does not need to be double as good in the latter case to pay for the extra expenditure. The cost of clearing or cultivating, the cost of fencing and maintenance, the rents or interest and the rates and taxes remain the same whether a good sole of grass or a bad one is secured. Let us take an instance from agricultural land valued at £30 per acre. There the cost of a crop of grass to last four years is roughly as follows:—

	£	s.	d.
Rent or interest, 4 years, at 30s. per acre	6	10	0
Taxes, rates, etc., 4 years, at 6s.	1	4	0
Maintenance—hedges and ditches, etc. at 1s.	0	4	0
Cultivation and sowing, say*	0	6	0
Seed	0	10	0
Total	£8	4	0

Now suppose the seed cost 20s. instead of 10s. the cost of the crop will be £9 4s., that is an increase under 6 per cent. Thus, though the increased cost of seed is 100 per cent. the increased cost of the crop is only 6 per cent., and it must be a poor selection of grasses that will not, for double the money, yield 6 per cent. more feed. It is from this point of view that one should not hesitate to use good varieties, good seed, and sufficient of it, when laying land down to grass even for a short ley. For permanent pasture the argument is infinitely more cogent.

**Weight of Seed.**—Grass seeds vary greatly in the number of seeds that go to a pound as well as in their average germination capacity. Thus the amount of seed required to sow an acre varies greatly also.

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\* Most of the cost of cultivation will be debited against the crop (oats, rape, etc.) with which the grass is sown.

The following table mostly taken from Cockayne (see reference at end of Chapter) gives the approximate number of seeds per pound in the different varieties. This table will be found strikingly different from the tables given in European works, but it is, of course, a record of the character of the seeds that are on the New Zealand market. The figures are only averages, various samples departing greatly from the means here recorded.

TABLE II.

	No. of Seeds per pound.	Average germination %	No. of living Seeds per pound.	No. of pounds average seed to completely sow 1 acre.
Perennial Rye ...	240,000	80	192,000	28
Italian Rye ...	270,000	80	216,000	25
Cocksfoot ...	540,500	70	378,000	16
Dogstail ...	900 000	75	675,000	10
Timothy ...	1,100,000	90	990,000	8
Foxtail ...	650 000	55	357,000	17
Meadow Fescue	220,000	80	176,000	31
Chewings Fescue	540,000	75	405,000	14
Poa pratensis ...	2,000,000	40	800,000	12
Poa trivialis ...	2,400,000	60	1,440,000	7
Creeping Bent...	3,000,000	70	1,750,000	6
Danthonia pilosa	550,000	60	330,000	18
D. semiannularis	950,000	60	570,000	12
Prairie Grass ...	40,000	90	36,000	40*
Paspalum ...	440,000	25	110,000	54
Red Clover ...	220,000	90	198,000	27
White Clover ...	650,000	85	552,000	11
Alsike ...	600,000	90	540,000	12
Birdsfoot Trefoil	800,000	70	560,000	12

\*Drilled as oats are : 20 lbs. sown first and 20 lbs. cross drilled.

In the last column are given the number of pounds necessary to completely sow an acre with average commercial seed. The figures are based on the quantities of seeds sown in the mixtures commonly used in the country, from which it is found that from five millions to ten millions living seeds are sown per acre. For instance the following are typical mixtures, one of Canterbury fields and one of Auckland bush burns.

TABLE III.

Mixture.	No. of Seeds.	Mixture.	No. of Seeds.
Perennial Rye 16 lbs.	3,072,000	Perennial Rye 10 lbs.	1,920,000
Italian Rye 5 lbs.	1,080,000	Italian Rye 4 lbs.	864,000
Red Clover 3 lbs.	594,000	Cocksfoot 8 lbs.	3,024,060
White Clover 1 lb.	552,000	Dogstail 1 lb.	675,000
		Timothy 1 lb.	990,000
		Poa pratensis $\frac{1}{2}$ lb.	400,000
		Poa trivialis $\frac{1}{2}$ lb.	720,000
		Red Clover 1 lb.	198,000
		White Clover 1 lb.	552,000
<b>Total 25 lbs.</b>	<b>5,298,000</b>	<b>Total 27 lbs.</b>	<b>9,343,000</b>

In the last column of Table II. then, the calculations are based on the assumption that five millions of the large seeds up to 12 millions of the smallest are necessary to sow an acre. The smaller seeds are more easily buried, or their tiny plants more easily destroyed, and thus in practice greater quantities of these seeds are sown than their number to the pound would necessitate. Since these seeds are never sown pure, and since conditions vary immensely, the figures in the last column are to be taken merely as an indication that in general the quantities of different seeds required for an acre vary greatly, and that certain seeds are much more economical in use than others are.

**The Clifton Park System.**—This system of laying land down to temporary pasture was devised by Elliot, for the purpose of renovating or improving dry upland pastures with thin soil and hard clay subsoil, the soil being either naturally poor in organic matter, or impoverished by over much cropping.

In New Zealand there are large areas of land with thin soil, poor in humus and underlaid by stiff clays, and it is probable that the application of Elliot's principles may bring these lands within the limits of cultivation and largely increase their productivity. If a soil is poor in humus this may most quickly and cheaply be supplied by growing grasses that produce a thick and bulky turf, which, while they support stock well during their growth, enrich the land in organic matter when the turf is ploughed under. For this purpose the Rye Grasses, with their shallow root systems on poor land, are quite unsuited, but Cocksfoot is eminently adapted for the purpose. The habits of *Phalaris bulbosa* suggest that it too would give satisfactory results, but so far as we know it has not yet been used for the purpose here discussed. The supply of organic matter may be further augmented, and the stiff subsoil broken up at the same time, by the use of plants with deep penetrating tap-roots. These not only enrich the surface soil by conveying water and food supplies from the subsoil upwards, but by their bursting action tend to increase the depths to which the tender roots of the grasses may go. Of such plants Chicory is one of the most profitable. It provides a moderate amount of very palatable feed, and its roots, which are bulky, will burst through some of the hardest clays. Lucerne too might well be employed. The extraordinary penetrating power of its roots is well known, and while it is impossible to secure a close crop of lucerne under heavy grazing, yet a few scattered plants will always persist in a pasture, where their strong



growth is attested by the thickness of the roots seen at the next ploughing. Success nearly always follows the use of these plants on poor soils underlain by clays. When broken out of their present grass they might be put in rape, or turnips followed by rape, and then sown in Cocksfoot, about 15 pounds, Chicory say 5 pounds, and Lucerne 3 pounds, or if it is preferred, the Cocksfoot may be sown quite pure. On a small area it would be worth trying *Phalaris bulbosa* at say 8 pounds per acre to replace one-third of the Cocksfoot, but this should be tried on a purely experimental scale at present.

Two objections are levelled against this plan of grassing, one by those who have tried it and one by those who have not. Some who have tried the plan find that several plants recommended by Elliot are not suitable for New Zealand conditions. This is quite true, since Meadow Fescue does not succeed on light dry soils, Tall Oat Grass is not palatable, and Sheep's Burnet and Kidney Vetch are not capable of penetrating our stiff clay subsoils. While all this is true the method as modified by colonial experience remains of great value, and Cocksfoot, Chicory and Lucerne have proved themselves. The objection made by some who have not tried the system is that the Cocksfoot will not carry sufficient stock to be payable during its first few years. This, as pointed out before, is a pure fallacy, based on observations made on the growth of Cocksfoot when sown in mixtures with Rye Grass. One can say with assurance that Cocksfoot sown pure will carry, even in its first year, though not so early in its first year, as much stock or more than the ordinary Rye Grass mixtures, and its superiority increases with time. In South Taranaki a field of Cocksfoot sown pure, 15 pounds to the acre, was 18 inches high, and ready to be cut for hay seven months from sowing. At Lincoln a field was laid down in seven plots of about

two acres each. One plot was almost pure Cocksfoot, 14 pounds per acre, and in its first season both cattle and sheep crowded on to it, so that it carried more than any other plot. It has still, after three years, much the best sole of grass. In another field a bag of Cocksfoot was sown pure by mistake, while most of the paddock was sown in an ordinary mixture. It was never noticed that the Cocksfoot side of the paddock carried less sheep than the other part, and the Cocksfoot side is now, after three years, much the best. In South Canterbury, on light land, 10 acres in a 50 acre field were sown in Cocksfoot pure, with the idea of saving it for seed. From its first to its third year it was estimated that the 10 acres of Cocksfoot carried more sheep than the remaining 40 acres of the paddock, which were sown in a Rye Grass mixture. The ploughing up of the part not in Cocksfoot terminated the experiment.

It appears likely that the adoption of Cocksfoot and deep rooting plants may materially increase the stock carrying capacity of much of our poorer lands, and at the same time the soil may be permanently enriched in humus by the ploughing in of a thick turf, and deepened by the opening up of the subsoil. A system promising so great a reward is well worth a trial.

**Grass Mixtures.**—The characters of the various grasses and clovers have been sufficiently described in Chapters I. and IV. From this information may be deduced suitable mixtures for different leys on different classes of land, and it would be much the most satisfactory plan to leave the matter at that, so that each farmer might work out the grass mixture most suitable for his own conditions. For the sake of definiteness, however, there are appended hereto tables showing the mixtures usually employed, and some mixtures suggested for trial. The main differences between these suggested mixtures and those in common use are (1) the

greater distinction between mixtures intended for temporary and those intended for permanent pastures; (2) the greater distinction between mixtures intended for different classes of land; (3) the omission of small quantities of many grasses; (4) the much greater use of Cocksfoot and the lessened use of Perennial Rye.

It cannot be too strongly emphasised that these suggestions are merely for generalised conditions, and that in every particular circumstance some modification will almost certainly be necessary.

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TABLE IV.

GRASS MIXTURES USUALLY EMPLOYED.

**For 3 to 6 years :—**

Perennial Rye	..	16 pounds per	acre
Italian Rye	..	5	„
Cocksfoot	..	3	„
Red Clover	..	3	„
White Clover	..	2	„

**For Permanent Pasture :—**

ON LIGHT TO MEDIUM LAND.

Perennial Rye	..	12 pounds per	acre
Italian Rye	..	4	„
Cocksfoot	..	8	„
Dogstail	..	1	„
Red Clover	..	3	„
White Clover	..	2	„

## ON HEAVY LAND.

Perennial Rye	..	10	pounds per acre
Italian Rye	..	4	„ „
Cocksfoot	..	8	„ „
Dogstail	..	1	„ „
Timothy	..	1	„ „
Poa pratensis	..	$\frac{1}{2}$	„ „
Poa trivialis	..	$\frac{1}{2}$	„ „
Red Clover	..	1	„ „
White Clover	..	1	„ „

TABLE V.

## MIXTURES SUGGESTED FOR TRIAL.

NOTES.—1. Medium soils with rainfall of over 40 inches would best be treated as heavy soils.

2. Where a fine tilth has not been obtainable the quantities of seed must be increased proportionately. Climates or seasons unfavourable for working the land may demand an increase of up to 50 per cent. in the quantities indicated below.

**For 1 year :—**

## LIGHT TO MEDIUM SOILS.

Italian Rye	..	20	pounds per acre
Red Clover	..	5	„ „

## HEAVY SOILS.

Italian Rye	..	20	pounds per acre
Red Clover	..	5	„ „

**For two or three years :—**

## LIGHT TO MEDIUM SOILS.

*	{	Italian Rye	..	7	pounds per acre
		Perennial Rye	..	13	„ „
		Red Clover	..	3	„ „

\* See foot-note on page 84.

## HEAVY SOILS.

*	{	Italian Rye ..	3	pounds per acre
		Perennial Rye ..	10	" "
		Timothy ..	4	" "
		Red Clover ..	3	" "

For three to six years :—

## LIGHT AND MEDIUM SOILS.

*	{	Italian Rye ..	3	pounds per acre
		Perennial Rye ..	4	" "
		Cocksfoot ..	12	" "
		Red Clover ..	4	" "

## HEAVY SOILS.

*	{	Italian Rye ..	4	pounds per acre
		Perennial Rye ..	4	" "
		Timothy ..	6	" "
		Red Clover ..	3	" "
		Alsike ..	2	" "

For permanent pastures :—

## LIGHT SOILS.

*	{	Cocksfoot ..	14	pounds per acre
		Red Clover ..	5	" "
		Lotus Corniculatus ..	3	" "
		Dogstail ..	1	" "

## MEDIUM SOILS.

*	{	Cocksfoot ..	14	pounds per acre
		Red Clover ..	5	" "
		Dogstail ..	2	" "

\* See foot-note on page 84.

## HEAVY SOILS.

† Foxtail	..	7	pounds per acre
Cocksfoot	..	3	„ „
Timothy	..	3	„ „
Alsike	..	5	„ „
Perennial Rye	..	3	„ „
Italian Rye	..	3	„ „

## HEAVY AND WET SOILS.

† Timothy	..	3	pounds per acre
Foxtail	..	10	„ „
Creeping Bent	..	3	„ „
Alsike	..	5	„ „
Perennial Rye	..	3	„ „

## BUSH BURNS.

† Perennial Rye	..	5	pounds per acre
Italian Rye	..	3	„ „
Cocksfoot	..	10	„ „
Dogstail	..	1	„ „
Poa trivialis	..	1	„ „
Timothy	..	1	„ „
Red Clover	..	2	„ „
White Clover	..	1	„ „

## WITH HARD DRY SUBSOILS.

*	{	Cocksfoot	..	14	pounds per acre
		Red Clover	..	3	„ „
		Chicory	..	3	„ „
		Lucerne	..	3	„ „
		Dogstail	..	1	„ „

\* To all mixtures marked thus add one pound White Clover if this has not already been found growing on the land under consideration.

† The mixtures marked thus may be increased till they are nearly doubled when local conditions demand it.

**Testing of Seeds.**—When the grass mixture has been decided on, the seed has to be bought. It will be observed that the quantities given in the mixtures are based upon average germination capacity as given in the third column of Table II., p. 76. It is clear from this that the quantities of seed used must be increased or diminished as the germination of the sample falls below or exceeds that stated in the Table. Thus if one determines to use 20 pounds of average Perennial Rye in a mixture and the germination of the sample proves to be 90 per cent., then instead of 20 pounds only 18 pounds of seed are needed, while if the germination of the sample proves to be 70 per cent. then 22 pounds of seed must be used. It is therefore necessary to know the germination percentage of a sample before determining the amount of seed to be sown, and of course the same knowledge is necessary before determining on the sample to be chosen when several samples of different prices are submitted for purchase. This is quite obvious, and yet the testing of seeds for germination capacity is very seldom done. It is not that the trouble is too great, for few farmers would grudge the small amount of time requisite to make so simple a test, but because the buying of seed is usually put off till the field is ready for sowing, and then there is no time to test samples before placing the order. Certain of the higher class of seed merchants in the Dominion, however, are willing to certify to the germination capacity of the seeds they sell, and this matter is obviously worth inquiring into. If a merchant will not state the germination percentage of the seed, it is probably not because the seed is extraordinarily good. Ten per cent. difference in the germination of a seed means a difference of about one penny per pound in the price of the clovers, and about 6d. per bushel in the price of Rye Grass—a difference that no buyer is willing to ignore. When it is stated that samples of certain

seeds commonly vary by as much as 50 per cent. in the germination capacity, it is clear that this is often the ruling factor in the value of the seed, and appearances count for but little. It cannot be too often emphasised that in sowing grasses to remain down for six to twenty years everything should be done to secure a good start, and a small extra initial outlay is justified a hundred times over if bare patches and an indifferent herbage are thereby avoided. A farmer will studiously avoid sowing shrivelled wheat, or turnip seed reputed to be old—it is very much more important that he should avoid grass seed with a low germination.

To test seeds is the simplest of matters. Take a square of cloth or of blotting paper, damp it thoroughly, and lay it on a plate. On this place about 100 seeds, spreading them out slightly. On these place another piece of damp blotting paper or flannel, and cover the whole with an inverted plate to keep the moisture in. The temperature of an ordinary living room—about 60 degrees F.—is best for germination, and during the trial the upper plate should be removed for a second or two each day to allow free admission of air, and the escape of foul gases generated when the plates fit too closely. Certain grasses germinate better in the light than in the dark, for example *Poa pratensis*, and for these the following plan is perhaps the easiest: Take a piece of porous roofing tile, lay it on the flat, and immerse it for half its depth in a dish of water. On the tile spread out the seeds which will then need no further attention than to keep the water in the dish replenished as it evaporates. This plan is really easier than that of the blotting paper, if only a piece of porous earthenware is available.

The above methods of seed testing are quite good enough for common use. The best results, however, are obtained when blotting paper is used between glass dishes, and this method must be adopted for accurate determinations. The



time required for complete germination of various farm seeds is shown in the following table, though of course the greater proportion of good seed will have germinated in about half the time noted below :—

TABLE VI.

MAXIMUM PERIOD REQUIRED FOR GERMINATION  
OF FARM SEEDS.

Cereals, Clovers, Turnips, Rape, etc.	..	10	days
Mangels, Rye Grass, Timothy, Cocksfoot, Agrostis, and Meadow Fescue	..	14	„
For Grasses not mentioned above or below	..	21	„
<i>Poa trivialis</i> and <i>Poa pratensis</i>	..	28	„

In many samples of Clovers certain seeds will be found failing to germinate though they have remained perfectly firm and hard. These seeds will germinate in the soil, and in estimating the germination capacity of such samples, the number of hard seeds is usually divided by three, and the number thus obtained added to the seeds that have actually germinated.

**Methods of Sowing.**—For surface sowing of bush burns, etc., a broadcasting machine carried strapped to the shoulders is usually employed. The “fiddle” a special broadcasting machine, is also often used, and either of these devices gives a more even distribution of the seed than does broadcasting by hand; when the hand method is adopted the seed is usually carried in the bottom half of a sack, the top half of one side of which has been cut away. A slit is made in the remaining top half, and through this slit the head is thrust, so that the bag hangs on the shoulders and leaves both hands free for sowing.

In arable areas grass seed is usually sown from special grass seed sowers. The box containing the seed is frequently mounted on a special machine in which case the seed falls between boards that hang to within a few inches of the ground. Between the boards are numberless little pegs so that the seed becomes thoroughly distributed in its passage downward, and leaves the boards so close to the surface of the land that it has little chance of being scattered irregularly by the wind. These machines are drawn by one horse and sow a width of about 15 feet at a stroke. Perhaps more frequently the grass seed box is made to fit on to a grain drill or even a roller, and then the seed has to fall some distance through the air before it reaches the land and is often blown about by the wind. A grain drill itself with the tubes leading to the coulters detached, and the coulters hooked up, can be used with fairly satisfactory results. Of course in all these methods the width sown at a stroke is governed by the width of the implement to which the seed box is attached.

The question of the kind of surface to have on the land before and after the sowing of the seed is one that leads to much argument. Whether the soil should be loose or rolled before the seed is sown, or loose or rolled after the seed is sown are both matters that are open to question. Certain facts are clear. (1) Grass seed sown by the plants themselves are not covered at all, but merely lie on the surface, or are covered at most by a few fallen leaves. Grass seeds then are suited for germination with the slightest covering, and that they will do this is proved by the success of surface sowing. (2) As a corollary to this it may be taken for granted that grass seed sown deep will not germinate, or at least will not produce plants. In a trial in this matter Timothy seed was sown on the surface, and at depths of quarter of an inch, one inch, and two inches. The rows on the surface and at quarter of an inch grew perfectly, while the rows sown

at depths of one inch and two inches did not produce a single plant that reached the surface. (3) When grass seed is sown by falling from the plants themselves and germinates thus, it is lying on a firm surface in which the moisture from the soil below rises to the surface. If it lies on a loose surface it will not be moistened from below, will dry up after every shower, and so will perish. A good example of this is often seen when the seed sown on a harrowed field strikes much best in the horses' hoof marks. (4) When grass seed is sown on a loose or harrowed surface and then harrowed in, a large number of seeds must fall and be shaken through the crevices in the soil to the depths of one inch or more. This is specially true with the smaller and more compact seeds such as Timothy, and the quantity of seed thus lost must be very great. It is for this reason that in computing the numbers for the last column in Table II., double as many seeds per acre were allowed for the grasses with small seeds easily buried, as for those with large seeds that are unlikely to fall below germinating depth.

It would thus seem that an ideal condition for sowing grass seed would be to finish the cultivation of the field by rolling, then sow the seed, and then cover it as lightly as possible. If the land were finished with the Cambridge roller the seed would tend to fall into the little ridges formed by the roller, and if then a brush harrow consisting of a few boughs were dragged over the land the ridges would be rubbed down to fill the hollows. No seed would be lost through burying, it would receive moisture from below and so would germinate. It would be covered from birds, and the light powdering of soil above it would tend to reduce to some extent loss of water by evaporation.

In certain districts, however, where heavy rains usually follow seeding time, and where the land cakes badly, this plan of sowing after the roller is inadvisable. In such a case the

heavy rolling might be succeeded by a light harrowing, then the seed, then the brush harrows. By these means we shall approach most nearly Nature's method of sowing her seeds.

**Time of Sowing.**—As a general rule Autumn is the best time for sowing grasses. Surface sowing after burns must, of course, be done in Autumn, and on arable land also, the following considerations point to Autumn as being the best time. (1) If the sowing is postponed till Spring it is often so late before one can get on to the land with horses, owing to the Winter rains, that sowing has to be put off till unduly late. (2) If the young grass is wanted in Spring as is usually the case, it must be sown in Autumn. (3) In Autumn the nitrates so essential to vigorous growth of grass are in their maximum quantity in the soil, having being formed by the soil bacteria during the Summer warmth. In Spring the soil nitrates are at their minimum, production having ceased during the Winter cold, and all those formed during the preceding Summer having been washed out by the Winter rains. Where grass is sown alone as a special crop it is usually sown in Autumn, and the earlier the better, the determining factor in most districts being the presence of sufficient moisture in the soil to secure germination. If sown at the end of February or early in March it may often be fed off before Winter. On arable land most of the grass is sown down with oats in Autumn, broadcasting the grass after drilling the oats, and this usually gives a fair strike, though of course it is less likely to succeed than if the grass were sown alone. Occasionally the grass starts well, and then if a dry Summer supervenes, dies away because all the available moisture is seized on by the oats. Occasionally grass is sown with wheat in Autumn, but this is rare.

For Spring sowing several methods are used. (1) The grass may be sown alone in September, or as soon as the land is dry enough. (2) It may be sown with barley. (3) It

may be sown on top of wheat that has just been fed off, and then the seed harrowed in. Neither of methods (2) and (3) has much to recommend it. (4) It is very often sown at the same time as rape is drilled. There is one very distinct advantage in this method in districts that are affected with grass grub. For the cultivation in October kills all the brittle pupæ that are in the soil, and the sheep are on the rape in December, so that the beetles will not lay their eggs in the new sown grass. Thus at least one season of grass free from grub is assured. Of course the frequent lack of moisture in October, and the excessive trampling of the young grass while the sheep are on the rape are disadvantages of this time of sowing, but these are in certain districts quite overbalanced by the probability of immunity from attack by grub. (5) Grass is also occasionally sown with turnips—chiefly in those districts where white turnips are grown on the flat. Where there is a sufficient rainfall in Midsummer and Autumn, and where cereals are not grown, sowing with turnips often gives the best results.

**Improvement of Native Pastures.**—The improvement of native pastures in the North Island is chiefly a matter of manuring and so does not come within the scope of this little book. The native pastures that occur so widely in the South Island are almost entirely unimproved. Their carrying capacity is about one sheep to three acres, and has not materially changed in the last 45 years. The reasons for this state of things are threefold. (1) The native pasture is held in large blocks running from 10,000 acres to 100,000 acres. (2) The tenure of the land is almost entirely that of short leaseholds with revaluations at the end of the period, so that a run-holder hesitates to effect improvements for which he is likely to be fined in the shape of increased rentals. (3) The attempts at improving the pastures that have been made in the past have often failed and have still more often appeared to fail.

The land that has been occupied but unimproved for 50 or 60 years is of course not of the best quality, and the best sole of grass cannot be expected to grow upon it. Profitable results are obtained if the carrying capacity is increased by an amount that more than pays for the cost of labour and material. Yet one often sees back country ploughing condemned because the resultant pasture is poor, or thin, or obscured by sorrel. It, however, cannot be doubted that the poorest of improved pastures is often superior in carrying capacity to unimproved tussock. On the tussock there appears to be ample feed, where in reality there is very little, owing to the unpalatability of the tussock and the associated plants.

Where attempts at improving tussock really do fail is where weed grasses, such as Sweet Vernal, take possession of the ploughed land. This result probably follows the sowing of short-lived grasses such as the Rye Grasses for permanent pasture. Cocksfoot in liberal proportions—12 to 14 pounds per acre, with one pound each of Crested Dogstail and *Poa pratensis* is the type of mixture required, so that a close and permanent turf may be formed. Of course ploughing, working and seeding on such a scale does not look profitable for the poor land we are considering, but it has many more chances of being profitable than has the plan of ploughing, and then saving a small expense by sowing unsuitable grasses that soon die out, that admit the ingress of worthless weeds and that need ploughing again in a few years' time.

There is much of the tussock land of the South Island, however, that is stony, or too steep or poor to pay for ploughing, and which yet can be improved. The introduction of *Danthonia pilosa* by the means suggested on p. 27. is well worth considering, but should not be resorted to until the following plan has been tried. Broadcast Cocksfoot over the tussocks in as great quantities as convenient, say

6 to 8 pounds per acre. Then grub with a heavy, spring-tined cultivator so as to shake down the seed and loosen the surface soil, but not destroy the tussocks. Then, if possible, drive large mobs of sheep over the land thus treated so as to press in the seed, and when the Cocksfoot has germinated give it a good chance to become firmly rooted before turning sheep on to graze it. If Cocksfoot does not succeed, *Poa pratensis* or Creeping Bent almost surely will, but Cocksfoot should be tried first.

No runholder can have noted the heavily grazed weed grasses by roadsides or sheep camps without being convinced that the carrying capacity of the flatter parts of his run could be doubled if an economical way of establishing such grasses could be found. Burning and surface sowing fail because of the thin covering of ashes, and because of the exposure to drought while the young plants are establishing themselves. The light cultivation and the preservation of the sheltering tussock here suggested are very hopeful means of avoiding these difficulties.

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#### REFERENCES.

Grass mixtures for New Zealand have been dealt with in recent years chiefly by Cockayne and the Author. Cockayne's articles are in the "Journal, N.Z. Department of Agriculture" in various places. Among others are Bush burns, Vol. viii., No. 3; Surface sown grasses, Vol. xiv., No. 3; *Paspalum*, Vol. xv. No. 6, and special reference is due to "Transactions N.Z. Institute," Vol. 48, for an article on Tussock lands. The Author's papers are mostly in the Magazine of the Canterbury Agricultural College, and Cocksfoot especially is dealt with in the Journal, Canterbury A. and P. Association for 1916 and 1917.

[Since this work has been in the Press Cockayne has published a series of articles on "The Grass Lands of New Zealand" in "The Journal of Agriculture," N.Z. Department of Agriculture, March and following numbers, 1918].

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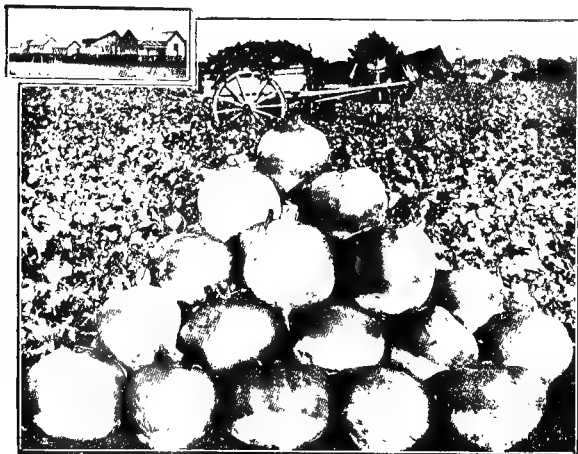
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