

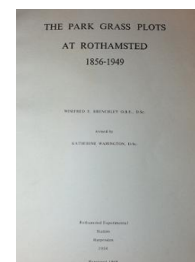
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The Park Grass Plots at Rothamsted 1856 -1949

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Chapter IV. Effect of Manures and Lime on Individual Plots

Rothamsted Research

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CHAPTER II

FLOWERING PLANTS AND MOSSES

Flowering Plants

A characteristic feature of grassland herbage is the large number of species that occur. During the ninety three years of the experiment i.e. up to 1949, certain changes have taken place, although fundamentally the orders and genera represented have remained practically the same both in number and in kind. During the first years certain species disappeared completely. All of these were originally present in very small quantity and in most cases occurred on a single plot, Carduus arvensis being the only one found on several plots.

The species which have disappeared are:-

Gramineae	None
Leguminosae	<u>Lotus major</u> <u>Trifolium minus</u> <u>Trifolium procumbens</u> <u>Vicia cracca</u>
Miscellaneous	<u>Alchemilla vulgaris</u> <u>Carduus arvensis</u> <u>Daucus carota</u> <u>Galium aparine</u> <u>Orchis morio</u> <u>Ornithogalum umbellatum</u> <u>Plantago media</u> <u>Ranunculus auricomus</u> <u>Ranunculus repens</u> <u>Sonchus oleraceus</u> <u>Stellaria holostea</u> <u>Veronica officinalis</u>

In 1949, the flora at the first cut of hay (which has been the standard of comparison throughout the experiment) consisted of 65 species, contained in 57 genera and 21 natural orders, little change having taken place since 1919. Their response to the different manures is the subject of chapter V.

A few species occur which do not usually appear in the hay samples, and

-6-

data regarding their distribution, based on field observations are given on page 144.

Mosses

During the early years of the experiment only three species of mosses were recognised, viz. Hypnum squarrosum, H. rutabulum and H. heans and they occurred chiefly on the unmanured plots. No species of this genus, however, was found in 1921 or in 1949 when further surveys were made*. In 1921, mosses were almost entirely confined to the unlimed areas. They were plentiful on plots with no manure (2, 3 and 12) and with minerals only (6), small amounts occurring on other mineral plots (4¹, 5², 7, 16) and with no manure after ammonium salts (5¹). In 1949, mosses were more plentiful and abundant on both limed and unlimed areas. The influence of manuring on their distribution based on the 1949 survey is as follows:-

Mosses are encouraged by plots receiving complete minerals (6, 7, 14, 15, 16), nitrate of soda (17), or organic manure (13).

They are discouraged on plots receiving ammonium salts (1, 4², 9, 10, 11¹, 11², 18), incomplete minerals (4¹, 8) and organic manure with minerals and nitrate of soda (19, 20). Except for Bryum sp. mosses are scarce on the unmanured plots 2 and 3, whether limed or unlimed, though they are plentiful on plot 12, also unmanured and without lime. The principal species here are Brachythecium rutabulum, Eurynchium praelongum with Fissidens bryoides, Bryum capillare and Dicranella heteromalla in addition. In general, liming has little effect on the moss flora, but the addition of lime increased it, particularly the amount of Eurynchium praelongum, on plot 18 and to a less extent on plot 9. Both these plots receive sulphate of ammonia, and minerals without super or complete, respectively. Of the species present over the whole area Eurynchium praelongum is the most abundant, with Brachythecium rutabulum second in importance. Many plots also contain Bryum sp. though this is never plentiful except on plot 6 where mosses are particularly abundant. Other species of special note on this plot are Fissidens bryoides, Brachythecium sp. Phascum cuspidatum and Aulacomnium androgynum.

*Identifications in 1921 and 1949 were kindly carried out by the Staff at Kew Gardens

-7-

Less important species are:- Barbula unguiculata, Funaria hygrometrica, Mnium cuspidatum, M.hornum and Weisia microstoma. The 1949 record differs considerably from that made in 1921, only three species, Barbula unguiculata, Dicranella heteromalla and Aulacomnium androgynum being common to both. Some of the genera listed are similar for both years but four entirely new species were recorded in 1949 viz. Funaria hygrometrica, Mnium cuspidatum, M.hornum and Phascum cuspidatum. Both the 1921 and 1949 surveys were made in the spring and examination of the plots later in the year might reveal yet other species. Association of mosses with mole heaps was frequently observed.

CHAPTER III

GENERAL EFFECT OF INDIVIDUAL AND COMBINED MANURES

Unlimed

YIELD. Most manurial treatments give an increase of crop over no manure, though the degree of improvement varies greatly. A decrease, however, usually occurs with ammonium salts either alone or with minerals without super.

Nitrogenous manures alone (Plots 1 and 17). Nitrate of soda generally gives an appreciable increase of yield, but sometimes the crop is little better than that on the unmanured plots. With sulphate of ammonia the yield is usually lower than where no manure is applied. Either type of nitrogenous manure gives rather a poor growth of herbage.

Mineral manures alone (Plots 6, 7, 8, 15). With complete minerals the yield is very considerably increased, being on an average two or three times that of the unmanured plots. In the absence of potash (Plot 8) however, it usually falls to about two-thirds of that with complete minerals. The

-8-

growth of the herbage is generally good.

Nitrogenous and mineral manures combined (Plots 9, 11¹, 11², 14, 16).

Very heavy yields are obtained with a combination of complete minerals and either nitrate of soda or ammonium sulphate, as much as three tons per acre being reached in some years. Nitrate of soda increases the yield the more rapidly, as a double dressing (= 86 lb. N per acre) often gives as heavy a crop as a triple dressing (= 129 lb. N per acre) of ammonium salts. Seasonal variation is smaller with nitrate of soda than with ammonium sulphate. With heavy dressings of ammonium sulphate, growth may become coarse and rank and the crop is then liable to lodge.

With ammonium salts and minerals without super (Plot 18), the yield is poor and since 1938 it has usually fallen below that of the unmanured plot.

Organic manures (Plots 13, 19, 20). These increase the yield and encourage the grass to get away earlier in the spring than where inorganic manures are used. The type of herbage, however, is much influenced by the other fertilizers applied.

NUMBER OF SPECIES. The largest number of species is found on the unmanured plots, 43 being recorded in 1940, but fluctuations are considerable and only 20 occurred in 1943. With organic manures the number is about 30 and these species are more regular in appearance than those on the unmanured plots. As the applications of inorganic manure, especially of a nitrogenous character, become successively heavier, the number of species decreases until with large dressings of ammonium sulphate only about 8 to 10 survive, of which only 2 or 3 occur in any quantity. Minerals are much less effective than nitrogen in reducing the number of species.

RELATIVE AMOUNTS OF GRAMINEAE, LEGUMINOSAE AND MISCELLANEOUS SPECIES. (Figures 1,2,3).

Nitrogenous manures alone or combined with minerals (Amm.Salts; Plots 1, 4², 9, 10, 11¹, 11², 18; Nitrate of Soda; Plots 14, 16, 17). An almost complete elimination of Leguminosae is effected by ammonium salts, whether given alone or with minerals. In the presence of nitrate of soda, reduction is less drastic, but still considerable. Miscellaneous species are also reduced by ammonium salts and where the dressing is heavy the herbage consists almost entirely of grass. With nitrate of soda alone, on the other hand, the quantity of Miscellaneous species may be of the order of 30 per cent (1947 and 1949).

Mineral manures alone (Plots 6, 7, 8, 15). All three groups are well represented here. Leguminous plants are specially encouraged and may constitute one third of the herbage, though in the absence of potash (Plot 8) the proportion is smaller. This beneficial effect is entirely offset by the addition of nitrogen as ammonium salts (Plots 9, 10, 11¹, 11²). With nitrate of soda, however, the counteraction is less noticeable, and Leguminosae, chiefly Lathyrus pratensis, may constitute almost 12 per cent of the herbage (Plot 16).

Organic manures (Plots 13, 19, 20). These seem to encourage Leguminosae if used alone, but in combination with inorganic fertilizers it is the nature of the latter which is the determining factor. Thus, when farmyard manure is used after prolonged treatment with ammonium salts (Plot 13), Leguminosae are almost or entirely absent, whereas in combination with nitrate of soda and minerals this group is fairly well represented (Plots 19 and 20). The most conspicuous leguminous plant throughout is Lathyrus pratensis, which both shows the most response to manurial treatment, and also the greatest fluctuations with season.

INDIVIDUAL SPECIES. The majority of species vary in quantity with the type of manuring, but it is often uncertain whether the variation is caused by the direct influence of the manure on the species concerned, or whether it is due to lessened or increased competition with other plants. Plantago lanceolata, Leontodon hispidus, Conopodium denudatum, Briza media and Lotus corniculatus, for

-10-

example, which are conspicuous on starved soils tend to disappear with more complete inorganic manuring.

Agrostis vulgaris has increased considerably, and as much as 44.0 per cent may occur on plots receiving heavy ammonium salts and minerals. Festuca rubra is much encouraged with ammonium salts alone, but the addition of minerals brings to the fore Holcus lanatus and Agrostis vulgaris, and to a lesser extent Anthoxanthum odoratum and Arrhenatherum avenaceum.

Ammonium salts and nitrate of soda favour quite different species, for Holcus lanatus is dominant with the former, whereas with the latter Arrhenatherum avenaceum, Dactylis glomerata and Alopecurus pratensis are the most important grasses, Holcus lanatus being almost entirely suppressed.

Minerals encourage Poa pratensis, Lathyrus pratensis and Trifolium pratense, but it is not possible to detect any special effect on species in the Miscellaneous group.

Generally speaking, with moderate or no manuring many species retain their footing even though they may be much reduced in quantity. With excessive manuring, on the other hand, a large number of species tend to disappear entirely, while one or two others increase to such an extent that the balance in the composition of the herbage is seriously upset.

Limed

YIELD. Liming has now increased the yield on all plots with ammonium salts and minerals, and also with complete minerals alone. With ammonium salts alone, lime did not at first have any constant effect, but since 1919 it has caused an improvement. On the unmanured plots lime brings about only a slight increase in crop.

With the light dressing of nitrate of soda, lime formerly improved the yield in certain seasons only, but since 1940 the benefit has been consistent. With the heavy dressing or mineral manuring, on the other hand, there has been a steady decrease in crop from the addition of lime.

When associated with farmyard manure and fish guano (Plot 13), lime decreased the yield till 1944, but since then the position has been reversed.

-11-

NUMBER OF SPECIES. Liming has no constant effect upon the number of species, but it increases them on plots receiving ammonium salts alone or with the addition of minerals, either complete or without super. In the latter case the crop is much increased and an entirely different type of herbage is produced.

RELATIVE AMOUNTS OF GRAMINEAE, LEGUMINOSAE AND MISCELLANEOUS SPECIES.

Since 1919, liming has caused some changes in the proportion of Gramineae. About half the plots show a decrease viz. those receiving ammonium salts (except the largest quantities) a light dressing of nitrate of soda with minerals, farmyard manure, super alone or no manure at all. The only plot showing an increase is that receiving nitrate of soda only. Elsewhere little change has occurred.

Leguminosae are affected in a variable manner and changes in the trends have occurred since 1919. In general no legumes occur where ammonium salts are given, though some may appear where they are applied alone or at a low rate mixed with minerals. Liming has decreased the legumes on the plot with complete minerals and the lower dressing of nitrate of soda but increased them where the higher rate is supplied. The largest increase, however, occurs on the F.Y.M. and fish guano plot where the proportion of Leguminosae has been as high as 41 per cent on the limed compared with 0.2 per cent on the unlimed section. On the remaining plots liming has had little consistent effect.

Miscellaneous species have increased on the limed sections of the unmanured plot 3, those with ammonium salts either with or without other fertilizers, and with F.Y.M. provided artificials are used in addition. Especially large increases have occurred with ammonium salts with minerals without super. Decreases have occurred with minerals or F.Y.M. alone, and to a slight extent where nitrate of soda is given without the addition of minerals. No effect of lime was observed with super alone, or with either dressing of nitrate of soda given with minerals.

INDIVIDUAL SPECIES. On the whole, the effect of lime is more marked on the plots receiving ammonium salts and mineral manures than on those with minerals only, no manure, or with the nitrogen applied as nitrate of soda.

Alopecurus pratensis shows a marked benefit from lime if the manuring is good and soil conditions tend towards acidity. Dactylis glomerata frequently shows a similar response, but Holcus lanatus and Anthoxanthum odoratum are

-12-

reduced by lime. Agrostis vulgaris is usually not affected, but is decreased by lime in the presence of ammonium salts (Plot 1), a response it shares with Festuca rubra. With Poa trivialis the effect varies, an increase sometimes occurring on the limed section of plots with minerals alone or F.Y.M., whereas there is an occasional decrease with heavy nitrate of soda and minerals.

Among the Leguminosae, Lathyrus pratensis shows a variable response. Specially large increases in this species were recorded in 1943 and 1944 on the limed half of the plot receiving F.Y.M. and fish guano. Trifolium pratense and Lotus corniculatus are also usually encouraged by lime.

Of the Miscellaneous species, Plantago lanceolata is always increased by lime on the plot receiving ammonium salts alone, though on other plots its response may vary. Conopodium denudatum is also increased on the limed section of this plot though elsewhere it is usually decreased by lime. Rumex acetosa is variable in response, but where manuring is complete, except for potash, there has been a consistent increase due to lime since 1919.

Silicate of Soda

Silicate of soda applied with heavy ammonium salts has a somewhat similar effect as lime, though it does not generally cause such a large increase in yield. The benefit from silicate is usually greater in the absence of lime and though the effect varies with season the increase in crop may be considerable. Silicate also seems to inhibit the colonization of Epilobium angustifolium on the unlimed areas, for in 1947 none appeared on the plot receiving sodium silicate (11²), though nearly 12 per cent occurred on the adjacent and similarly manured plot but without silicate (11¹). The large amount of bare ground due to the severity of the preceding winter made the high figure possible, for this species is normally unable to compete with grass cut for hay. Since the herbage recovered, Epilobium has almost disappeared and the two plots again have a very similar flora. Some differential effects of silicate on individual species in 1947 on plots receiving heavy ammonium salts and minerals are shown in the following table:-

-13-

	Plot 11 ²		Plot 11 ¹
	With Silicate per cent		No Silicate per cent
		Unlimed	
<u>Agrostis vulgaris</u>	44.1		4.5
<u>Arrhenatherum avenaceum</u>	12.7		0.3
<u>Holcus lanatus</u>	40.8		81.1
<u>Epilobium angustifolium</u>	-		11.9
		Limed	
<u>Alopecurus pratensis</u>	70.0		78.9
<u>Arrhenatherum avenaceum</u>	11.3		2.9

CHAPTER IV

EFFECT OF MANURES AND LIME ON INDIVIDUAL PLOTS

In this chapter, the plots are considered under six main headings viz. those receiving A. No Manure, B. Mineral Manures, C. Nitrate of Soda, with and without Mineral Manures, D. Ammonium Salts with Mixed Mineral Manures, E. Ammonium salts alone or with Incomplete Mineral Manure, F. Organic Manures. The characteristics of each individual plot are summarized and information provided regarding the pH of the soil, yield of hay and general type of herbage present. Details of the botanical composition follow, showing the chief constituents of the flora in 1949, the changes that have occurred since 1877, and where appropriate, the effect of lime. The tables have been arranged as far as possible to correspond with the above groups.

A. NO MANURE (Table 2).

UNMANURED since 1856 (Plot 3).

Condition of Plot in 1949 (Unlimed)

- (a) pH 5.5.
- (b) Herbage of a characteristic poverty-stricken type. The plants are nearly all low growing and give a leafy hay.
- (c) Growth starts late in spring.
- (d) Yield very low (Figure 4).

- (e) Thirty to thirty-six species, only a few of which are important. Considerable seasonal fluctuations.
- (f) The three main groups* of plants are all well represented, the proportion of Gramineae being low and very variable. The range as shown by partial separations from 1903-1947 was:-

	<u>Percent.</u>
G	28.6 - 57.0
L	4.2 - 11.0
M	35.3 - 67.2

Main Constituents of the Herbage on Plot 3.

GRAMINEAE

<u>Festuea rubra</u>	}	Usually the most abundant species
<u>Agrostis vulgaris</u>		
<u>Dactylis glomerata</u>	}	Occasionally among the three most abundant species
<u>Anthoxanthum odoratum</u>		
<u>Holcus lanatus</u>		
<u>Avena pubescens</u>		
<u>Briza media</u>		

LEGUMINOSAE

<u>Lotus corniculatus</u>	Usually the chief species
<u>Lathyrus pratensis</u>	
<u>Trifolium pratense</u>	

MISCELLANEOUS

<u>Plantago lanceolata</u>	Usually the chief species	
<u>Centaurea nigra</u>	}	Vary much with season
<u>Leontodon hispidus</u>		
<u>Poterium sanguisorba</u>		
<u>Achillea millefolium</u>		
<u>Carex praecox</u>		
<u>Conopodium denudatum</u>		
<u>Rumex acetosa</u>		
<u>Scabiosa arvensis</u>		
<u>Ranunculus spp.</u>		Much decreased since 1919

* Abbreviated in text:- G = Gramineae; L = Leguminosae; M = Miscellaneous species.

OTHER SPECIES:- Alopecurus, Arrhenatherum, Avena flavescens, Cynosurus, Lolium, Poa pratensis; Trifolium repens; Ajuga, Cerastium, Galium, Hieracium, Luzula, Pimpinella, Potentilla, Prunella, Stellaria, Taraxacum, Thymus, Tragopogon, Veronica. (See Tables).

Outline of Principal Changes during the Period 1877-1948.

Yield. Much reduced owing to the continued removal of soil nutrients by the hay without any addition of manure. Seasonal variation large.

Number of Species. Reduced.

	<u>Number of Species</u>									
	<u>1862</u>	<u>1867</u>	<u>1872</u>	<u>1877</u>	<u>1903</u>	<u>1914</u>	<u>1919</u>	<u>1929</u>	<u>1939</u>	<u>1948</u>
G	18	15	17	17	13	13	12	12	11	11
L	4	4	4	4	4	4	3	4	4	4
M	28	24	28	31	26	23	14	20	17	21
Total	50	43	49	52	43	40	29	36	32	36

Seasonal variation is considerable. Species that are reduced to the point of disappearance may reappear occasionally.

Composition of the herbage.

Percentage of Gramineae, Leguminosae and Miscellaneous Species

	<u>1862</u>	<u>1867</u>	<u>1872</u>	<u>1877</u>	<u>1903</u>	<u>1914</u>	<u>1919</u>	<u>1930</u>	<u>1939</u>	<u>1948</u>
G	70.6	65.5	68.7	71.2	52.2	56.8	47.8	47.6	37.9	53.0
L	8.1	5.4	9.0	8.5	7.8	6.1	4.5	9.3	6.7	7.2
M	21.3	29.1	22.3	20.3	40.0	37.1	47.6	43.1	55.4	39.8

GRAMINEAE. Proportion reduced

<u>Dactylis glomerata</u>	Increased
<u>Lolium perenne</u>	} Almost disappeared
<u>Poa trivialis</u>	

LEGUMINOSAE. Little changed

MISCELLANEOUS. Increased, fairly steady since 1903

<u>Poterium sanguisorba</u> <u>Leontodon hispidus</u> <u>Plantago lanceolata</u>	}	Responsible for greater part of increase
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The quantity of the individual Miscellaneous plants varies so much from year to year, that it is difficult to estimate their increase or decrease. Some of the species in the table below seem, however, to show a definite trend.

Changes in the Percentage of Certain Species

	<u>1862</u>	<u>1877</u>	<u>1903</u>	<u>1914</u>	<u>1919</u>	<u>1936</u>	<u>1939</u>	<u>1947</u>	<u>1948</u>
<u>Dactylis glomerata</u>	1.8	0.7	1.1	3.8	8.4	3.0	3.0	12.1	4.5
<u>Lolium perenne</u>	6.4	4.6	-	0.1	-	-	-	-	-
<u>Poa trivialis</u>	1.5	0.6	* <	-	-	0.1	-	-	-
<u>Poterium sanguisorba</u>	-	0.9	13.8	1.8	5.8	9.1	14.6	5.0	5.6
<u>Leontodon hispidus</u>	0.1	1.3	6.0	17.8	6.9	13.6	18.2	12.0	17.9
<u>Plantago lanceolata</u>	7.3	3.2	2.0	3.4	19.1	5.8	11.8	3.7	6.2
<u>Gentaurea nigra</u>	0.3	1.1	4.1	9.1	5.8	3.0	2.9	0.6	1.0
<u>Luzula campestris</u>	1.9	1.8	0.5	0.4	0.2	0.6	0.3	0.3	0.1

* < indicates less than 0.05

Effect of Lime

Until 1943 the limed half was not sharply differentiated from the unlimed area. The herbage was of similar character and appearance, growth beginning at much the same time in the spring. Since then an increase in leguminous plants has been a noticeable feature on the area receiving lime.

pH. 7.0

Yield. Considerably increased by liming up to 1943 but no regular effect since.

Number of Species. No constant effect.

Composition of the Herbage.

GRAMINEAE. Increased till 1938, after which generally reduced

LEGUMINOSAE. Increased

MISCELLANEOUS. Results variable till 1935, since when a tendency to increase

-17-

Effect of Lime on the Percentage of Certain Species

	1914		1919		1940		1947	
	U	L	U	L	U	L	U	L
<u>Agrostis vulgaris</u>	13.1	2.9	8.4	1.5	12.1	2.0	8.4	1.1
<u>Anthoxanthum odoratum</u>	2.8	1.0	7.0	3.1	2.8	0.9	5.1	2.6
<u>Avena flavescens</u>	0.6	1.1	0.9	2.8	0.2	2.0	0.6	1.9
<u>Avena pubescens</u>	4.0	14.2	4.2	19.3	5.7	18.2	3.4	13.6
<u>Briza media</u>	4.3	10.5	2.0	9.0	0.9	1.5	4.7	3.6
<u>Poa pratensis</u>	0.1	1.6	0.2	2.0	0.1	2.2	0.3	1.6
<u>Lathyrus pratensis</u>	0.5	2.7	0.9	1.2	0.7	2.3	2.7	2.5
<u>Lotus corniculatus</u>	3.5	3.6	1.6	2.5	6.3	13.7	3.3	5.0
<u>Ranunculus spp.</u>	0.2	1.0	0.4	2.6	0.1	1.9	1.1	8.6
<u>Conopodium denudatum</u>	0.5	0.1	4.7	0.6	1.5	-	5.7	0.9
<u>Leontodon hispidus</u>	17.8	3.6	6.9	1.5	12.3	7.0	12.0	8.8
<u>Rumex acetosa</u>	0.3	0.6	2.0	4.2	0.2	0.3	3.7	1.8

U = Unlimed

L = Limed

UNMANURED since 1856 (Plot 12)

Condition of Plot in 1949 (Unlimed)

- (a) pH 5.0
- (b) Herbage very similar to Plot 3, with minor differences in composition.
- (c) Growth starts late in spring.
- (d) Yield low but generally higher than on Plot 3.
- (e) Thirty to thirty-two species. Considerable seasonal fluctuations.

Main Constituents of the Herbage on Plot 12

The association closely resembles that of Plot 3.

OTHER SPECIES:- As Plot 3, except for Thymus and the addition of traces of Hypochaeris radicata.

Outline of Principal Changes during the Period 1877-1949

Yield. Reduced, slightly above Plot 3.

Number of Species. Reduced as on Plot 3, but varies with season.

Composition of the herbage.

Percentage of Gramineae, Leguminosae and Miscellaneous Species

	<u>1862</u>	<u>1867</u>	<u>1872</u>	<u>1877</u>	<u>1914</u>	<u>1919</u>	<u>1947</u>	<u>1949</u>
G	72.4	59.0	63.7	68.3	69.3	54.7	53.2	58.6
L	6.2	10.8	10.2	7.5	7.3	5.3	8.5	13.4
M	21.4	30.2	26.1	24.2	23.4	40.0	38.3	28.1

GRAMINEAE. Much the same as on Plot 3.

<u>Dactylis glomerata</u>	}	Probably increased
<u>Briza media</u>		
<u>Festuca pratensis</u>		Much reduced
<u>Poa trivialis</u>	}	Almost or entirely disappeared
<u>Cynosurus cristatus</u>		
<u>Lolium perenne</u>		

LEGUMINOSAE. Little changed, slightly more than on Plot 3.

MISCELLANEOUS. Increased, much the same as on Plot 3.

<u>Leontodon hispidus</u>		Responsible for most of increase
<u>Plantago lanceolata</u>	}	Prominent throughout
<u>Centaurea nigra</u>		
<u>Conopodium dendudatum</u>		
<u>Luzula campestris</u>		Much decreased

Changes in the Percentage of Certain Species

	<u>1862</u>	<u>1867</u>	<u>1872</u>	<u>1877</u>	<u>1914</u>	<u>1919</u>	<u>1949</u>
<u>Arrhenatherum avenaceum</u>	0.8	0.7	1.8	0.8	1.1	4.4	0.8
<u>Briza media</u>	1.4	1.7	4.2	3.7	10.3	2.2	6.0
<u>Cynosurus cristatus</u>	0.5	0.4	1.0	0.4	<	-	-
<u>Dactylis glomerata</u>	2.8	3.2	1.9	2.6	4.5	14.4	8.8
<u>Festuca pratensis</u>	10.1	3.9	2.3	3.3	-	-	1.6
<u>Lolium perenne</u>	4.5	3.1	1.9	2.3	0.1	0.1	-
<u>Poa trivialis</u>	2.7	1.9	0.9	0.8	0.1	-	-
<u>Conopodium demidatum</u>	1.6	5.4	2.2	2.8	0.5	10.6	1.3
<u>Leontodon hispidus</u>	0.1	0.1	0.1	0.1	6.5	2.6	10.0
<u>Plantago lanceolata</u>	7.7	8.3	0.4	1.4	5.2	15.1	6.8
<u>Luzula campestris</u>	1.1	3.0	3.0	1.5	0.5	0.3	0.6

< indicates less than 0.05

UNMANURED since 1864, after FARMYARD MANURE 1856-1863 (Plot 2)

Condition of Plot in 1949 (Unlimed)

Closely resembles Plot 3, but yield is consistently higher.

pH 5.0

Outline of Principal Changes during the Period 1877-1949

Yield. Reduced, as on Plot 3.

Number of Species. Reduced.

	<u>Number of Species</u>						
	<u>1862</u>	<u>1867</u>	<u>1872</u>	<u>1877</u>	<u>1919</u>	<u>1939</u>	<u>1949</u>
G	14	17	18	18	13	13	12
L	3	4	4	4	4	3	4
M	13	20	25	28	18	16	16
Total	30	41	47	50	35	32	32

Composition of the Herbage.

Percentage of Gramineae, Leguminosae and Miscellaneous Species

	<u>1862</u>	<u>1867</u>	<u>1872</u>	<u>1877</u>	<u>1914</u>	<u>1919</u>	<u>1947</u>	<u>1949</u>
G	75.1	84.5	80.0	75.4	60.5	57.9	58.0	53.6
L	1.9	1.6	4.9	6.5	5.7	4.4	10.7	15.4
M	23.0	13.9	15.1	18.0	33.9	37.7	31.3	31.0

GRAMINEAE. Proportion reduced.

<u>Briza media</u>	}	Increased
<u>Dactylis glomerata</u>		
<u>Lolium perenne</u>	}	Reduced
<u>Avena flavescens</u>		
<u>Poa trivialis</u>	}	Disappeared
<u>Bromus mollis</u>		

LEGUMINOSAE. Increased.

<u>Lotus corniculatus</u>	Responsible for most of increase
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MISCELLANEOUS. Increased.

<u>Leontodon hispidus</u>	}	Large increase in some years
<u>Plantago lanceolata</u>		
<u>Centaurea nigra</u>		Increased

Changes in the Percentage of Certain Species

	<u>1862</u>	<u>1867</u>	<u>1872</u>	<u>1877</u>	<u>1914</u>	<u>1919</u>	<u>1949</u>
<u>Agrostis vulgaris</u>	2.6	4.9	11.0	18.0	8.2	8.5	10.0
<u>Avena flavescens</u>	6.0	5.9	11.6	2.9	1.0	1.2	0.2
<u>Briza media</u>	-	<	0.2	0.7	5.6	3.4	1.8
<u>Bromus mollis</u>	17.8	16.4	3.9	0.2	-	-	-
<u>Lolium perenne</u>	1.4	3.6	3.2	4.9	0.3	0.5	-
<u>Poa trivialis</u>	28.2	15.8	3.1	2.4	-	-	-
<u>Lathyrus pratensis</u>	1.0	1.2	4.0	5.3	0.7	0.8	2.1
<u>Lotus corniculatus</u>	-	0.1	0.2	0.2	3.8	2.7	9.4
<u>Centaurea nigra</u>	<	0.1	1.3	0.9	7.3	4.9	1.3
<u>Leontodon hispidus</u>	-	<	<	<	16.5	2.8	12.4
<u>Plantago lanceolata</u>	1.7	3.1	1.5	3.7	5.5	20.6	5.7

< indicates less than 0.05

Effect of Lime

In general, the herbage resembles that of Plot 3 limed.

pH. 7.0

Yield. Increased till 1910 when for some years it was depressed. The effect now varies with season, but lime is usually beneficial.

Number of Species. No regular effect.

Composition of the Herbage.

GRAMINEAE Hardly affected
 LEGUMINOSAE Increased
 MISCELLANEOUS Decreased

Effect of Lime on the Percentage of Certain Species

	1914		1919		1949	
	U	L	U	L	U	L
<u>Agrostis vulgaris</u>	8.2	1.9	8.5	0.5	10.0	0.5
<u>Anthoxanthum odoratum</u>	4.0	1.5	8.8	1.7	1.1	0.4
<u>Avena flavescens</u>	1.0	1.7	1.2	3.7	0.2	1.5
<u>Avena pubescens</u>	4.9	18.1	4.7	20.3	3.5	22.5
<u>Briza media</u>	5.6	2.7	3.4	1.7	1.8	3.9
<u>Dactylis glomerata</u>	3.8	4.9	10.7	15.2	7.9	7.5
<u>Festuca rubra</u>	25.7	24.1	5.3	4.6	15.5	7.4
<u>Poa pratensis</u>	0.5	1.4	0.5	1.8	0.1	1.0
<u>Lathyrus pratensis</u>	0.7	2.4	0.8	2.2	2.1	2.4
<u>Ranunculus spp.</u>	0.3	1.4	0.5	4.4	0.9	2.8
<u>Conopodium denudatum</u>	0.5	0.1	4.4	0.7	3.2	0.2
<u>Leontodon hispidus</u>	16.5	8.5	2.8	1.7	12.4	8.7
<u>Rumex acetosa</u>	0.5	0.4	1.5	2.8	1.4	0.6

U = Unlimed L = Limed

UNMANURED after AMMONIUM SALTS 1856-1897 (Plot 5¹)

Condition of Plot in 1949 (Unlimed)

- (a) pH 4.5.
- (b) Herbage rather short and patchy in appearance; clumps of Dactylis glomerata with Festuca rubra frequently dominant.
- (c) Growth starts late in spring.
- (d) Yield low, often below that of wholly unmanured Plot 3 (Figure 5).
- (e) About thirty species or less.
- (f) GRAMINEAE form bulk of herbage.
LEGUMINOSAE barely represented.
MISCELLANEOUS plants in good proportion with a large number of species in very small quantity.

Main Constituents of the Herbage on Plot 5¹

GRAMINEAE

<u>Festuca rubra</u>	Forms about half of the total herbage
<u>Agrostis vulgaris</u>	} Plentiful; order of prevalence varies with season
<u>Anthoxanthum odoratum</u>	
<u>Dactylis glomerata</u>	
<u>Arrhenatherum avenaceum</u>	Variable
<u>Poa pratensis</u>	Small amount

MISCELLANEOUS

<u>Centaurea nigra</u>	} Usually well represented
<u>Conopodium denudatum</u>	
<u>Hieracium pilosella</u>	} May be very plentiful
<u>Hypochaeris radicata</u>	
<u>Plantago lanceolata</u>	
<u>Rumex acetosa</u>	} Fairly plentiful
<u>Scabiosa arvensis</u>	
<u>Galium verum</u>	Variable

OTHER SPECIES (Several of rare occurrence only):- Aira, Alopecurus, Avena flavescens, A. pubescens, Bromus, Holcus; Lathyrus, Lotus, Trifolium pratense; Achillea, Cerastium, Heracleum, Leontodon, Luzula, Pimpinella, Ranunculus spp. Stellaria, Veronica (See Tables).

Outline of Principal Changes during the Period 1877-1949

Yield. Generally reduced since 1898 when manuring was discontinued, but occasionally heavy.

Number of Species. Considerable variation since the application of ammonium salts was discontinued.

	<u>Number of Species</u>											
	<u>1862</u>	<u>1867</u>	<u>1872</u>	<u>1877</u>	<u>1903</u>	<u>1914</u>	<u>1919</u>	<u>1930</u>	<u>1939</u>	<u>1947</u>	<u>1949</u>	
G	17	15	15	13	13	11	10	10	9	7	10	
L	4	4	3	2	0	3	1	1	5	3	1	
M	17	17	13	14	8	17	14	12	17	17	11	
Total	38	36	31	29	21	31	25	23	31	27	22	

Composition of the Herbage.

Percentage of Gramineae, Leguminosae and Miscellaneous Species

	<u>1862</u>	<u>1867</u>	<u>1872</u>	<u>1877</u>	<u>1903</u>	<u>1914</u>	<u>1919</u>	<u>1930</u>	<u>1934</u>	<u>1947</u>	<u>1949</u>
G	86.3	71.9	84.7	94.1	82.4	86.4	76.6	59.0	70.6	72.8	82.2
L	0.1	0.3	0.5	0.2	-	0.5	0.4	1.5	4.4	1.1	3.1
M	13.6	27.8	14.8	5.8	17.6	13.1	23.0	39.5	25.0	26.1	14.8

GRAMINEAE. Proportion reduced

<u>Anthoxanthum odoratum</u>	Increased
<u>Dactylis glomerata</u>	Increased since change in manuring
<u>Agrostis vulgaris</u>	Decreased
<u>Holcus lanatus</u>	
<u>Lolium perenne</u>	Disappeared

LEGUMINOSAE. Little changed

<u>Lotus corniculatus</u>	Chief species throughout
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MISCELLANEOUS. Increased

Centaurea nigra Increased since change in manuring
Rumex acetosa Occasionally plentiful

Changes in the Percentage of Certain Species

	<u>1862</u>	<u>1867</u>	<u>1872</u>	<u>1877</u>	<u>1903</u>	<u>1914</u>	<u>1919</u>	<u>1949</u>
<u>Agrostis vulgaris</u>	24.3	21.0	26.6	29.5	11.7	17.7	4.5	17.8
<u>Anthoxanthum odoratum</u>	5.8	5.5	3.0	4.1	12.3	8.5	11.7	1.1
<u>Dactylis glomerata</u>	2.4	1.4	0.7	3.3	1.3	9.5	8.9	4.1
<u>Holcus lantatus</u>	10.1	5.2	1.9	3.0	<	0.2	0.6	0.7
<u>Lolium perenne</u>	3.3	1.2	1.0	0.1	-	-	-	-
<u>Centaurea nigra</u>	<	2.4	2.2	0.5	0.7	7.2	3.9	2.0
<u>Rumex acetosa</u>	9.2	15.9	7.1	2.1	14.8	1.4	12.3	1.0

< indicates below 0.05

B. MINERAL MANURES (Tables 3 and 4)

MIXED MINERAL MANURE (Plot 7)

Condition of Plot in 1949 (Unlimed)

- (a) pH 5.0.
- (b) Herbage very varied and well grown, with thick bottom grass. Colour is good, sometimes rather light.
- (c) Growth starts fairly late in spring.
- (d) Yield good (Figure 6).
- (e) Twenty to thirty-three species.
- (f) The three main groups of plants are all well represented, the proportions being very variable, though Leguminosae are always plentiful. The range as shown by the partial separations from 1903-1948 was:-

Main Constituents of the Herbage on Plot 17

GRAMINEAE

<u>Dactylis glomerata</u>		Usually dominant
<u>Alopecurus pratensis</u>	}	Usually second in importance
<u>Holcus lanatus</u>		
<u>Agrostis vulgaris</u>	}	Plentiful
<u>Anthoxanthum odoratum</u>		
<u>Festuca rubra</u>		
<u>Avena pubescens</u>	}	Considerably less plentiful
<u>Lolium perenne</u>		
<u>Briza media</u>		
<u>Avena flavescens</u>		

MISCELLANEOUS

<u>Plantago lanceolata</u>		Very abundant
<u>Centaurea nigra</u>	}	Plentiful
<u>Leontodon hispidus</u>		

OTHER SPECIES:- Arrhenatherum, Bromus, Cynosurus, Poa pratensis, P. trivialis; Lathyrus, Lotus; Ajuga, Carex, Cerastium, Fritillaria, Luzula, Ophioglossum, Ranunculus spp. Rumex, Taraxacum, Veronica (See Tables).

Outline of Principal Changes during the Period 1877-1949

Yield. Little variation except for marked falls in 1919 and 1944. Seasonal fluctuations small.

Number of Species. Little variation. LEGUMINOSAE reduced since 1914 and MISCELLANEOUS species since 1903.

	<u>Number of Species</u>									
	<u>1862</u>	<u>1867</u>	<u>1872</u>	<u>1877</u>	<u>1903</u>	<u>1914</u>	<u>1919</u>	<u>1933</u>	<u>1949</u>	
G	16	16	17	15	15	14	14	15	9	
L	4	3	4	4	4	3	2	1	1	
M	13	23	22	29	20	14	15	14	10	
Total	33	42	43	48	39	31	31	30	20	

Composition of the Herbage.

Percentage of Gramineae, Leguminosae and Miscellaneous Species

	<u>1862</u>	<u>1867</u>	<u>1872</u>	<u>1877</u>	<u>1903</u>	<u>1914</u>	<u>1919</u>	<u>1931</u>	<u>1933</u>	<u>1949</u>
G	81.4	75.7	73.3	75.9	56.0	68.8	58.5	80.4	71.5	70.6
L	0.4	0.7	1.4	0.9	2.6	0.6	0.4	0.4	0.1	0.1
M	18.2	23.6	25.3	23.2	41.4	30.6	41.1	19.2	28.5	29.3

GRAMINEAE. Proportion little permanently changed

<u>Dactylis glomerata</u>	Much increased
<u>Alopecurus pratensis</u>	Slightly increased

LEGUMINOSAE. Little changed

MISCELLANEOUS. Little changed

<u>Plantago lanceolata</u>	Variable, usually important
<u>Centaurea nigra</u>	} Increased
<u>Leontodon hispidus</u>	
<u>Heraacleum sphondylium</u>	Disappeared

Changes in the Percentage of Certain Species

	<u>1862</u>	<u>1867</u>	<u>1872</u>	<u>1877</u>	<u>1903</u>	<u>1914</u>	<u>1919</u>	<u>1931</u>	<u>1933</u>	<u>1949</u>
<u>Alopecurus pratensis</u>	23.9	21.7	16.3	12.7	9.7	14.3	12.9	18.0	14.3	14.5
<u>Dactylis glomerata</u>	1.8	0.6	0.6	0.6	0.9	5.7	8.3	25.5	17.7	25.4
<u>Heraacleum sphondylium</u>	-	-	-	-	-	-	0.3	-	-	-
<u>Centaurea nigra</u>	4.4	4.1	10.3	2.8	11.2	8.0	8.7	5.9	5.2	5.5
<u>Leontodon hispidus</u>	0.1	0.1	0.1	0.3	3.7	4.4	3.4	1.9	1.3	4.0
<u>Plantago lanceolata</u>	3.9	4.8	2.4	8.0	10.7	13.9	24.1	8.0	16.2	14.0

Effect of Lime

pH. 7.0.

Yield. Little consistent change.

Number of Species. No effect.

Composition of the Herbage.

GRAMINEAE

Avena pubescens, Festuca rubra and to a less extent Avena flavescens are encouraged by lime, while Anthoxanthum odoratum is discouraged; on other species the effect of lime is variable.

Effect of Lime on the Percentage of Certain Species

	1921		1925		1929		1933		1949	
	U	L	U	L	U	L	U	L	U	L
<u>Anthoxanthum odoratum</u>	8.6	3.1	7.1	0.9	2.7	0.2	10.3	0.5	8.7	0.8
<u>Avena flavescens</u>	0.8	2.4	0.4	1.2	0.3	1.5	0.3	2.6	-	1.5
<u>Avena pubescens</u>	4.1	6.9	2.3	15.6	2.3	18.1	1.7	10.5	1.7	20.5
<u>Dactylis glomerata</u>	5.2	10.6	28.3	15.0	18.6	7.6	17.7	10.7	25.4	21.1
<u>Festuca rubra</u>	11.5	21.4	6.2	21.7	6.4	26.8	6.8	29.3	9.4	22.3
<u>Holcus lanatus</u>	15.9	12.6	9.8	6.5	8.8	2.0	13.6	5.9	8.5	20.1
<u>Centaurea nigra</u>	2.0	3.6	1.7	2.4	8.4	3.4	5.2	0.3	5.5	1.4
<u>Plantago lanceolata</u>	29.4	17.7	17.4	10.7	23.0	14.8	16.2	17.1	14.0	5.6

U = Unlimed L = Limed

NITRATE OF SODA (= 43 lb. N per acre) AND MIXED MINERAL MANURE (Plot 16)

Condition of Plot in 1949 (Unlimed)

- (a) pH 5.0.
- (b) Herbage tall and inclined to lodge, with thick bottom grass. Fairly dark colour, occasional bare patches early in year.
- (c) Growth starts fairly early.
- (d) Yield heavy, but below Plot 14 (Figure 9).
- (e) About twenty-two species, with occasional traces of others.
- (f) Composition of herbage variable, the proportion of the three groups changing much with season.

-48-

	Per cent		
	1914	1919	1947
G	75.6	86.0	68.2
L	15.9	1.2	13.0
M	8.5	12.8	18.8

Main Constituents of the Herbage on Plot 16

GRAMINEAE

<u>Alopecurus pratensis</u>	Usually the chief species
<u>Anthoxanthum odoratum</u>	} Occasionally very plentiful
<u>Dactylis glomerata</u>	
<u>Bromus mollis</u>	
<u>Arrhenatherum avenaceum</u>	
<u>Avena pubescens</u>	
<u>Festuca rubra</u>	

LEGUMINOSAE

<u>Lathyrus pratensis</u>	Very variable in quantity
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MISCELLANEOUS

<u>Taraxacum vulgare</u>	Occasionally plentiful
<u>Achillea millefolium</u>	
<u>Plantago lanceolata</u>	

OTHER SPECIES:- Agrostis, Avena flavescens, Holcus, Lolium, Poa pratensis, P.trivialis; Lotus, Trifolium pratense, T.repens; Anthriscus, Conopodium, Leontodon, Ranunculus spp. Rumex, Tragopogon (See Tables).

Outline of Principal Changes during the Period 1877-1949

Yield. Slightly reduced soon after 1877, but has since remained constant, except for seasonal fluctuations.

Number of Species. Reduced particularly in the MISCELLANEOUS group.

	<u>Number of Species</u>							
	<u>1862</u>	<u>1867</u>	<u>1872</u>	<u>1877</u>	<u>1914</u>	<u>1919</u>	<u>1947</u>	<u>1949</u>
G	17	14	17	15	12	11	8	13
L	3	4	4	4	3	1	4	2
M	14	16	15	22	11	9	11	8
Total	34	34	36	41	26	21	22	23

Composition of the Herbage.

Percentage of Gramineae, Leguminosae and Miscellaneous Species

	<u>1862</u>	<u>1867</u>	<u>1872</u>	<u>1877</u>	<u>1914</u>	<u>1919</u>	<u>1947</u>	<u>1949</u>
G	78.0	84.4	81.6	82.9	75.6	86.0	68.2	75.3
L	2.2	1.8	7.4	9.4	15.9	1.2	13.0	11.9
M	19.8	13.8	11.0	7.7	8.5	12.8	18.8	12.8

GRAMINEAE Proportion little permanently changed

<u>Alopecurus pratensis</u>	}	Much increased
<u>Arrhenatherum avenaceum</u>		
<u>Anthoxanthum odoratum</u>	}	Increased
<u>Dactylis glomerata</u>		
<u>Agrostis vulgaris</u>	}	Decreased
<u>Festuca rubra</u>		
<u>Avena flavescens</u>	}	Almost disappeared
<u>Holcus lanatus</u>		
<u>Lolium perenne</u>		
<u>Poa trivialis</u>		

LEGUMINOSAE Very variable

<u>Lathyrus pratensis</u>	Chief species
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MISCELLANEOUS Some increase

<u>Plantago lanceolata</u>	}	Increased
<u>Taraxacum vulgare</u>		
<u>Rumex acetosa</u>		Probably decreased

-50-

Changes in the Percentage of Certain Species

	<u>1862</u>	<u>1867</u>	<u>1872</u>	<u>1877</u>	<u>1914</u>	<u>1919</u>	<u>1949</u>
<u>Agrostis vulgaris</u>	12.5	13.6	12.4	14.6	4.8	1.3	2.3
<u>Alopecurus pratensis</u>	0.7	8.3	15.2	12.2	26.5	50.6	22.5
<u>Arrhenatherum avenaceum</u>	0.1	-	0.2	0.1	2.8	3.3	22.0
<u>Avena flavescens</u>	18.4	14.9	18.8	6.7	3.6	1.2	0.6
<u>Dactylis glomerata</u>	1.6	2.6	3.8	4.6	9.7	20.1	9.9
<u>Festuca rubra</u>	11.1	10.4	10.3	16.7	7.6	1.8	6.2
<u>Holcus lanatus</u>	10.5	11.7	5.1	12.6	1.4	1.7	1.1
<u>Lolium perenne</u>	5.6	6.2	3.1	3.6	-	-	0.1
<u>Poa trivialis</u>	6.9	9.0	6.5	4.8	0.1	0.3	0.1
<u>Plantago lanceolata</u>	1.3	0.8	0.1	0.2	2.9	2.5	6.3
<u>Taraxacum vulgare</u>	0.2	<	-	-	1.4	7.3	0.9
<u>Rumex acetosa</u>	5.5	5.6	1.2	2.2	0.1	1.0	0.2

< indicates below 0.05

Effect of Lime

pH. 7.0.

Yield. Reduced till 1939, since when it has increased. Tendency to lodge lessened.

Number of Species. No constant effect.

Composition of the herbage.

GRAMINEAE Decreased except Avena pubescens and Festuca rubra.

LEGUMINOSAE Decreased.

MISCELLANEOUS Little consistent change.

Effect of Lime on the Percentage of Certain Species

	1914		1919		1949	
	U	L	U	L	U	L
<u>Agrostis vulgaris</u>	4.8	0.2	1.3	0.2	2.3	0.2
<u>Alopecurus pratensis</u>	26.0	25.5	50.5	35.9	22.5	10.9
<u>Anthoxanthum odoratum</u>	2.8	0.1	2.0	<	4.2	0.2
<u>Avena pubescens</u>	5.0	13.8	2.8	17.6	5.8	15.3
<u>Bromus mollis</u>	7.8	3.0	<	<	0.2	0.6
<u>Dactylis glomerata</u>	9.7	9.5	20.1	18.9	9.9	13.4
<u>Festuca rubra</u>	7.8	30.9	1.8	11.4	6.2	14.4
<u>Holcus lanatus</u>	1.5	0.6	1.7	0.2	1.1	-
<u>Poa trivialis</u>	0.1	1.6	0.3	0.4	0.1	0.4
<u>Lathyrus pratensis</u>	14.4	1.3	1.2	0.7	11.7	8.5
<u>Plantago lanceolata</u>	2.8	0.4	2.5	1.5	6.3	5.3
<u>Taraxacum vulgare</u>	1.4	0.3	7.2	0.1	0.9	3.3

U = Unlimed L = Limed

NITRATE OF SODA (= 86 lb. N per acre) AND MIXED MINERAL MANURE (Plot 14)

Condition of Plot in 1949 (Unlimed)

- (a) pH 6.0.
- (b) Herbage dark green, very lush, and often lodges badly. Anthriscus sylvestris is conspicuous and Taraxacum vulgare very prevalent in some seasons.
- (c) Growth starts very early in spring.
- (d) Yield heavy, being higher than that where equal or even greater amounts of nitrogen as sulphate of ammonia are given (Plots 9, 11¹, 11²).
- (e) Ten to eighteen species, with occasional traces of several others.
- (f) GRAMINEAE usually forms 90 per cent of the herbage.

LEGUMINOSAE	} in small quantity only.
MISCELLANEOUS	

Main Constituents of the Herbage on Plot 14

GRAMINEAE

<u>Alopecurus pratensis</u>	}	Chief species
<u>Arrhenatherum avenaceum</u>		
<u>Dactylis glomerata</u>		Important
<u>Poa pratensis</u>	}	Usually in fair quantity, some times important
<u>Poa trivialis</u>		
<u>Bromus mollis</u>		Very variable

LEGUMINOSAE

<u>Lathyrus pratensis</u>	Usually the only species
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MISCELLANEOUS

<u>Anthriscus sylvestris</u>	}	Chief species
<u>Taraxacum vulgare</u>		
<u>Rumex acetosa</u>	}	Quantity small but characteristic
<u>Plantago lanceolata</u>		

OTHER SPECIES :- (Some of rare occurrence only). Agrostis, Anthoxanthum, Avena flavescens, A. pubescens, Briza, Bromus, Festuca rubra, Holcus; Trifolium repens; Achillea, Agrimonia, Centaurea, Conopodium, Heracleum, Hypochaeris, Leontodon, Pimpinella, Ranunculus spp. (See Tables).

Outline of Principal Changes during the Period 1877-1948

Yield. Little changed.

Number of Species. Reduced, chiefly since 1903.

	<u>Number of Species</u>									
	<u>1862</u>	<u>1867</u>	<u>1872</u>	<u>1877</u>	<u>1903</u>	<u>1914</u>	<u>1919</u>	<u>1935</u>	<u>1948</u>	
G	15	14	14	15	13	12	11	10	10	
L	3	3	2	1	2	1	1	1	1	
M	10	13	14	11	9	6	4	4	5	
Total	28	30	30	27	24	19	16	15	16	

Composition of the herbage.

Percentage of Gramineae, Leguminosae and Miscellaneous species

	<u>1862</u>	<u>1867</u>	<u>1872</u>	<u>1877</u>	<u>1903</u>	<u>1914</u>	<u>1919</u>	<u>1935</u>	<u>1940</u>	<u>1948</u>
G	89.5	94.3	92.9	87.8	85.5	92.2	93.0	93.0	96.1	92.4
L	0.1	0.4	1.4	0.8	3.4	4.0	2.4	0.9	0.7	2.1
M	10.4	5.3	5.7	11.4	11.1	3.8	4.6	6.1	3.2	5.5

GRAMINEAE

<u>Alopecurus pratensis</u>	}	Increased
<u>Arrhenatherum avenaceum</u>		
<u>Dactylis glomerata</u>		
<u>Poa trivialis</u>		Much reduced
<u>Poa pratensis</u>		Variable
<u>Festuca rubra</u>		Increased at first, but now practically disappeared
<u>Lolium perenne</u>	}	Disappeared
<u>Holcus lanatus</u>		

LEGUMINOSAE

<u>Lathyrus pratensis</u>	Very variable
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MISCELLANEOUS

<u>Anthriscus sylvestris</u>	Decreased, especially since 1941
<u>Taraxacum vulgare</u>	Increased considerably
<u>Plantago lanceolata</u>	Increased
<u>Rumex acetosa</u>	Variable

Several unimportant species have disappeared.

Changes in the Percentage of Certain Species

	<u>1862</u>	<u>1867</u>	<u>1872</u>	<u>1877</u>	<u>1903</u>	<u>1914</u>	<u>1919</u>	<u>1935</u>	<u>1940</u>	<u>1948</u>
<u>Alopecurus pratensis</u>	0.2	3.5	3.7	20.2	28.7	22.6	53.6	61.9	49.1	31.8
<u>Arrhenatherum avenaceum</u>	3.1	-	-	0.3	17.3	40.9	23.4	25.8	30.9	36.2
<u>Avena pubescens</u>	0.9	0.9	0.2	0.5	2.3	3.6	3.7	<	0.1	1.4
<u>Bromus mollis</u>	18.0	17.7	42.1	8.0	23.0	5.2	0.5	1.7	<	0.3
<u>Dactylis glomerata</u>	10.0	7.3	3.3	12.5	0.7	6.2	3.2	2.0	5.7	14.2
<u>Festuca rubra</u>	0.9	1.6	0.2	0.5	2.8	5.9	5.1	0.2	0.1	-
<u>Holcus lanatus</u>	6.6	6.6	3.7	12.8	<	-	-	-	-	-
<u>Lolium perenne</u>	13.8	9.4	5.6	2.6	<	0.1	-	-	-	-
<u>Poa pratensis</u>	1.5	1.1	2.6	4.0	9.2	2.2	0.8	0.7	0.3	4.7
<u>Poa trivialis</u>	22.5	32.9	24.8	21.6	1.0	1.3	1.0	0.6	9.8	2.4
<u>Lathyrus pratensis</u>	0.1	0.4	1.4	0.8	3.3	4.0	2.4	0.9	0.7	2.1
<u>Anthriscus sylvestris</u>	-	1.5	3.9	4.6	9.5	1.0	2.4	4.9	1.3	0.1
<u>Taraxacum vulgare</u>	0.2	0.2	0.2	0.6	0.7	2.0	1.2	0.2	0.7	3.2
<u>Rumex acetosa</u>	6.9	1.1	0.6	4.4	0.6	0.5	1.0	0.9	1.3	0.4

< indicates below 0.05

Effect of Lime

The limed section of Plot 14 is partly shaded by a large tree and both herbage and yield differ in sun and shade areas.

pH. 7.0.

Yield. Slightly reduced by lime, more so in the shade than in the sun.

Number of Species. Hardly affected in recent years. Earlier a tendency to increase in the shade area.

Composition of the herbage. Little regular variation in any of the three groups of plants.

Effect of Lime on the Percentage of Certain Species

	1935			1940			1948		
	U	L. sun	L. sh.	U	L. sun	L. sh.	U	L. sun	L. sh.
<u>Alopecurus pratensis</u>	61.9	22.3	20.0	49.1	18.5	12.4	31.8	12.1	6.7
<u>Arrhenatherum avenaceum</u>	25.8	38.1	11.0	30.9	52.0	12.1	36.2	45.0	34.7
<u>Dactylis glomerata</u>	2.0	4.5	2.2	5.7	6.0	1.9	14.2	13.6	5.0
<u>Festuca rubra</u>	0.2	9.5	43.2	0.1	5.3	36.6	-	13.3	27.4
<u>Poa pratensis</u>	0.7	4.6	3.2	0.3	1.0	1.6	4.7	2.9	2.9
<u>Lathyrus pratensis</u>	0.9	12.4	4.2	0.7	1.5	15.0	2.0	3.2	3.6
<u>Taraxacum vulgare</u>	0.2	0.2	0.2	0.6	0.9	0.7	3.2	1.1	1.7

U = Unlimed L = Limed

D. AMMONIUM SALTS WITH MIXED MINERAL MANURES (Table 5)

AMMONIUM SALTS (= 86 lb. N per acre) AND MIXED MINERAL
MANURE (Plot 9)

Condition of Plot in 1949 (Unlimed)

- (a) pH 4.0.
- (b) Herbage uneven, luxuriant in parts with some bare patches especially in spring. Colour dark green, comparatively little bottom grass, and hay often stemmy. In 1929 all the herbage on the unlimed half was killed by the severe winter and recolonization during the next two years consisted almost entirely of Holcus lanatus. After 1946 this species decreased rapidly to 51 per cent, but it has since largely regained its dominant position.

The scarcity of MISCELLANEOUS plants brings the plot into sharp contrast with the neighbouring Plots 8, 7, 6.

- (c) Growth starts early in spring.
- (d) Yield usually high, with large seasonal fluctuations (Figure 10).

(e) About three to nine species and frequently only one viz. Holcus lanatus.

(f) GRAMINEAE 99 to 100 per cent; 1947 was unusual with 96.4%.

LEGUMINOSAE absent.

MISCELLANEOUS species usually under 1 per cent except in 1947 when they reached 3.6 per cent.

Main Constituents of the Herbage on Plot 9

GRAMINEAE

<u>Holcus lanatus</u>	Since 1930, frequently 100% of herbage
<u>Agrostis vulgaris</u>	} Relative proportions vary greatly with season
<u>Anthoxanthum odoratum</u>	
<u>Arrhenatherum avenaceum</u>	
<u>Festuca rubra</u>	

MISCELLANEOUS

Rumex acetosa The only significant species

OTHER SPECIES (Of rare occurrence only). Alopecurus, Avena flavescens, A. pubescens, Bromus, Dactylis, Lolium, Poa pratensis, P. trivialis; Achillea, Epilobium, Heracleum (See Tables).

Outline of Principal Changes during the Period 1877-1949

Yield. Tendency for reduction at first but since 1929, when the herbage was killed by a severe winter, yields have somewhat increased and become more uniform.

Number of Species. Greatly reduced.

	<u>Number of Species</u>									
	<u>1862</u>	<u>1867</u>	<u>1872</u>	<u>1877</u>	<u>1903</u>	<u>1914</u>	<u>1919</u>	<u>1930</u>	<u>1940</u>	<u>1948</u>
G	13	14	16	13	12	9	8	1	6	5
L	2	2	1	4	1	-	-	-	-	-
M	13	13	13	10	7	5	3	-	-	1
Total	28	29	30	27	20	14	11	1	6	6

Composition of the Herbage.

Percentage of Gramineae, Leguminosae and Miscellaneous Species

	<u>1862</u>	<u>1867</u>	<u>1872</u>	<u>1877</u>	<u>1903</u>	<u>1914</u>	<u>1919</u>	<u>1930</u>	<u>1940</u>	<u>1948</u>
G	88.6	77.1	92.2	94.7	95.9	94.7	85.0	100.0	100.0	99.5
L	0.1	0.2	<	0.4	-	-	-	-	-	-
M	11.3	22.8	7.8	4.9	4.1	5.3	15.0	-	-	0.5

GRAMINEAE

<u>Holcus lanatus</u>	Greatly increased, may comprise entire herbage
<u>Agrostis vulgaris</u>	Very variable since 1929
<u>Anthoxanthum odoratum</u>	} Increased till 1929 since when almost disappeared
<u>Arrhenatherum avenaceum</u>	

Avena flavescens, A. pubescens, Dactylis glomerata, Lolium perenne, Poa pratensis and P. trivialis have all practically disappeared, but may occur occasionally.

LEGUMINOSAE

Disappeared

MISCELLANEOUS

Rumex acetosa Very variable, may have disappeared

Changes in the Percentage of Certain Species

	<u>1862</u>	<u>1867</u>	<u>1872</u>	<u>1877</u>	<u>1903</u>	<u>1914</u>	<u>1919</u>	<u>1930</u>	<u>1940</u>	<u>1948</u>
<u>Agrostis vulgaris</u>	12.8	13.4	15.5	12.2	3.8	18.4	12.4	<	5.3	7.8
<u>Anthoxanthum odoratum</u>	1.2	3.6	2.3	2.9	16.2	38.9	5.4	-	0.3	0.4
<u>Arrhenatherum avenaceum</u>	-	2.5	11.4	13.2	43.3	8.6	46.9	-	0.9	0.6
<u>Avena flavescens</u>	9.1	3.8	5.3	0.7	0.2	0.1	-	-	-	-
<u>Avena pubescens</u>	10.2	1.4	0.5	0.1	0.1	-	-	-	-	-
<u>Dactylis glomerata</u>	5.6	4.6	11.9	14.1	5.1	5.0	3.3	-	-	-
<u>Holcus lanatus</u>	12.1	9.8	7.6	10.4	3.9	4.1	12.4	100.0	93.3	90.6
<u>Lolium perenne</u>	4.2	1.0	1.1	0.2	-	-	-	-	-	-
<u>Poa pratensis</u>	10.7	13.0	22.7	18.0	11.7	1.8	0.2	-	-	-
<u>Poa trivialis</u>	8.7	2.1	0.6	0.1	<	-	-	-	-	-
<u>Rumex acetosa</u>	5.4	10.9	4.6	3.6	2.8	4.4	14.8	-	-	-

< indicates below 0.05

Effect of Lime

pH. 5.0.

Yield. Much increased. Herbage uniform and contrasts sharply with the unlimed half. Tends to lodge.

Number of Species. Increased, especially since 1929.

Effect of Lime on the Percentage of Certain Species

	1914		1919		1930		1940		1948	
	U	L	U	L	U	L	U	L	U	L
<u>Agrostis vulgaris</u>	18.2	2.7	12.4	2.3	-	3.3	5.3	2.6	7.8	4.3
<u>Alopecurus pratensis</u>	1.7	17.7	0.7	25.9	-	57.4	0.1	55.0	-	38.1
<u>Anthoxanthum odoratum</u>	38.5	12.7	5.4	1.1	-	0.8	0.3	2.4	0.4	4.2
<u>Arrhenatherum avenaceum</u>	8.5	38.6	46.8	47.2	-	20.9	0.9	21.9	0.6	14.7
<u>Dactylis glomerata</u>	5.0	6.9	3.3	6.8	-	2.3	-	4.1	-	11.6
<u>Holcus lanatus</u>	4.0	2.2	12.4	0.8	100.0	0.5	93.4	2.1	90.6	2.5
<u>Poa pratensis</u>	1.8	7.5	0.2	5.6	-	7.0	-	2.1	-	9.4
<u>Rumex acetosa</u>	4.4	0.7	14.8	3.5	-	0.1	-	0.3	-	1.1

U = Unlimed L = Limed

Composition of the Herbage.

GRAMINEAE Approach 100 per cent

<u>Alopecurus pratensis</u>	}	Much increased
<u>Arrhenatherum avenaceum</u>		Increased
<u>Poa pratensis</u>		
<u>Holcus lanatus</u>		Much decreased

LEGUMINOSAE Increased

MISCELLANEOUS Increased in some seasons

<u>Heraacleum sphondylium</u>	}	Increased since 1935
<u>Taraxacum vulgare</u>		

Almost every species is affected by liming but the response may vary with season

e.g. Arrhenatherum avenaceum.

AMMONIUM SALTS (= 86 lb. N per acre) AND MIXED MINERAL MANURE
WITHOUT POTASH (Plot 10)

Condition of Plot in 1949 (Unlimed)

- (a) pH 4.0.
- (b) Herbage less luxuriant than on Plot 9, and now differs from it in type.
- (c) Growth starts early.
- (d) Yield medium, much below that of Plot 9.
- (e) About six to sixteen species.
- (f) GRAMINEAE usually 98-100 per cent.
LEGUMINOSAE absent.
MISCELLANEOUS species below 2 per cent.

Main Constituents of the Herbage on Plot 10

GRAMINEAE

<u>Agrostis vulgaris</u>	}	Chief species
<u>Anthoxanthum odoratum</u>		
<u>Holcus lanatus</u>		
<u>Alopecurus pratensis</u>		Very small amounts
<u>Festuca rubra</u>		Very small amounts till 1948
<u>Arrhenatherum avenaceum</u>		Usually very small amounts, but important in 1945 and 1946

MISCELLANEOUS

<u>Rumex acetosa</u>	Very small amount
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OTHER SPECIES (Mostly of very rare occurrence). Avena flavescens, A. pubescens, Dactylis, Poa pratensis, P. trivialis; Achillea, Centaurea, Galium, Heracleum, Hieracium, Leontodon, Luzula, Plantago, Potentilla, Poterium, Scabiosa, Taraxacum, Veronica. (See Tables).

Outline of Principal Changes during the Period 1877-1948

Yield. Reduced but fluctuating, change first evident in 1909.

Number of Species. Greatly reduced.

	<u>Number of Species</u>									
	<u>1862</u>	<u>1867</u>	<u>1872</u>	<u>1877</u>	<u>1914</u>	<u>1919</u>	<u>1935</u>	<u>1940</u>	<u>1948</u>	
G	16	15	15	15	8	9	8	7	7	
L	2	1	2	2	-	-	-	1	-	
M	13	11	6	11	4	1	2	-	1	
Total	31	27	23	28	12	10	10	8	8	

Composition of the Herbage.

The balance between the GRAMINEAE and MISCELLANEOUS species is unchanged except for seasonal fluctuations but the LEGUMINOSAE have practically disappeared.

Percentage of Gramineae, Leguminosae and Miscellaneous Species

	<u>1862</u>	<u>1867</u>	<u>1872</u>	<u>1877</u>	<u>1914</u>	<u>1919</u>	<u>1935</u>	<u>1940</u>	<u>1948</u>
G	85.5	82.6	94.7	93.4	98.7	92.6	99.9	99.9	99.7
L	0.1	0.1	<	<	-	-	-	<	-
M	14.4	17.3	5.3	6.6	1.3	7.4	0.1	-	0.3

< indicates below 0.05

GRAMINEAE

<u>Anthoxanthum odoratum</u>	Large increase usually maintained
<u>Arrhenatherum avenaceum</u>	Very variable
<u>Alopecurus pratensis</u>	Increase of 1877 maintained until 1929, since when it has become unimportant
<u>Agrostis vulgaris</u>	Reduced at first, but large increase since 1939
<u>Holcus lanatus</u>	Reduced at first, but large increase since 1935
<u>Dactylis glomerata</u>	Reduced
Avena flavescens, A. pubescens, Bromus mollis, Lolium perenne, Poa pratensis and P. trivialis have practically disappeared.	

MISCELLANEOUS

<u>Rumex acetosa</u>	The only constant representative; quantity very variable
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Changes in the Percentage of Certain Species

	<u>1862</u>	<u>1867</u>	<u>1872</u>	<u>1877</u>	<u>1914</u>	<u>1919</u>	<u>1935</u>	<u>1940</u>	<u>1948</u>
<u>Agrostis vulgaris</u>	9.4	8.6	14.1	16.3	3.0	4.0	10.3	33.9	51.9
<u>Alopecurus pratensis</u>	2.1	3.0	10.4	15.5	18.6	20.8	0.2	0.1	0.3
<u>Arrhenatherum avenaceum</u>	0.1	11.7	13.2	9.6	4.8	25.9	1.4	0.9	4.1
<u>Anthoxanthum odoratum</u>	1.5	5.3	3.3	5.8	49.4	21.0	21.1	31.5	10.3
<u>Avena flavescens</u>	10.1	2.0	0.8	0.2	-	-	-	-	-
<u>Avena pubescens</u>	10.6	1.6	0.4	0.2	-	-	-	-	-
<u>Bromus mollis</u>	2.5	0.7	1.7	1.6	-	-	-	-	-
<u>Dactylis glomerata</u>	12.5	5.4	3.1	4.9	1.0	1.6	0.1	-	0.3
<u>Holcus lanatus</u>	9.5	8.2	4.4	4.7	1.1	11.6	64.4	31.3	21.6
<u>Lolium perenne</u>	3.0	1.8	0.6	0.2	-	-	-	-	-
<u>Poa pratensis</u>	4.1	14.8	19.6	6.5	0.9	0.3	-	-	-
<u>Poa trivialis</u>	10.2	2.8	1.2	0.5	-	-	0.1	-	-

Effect of Lime

The difference in appearance between limed and unlimed areas is clearly marked.
Tendency to lodge increased.

pH. 5.0

Yield. Much increased.

Number of Species. Practically no effect.

Composition of the Herbage.

GRAMINEAE Usually slightly decreased, but seasonal differences.

<u>Alopecurus pratensis</u>	}	Much increased
<u>Festuca rubra</u>		
<u>Anthoxanthum odoratum</u>	}	Much decreased
<u>Holcus lanatus</u>		

LEGUMINOSAE Not affected.

MISCELLANEOUS Slightly increased.

Effect of Lime on the Percentage of Certain Species

	1914		1919		1935		1948	
	U	L	U	L	U	L	U	L
<u>Agrostis vulgaris</u>	3.0	3.1	4.0	0.5	10.3	1.0	51.9	1.0
<u>Alopecurus pratensis</u>	18.6	46.5	20.8	76.8	0.2	55.2	0.3	28.6
<u>Anthoxanthum odoratum</u>	49.4	15.2	21.0	1.1	21.1	1.9	10.3	1.8
<u>Arrhenatherum avenaceum</u>	4.8	9.2	25.9	8.1	1.4	1.7	5.1	4.1
<u>Festuca rubra</u>	19.0	14.8	6.9	5.2	2.4	33.3	10.2	54.5
<u>Holcus lanatus</u>	1.1	1.5	11.6	0.1	64.4	-	21.6	0.5
<u>Poa pratensis</u>	0.9	4.3	0.3	6.0	-	6.2	-	3.4
<u>Rumex acetosa</u>	1.0	0.2	7.4	0.4	0.1	0.5	0.3	5.0

U = Unlimed L = Limed

AMMONIUM SALTS (= 129 lb. N per acre) AND MIXED MINERAL MANURE
(Plot · 11¹)

Condition of Plot in 1949 (Unlimed)

- (a) pH 4.0.
- (b) Extremely patchy, especially in winter and spring. Herbage consists of large tufts of grass interspersed with extensive bare patches, covered with partially decayed peaty matter. In favourable seasons seedlings of Holcus lanatus quickly spring up on the bare patches. There is practically no bottom grass and the herbage is very coarse and rank, with a tendency to lodge.
- (c) Growth starts very early and may be vividly green in January and February, when most other plots are still dormant.
- (d) Yield very heavy.
- (e) Only four species of any significance, with occasional traces of a few others.
- (f) GRAMINEAE form practically all the herbage.
LEGUMINOSAE almost always absent.
MISCELLANEOUS usually below 2 per cent.

Main Constituents of the Herbage on Plot 11¹

GRAMINEAE

Holcus lanatus Dominant species
Arrhenatherum avenaceum Used to be plentiful in some seasons, now scarce

MISCELLANEOUS

Epilobium angustifolium Very variable; occasionally important

OTHER SPECIES (Some of rare occurrence only). Agrostis, Alopecurus, Anthoxanthum, Avena pubescens, Dactylis, Festuca rubra, Poa pratensis; Lotus, Trifolium pratense; Leontodon, Ranunculus spp. Rumex (See Tables).

Outline of Principal Changes during the Period 1877-1949

Yield. Reduced but crop heavy in 1932 and 1943.

Number of Species. Reduced.

	<u>Number of Species</u>									
	<u>1862</u>	<u>1867</u>	<u>1872</u>	<u>1877</u>		<u>1914</u>	<u>1919</u>	<u>1947</u>	<u>1949</u>	
G	15	13	11	11		7	7	6	2	
L	1	1	1	-		-	-	1	-	
M	12	4	4	4		-	1	2	1	
Total	28	18	16	15		7	8	9	3	

Composition of the Herbage.

	<u>Percentage of Gramineae, Leguminosae and Miscellaneous Species</u>									
	<u>1862</u>	<u>1867</u>	<u>1872</u>	<u>1877</u>		<u>1903</u>	<u>1914</u>	<u>1919</u>	<u>1947</u>	<u>1949</u>
G	89.4	94.1	98.8	97.5		99.8	100.0	98.9	87.8	99.7
L	-	-	-	-		-	-	-	0.2	-
M	10.6	5.9	1.2	2.5		0.2	-	1.1	12.0*	0.3

* The high proportion of Miscellaneous species in 1947 is due to the big influx of Epilobium angustifolium which occurred that year.

GRAMINEAE.

<u>Holcus lanatus</u>	Much increased
<u>Agrostis vulgaris</u>	Reduced
<u>Alopecurus pratensis</u>	Much reduced

Dactylis glomerata, Festuca rubra, Poa pratensis and P. trivialis seem to have disappeared.

Changes in the Percentage of Certain Species

	<u>1862</u>	<u>1867</u>	<u>1872</u>	<u>1877</u>	<u>1903</u>	<u>1914</u>	<u>1919</u>	<u>1947</u>	<u>1949</u>
<u>Agrostis vulgaris</u>	13.2	19.3	13.6	29.2	1.4	0.5	1.7	4.5	-
<u>Alopecurus pratensis</u>	2.8	13.1	12.4	9.9	28.5	1.2	0.8	1.1	0.1
<u>Dactylis glomerata</u>	24.2	39.3	39.3	17.1	0.2	0.2	0.2	-	-
<u>Festuca rubra</u>	1.5	0.5	0.4	4.2	<	0.1	0.1	0.2	-
<u>Holcus lanatus</u>	9.9	2.9	10.3	20.3	45.6	90.9	64.8	81.1	99.7
<u>Poa pratensis</u>	9.4	12.9	10.4	1.5	0.2	-	-	-	-
<u>Poa trivialis</u>	13.3	0.1	0.1	0.3	-	-	-	-	-

Effect of Lime

pH. 4.5.

Yield. Much increased.

Number of Species. Increased.

Composition of the Herbage.

The contrast between the limed and unlimed areas is greater here than on almost any other plot. The herbage is uniform and there are no bare patches.

GRAMINEAE Proportion little affected.

<u>Alopecurus pratensis</u>	Replaces <u>Holcus lanatus</u> as the dominant species
<u>Arrhenatherum avenaceum</u>	Response varies with season
<u>Dactylis glomerata</u>	} Increased
<u>Poa pratensis</u>	

-25-

	Per cent
G	22.8 - 74.8
L	8.7 - 40.1
M	10.0 - 48.8

Main Constituents of the Herbage on Plot 7

GRAMINEAE

<u>Festuca rubra</u>	}	Usually the most abundant species
<u>Dactylis glomerata</u>		
<u>Agrostis vulgaris</u>	}	Frequently important.
<u>Alopecurus pratensis</u>		
<u>Anthoxanthum odoratum</u>		
<u>Holcus lanatus</u>		Present in fair quantity
<u>Avena pubescens</u>	}	Occasionally conspicuous, otherwise insignificant
<u>Arrhenatherum avenaceum</u>		
<u>Bromus mollis</u>		Usually insignificant, but abundant in 1948

LEGUMINOSAE

<u>Lathyrus pratensis</u>	}	Usually the chief species
<u>Trifolium pratense</u>		Occasionally the chief species
<u>Lotus corniculatus</u>		

MISCELLANEOUS

<u>Conopodium demudatum</u>	}	Vary much with season
<u>Heracleum sphondylium</u>		
<u>Achillea millefolium</u>		
<u>Centaurea nigra</u>		
<u>Plantago lanceolata</u>		
<u>Rumex acetosa</u>		

OTHER SPECIES:- Avena flavescens, Briza, Festuca pratensis, Lolium, Poa pratensis, P. trivialis; Trifolium repens, Vicia; Carex, Cerastium, Galium, Leontodon, Luzula, Pimpinella, Primula, Ranunculus spp. Scabiosa, Spireae, Stellaria, Taraxacum, Tragopogon, Veronica. (See Tables).

Outline of Principal Changes during the Period 1877-1948

Yield. Fairly constant except for seasonal fluctuations, with a period of high yields from 1902-1907.

Number of Species. Reduced.

	<u>Number of Species</u>									
	<u>1862</u>	<u>1867</u>	<u>1872</u>	<u>1877</u>	<u>1903</u>	<u>1914</u>	<u>1919</u>	<u>1930</u>	<u>1938</u>	<u>1948</u>
G	18	16	17	17	16	14	12	10	12	13
L	4	4	4	4	4	5	5	4	4	5
M	20	22	20	22	17	14	15	14	11	12
Total	42	42	41	43	37	33	32	28	27	30

Composition of the Herbage. Seasonal effect is very considerable, and the balance of the groups varies from year to year.

Percentage of Gramineae, Leguminosae and Miscellaneous Species

	<u>1862</u>	<u>1877</u>	<u>1903</u>	<u>1914</u>	<u>1919</u>	<u>1930</u>	<u>1939</u>	<u>1946</u>	<u>1948</u>
G	64.7	74.4	41.7	68.3	52.0	43.5	45.3	28.6	46.6
L	24.7	13.7	33.2	17.0	8.8	35.3	39.7	25.9	19.8
M	10.6	11.9	25.1	14.7	39.2	21.2	15.0	45.5	33.6

GRAMINEAE

<u>Festuca rubra</u>	}	Usually dominant
<u>Dactylis glomerata</u>		
<u>Alopecurus pratensis</u>	}	Occasionally dominant
<u>Poa trivialis</u>		Reduced
<u>Avena flavescens</u>		

LEGUMINOSAE

<u>Lathyrus pratensis</u>	}	Usually dominant
<u>Trifolium pratense</u>		Occasionally dominant
<u>Lotus corniculatus</u>		

MISCELLANEOUS

<u>Conopodium denudatum</u>	}	Occasionally dominant
<u>Heracleum sphondylium</u>		
<u>Achillea millefolium</u>		
<u>Plantago lanceolata</u>		
<u>Rumex acetosa</u>		

Changes in the Percentage of Certain Species

	<u>1862</u>	<u>1867</u>	<u>1872</u>	<u>1877</u>	<u>1903</u>	<u>1914</u>	<u>1919</u>	<u>1939</u>	<u>1947</u>	<u>1948</u>
<u>Alopecurus pratensis</u>	0.3	0.9	1.2	0.5	4.5	1.7	1.7	1.2	4.5	8.3
<u>Avena flavescens</u>	4.0	4.8	3.7	3.7	6.6	1.8	0.7	0.5	0.8	1.0
<u>Dactylis glomerata</u>	2.6	4.7	1.7	3.7	5.0	10.2	21.6	21.8	20.8	15.7
<u>Festuca rubra</u>	13.7	11.4	14.9	26.6	7.7	31.6	7.2	7.7	4.1	4.6
<u>Poa trivialis</u>	3.8	4.4	2.3	2.1	1.0	0.5	0.4	-	0.2	0.3
<u>Lathyrus pratensis</u>	13.5	6.8	36.7	12.1	22.0	10.7	7.2	28.8	11.4	11.3
<u>Lotus corniculatus</u>	1.3	0.7	0.2	0.1	0.4	0.6	0.5	2.3	0.4	0.5
<u>Trifolium pratense</u>	6.8	4.8	1.1	1.6	6.4	4.7	1.0	4.6	4.3	4.6
<u>Conopodium denudatum</u>	0.9	1.2	0.2	0.3	1.7	0.8	9.5	1.3	4.4	1.4
<u>Heracleum sphondylium</u>	-	0.2	<	0.6	1.9	0.5	4.2	1.3	1.1	1.0
<u>Achillea millefolium</u>	-	-	-	-	8.9	2.5	6.3	2.8	7.6	14.0
<u>Centaurea nigra</u>	<	0.8	0.3	0.1	1.0	6.9	2.6	4.0	7.0	4.3
<u>Plantago lanceolata</u>	0.2	1.1	0.1	0.1	0.1	0.7	1.3	1.6	5.4	6.5

< indicates below 0.05

Effect of Lime

pH. 7.0

Yield. Generally much increased.

Number of Species. No constant effect.

Composition of the Herbage.

GRAMINEAE Proportion increased.

<u>Dactylis glomerata</u>	}	Unaffected, remains dominant
<u>Alopecurus pratensis</u>		
<u>Arrhenatherum avenaceum</u>		

Increased

Agrostis vulgaris
Anthoxanthum odoratum
Festuca rubra } Reduced

LEGUMINOSAE No constant effect

MISCELLANEOUS Most species reduced

Effect of Lime on the Percentage of Certain Species

	1914		1919		1936		1940		1947	
	U	L	U	L	U	L	U	L	U	L
<u>Agrostis vulgaris</u>	7.0	4.3	5.4	2.0	6.1	0.5	3.1	0.2	4.7	0.1
<u>Alopecurus pratensis</u>	1.7	9.8	1.7	15.2	0.8	8.4	6.1	22.9	4.5	15.7
<u>Anthoxanthum odoratum</u>	4.2	0.6	3.6	0.5	3.7	0.3	2.6	0.1	6.7	0.3
<u>Avena flavescens</u>	1.9	4.0	0.7	1.0	0.9	2.8	0.6	2.6	0.8	2.1
<u>Avena pubescens</u>	2.6	4.5	2.8	8.8	1.8	4.5	1.8	2.7	1.2	3.9
<u>Bromus mollis</u>	2.1	15.6	0.1	0.6	-	0.8	0.2	7.3	-	0.2
<u>Festuca rubra</u>	31.6	13.3	7.2	5.4	10.0	2.7	6.6	1.2	4.1	1.0
<u>Poa trivialis</u>	0.5	1.9	0.4	1.2	0.1	9.0	0.3	9.3	0.2	2.1
<u>Lathyrus pratensis</u>	10.7	15.9	7.2	19.6	16.0	15.6	8.8	6.4	11.4	5.2
<u>Trifolium pratense</u>	4.7	2.8	1.0	<	9.9	4.5	4.9	2.1	4.3	0.1
<u>Gonopodium denudatum</u>	0.8	0.3	9.5	3.7	1.8	0.4	2.0	0.1	4.4	0.1
<u>Heracleum sphondylium</u>	0.5	0.3	4.2	1.6	3.9	5.6	4.8	4.4	1.1	4.6
<u>Achillea millefolium</u>	2.5	0.7	6.3	1.0	2.7	0.9	1.2	0.1	7.6	0.3
<u>Centaurea nigra</u>	6.9	3.5	2.6	1.1	7.7	4.4	3.1	0.1	7.0	1.5
<u>Plantago lanceolata</u>	0.7	0.2	1.3	0.5	3.2	1.1	1.3	0.6	5.4	1.8

U = Unlimed L = Limed

MINERAL MANURE WITHOUT POTASH (Plot 8)

Condition of Plot in 1949 (Unlimed)

- (a) pH 5.0.
- (b) Herbage shorter and less luxuriant than in the presence of potash (Plot 7); very varied, with much bottom grass; growth patchy, colour usually rather pale.
- (c) Growth starts later than Plot 7.

- (d) Yield rather low (Figure 7) and much below that of Plot 7.
- (e) Twenty-eight to thirty-six species according to season, number has become more steady since 1935.
- (f) The three main groups of plants are all well represented, with a large proportion of Leguminosae. The range as shown by partial separations from 1903-1948 was:-

	Per cent
G	27.4 - 69.0
L	2.7 - 25.3
M	22.7 - 64.8

Main Constituents of the Herbage on Plot 8

GRAMINEAE

<u>Agrostis vulgaris</u>	}	Usually among the most abundant species
<u>Arrhenatherum avenaceum</u>		
<u>Dactylis glomerata</u>		
<u>Festuca rubra</u>		
<u>Holcus lanatus</u>		
<u>Anthoxanthum odoratum</u>		
<u>Avena flavescens</u>	}	Present in fair quantity
<u>Avena pubescens</u>		
<u>Briza media</u>		
		Small in amount but characteristic

LEGUMINOSAE

<u>Trifolium pratense</u>	}	Chief species
<u>Lotus corniculatus</u>		

MISCELLANEOUS

<u>Plantago lanceolata</u>	}	Chief species
<u>Ranunculus spp.</u>		
<u>Conopodium denudatum</u>		
<u>Scabiosa arvensis</u>		
<u>Achillea millefolium</u>		
<u>Centaurea nigra</u>		
<u>Leontodon hispidus</u>		
<u>Rumex acetosa</u>		Vary in relative abundance

OTHER SPECIES:- Alopecurus, Bromus, Cynosurus, Lolium, Poa pratensis, P. trivialis; Lathyrus, Trifolium repens; Agrimonia, Ajuga, Carex, Gerastium, Galium, Heracleum, Luzula, Pimpinella, Primula, Prunella, Spirea, Stellaria, Taraxacum, Tragopogon, Veronica (See Tables).

Outline of Principal Changes during the Period 1877-1948

Yield. No general reduction but considerable seasonal variation.

Number of Species. Reduced since 1903, but little change after 1914.

	<u>Number of Species</u>							
	<u>1862</u>	<u>1877</u>	<u>1903</u>	<u>1914</u>	<u>1919</u>	<u>1935</u>	<u>1948</u>	
G	17	16	15	15	13	11	14	
L	4	4	4	4	4	4	4	
M	17	26	23	16	15	17	15	
Total	38	46	42	35	32	32	33	

Composition of the Herbage.

Percentage of Gramineae, Leguminosae and Miscellaneous Species

	<u>1862</u>	<u>1867</u>	<u>1872</u>	<u>1877</u>	<u>1903</u>	<u>1914</u>	<u>1919</u>	<u>1935</u>	<u>1948</u>
G	71.7	63.0	71.5	81.2	43.5	63.3	46.6	55.6	52.5
L	19.3	8.9	8.0	4.0	18.6	10.7	10.6	11.3	7.3
M	9.0	28.1	20.5	14.8	37.9	26.0	42.8	33.1	40.2

GRAMINEAE Decreased

<u>Poa trivialis</u>	}	Much reduced
<u>Lolium perenne</u>		
<u>Cynosurus cristatus</u>	}	Almost disappeared
<u>Festuca pratensis</u>		

LEGUMINOSAE Much increased

<u>Trifolium pratense</u>	Usually responsible for most of increase
<u>Lotus corniculatus</u>	Increased

MISCELLANEOUS Increased, but very variable since 1903

<u>Plantago lanceolata</u>	Responsible for most of increase
<u>Centaurea nigra</u>	} Very variable
<u>Rumex acetosa</u>	
<u>Leontodon hispidus</u>	Considerably increased since 1919

Changes in the Percentage of Certain Species

	<u>1862</u>	<u>1867</u>	<u>1872</u>	<u>1877</u>	<u>1903</u>	<u>1914</u>	<u>1919</u>	<u>1935</u>	<u>1948</u>
<u>Cynosurus cristatus</u>	0.3	0.2	1.0	1.1	0.5	0.1	-	-	-
<u>Festuca pratensis</u>	2.2	0.4	0.3	0.5	0.1	-	-	-	0.4
<u>Lolium perenne</u>	5.9	2.6	1.9	7.6	0.1	0.4	0.3	-	0.1
<u>Poa trivialis</u>	5.5	3.5	1.6	3.2	0.1	0.2	0.6	-	0.2
<u>Lotus corniculatus</u>	0.2	0.8	3.5	1.2	12.2	1.8	1.3	4.4	3.3
<u>Trifolium pratense</u>	7.7	1.1	0.3	0.4	1.4	5.4	5.0	6.5	2.7
<u>Gentaurea nigra</u>	0.2	0.5	0.2	0.8	7.2	9.3	4.8	2.9	2.0
<u>Leontodon hispidus</u>	-	-	-	-	0.9	1.0	0.7	6.1	4.5
<u>Plantago lanceolata</u>	0.7	1.5	0.3	0.3	5.9	8.8	18.5	13.0	15.1
<u>Rumex acetosa</u>	1.9	7.9	2.0	5.8	1.9	0.6	6.9	0.8	2.9

Effect of Lime

pH. 7.0.

Yield. Not much affected for the first few years, but since 1909 it has been reduced.

Number of Species. No constant effect; usually similar to unlimed area.

Composition of the Herbage.

GRAMINEAE Increased, particularly Avena pubescens and Arrhenatherum avenaceum in certain years.

LEGUMINOSAE At first decreased, but since 1936 has increased.

MISCELLANEOUS Decreased.

Effect of Lime on the Percentage of Certain Species

	1914		1919		1935		1947		1948	
	U	L	U	L	U	L	U	L	U	L
<u>Agrostis vulgaris</u>	7.8	5.3	3.9	2.0	8.8	1.7	4.2	0.9	3.0	1.3
<u>Arrhenatherum avenaceum</u>	3.1	4.0	8.0	18.2	7.7	31.7	12.4	8.3	14.2	14.7
<u>Avena pubescens</u>	5.2	9.4	3.4	12.1	5.8	15.2	1.7	16.7	1.9	11.3
<u>Briza media</u>	1.5	9.4	0.4	2.0	0.4	1.4	0.2	2.4	0.1	0.9
<u>Holcus lanatus</u>	8.0	6.9	11.2	5.2	6.4	5.1	6.5	4.2	7.4	2.1
<u>Lotus corniculatus</u>	1.8	2.1	1.3	1.6	4.4	3.4	1.8	2.1	3.3	5.9
<u>Trifolium pratense</u>	5.4	5.0	5.0	1.5	6.5	4.6	6.5	7.3	2.7	3.5
<u>Scabiosa arvensis</u> *	0.8	1.5	0.8	4.5	2.1	5.8	0.7	4.7	0.9	3.6
<u>Achillea millefolium</u>	2.8	1.3	4.8	2.1	3.6	0.8	4.1	1.1	6.9	4.0
<u>Leontodon hispidus</u>	1.0	0.3	0.7	0.3	6.1	4.1	4.9	3.4	4.4	5.6
<u>Plantago lanceolata</u>	8.8	5.3	18.5	7.7	13.0	7.8	10.0	9.5	15.0	13.1
<u>Rumex acetosa</u>	0.6	0.5	6.9	7.8	0.8	1.1	5.7	2.6	2.9	1.7

U = Unlimed L = Limed

* The increase in Scabiosa arvensis with lime is chiefly evident in the aftermath.

MIXED MINERAL MANURE, AFTER AMMONIUM SALTS 1856-1868 (Plot 6)

Condition of Plot in 1949 (Unlimed)

Closely resembles Plot 7, but proportion of Leguminosae is frequently higher.

pH 5.0.

Outline of Principal Changes during the Period 1877-1949

Yield. Constant, except for seasonal fluctuations.

Number of Species. Probably only affected by season.

Composition of the Herbage.

Percentage of Gramineae, Leguminosae and Miscellaneous Species

	<u>1862</u>	<u>1877</u>	<u>1903</u>	<u>1914</u>	<u>1919</u>	<u>1936</u>	<u>1949</u>
G	80.5	80.0	35.6	63.1	57.2	37.5	37.7
L	0.3	6.7	40.8	24.4	11.4	39.4	31.3
M	19.2	13.3	23.6	12.5	31.4	23.1	31.0

GRAMINEAE Proportion decreased.

<u>Alopecurus pratensis</u>	}	Increased
<u>Avena pubescens</u>		
<u>Lolium perenne</u>		

LEGUMINOSAE Much increased.

<u>Lathyrus pratensis</u>	Responsible for most of increase
<u>Trifolium pratense</u>	Increased

MISCELLANEOUS Very variable.

<u>Centaurea nigra</u>	Increased
<u>Rumex acetosa</u>	Variable

Changes in the Percentage of Certain Species

	<u>1862</u>	<u>1867</u>	<u>1872</u>	<u>1877</u>	<u>1903</u>	<u>1914</u>	<u>1919</u>	<u>1949</u>
<u>Alopecurus pratensis</u>	1.7	<	<	0.1	0.6	1.9	3.0	6.1
<u>Dactylis glomerata</u>	2.1	1.7	1.3	4.1	3.5	27.6	21.2	11.8
<u>Avena pubescens</u>	14.5	0.9	1.8	1.7	7.5	6.5	5.1	3.1
<u>Lolium perenne</u>	4.6	1.4	0.7	2.0	0.1	-	-	-
<u>Trifolium pratense</u>	<	<	<	0.1	5.9	5.2	0.4	5.3
<u>Lathyrus pratensis</u>	0.2	-	1.5	6.6	30.9	17.5	9.9	20.7
<u>Centaurea nigra</u>	-	1.4	1.4	0.4	1.4	6.1	1.8	5.5
<u>Rumex acetosa</u>	12.1	24.3	7.5	7.7	5.2	0.3	10.9	1.5

< indicates below 0.05

MIXED MINERAL MANURE AFTER NITRATE OF SODA 1858-1875 (Plot 15)

Condition of Plot in 1949 (Unlimed)

- (a) PH 5.0.
- (b) Herbage varied, compares with that on Plot 7, but seasonal differences not always the same on the two plots. Much bottom grass.
- (c) Growth starts later than Plot 7.
- (d) Yield medium, average generally below that of Plot 7, but sometimes exceeds it.
- (e) Twenty-three to thirty species.
- (f) The three groups are well represented, but all are exceptionally variable.
The range as shown by the partial separations from 1903-1949 was:-

	Per cent
G	37.8 - 98.5
L	0.0 - 49.9
M	1.5 - 36.5

Main Constituents of the Herbage on Plot 15

GRAMINEAE

<u>Agrostis vulgaris</u>	}	The most abundant species, but precedence varies with season.
<u>Alopecurus pratensis</u>		
<u>Dactylis glomerata</u>		
<u>Festuca rubra</u>		
<u>Anthoxanthum odoratum</u>	}	Usually present
<u>Arrhenatherum avenaceum</u>		
<u>Avena pubescens</u>		
<u>Holcus lanatus</u>		

LEGUMINOSAE

<u>Lathyrus pratensis</u>	Sometimes plentiful
<u>Trifolium pratense</u>	Usually in small quantity

MISCELLANEOUS

<u>Conopodium denudatum</u>	}	The most abundant species, but quantity varies with season
<u>Achillea millefolium</u>		
<u>Plantago lanceolata</u>		
<u>Rumex acetosa</u>		

OTHER SPECIES:- Avena flavescens, Bromus, Lolium, Poa pratensis, P.trivialis;
Lotus, Trifolium repens; Centaurea, Galium, Cerastium, Luzula, Pimpinella,
Ranunculus spp. Stellaria, Tragopogon (See Tables).

Outline of Principal Changes during the Period 1877-1949

Yield. Reduced after the manuring changed from nitrate of soda to minerals in 1876. A period of high yields followed from 1897-1908, but since then depression has again set in.

Number of Species. Reduced.

	<u>Number of Species</u>									
	<u>1862</u>	<u>1867</u>	<u>1872</u>	<u>1877</u>	<u>1903</u>	<u>1914</u>	<u>1919</u>	<u>1931</u>	<u>1947</u>	<u>1949</u>
G	17	16	16	17	16	14	12	12	10	10
L	4	4	3	4	5	4	2	4	4	4
M	18	19	19	24	15	12	11	12	9	9
Total	39	39	39	43	36	30	25	28	23	23

Composition of the Herbage.

	<u>Percentage of Gramineae, Leguminosae and Miscellaneous Species</u>									
	<u>1862</u>	<u>1867</u>	<u>1872</u>	<u>1877</u>	<u>1903</u>	<u>1914</u>	<u>1919</u>	<u>1931</u>	<u>1947</u>	<u>1949</u>
G	78.3	80.0	78.8	83.5	50.1	59.4	69.3	80.2	61.9	42.2
L	0.3	0.5	0.1	1.8	29.0	33.1	5.4	7.7	14.1	27.8
M	21.4	19.5	21.1	14.7	20.9	7.5	25.3	12.1	24.0	30.0

GRAMINEAE Proportion reduced in some seasons.

<u>Agrostis vulgaris</u>	}	Increased in some seasons
<u>Arrhenatherum avenaceum</u>		
<u>Alopecurus pratensis</u>		Increased until 1919, then somewhat decreased
<u>Dactylis glomerata</u>		Increased
<u>Poa trivialis</u>		Decreased
<u>Lolium perenne</u>		Much reduced since 1919
<u>Briza media</u>	}	Disappeared
<u>Cynosurus cristatus</u>		

LEGUMINOSAE Increased in some seasons

<u>Lathyrus pratensis</u>	}	Chief species to account for increase
<u>Trifolium pratense</u>		Some increase
<u>Trifolium repens</u>		

MISCELLANEOUS Little changed, but decreased in a few seasons

<u>Achillea millefolium</u>	}	Increased, particularly in some seasons
<u>Plantago lanceolata</u>		Little changed, variable
<u>Rumex acetosa</u>		
<u>Conopodium denudatum</u>		

Ajuga, Anthriscus, Heracleum and Veronica are among other species which were present in small quantity before 1919 but have now disappeared.

Changes in the Percentage of Certain Species

	<u>1862</u>	<u>1867</u>	<u>1872</u>	<u>1877</u>	<u>1903</u>	<u>1914</u>	<u>1919</u>	<u>1933</u>	<u>1949</u>
<u>Agrostis vulgaris</u>	7.7	6.9	7.7	12.9	3.0	12.0	11.3	16.8	2.8
<u>Alopecurus pratensis</u>	6.9	6.0	2.5	7.2	10.2	13.8	30.1	10.6	18.6
<u>Arrhenatherum avenaceum</u>	0.1	-	-	-	0.2	0.5	1.5	10.8	0.6
<u>Briza media</u>	0.1	-	0.2	0.3	0.2	-	-	-	-
<u>Cynosurus cristatus</u>	0.1	-	-	0.1	-	-	-	-	-
<u>Dactylis glomerata</u>	2.1	0.2	0.1	0.4	0.5	2.4	4.9	12.3	8.4
<u>Lolium perenne</u>	7.5	3.2	4.4	7.3	-	-	-	0.2	-
<u>Poa trivialis</u>	6.5	23.7	8.0	6.1	1.2	0.4	0.2	0.1	-
<u>Lathyrus pratensis</u>	-	-	-	1.5	16.3	28.0	5.3	7.7	22.3
<u>Trifolium pratense</u>	0.2	-	-	0.3	5.8	2.6	0.1	0.5	1.8
<u>Trifolium repens</u>	-	0.1	0.1	-	6.7	2.4	-	0.9	2.8
<u>Conopodium denudatum</u>	0.6	0.2	0.4	0.8	1.1	0.2	3.6	1.5	1.1
<u>Achillea millefolium</u>	2.5	1.1	2.6	0.6	10.0	4.3	5.3	1.5	10.0
<u>Plantago lanceolata</u>	6.9	4.7	0.3	0.6	0.2	0.3	3.7	4.4	9.7
<u>Rumex acetosa</u>	6.6	7.3	2.1	5.8	1.6	0.2	7.3	2.3	0.8

Effect of Lime

pH. 6.5.

Yield. Usually reduced till 1935 since when it has often increased.

Number of Species. No effect.

Composition of the Herbage. Liming did not begin until 1919, and no botanical separation was made before 1921. Little consistent effect is evident on any of the three main groups, but differences in the composition of the herbage are considerable. Avena pubescens is usually encouraged, while Agrostis vulgaris and Anthoxanthum odoratum are discouraged by liming. Lathyrus pratensis, Trifolium pratense and T.repens are all increased by lime in some seasons. Achillea millefolium is much reduced in the presence of lime, while Heracleum sphondylium is favoured by it.

Effect of Lime on the Percentage of Certain Species

	1931		1933		1949	
	U	L	U	L	U	L
<u>Agrostis vulgaris</u>	20.5	2.2	16.8	3.6	2.8	0.5
<u>Alopecurus pratensis</u>	18.3	28.7	10.6	8.9	18.6	6.8
<u>Anthoxanthum odoratum</u>	4.9	0.6	8.2	0.8	1.7	0.3
<u>Arrhenatherum avenaceum</u>	5.8	5.9	10.8	8.0	0.6	13.9
<u>Avena pubescens</u>	3.2	12.6	4.2	12.6	1.1	12.6
<u>Lathyrus pratensis</u>	4.7	3.8	7.8	13.8	22.3	13.4
<u>Trifolium pratense</u>	0.1	0.5	0.5	6.0	1.7	2.8
<u>Trifolium repens</u>	2.8	1.6	0.9	6.6	2.8	16.5
<u>Heracleum sphondylium</u>	-	1.3	-	1.4	-	3.2
<u>Achillea millefolium</u>	7.7	3.3	1.5	0.8	10.0	1.2
<u>Plantago lanceolata</u>	1.9	5.5	4.4	10.0	9.7	9.6

U = Unlimed L = Limed

SUPERPHOSPHATE AND SULPHATE OF POTASH, AFTER AMMONIUM SALTS

1856-1897 (Plot 5²)

Condition of Plot in 1949 (Unlimed)

- (a) pH 4.5.
- (b) Herbage very patchy and uneven in height. Dactylis glomerata clumps characteristic. Better growth than on Plot 5¹.
- (c) Growth starts late in spring.
- (d) Yield medium; considerably higher than Plot 5¹ (Figure 5).
- (e) Nineteen to twenty-seven species.
- (f) Herbage well mixed, but the relative proportions of the three main groups vary widely. The range from 1903-1949 was:-

	Per cent
G	44.6 - 88.7
L	2.2 - 35.5
M	7.7 - 39.9

Main Constituents of the Herbage on Plot 5²

GRAMINEAE

<u>Festuca rubra</u>		Chief species, abundant
<u>Agrostis vulgaris</u>	}	Well represented but vary in relative abundance
<u>Alopecurus pratensis</u>		
<u>Anthoxanthum odoratum</u>		
<u>Poa pratensis</u>		
<u>Arrhenatherum avenaceum</u>	}	Quantities small and variable
<u>Avena pubescens</u>		
<u>Dactylis glomerata</u>		
<u>Holcus lanatus</u>		

LEGUMINOSAE

<u>Lathyrus pratensis</u>		Chief species
<u>Lotus corniculatus</u>	}	Sometimes well represented
<u>Trifolium pratense</u>		

MISCELLANEOUS

<u>Achillea millefolium</u>	Very prevalent in some years
<u>Scabiosa arvensis</u>	} Vary much with season
<u>Centaurea nigra</u>	
<u>Rumex acetosa</u>	
<u>Luzula campestris</u>	Dominant in 1930, but had disappeared by 1947

OTHER SPECIES:- Poa trivialis; Trifolium repens, Vicia; Cerastium, Conopodium, Galium, Heracleum, Hieracium, Hypochaeris, Pimpinella, Plantago, Ranunculus spp. Stellaria, Veronica (See Tables).

Outline of Principal Changes during the Period 1877-1949

Yield. Reduced during the first fifteen years following the change in manuring in 1898, but since 1912 has tended to increase, and is always higher than that on Plot 5¹.

Number of Species. Reduced after 1867, and have remained fairly constant since 1919. A temporary drop occurred in 1930.

	<u>Number of Species</u>									
	<u>1862</u>	<u>1867</u>	<u>1872</u>	<u>1877</u>	<u>1914</u>	<u>1919</u>	<u>1930</u>	<u>1947</u>	<u>1949</u>	
G	17	15	15	13	11	11	8	10	9	
L	4	4	3	2	4	3	3	4	5	
M	17	17	13	14	17	17	8	13	12	
Total	38	36	31	29	32	31	19	27	26	

Composition of the Herbage.

	<u>Percentage of Gramineae, Leguminosae and Miscellaneous Species</u>										
	<u>1862</u>	<u>1867</u>	<u>1872</u>	<u>1877</u>	<u>1904</u>	<u>1914</u>	<u>1919</u>	<u>1930</u>	<u>1934</u>	<u>1947</u>	<u>1949</u>
G	86.3	71.9	84.7	94.1	88.7	76.3	63.2	46.0	56.0	49.1	44.6
L	0.1	0.3	0.5	0.2	3.2	8.4	4.5	26.6	35.5	11.0	26.5
M	13.6	27.8	14.8	5.7	8.1	15.3	32.3	27.4	8.5	39.9	28.9

GRAMINEAE Proportion decreased since change in manuring

<u>Alopecurus pratensis</u>	Increased
<u>Poa pratensis</u>	Some increase
<u>Agrostis vulgaris</u>	} Decreased
<u>Festuca rubra</u>	
<u>Lolium perenne</u>	

LEGUMINOSAE Considerably increased

<u>Lathyrus pratensis</u>	} Much increased
<u>Lotus corniculatus</u>	

MISCELLANEOUS Increased

<u>Centaurea nigra</u>	Responsible for most of increase
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Changes in the Percentage of Certain Species

	<u>1862</u>	<u>1867</u>	<u>1872</u>	<u>1877</u>	<u>1914</u>	<u>1919</u>	<u>1926</u>	<u>1949</u>
<u>Alopecurus pratensis</u>	0.7	0.5	0.8	0.2	4.0	11.2	12.6	9.1
<u>Poa pratensis</u>	1.1	0.7	0.6	0.2	4.7	6.3	2.2	2.6
<u>Bromus mollis</u>	-	-	-	-	3.0	0.1	-	-
<u>Agrostis vulgaris</u>	24.3	21.0	26.6	29.5	16.7	8.4	20.7	7.1
<u>Festuca rubra</u>	22.0	30.6	46.6	53.3	34.3	19.6	13.7	11.5
<u>Lolium perenne</u>	3.3	1.2	1.0	0.1	-	-	-	-
<u>Lotus corniculatus</u>	0.1	0.3	0.4	0.1	3.9	3.1	1.6	5.2
<u>Lathyrus pratensis</u>	<	<	<	0.1	2.0	1.3	6.7	16.8
<u>Centaurea nigra</u>	<	2.4	2.2	0.5	9.0	3.4	3.2	5.4
<u>Rumex acetosa</u>	9.2	15.9	7.1	2.1	2.5	18.1	3.0	5.7
<u>Luzula campestris</u>	1.1	0.6	0.2	0.1	0.7	4.3	3.3	1.8

< indicates below 0.05

-41-

SUPERPHOSPHATE OF LIME (Plot 4¹)

Condition of Plot in 1949 (Unlimed)

- (a) pH 5.5.
- (b) Herbage resembles that of unmanured plots in spring, but later becomes more luxuriant.
- (c) Growth starts late in spring.
- (d) Yield medium (Figure 8).
- (e) Twenty-nine to forty-four species. Considerable seasonal fluctuation but tending to decrease.
- (f) The three main groups of plants are all well represented, the proportion being very variable. The range as shown by the partial separations from 1903-1949 was:-

Per cent.

G	32.5	-	67.7
L	2.6	-	17.6
M	28.4	-	54.0

Main Constituents of the Herbage on Plot 4¹

GRAMINEAE

Avena pubescens

Festuca rubra

Dactylis glomerata

Holcus lanatus

Anthoxanthum odoratum

Chief species; vary in relation
abundance

LEGUMINOSAE

Trifolium pratense

Lathyrus pratensis

Lotus corniculatus

Trifolium repens

Well represented

MISCELLANEOUS

<u>Plantago lanceolata</u>	}	Often very plentiful
<u>Ranunculus spp.</u>		
<u>Achillea millefolium</u>		
<u>Leontodon hispidus</u>		
<u>Rumex acetosa</u>		

OTHER SPECIES:- Agrostis, Alopecurus, Arrhenatherum, Festuca pratensis, Lolium, Poa pratensis; Centaurea, Cerastium, Conopodium, Luzula, Pimpinella, Poterium, Stellaria, Taraxacum, Hypochaeris (See Tables).

Outline of Principal Changes during the Period 1877-1949

Yield. Fairly constant, but fell during 1936-45 since when the former level has been nearly regained.

Number of Species. Reduced, but only Miscellaneous species show a marked change.

	<u>Number of Species</u>									
	<u>1862</u>	<u>1867</u>	<u>1872</u>	<u>1877</u>	<u>1903</u>	<u>1914</u>	<u>1919</u>	<u>1947</u>	<u>1949</u>	
G	16	15	16	16	15	14	14	14	15	
L	4	4	5	5	4	5	5	4	5	
M	24	25	26	22	22	15	13	14	14	
Total	44	44	47	43	41	34	32	32	34	

Composition of the Herbage.

Percentage of Gramineae, Leguminosae and Miscellaneous Species

	<u>1862</u>	<u>1867</u>	<u>1872</u>	<u>1877</u>	<u>1903</u>	<u>1914</u>	<u>1919</u>	<u>1947</u>	<u>1949</u>
G	75.0	66.9	67.0	71.8	43.0	57.7	52.8	46.8	46.7
L	2.8	2.8	8.6	5.5	17.6	17.7	2.7	13.5	14.4
M	22.2	30.3	24.4	22.7	39.4	34.6	44.5	39.7	38.9

GRAMINEAE Proportion reduced

<u>Dactylis glomerata</u>	}	Increased
<u>Agrostis vulgaris</u>		
<u>Lolium perenne</u>		
<u>Poa trivialis</u>		
		Much decreased

LEGUMINOSAE Variable, but on the whole increased

MISCELLANEOUS Increased

<u>Leontodon hispidus</u>	}	Responsible for most of increase
<u>Plantago lanceolata</u>		
<u>Rumex acetosa</u>		Variable, dominant in 1947

Changes in the Percentage of Certain Species

	<u>1862</u>	<u>1867</u>	<u>1872</u>	<u>1877</u>	<u>1903</u>	<u>1914</u>	<u>1919</u>	<u>1949</u>
<u>Agrostis vulgaris</u>	7.2	6.1	13.9	9.9	-	0.9	0.7	2.0
<u>Alopecurus pratensis</u>	1.3	1.8	0.9	1.4	0.3	0.1	0.1	2.2
<u>Avena pubescens</u>	9.4	5.0	4.1	4.0	9.8	9.9	13.9	5.5
<u>Dactylis glomerata</u>	2.3	1.0	0.6	1.4	1.3	4.6	11.3	7.1
<u>Lolium perenne</u>	9.3	5.2	3.1	4.4	-	0.1	0.2	0.3
<u>Poa trivialis</u>	5.2	5.7	3.8	4.7	0.6	0.6	1.4	0.5
<u>Ranunculus spp.</u>	5.9	1.4	4.3	6.1	1.5	0.4	1.6	3.8
<u>Centaurea nigra</u>	0.4	0.4	1.0	0.7	4.8	8.6	7.5	1.7
<u>Leontodon hispidus</u>	0.6	0.6	0.1	0.9	14.7	12.4	2.5	11.0
<u>Plantago lanceolata</u>	5.6	9.7	3.1	3.8	2.5	6.8	17.8	8.5

Effect of Lime

pH. 7.0

Yield. Consistently decreased.

Number of Species. No effect.

Composition of Herbage.

GRAMINEAE Reduced or little affected.

LEGUMINOSAE Considerably increased.

MISCELLANEOUS Reduced or little affected.

A noticeable feature is the number of species that are affected by liming whether beneficially or adversely. The action of lime on Leontodon hispidus and Rumex acetosa varies with season.

Effect of Lime on the Percentage of Certain Species

	1914		1919		1949	
	U	L	U	L	U	L
<u>Alopecurus pratensis</u>	-	1.3	0.1	1.5	2.2	2.4
<u>Anthoxanthum odoratum</u>	4.0	1.5	3.2	1.8	3.4	1.1
<u>Avena pubescens</u>	9.9	12.7	13.9	19.8	5.5	18.1
<u>Briza media</u>	2.2	3.4	1.3	2.8	0.5	1.8
<u>Dactylis glomerata</u>	4.6	1.8	11.3	6.4	7.1	4.9
<u>Holcus lanatus</u>	8.6	6.4	9.9	6.8	6.7	4.5
<u>Lathyrus pratensis</u>	1.7	11.2	1.6	5.0	3.0	7.3
<u>Lotus corniculatus</u>	1.1	2.1	0.7	3.6	3.7	7.7
<u>Raminoulus spp.</u>	0.4	1.1	1.6	4.5	3.8	2.3
<u>Leontodon hispidus</u>	12.4	6.8	2.5	2.3	11.0	6.3
<u>Plantago lanceolata</u>	6.8	4.0	17.8	11.2	8.5	9.7
<u>Rumex acetosa</u>	0.7	0.6	10.2	6.2	5.8	2.1

U = Unlimed L = Limed

C. NITRATE OF SODA WITH AND WITHOUT MINERAL MANURES (Table 4).

NITRATE OF SODA (= 43 lb. N per acre) (Plot 17).

Condition of Plot in 1949 (Unlimed)

- (a) pH 6.0.
 - (b) Herbage very mixed, uneven, of a dark blackish green colour; not so tall as on Plot 16.
 - (c) Growth starts early, but progresses slowly.
 - (d) Yield medium, rather less variable than on many other plots.
 - (e) Usually about thirty species with an occasional trace of several others.
 - (f) GRAMINEAE rather more than twice as plentiful as MISCELLANEOUS species.
LEGUMINOSAE scarce.
- A large number of species occur in very small quantity.

Effect of Lime on the Percentage of Certain Species

	1914		1919		1947		1949	
	U	L	U	L	U	L	U	L
<u>Alopecurus pratensis</u>	1.2	27.2	0.8	63.9	1.1	78.9	0.1	82.0
<u>Anthoxanthum odoratum</u>	0.1	2.1	-	0.1	0.8	0.6	-	<
<u>Arrhenatherum avenaceum</u>	6.6	27.0	31.3	15.5	0.3	2.0	-	2.3
<u>Dactylis glomerata</u>	0.2	4.9	0.2	5.7	-	2.5	-	4.9
<u>Holcus lanatus</u>	90.9	32.0	64.8	11.6	81.1	7.6	99.6	3.5
<u>Poa pratensis</u>	-	2.7	-	2.0	-	4.5	-	5.2

U = Unlimed L = Limed

The percentage of Holcus lanatus on the unlimed area in 1947 would probably have been greater if Epilobium angustifolium had not been so prevalent.

AMMONIUM SALTS (=129 lb. N per acre) AND MIXED MINERAL MANURE WITH
SILICATE OF SODA (Plot 11²)

Condition of Plot in 1949 (Unlimed)

- (a) Ph 4.0.
- (b) Bare patches rather less extensive than on Plot 11¹, owing to the ameliorating action of the silicate. The latter seems to have decreased Holcus lanatus but increased Agrostis vulgaris and Arrhenatherum avenaceum.
- (c) Growth starts very early as on Plot 11¹.
- (d) Yield the heaviest of the unlimed plots; generally less variable than that of Plot 11¹.
- (e) Eight species, with occasional traces of a few others.
- (f) GRAMINEAE form practically all the herbage.
LEGUMINOSAE almost always absent.
MISCELLANEOUS plants usually absent, but occasionally up to 1.5 per cent.

Main Constituents of the Herbage on Plot 11²

GRAMINEAE

<p><u>Agrostis vulgaris</u> <u>Arrhenatherum avenaceum</u> <u>Holcus lanatus</u></p>	}	<p>Relative proportions vary with season</p>
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OTHER SPECIES (Mostly of very rare occurrence). Alopecurus, Anthoxanthum, Avena flavescens, A. pubescens, Dactylis, Festuca rubra, Poa pratensis, P. trivialis; Lathyrus, Lotus; Plantago, Ranunculus spp. Rumex (See Tables).

Outline of Principal Changes during the Period 1877-1949

Yield. Reduced, especially since 1904.

Number of Species. Reduced.

	<u>Number of Species</u>							
	<u>1862</u>	<u>1867</u>	<u>1872</u>	<u>1877</u>	<u>1914</u>	<u>1919</u>	<u>1947</u>	<u>1949</u>
G	14	14	13	11	9	9	7	6
L	-	-	-	-	-	-	-	-
M	7	5	3	5	-	1	1	1
Total	21	19	16	16	9	10	8	7

Composition of the Herbage.

Percentage of Gramineae, Leguminosae and Miscellaneous Species

	<u>1862</u>	<u>1867</u>	<u>1872</u>	<u>1877</u>	<u>1914</u>	<u>1919</u>	<u>1947</u>	<u>1949</u>
G	94.2	95.7	99.3	98.5	100.0	99.6	98.8	99.4
L	-	-	-	-	-	-	-	-
M	5.8	4.3	0.7	1.5	-	0.4	1.2	0.6

GRAMINEAE

<p><u>Agrostis vulgaris</u></p>	<p>Much reduced between 1877 and 1914. Temporary increase up to 1947 at expense of <u>Alopecurus pratensis</u>*.</p>
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* This increase probably dates from 1929 when most of the herbage was killed by frost, and changes in flora occurred during recolonisation. Precise data are, however, lacking.

-67-

<u>Holcus lanatus</u>	Much increased
<u>Arrhenatherum avenaceum</u>	} Recently much reduced
<u>Alopecurus pratensis</u>	
<u>Dactylis glomerata</u>	} Almost disappeared
<u>Poa pratensis</u>	
<u>Festuca rubra</u>	Little affected

Changes in the Percentage of Certain Species

	<u>1862</u>	<u>1867</u>	<u>1872</u>	<u>1877</u>	<u>1914</u>	<u>1919</u>	<u>1947</u>	<u>1949</u>
<u>Agrostis vulgaris</u>	18.8	24.2	10.2	17.1	0.5	0.7	44.1	5.3
<u>Alopecurus pratensis</u>	1.5	6.3	22.7	20.1	17.5	29.8	0.8	0.3
<u>Arrhenatherum avenaceum</u>	6.4	4.8	12.7	21.1	20.7	45.7	12.7	0.8
<u>Dactylis glomerata</u>	23.3	38.3	27.2	13.4	0.3	2.8	-	<
<u>Festuca rubra</u>	0.7	2.1	0.3	2.6	<	0.1	0.2	0.1
<u>Holcus lanatus</u>	7.4	4.8	10.6	19.5	59.4	20.4	40.8	92.8
<u>Poa pratensis</u>	5.1	10.4	12.4	4.5	0.7	0.1	0.1	-

< indicates below 0.05

Effect of Lime

pH. 4.5.

Yield. Usually increased but the difference due to lime is much less regular or marked than on Plot 11¹ and yield may occasionally be reduced.

Number of Species. No constant effect.

Composition of the Herbage. Balance between GRAMINEAE, LEGUMINOSAE and MISCELLANEOUS species not affected.

Effect of Lime on the Percentage of Certain Species

	<u>1914</u>		<u>1919</u>		<u>1947</u>		<u>1949</u>	
	U	L	U	L	U	L	U	L
<u>Agrostis vulgaris</u>	0.5	0.2	0.7	-	44.1	0.2	5.3	-
<u>Alopecurus pratensis</u>	17.6	49.7	29.8	76.0	0.8	70.2	0.3	57.6
<u>Arrhenatherum avenaceum</u>	20.8	25.6	45.7	16.3	12.7	11.3	0.8	17.5
<u>Dactylis glomerata</u>	0.3	11.0	2.8	7.3	-	7.8	<	10.3
<u>Holcus lanatus</u>	59.4	6.2	20.4	<	40.8	2.4	92.8	1.6
<u>Poa pratensis</u>	0.7	3.5	0.1	0.2	0.1	6.3	-	10.7

U = Unlimed L = Limed

-68-

The increase in Alopecurus pratensis and the decrease in Holcus lanatus are very marked. Arrhenatherum avenaceum shows a seasonal response to lime similar to that on Plot 11¹.

E. AMMONIUM SALTS ALONE OR WITH INCOMPLETE MINERAL MANURE

(Tables 5 and 6)

AMMONIUM SALTS (= 43 lb. N per acre) ALONE, ALSO WITH FARMYARD MANURE 1856-1863
(Plot 1)

Condition of Plot in 1949 (Unlimed)

- (a) pH 4.5.
- (b) The herbage is very patchy and areas of bare soil often occur. Later in the season the grass becomes fairly long and very dark green with a tendency to lodge.
- (c) Growth starts late.
- (d) Yield usually low, occasionally higher than on unmanured plots but may be lower.
- (e) About eleven species, with traces of several others.
- (f) GRAMINEAE form bulk of herbage.
LEGUMINOSAE absent.
MISCELLANEOUS species up to about 7 per cent, but frequently less.

Main Constituents of the Herbage on Plot 1

GRAMINEAE

<u>Agrostis vulgaris</u>	Chief species
<u>Festuca rubra</u>	Plentiful
<u>Dactylis glomerata</u>	Usually present in small quantities

MISCELLANEOUS

<u>Centaurea nigra</u>	}	Quantity variable, may be very plentiful
<u>Rumex acetosa</u>		
<u>Potentilla reptans</u>		Quantity small but characteristic

OTHER SPECIES (Mostly of very rare occurrence). Alopecurus, Anthoxanthum, Arrhenatherum, Avena flavescens, A. pubescens, Holcus, Lolium, Poa pratensis P. trivialis; Lathyrus, Lotus, Trifolium pratense, T. repens; Achillea, Anthriscus, Cerastium, Conopodium, Epilobium, Galium, Heracleum, Leontodon, Luzula, Pimpinella, Plantago, Poterium, Ranunculus spp., Taraxacum, Tragopogon, Veronica (See Tables).

Outline of Principal Changes during the Period 1877-1948

Yield. Reduced.

Number of Species. Very much reduced.

	<u>Number of Species</u>							
	<u>1862</u>	<u>1867</u>	<u>1872</u>	<u>1877</u>	<u>1914</u>	<u>1919</u>	<u>1939</u>	<u>1948</u>
G	15	15	18	15	9	10	7	6
L	4	4	3	2	-	-	-	-
M	9	15	15	17	8	5	4	5
Total	28	34	36	34	17	15	11	11

Composition of the Herbage.

Percentage of Gramineae, Leguminosae and Miscellaneous Species

	<u>1862</u>	<u>1867</u>	<u>1872</u>	<u>1877</u>	<u>1914</u>	<u>1919</u>	<u>1939</u>	<u>1948</u>
G	89.0	86.4	82.2	84.0	78.9	86.4	95.3	94.7
L	0.2	1.0	0.3	0.5	-	-	-	-
M	10.8	12.6	17.5	15.5	21.1	13.6	4.7	5.3

GRAMINEAE Increased.

<u>Agrostis vulgaris</u>	}	Much increased
<u>Festuca rubra</u>		
<u>Dactylis glomerata</u>		Variable
<u>Avena pubescens</u>	}	Practically disappeared
<u>Poa pratensis</u>		
<u>Avena flavescens</u>	}	Disappeared
<u>Poa trivialis</u>		
<u>Bromus mollis</u>		
<u>Lolium perenne</u>		

LEGUMINOSAE Traces in some years.

MISCELLANEOUS

<u>Centaurea nigra</u>	Little change, but unusually plentiful in 1914
<u>Rumex acetosa</u>	Variable

Changes in the Percentage of Certain Species

	<u>1862</u>	<u>1867</u>	<u>1872</u>	<u>1877</u>	<u>1914</u>	<u>1919</u>	<u>1939</u>	<u>1948</u>
<u>Agrostis vulgaris</u>	0.6	6.5	20.8	23.5	16.0	18.5	52.5	75.4
<u>Avena flavescens</u>	4.0	6.9	6.2	1.4	-	0.1	-	-
<u>Avena pubescens</u>	0.5	1.6	2.8	2.1	0.1	0.2	-	0.2
<u>Bromus mollis</u>	21.9	10.6	4.6	0.8	-	-	-	-
<u>Dactylis glomerata</u>	16.4	6.4	3.3	4.2	9.5	11.3	0.8	3.2
<u>Festuca rubra</u>	0.8	6.2	6.4	10.8	28.1	14.3	40.9	15.6
<u>Lolium perenne</u>	1.4	3.2	1.7	1.7	-	-	-	-
<u>Poa pratensis</u>	1.5	6.6	7.4	1.4	0.6	0.4	0.2	-
<u>Poa trivialis</u>	31.9	22.3	4.4	2.7	-	-	-	-
<u>Centaurea nigra</u>	-	0.2	1.2	0.3	19.2	2.1	0.4	0.8
<u>Rumex acetosa</u>	6.1	5.7	9.3	10.5	0.6	9.9	2.0	2.5

Effect of Lime

The herbage is more even and thicker than when unlimed.

pH. 7.0.

Yield. Generally much increased but effect varies with season.

Number of Species. Considerably increased.

Composition of the Herbage.

GRAMINEAE Reduced.

<u>Agrostis vulgaris</u>	}	Decreased
<u>Alopecurus pratensis</u>		Increased
<u>Avena pubescens</u>		
<u>Dactylis glomerata</u>		
<u>Festuca rubra</u>		

LEGUMINOSAE Slightly increased.

MISCELLANEOUS Considerably increased.

Plantago lanceolata Accounts for most of increase

Effect of Lime on the Percentage of Certain Species

	1914		1919		1939		1948	
	U	L	U	L	U	L	U	L
<u>Agrostis vulgaris</u>	16.0	12.3	18.5	8.5	52.5	3.7	75.3	1.5
<u>Alopecurus pratensis</u>	2.0	4.5	1.3	5.9	0.2	4.0	0.1	2.5
<u>Anthoxanthum odoratum</u>	15.0	6.9	17.5	7.9	0.7	2.4	0.2	1.4
<u>Avena pubescens</u>	0.1	5.1	0.2	7.7	-	34.8	0.2	12.1
<u>Dactylis glomerata</u>	9.5	7.0	11.3	23.4	0.8	13.1	3.2	18.3
<u>Festuca rubra</u>	28.1	25.9	14.3	10.6	40.9	15.2	15.6	15.4
<u>Holcus lanatus</u>	7.1	5.5	22.4	10.0	-	3.6	-	5.8
<u>Poa pratensis</u>	0.6	3.9	0.4	1.8	0.2	2.3	-	1.3
<u>Centaurea nigra</u>	19.2	22.2	2.1	4.1	<	4.7	0.7	2.0
<u>Plantago lanceolata</u>	-	-	-	-	-	3.5	-	19.8
<u>Rumex acetosa</u>	0.6	1.0	9.9	11.5	2.0	1.7	2.5	2.1

U = Unlimed L = Limed

< indicates below 0.05

AMMONIUM SALTS (= 86 lb. N per acre) AND SUPERPHOSPHATE OF LIME
(Plot 4²)

Condition of Plot in 1949 (Unlimed)

- (a) pH. 4.0.
- (b) Herbage dark green. Tufts of Anthoxanthum odoratum and Festuca rubra with much Agrostis vulgaris at the base are characteristic. Bare patches of undecomposed peaty matter common.
- (c) Growth starts early in spring.
- (d) Yield medium to low, but very variable (Figure 11).
- (e) Eleven to eighteen species with occasional traces of several others till 1919, but only seven present in 1947.
- (f) GRAMINEAE form bulk of herbage.
LEGUMINOSAE absent.
MISCELLANEOUS species in fair quantity in some seasons, very scanty in others.

Main Constituents of the Herbage on Plot 4²

GRAMINEAE

<u>Agrostis vulgaris</u>	}	Chief species
<u>Festuca rubra</u>		
<u>Anthoxanthum odoratum</u>		Varies with season
<u>Holcus lanatus</u>		Sometimes fairly plentiful

MISCELLANEOUS

<u>Rumex acetosa</u>	Very variable
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OTHER SPECIES (Mostly of rare occurrence). Alopecurus, Avena pubescens, Dactylis, Poa pratensis, P. trivialis; Lathyrus; Achillea, Conopodium, Epilobium, Leontodon (See Tables).

Outline of Principal Changes during the Period 1877-1949

Yield. Considerably reduced, particularly since 1911.

Number of Species. Reduced in all three groups of plants independent of season.

	<u>Number of Species</u>									
	<u>1862</u>	<u>1867</u>	<u>1872</u>	<u>1877</u>	<u>1903</u>	<u>1914</u>	<u>1919</u>	<u>1947</u>	<u>1949</u>	
G	14	14	15	13	9	9	8	5	5	
L	3	3	2	2	1	-	-	-	-	
M	18	13	11	11	5	6	2	2	1	
Total	35	30	28	26	15	15	10	7	6	

Composition of the Herbage.

Percentage of Gramineae, Leguminosae and Miscellaneous Species

	<u>1862</u>	<u>1867</u>	<u>1872</u>	<u>1877</u>	<u>1903</u>	<u>1914</u>	<u>1919</u>	<u>1947</u>	<u>1949</u>
G	80.3	86.1	88.7	94.6	93.6	98.7	92.0	97.9	99.8
L	0.1	<	<	<	<	-	-	-	-
M	19.6	13.8	11.3	5.3	6.4	1.3	8.0	2.1	0.2

< indicates below 0.05

GRAMINEAE

<u>Anthoxanthum odoratum</u>	Increased, very considerably in some seasons
<u>Agrostis vulgaris</u>	Reduced between 1877 and 1919, but had increased again by 1947
<u>Holcus lanatus</u>	Apparently increasing
<u>Festuca rubra</u>	Decreased in some seasons
<u>Lolium perenne</u>	} Disappeared
<u>Poa trivialis</u>	

LEGUMINOSAE Disappeared.

MISCELLANEOUS

Rumex acetosa Now the chief species but quantity small and very variable

Changes in the Percentage of Certain Species

	<u>1862</u>	<u>1867</u>	<u>1872</u>	<u>1877</u>	<u>1903</u>	<u>1914</u>	<u>1919</u>	<u>1947</u>	<u>1949</u>
<u>Agrostis vulgaris</u>	19.4	14.0	20.6	24.4	2.0	12.9	4.3	68.8	36.2
<u>Anthoxanthum odoratum</u>	2.2	5.5	1.5	2.4	23.4	7.7	34.1	14.5	10.0
<u>Festuca rubra</u>	6.8	26.1	49.3	55.2	53.6	73.0	47.9	9.6	35.3
<u>Holcus lanatus</u>	16.2	10.5	2.0	6.0	1.1	<	0.3	4.8	17.5
<u>Lolium perenne</u>	6.5	1.4	0.7	0.2	-	-	-	-	-
<u>Poa trivialis</u>	8.1	2.2	2.1	0.3	0.2	-	-	-	-
<u>Rumex acetosa</u>	13.4	8.4	6.9	3.1	0.5	0.5	8.0	1.3	0.2

< indicates below 0.05

Effect of Lime

Herbage greatly improved. Grass tall, thick and less tussocky, though inclined to be rank. Starts into growth much earlier than unlimed area.

pH. 5.5.

Yield. Much increased.

Number of Species. No constant effect until 1919, but much increased by 1947.

Composition of the Herbage.

The GRAMINEAE may be considerably reduced on the limed area in some seasons by an influx of MISCELLANEOUS species. In 1947, for example, the GRAMINEAE comprised

98 per cent and MISCELLANEOUS species 2 per cent of the herbage on the unlimed area, whereas with lime the GRAMINEAE amounted to only 77 per cent, 21 per cent of the remaining herbage consisting of Rumex acetosa.

Alopecurus pratensis is much increased and Agrostis vulgaris much decreased by lime, but the effect on Anthoxanthum odoratum and Rumex acetosa varies with season.

Effect of Lime on the Percentage of Certain Species

	1914		1919		1947		1949	
	U	L	U	L	U	L	U	L
<u>Agrostis vulgaris</u>	12.9	1.0	4.2	0.3	68.8	1.8	36.2	2.2
<u>Alopecurus pratensis</u>	2.5	42.2	1.4	76.1	0.2	32.5	0.7	24.3
<u>Anthoxanthum odoratum</u>	7.7	7.6	34.0	1.1	14.5	4.6	10.0	1.2
<u>Festuca rubra</u>	73.0	35.1	47.9	7.7	9.6	29.8	35.3	57.4
<u>Poa pratensis</u>	1.2	12.6	0.4	12.8	-	5.3	-	6.3
<u>Rumex acetosa</u>	0.5	0.5	8.0	1.6	1.3	20.6	0.2	3.9

U = Unlimed L = Limed

AMMONIUM SALTS (= 86 lb. N per acre) AND MIXED MINERAL MANURE WITHOUT SUPERPHOSPHATE, AFTER MINERALS AND AMMONIUM SALTS SUPPLYING THE CONSTITUENTS OF 1 TON OF HAY, 1865-1904 (Plot 18)

Condition of Plot in 1949 (Unlimed)

- (a) pH not determined in 1945. (4.0 in 1957).
- (b) Herbage dark green in summer; growth patchy with much bare ground; brown in winter with dead Agrostis vulgaris and Festuca rubra.
- (c) Growth starts fairly early, but young green is masked by dead grass.
- (d) Yield usually medium, but frequently low especially in later years.
- (e) Seven to nineteen species with occasional traces of others.
- (f) GRAMINEAE usually form bulk of herbage.

LEGUMINOSAE absent.

MISCELLANEOUS species, chiefly Rumex acetosa, may be up to 20 per cent in some seasons.

Main Constituents of the Herbage on Plot 18

GRAMINEAE

<u>Agrostis vulgaris</u>	Chief species
<u>Dactylis glomerata</u>	Formerly the chief species, now unimportant
<u>Festuca rubra</u>	Plentiful in some seasons
<u>Alopecurus pratensis</u>	} All much less plentiful than the above but quantity varies with season
<u>Anthoxanthum odoratum</u>	
<u>Arrhenatherum avenaceum</u>	
<u>Holcus lanatus</u>	

MISCELLANEOUS

<u>Rumex acetosa</u>	Chief species, but quantity variable
<u>Centaurea nigra</u>	Frequently absent, but may be important e.g. 1938

OTHER SPECIES (Mostly of very rare occurrence). Avena flavescens, Bromus, Poa annua, P.pratensis, P.trivialis; Lotus, Trifolium pratense, T.repens; Achillea, Gerastium, Conopodium, Epilobium, Heracleum, Leontodon, Luzula, Pimpinella, Plantago, Prunella, Ranunculus spp., Stellaria, Taraxacum, Tragopogon (See Tables).

Outline of Principal Changes during the Period 1877-1948

Yield. Fairly constant till the change in manuring in 1905. Reduced since 1908 though seasonal fluctuations are large.

Number of Species. Considerably reduced. Data regarding the effect of the manurial change are unfortunately lacking.

Number of Species

	<u>1867</u>	<u>1872</u>	<u>1877</u>	<u>1914</u>	<u>1919</u>	<u>1928</u>	<u>1946</u>	<u>1948</u>
G	15	18	14	10	10	10	6	6
L	4	4	4	1	-	-	-	-
M	21	22	21	5	5	6	2	3
Total	40	44	39	16	15	16	8	9

Composition of the Herbage.

Percentage of Gramineae, Leguminosae and Miscellaneous Species

	<u>1862</u>	<u>1872</u>	<u>1877</u>	<u>1914</u>	<u>1919</u>	<u>1928</u>	<u>1946</u>	<u>1948</u>
G	55.5	80.8	84.2	93.3	68.9	96.3	93.7	88.5
L	5.0	3.6	2.0	0.1	-	-	-	-
M	39.5	15.6	13.8	6.7	31.1	3.7	6.3	11.5

GRAMINEAE

<u>Agrostis vulgaris</u>	Much increased
<u>Dactylis glomerata</u>	Much increased at first, but practically disappeared by 1943
<u>Alopecurus pratensis</u>	Increased at first, then fairly steady but quantity small
<u>Holcus lanatus</u>	Much reduced
<u>Avena flavescens</u>	Disappeared
<u>Avena pubescens</u>	
<u>Lolium perenne</u>	
<u>Poa trivialis</u>	

LEGUMINOSAE Practically disappeared

MISCELLANEOUS

<u>Centaurea nigra</u>	Almost disappeared, but prominent in 1938
<u>Rumex acetosa</u>	Very variable, probably increased
<u>Ranunculus spp.</u>	Disappeared

Changes in the Percentage of Certain Species

	<u>1867</u>	<u>1872</u>	<u>1877</u>	<u>1914</u>	<u>1919</u>	<u>1928</u>	<u>1946</u>	<u>1948</u>
<u>Agrostis vulgaris</u>	7.3	22.0	16.4	10.0	17.6	59.0	74.6	76.9
<u>Alopecurus pratensis</u>	1.0	0.9	0.8	3.3	5.1	5.3	1.8	0.1
<u>Avena flavescens</u>	3.4	5.8	3.1	0.1	-	<	-	-
<u>Avena pubescens</u>	2.9	2.6	1.9	0.1	0.1	-	-	-
<u>Dactylis glomerata</u>	1.8	1.2	1.3	37.1	34.0	9.3	-	1.3
<u>Holcus lanatus</u>	12.8	7.3	17.5	0.9	2.4	8.2	0.5	--
<u>Lolium perenne</u>	5.2	3.4	6.5	-	-	-	-	-
<u>Poa trivialis</u>	4.8	2.9	2.8	-	-	<	0.1	-
<u>Ranunculus spp.</u>	5.7	3.1	2.6	-	-	-	-	-
<u>Centaurea nigra</u>	0.8	0.8	0.9	4.5	1.9	<	-	-
<u>Rumex acetosa</u>	24.3	2.0	4.7	1.1	24.6	3.2	6.2	11.2

< indicates below 0.05

Effect of Lime

In 1920 the plot was divided into three sections, one of which remained unlimed, while the other two received light (3,951 lb. per acre) and heavy (6,788 lb. per acre) dressings of ground lime respectively every four years. These quantities were originally based on the lime requirement of the soil as shown by its pH value (light dressing, LL) and the Hutchinson-MacLennan method (heavy

-77-

dressing, HL). A complete change in the herbage resulted with both levels of lime, the appearance of large quantities of Taraxacum vulgare being the chief feature.

pH. Not determined in 1945. (LL = 7.5; HL = 8.0 in 1957).

Yield. Much increased, especially by the heavy dressing.

Number of Species. Increased.

	<u>Number of Species</u>								
	1928			1946			1948		
	U	LL	HL	U	LL	HL	U	LL	HL
G	10	11	10	6	13	13	6	14	11
L	-	-	1	-	3	2	-	1	2
M	6	5	6	2	11	9	3	11	6
Total	16	16	17	8	27	24	9	26	19

Composition of the Herbage.

GRAMINEAE

<u>Agrostis vulgaris</u>	Much decreased
<u>Arrhenatherum avenaceum</u>	} Much increased
<u>Dactylis glomerata</u>	

LEGUMINOSAE Slightly increased

MISCELLANEOUS Much increased

<u>Taraxacum vulgare</u>	Responsible for most of increase
<u>Plantago lanceolata</u>	Increased
<u>Centaurea nigra</u>	Increased in some seasons
<u>Rumex acetosa</u>	Decreased

Effect of Lime on the Percentage of Certain Species

	1921			1928			1946			1948		
	U	LL	HL	U	LL	HL	U	LL	HL	U	LL	HL
<u>Agrostis vulgaris</u>	50.9	41.2	42.5	59.0	17.5	4.8	74.6	2.0	1.4	76.9	3.4	1.2
<u>Arrhenatherum avenaceum</u>	0.8	2.0	1.7	0.4	2.9	18.1	-	10.1	10.3	0.5	24.6	25.0
<u>Dactylis glomerata</u>	12.0	21.8	12.9	9.3	21.1	37.7	-	12.5	36.5	1.3	35.0	48.3
<u>Festuca rubra</u>	11.4	6.0	7.5	6.2	2.8	3.1	12.5	9.8	5.1	8.9	6.8	2.2
<u>Lathyrus pratensis</u>	-	-	-	-	-	0.2	-	0.1	1.4	-	-	0.5
<u>Trifolium pratense</u>	-	-	-	-	-	-	-	0.4	<	-	0.1	0.1
<u>Centaurea nigra</u>	1.7	2.3	1.8	<	<	0.2	-	10.3	0.9	-	3.5	-
<u>Heracleum sphondylium</u>	0.3	-	0.5	0.1	-	3.1	-	1.5	2.4	-	0.6	1.6
<u>Plantago lanceolata</u>	-	-	-	-	-	-	0.1	17.3	4.5	-	3.8	1.0
<u>Taraxacum vulgare</u>	-	-	-	-	<	0.2	-	22.6	23.4	0.2	8.9	10.8
<u>Rumex acetosa</u>	6.3	11.2	14.1	3.2	2.4	1.0	6.2	0.5	0.9	11.2	0.2	0.4

U = Unlimed; LL = Light Lime; HL = Heavy Lime

< indicates below 0.25

F. ORGANIC MANURES (TABLE 6).

FARMYARD MANURE AND FISH GUANO ALTERNATELY (EACH ONCE IN FOUR YEARS)
AFTER CUT WHEAT STRAW, MINERALS AND AMMONIUM SALTS 1856-1897, AND
MINERALS AND AMMONIUM SALTS 1898-1904 (Plot 13)

Condition of Plot in 1949 (Unlimed)

- (a) pH 4.6.
- (b) Herbage very strong and tall; inclined to lodge; little bottom grass.
- (c) Growth starts early in spring, especially in years that farmyard manure is applied.
- (d) Yield heavy, but less so since 1938. More uniform than on plots receiving large dressings of artificial manures.
- (e) Twenty to twenty-six species with occasional traces of several others.
- (f) GRAMINEAE usually from 75-86 per cent.

(f) contd. LEGUMINOSAE very scarce.

MISCELLANEOUS plants 14-25 per cent.

Main Constituents of the Herbage on Plot 13

GRAMINEAE

<u>Alopecurus pratensis</u>	}	Chief species
<u>Agrostis vulgaris</u>		Relative abundance varies with season
<u>Anthoxanthum odoratum</u>		
<u>Dactylis glomerata</u>		
<u>Festuca rubra</u>		
<u>Holcus lanatus</u>		

MISCELLANEOUS

<u>Plantago lanceolata</u>	}	Chief species
<u>Conopodium denudatum</u>		Vary with season
<u>Achillea millefolium</u>		
<u>Rumex acetosa</u>		

OTHER SPECIES:- Arrhenatherum, Avena flavescens, A. pubescens, Bromus, Lolium, Poa pratensis, P. trivialis; Lathyrus, Trifolium pratense; Anthriscus, Ajuga, Centaurea, Gerastium, Galium, Heracleum, Hypochaeris, Leontodon, Luzula, Ranunculus spp., Stellaria, Taraxacum, Tragopogon, Veronica (See Tables).

Outline of Principal Changes during the Period 1877-1948

Yield. Slightly reduced at first, but fell sharply when manuring changed in 1904. Some improvement then occurred till 1938 when further reduction set in.

Number of Species. Little changed but considerable seasonal variation.

Composition of the Herbage. Changes are confined to the GRAMINEAE, and probably date from the alteration in manuring in 1904, but unfortunately no complete botanical analysis was made in 1903.

Percentage of Gramineae, Leguminosae and Miscellaneous Species

	<u>1862</u>	<u>1867</u>	<u>1872</u>	<u>1877</u>	<u>1914</u>	<u>1919</u>	<u>1944</u>	<u>1947</u>	<u>1948</u>
G	90.4	86.3	95.4	92.0	96.6	79.8	85.8	76.6	73.8
L	0.3	0.1	0.3	-	0.5	0.1	0.3	0.7	0.5
M	9.3	13.6	4.3	8.0	3.0	20.1	13.9	22.7	25.7

GRAMINEAE Proportion reduced

<u>Alopecurus pratensis</u>	}	Increased
<u>Anthoxanthum odoratum</u>		
<u>Arrhenatherum avenaceum</u>		Decreased since 1919
<u>Dactylis glomerata</u>	}	Much reduced
<u>Poa pratensis</u>		
<u>Lolium perenne</u>		

LEGUMINOSAE No change, quantity small

MISCELLANEOUS Increased, large seasonal fluctuations

Change in the Percentage of Certain Species

	<u>1862</u>	<u>1867</u>	<u>1872</u>	<u>1877</u>	<u>1914</u>	<u>1919</u>	<u>1944</u>	<u>1947</u>	<u>1948</u>
<u>Alopecurus pratensis</u>	3.4	4.5	5.9	6.8	18.5	22.2	56.7	27.6	31.9
<u>Anthoxanthum odoratum</u>	0.7	1.9	0.4	0.3	4.0	5.2	4.8	14.2	6.2
<u>Arrhenatherum avenaceum</u>	0.4	2.5	9.2	11.1	24.4	17.3	0.9	2.1	3.4
<u>Dactylis glomerata</u>	27.9	20.3	43.1	40.8	7.6	9.2	6.7	9.8	9.1
<u>Lolium perenne</u>	2.8	1.2	0.2	0.1	-	-	<	-	-
<u>Poa pratensis</u>	3.9	10.3	11.4	10.1	0.8	1.7	1.3	0.9	0.9

Effect of Lime

pH. 6.5

Yield. Increased in some seasons at first, but from 1910-1943 it was reduced. Since then lime has always improved the yield.

Number of Species. Slight increase in some seasons.

Composition of the Herbage. Balance of the three groups little affected except between 1943-1948 when GRAMINEAE increased and LEGUMINOSAE showed large fluctuations. An increase in LEGUMINOSAE (Lathyrus pratensis and Trifolium pratense) began in 1943 and reached a maximum in 1944 and 1945. In 1946 there was a sudden decrease and a low level has since been maintained.

Percentage of Gramineae, Leguminosae and Miscellaneous Species on the Limed Area of Plot 13, 1944-48.

	<u>1944</u>	<u>1945</u>	<u>1946</u>	<u>1947</u>	<u>1948</u>
G	26.4	36.1	62.5	66.9	67.0
L	41.1	36.9	7.6	7.5	10.6
M	32.5	27.0	29.9	25.6	22.4

GRAMINEAE

<u>Arrhenatherum avenaceum</u>	Usually much increased
<u>Agrostis vulgaris</u>	} Much reduced
<u>Anthoxanthum odoratum</u>	
<u>Alopecurus pratensis</u>	

MISCELLANEOUS

<u>Taraxacum vulgare</u>	Increased
<u>Rumex acetosa</u>	Usually reduced

Effect of Lime on the Percentage of Certain Species

	1914		1919		1947		1948	
	U	L	U	L	U	L	U	L
<u>Agrostis vulgaris</u>	11.8	2.4	11.0	3.3	10.9	-	15.7	0.2
<u>Alopecurus pratensis</u>	18.5	18.3	22.2	35.3	27.6	13.7	31.9	10.4
<u>Anthoxanthum odoratum</u>	4.0	1.5	5.2	2.0	14.2	0.8	6.2	0.3
<u>Arrhenatherum avenaceum</u>	24.4	40.4	17.3	20.6	2.1	14.2	3.4	25.9
<u>Festuca rubra</u>	14.6	10.7	5.5	4.7	4.5	1.0	4.0	0.9
<u>Poa pratensis</u>	0.8	1.2	1.7	3.9	0.9	2.3	0.9	1.8
<u>Taraxacum vulgare</u>	-	0.1	-	0.2	0.9	5.4	1.5	3.2
<u>Rumex acetosa</u>	1.8	0.6	15.1	6.3	2.9	2.5	1.9	0.8

U = Unlimed L = Limed

FARMYARD MANURE EVERY FOURTH YEAR, AFTER NITRATE OF SODA
AND MINERALS 1872-1904 (Plot 19)

Condition of Plot in 1949 (Unlimed)

- (a) pH not determined in 1945. (5.5 in 1957).
- (b) Herbage patchy and very dark green in spring; a good thick stand of moderately tall mixed herbage.
- (c) Growth starts early, and grows rapidly in the year that manure is applied.
- (d) Yield medium.
- (e) Twenty-one to twenty-eight species, with occasional traces of several others.

-140-

Usually absent

All other plots.

LIMED

Soabiosa is a marked feature of the aftermath on Plot 8 (minerals without potash), and also sometimes on Plots 2, 3, 12 (unmanured). It has greatly increased and may on occasions reach a figure as high as 8 or 10 percent, e.g. Plots 3 and 8 respectively in 1936.

SPIREA ULMARIA (Filipendula ulmaria)

May occur locally in fair quantity, but more usually absent.

UNLIMED

QUANTITY

Sometimes appreciable

Plots 7, 8

Minerals with and without potash (3 percent 1938; 2 percent 1940 Plot 7)

LIMED

QUANTITY

Much increased

Plot 8

Minerals without potash

Trace

Plot 1
3

Ammonium salts
Unmanured

Suppressed

Plot 7

Minerals

STELLARIA GRAMINEA

UNLIMED

Less plentiful than previously, but a small quantity is found on a few plots viz.

Plots 1

Ammonium salts

2, 3, 12

Unmanured

7, 8, 15

Minerals with and without potash

13

F.Y.M. and fish guano alternately

-141-

LIMED

Quantity usually slightly decreased, except occasionally with ammonium salts (Plot 1) or minerals (Plot 7).

TARAXACUM VULGARE (T. officinale).

Flowers and dies down early and is much more abundant where it occurs than the hay analyses indicate. Has increased considerably since 1919, particularly on the limed areas.

UNLIMED

QUANTITY

Small

Plots	14, 16	Minerals and nitrate of soda (up to 3 percent Plot 14)
	13, 19, 20	F.Y.M. with and without other fertilizers

Very small

Plots 3, 6, 7, 8, 15, 17, 18.

Absent

All other plots.

LIMED

QUANTITY

Very much increased

Plot	18	Minerals without super and ammonium salts
------	----	---

Considerably increased

Plots	7, 9	Minerals with and without ammonium salts
	13	F.Y.M. and fish guano alternately

Slightly increased

Plots	1	Ammonium salts
	4 ¹	Super
	2, 3	Urmanured
	11 ¹ , 11 ²	Minerals and heavy ammonium salts
	14, 16	Minerals and nitrate of soda
	19, 20	F.Y.M. with and without minerals and sodium nitrate

Unaffected

Plots 4², 8, 10, 15, 17.

-142-

TRAGOPOGON PRATENSIS

Has increased since 1915, especially on the limed areas.

UNLIMED

QUANTITY

Fairly plentiful (up to 3 percent)

Plot 20 F.Y.M., minerals and nitrate of soda

Small (under 1 percent)

Plots 3 Unmanured
6, 7, 15 Minerals

Traces or Absent

All other plots.

LIMED

QUANTITY

Considerably increased

Plots 2 Unmanured
7, 9 Minerals with and without ammonium salts
13, 19 F.Y.M. with and without fish guano
14, 16 Minerals and nitrate of soda
18 Minerals without super and ammonium salts

URTICA DIOICA

Rarely present, but has occurred in fair amount as follows:-

UNLIMED

Plots 7 Minerals (0.9 percent 1947; 1.7 percent 1948)
8 Minerals without potash (0.2 percent 1947).

LIMED

Plot 7 Minerals (trace in 1948).

VERONICA CHAMAEDRYIS

Occurs in small quantities and is encouraged by lime.

-143-

UNLIMED

QUANTITY

Very small

Plot 3, 12

4¹

5¹, 5²

6, 7, 8

13, 19

17

20

Unmanured

Super

Unmanured or minerals after ammonium salts
till 1897

Minerals with and without potash

F.Y.M. with and without fish guano

Nitrate of soda

F.Y.M., minerals and nitrate of soda

LIMED

QUANTITY

Increased

Plots 2, 3

7, 8, 15

19(LL)

Unmanured

Minerals with and without potash

F.Y.M. after minerals and nitrate of soda.

-144-

Species present 1940-49 in very small amounts which rarely, or never, appear in the Hay Samples.

SPECIES	PLOTS	
	<u>Unlimed</u>	<u>Limed</u>
<u>Agropyron repens</u>	20	-
<u>Bellis perennis</u>	4 ¹ ,17	2
<u>Cardamine pratensis</u>	19	-
<u>Chrysanthemum leucanthemum</u>	3,4 ¹	2,8
<u>Crepis spp.</u>	-	19
<u>Festuca loliacea</u>	-	9,19
<u>Fritillaria meleagris</u>	17 (considerable)	-
<u>Galium mollugo</u>	-	13
<u>Geum urbanum</u>	-	7,19
<u>Hypericum perforatum</u>	12.	-
<u>Lapsana communis</u>	-	18
<u>Ophioglossum vulgatum</u>	17	2
<u>Potentilla sterilis</u>	12,17	-
<u>Potentilla tormentilla (P. erecta)</u>	5 ¹	-
<u>Prunella vulgaris</u>	-	13
<u>Rosa spp.</u>	12,5 ¹ ,5 ²	17
<u>Rubus spp.</u>	1,4 ² ,18	-
<u>Senecio jacobea</u>	2,3	1,2,4 ¹ ,4 ² ,8
<u>Stachys betonica (S. officinale)</u>	12	-
<u>Stellaria media</u>	20	18,20
<u>Thymus serpyllum</u>	12	3
<u>Veronica serpyllifolia</u>	12	-
<u>Viola canina</u>	5 ¹	-

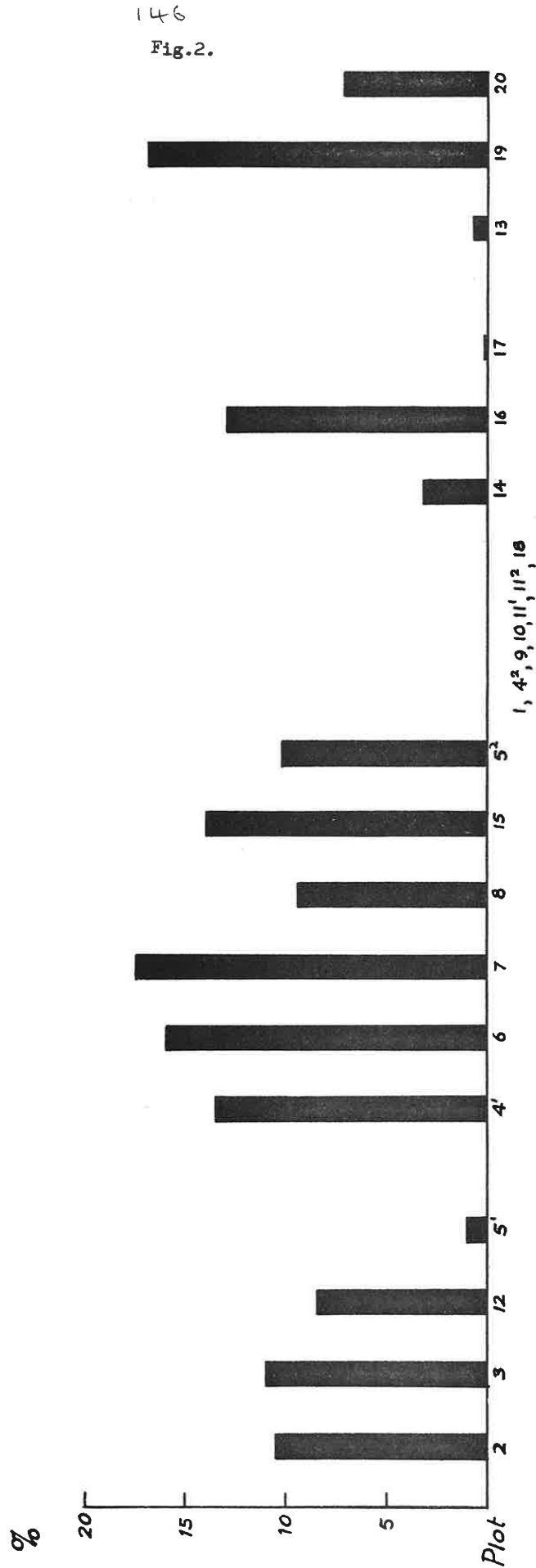
145

Fig. 1.

Fig. 1. Percentage of GRAMINEAE in 1947



Fig. 2. Percentage of LEGUMINOSAE in 1947



147
Fig. 3.

Fig. 3. Percentage of MISCELLANEOUS SPECIES in 1947

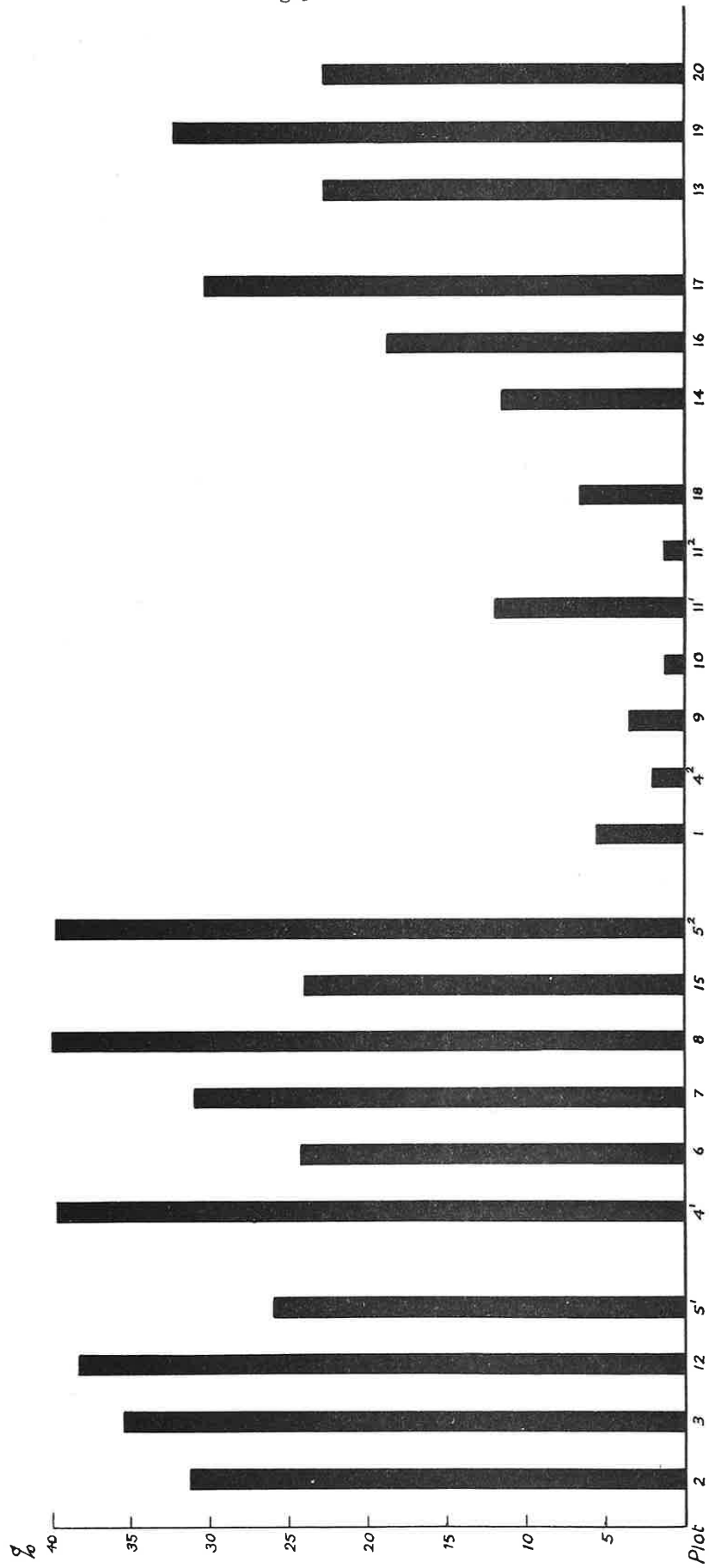


TABLE 2

Botanical analyses
Plots 3, 12, (2, 5)
Unmeasured
<= less than 0.05

Number of species, and percentage of each species and group of species.	MANURE.																
	Since 1936.					12					2					After Ammonium Salt, 1936-1937.	
	UNLIMITED		LIMITED		UNLIMITED		UNLIMITED		LIMITED		UNLIMITED		LIMITED		UNLIMITED		
Year	Plot	Year	Plot	Year	Plot	Year	Plot	Year	Plot	Year	Plot	Year	Plot	Year	Plot	Year	Plot
GRAMINEAE	1933	13	13	1934	13	1935	12	1936	12	1937	12	1938	12	1939	12	1940	12
	1940	13	13	1941	13	1942	12	1943	12	1944	12	1945	12	1946	12	1947	12
	1948	13	13	1949	13	1950	12	1951	12	1952	12	1953	12	1954	12	1955	12
	1956	13	13	1957	13	1958	12	1959	12	1960	12	1961	12	1962	12	1963	12
	1964	13	13	1965	13	1966	12	1967	12	1968	12	1969	12	1970	12	1971	12
	1972	13	13	1973	13	1974	12	1975	12	1976	12	1977	12	1978	12	1979	12
	1980	13	13	1981	13	1982	12	1983	12	1984	12	1985	12	1986	12	1987	12
	1988	13	13	1989	13	1990	12	1991	12	1992	12	1993	12	1994	12	1995	12
	1996	13	13	1997	13	1998	12	1999	12	2000	12	2001	12	2002	12	2003	12
	2004	13	13	2005	13	2006	12	2007	12	2008	12	2009	12	2010	12	2011	12
	2012	13	13	2013	13	2014	12	2015	12	2016	12	2017	12	2018	12	2019	12
	2020	13	13	2021	13	2022	12	2023	12	2024	12	2025	12	2026	12	2027	12
	2028	13	13	2029	13	2030	12	2031	12	2032	12	2033	12	2034	12	2035	12
	2036	13	13	2037	13	2038	12	2039	12	2040	12	2041	12	2042	12	2043	12
	2044	13	13	2045	13	2046	12	2047	12	2048	12	2049	12	2050	12	2051	12
	2052	13	13	2053	13	2054	12	2055	12	2056	12	2057	12	2058	12	2059	12
	2060	13	13	2061	13	2062	12	2063	12	2064	12	2065	12	2066	12	2067	12
2068	13	13	2069	13	2070	12	2071	12	2072	12	2073	12	2074	12	2075	12	
2076	13	13	2077	13	2078	12	2079	12	2080	12	2081	12	2082	12	2083	12	
2084	13	13	2085	13	2086	12	2087	12	2088	12	2089	12	2090	12	2091	12	
2092	13	13	2093	13	2094	12	2095	12	2096	12	2097	12	2098	12	2099	12	
2100	13	13	2101	13	2102	12	2103	12	2104	12	2105	12	2106	12	2107	12	
2108	13	13	2109	13	2110	12	2111	12	2112	12	2113	12	2114	12	2115	12	
2116	13	13	2117	13	2118	12	2119	12	2120	12	2121	12	2122	12	2123	12	
2124	13	13	2125	13	2126	12	2127	12	2128	12	2129	12	2130	12	2131	12	
2132	13	13	2133	13	2134	12	2135	12	2136	12	2137	12	2138	12	2139	12	
2140	13	13	2141	13	2142	12	2143	12	2144	12	2145	12	2146	12	2147	12	
2148	13	13	2149	13	2150	12	2151	12	2152	12	2153	12	2154	12	2155	12	
2156	13	13	2157	13	2158	12	2159	12	2160	12	2161	12	2162	12	2163	12	
2164	13	13	2165	13	2166	12	2167	12	2168	12	2169	12	2170	12	2171	12	
2172	13	13	2173	13	2174	12	2175	12	2176	12	2177	12	2178	12	2179	12	
2180	13	13	2181	13	2182	12	2183	12	2184	12	2185	12	2186	12	2187	12	
2188	13	13	2189	13	2190	12	2191	12	2192	12	2193	12	2194	12	2195	12	
2196	13	13	2197	13	2198	12	2199	12	2200	12	2201	12	2202	12	2203	12	
2204	13	13	2205	13	2206	12	2207	12	2208	12	2209	12	2210	12	2211	12	
2212	13	13	2213	13	2214	12	2215	12	2216	12	2217	12	2218	12	2219	12	
2220	13	13	2221	13	2222	12	2223	12	2224	12	2225	12	2226	12	2227	12	
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2244	13	13	2245	13	2246	12	2247	12	2248	12	2249	12	2250	12	2251	12	
2252	13	13	2253	13	2254	12	2255	12	2256	12	2257	12	2258	12	2259	12	
2260	13	13	2261	13	2262	12	2263	12	2264	12	2265	12	2266	12	2267	12	
2268	13	13	2269	13	2270	12	2271	12	2272	12	2273	12	2274	12	2275	12	
2276	13	13	2277	13	2278	12	2279	12	2280	12	2281	12	2282	12	2283	12	
2284	13	13	2285	13	2286	12	2287	12	2288	12	2289	12	2290	12	2291	12	
2292	13	13	2293	13	2294	12	2295	12	2296	12	2297	12	2298	12	2299	12	
2300	13	13	2301	13	2302	12	2303	12	2304	12	2305	12	2306	12	2307	12	
2308	13	13	2309	13	2310	12	2311	12	2312	12	2313	12	2314	12	2315	12	
2316	13	13	2317	13	2318	12	2319	12	2320	12	2321	12	2322	12	2323	12	
2324	13	13	2325	13	2326	12	2327	12	2328	12	2329	12	2330	12	2331	12	
2332	13	13	2333	13	2334	12	2335	12	2336	12	2337	12	2338	12	2339	12	
2340	13	13	2341	13	2342	12	2343	12	2344	12	2345	12	2346	12	2347	12	
2348	13	13	2349	13	2350	12	2351	12	2352	12	2353	12	2354	12	2355	12	
2356	13	13	2357	13	2358	12	2359	12	2360	12	2361	12	2362	12	2363	12	
2364	13	13	2365	13	2366	12	2367	12	2368	12	2369	12	2370	12	2371	12	
2372	13	13	2373	13	2374	12	2375	12	2376	12	2377	12	2378	12	2379	12	
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2388	13	13	2389	13	2390	12	2391	12	2392	12	2393	12	2394	12	2395	12	
2396	13	13	2397	13	2398	12	2399	12	2400	12	2401	12	2402	12	2403	12	
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2420	13	13	2421	13	2422	12	2423	12	2424	12	2425	12	2426	12	2427	12	
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2444	13	13	2445	13	2446	12	2447	12	2448	12	2449	12	2450	12	2451	12	
2452	13	13	2453	13	2454	12	2455	12	2456	12	2457	12	2458	12	2459	12	
2460	13	13	2461	13	2462	12	2463	12	2464	12	2465	12	2466	12	2467	12	
2468	13	13	2469	13	2470	12	2471	12	2472	12	2473	12	2474	12	2475	12	
2476	13	13	2477	13	2478	12	2479	12	2480	12	2481	12	2482	12	2483	12	
2484	13	13	2485	13	2486	12	2487	12	2488	12	2489	12	2490	12	2491	12	
2492	13	13	2493	13	2494	12	2495	12	2496	12	2497	12	2498	12	2499	12	
2500	13	13	2501	13	2502	12	2503	12	2504	12	2505	12	2506	12	2507	12	
2508	13	13	2509	13	2510	12	2511	12	2512	12	2513	12	2514	12	2515	12	
2516	13	13	2517	13	2518	12	2519	12	2520	12	2521	12	2522	12	2523	12	
2524	13	13	2525	13													

TABLE 6a
NUMBER OF SPECIES AND PERCENTAGE OF EACH SPECIES AND GROUP OF SPECIES

Manuring	AMMONIUM SALTS																										
	1									4 ²									18								
	UNLIMED			LIMED			LIMED			UNLIMED			LIMED			UNLIMED			LIGHT LIME			HEAVY LIME					
	Alone = 43 lb N; also F Y M 8 years 1856-63																										
	= 86 lb N with Superphosphate																										
	= 86 lb N with Mixed Minerals without Super; after Minerals + Nitrogen, 40 years, 1865-1904.																										
Plot number	1914	1919	1939	1948	1914	1919	1939	1948	1914	1919	1949	1949	1949	1949	1914	1919	1923	1928	1923	1928	1948	1923	1928	1948	1923	1928	1948
Season	10	10	7	6	12	10	11	11	9	10	8	5	8	7	11	10	8	10	9	11	14	8	10	11	8	10	11
GRAMINEAE	16.0	18.5	52.5	75.3	12.3	8.5	3.7	1.5	2.0	12.9	4.3	36.2	1.0	0.3	10.0	17.6	47.9	59.0	28.3	17.5	3.4	27.2	4.8	1.2	27.2	4.8	1.2
Number of species	2.0	1.3	0.1	0.1	4.5	5.9	4.0	2.5	4.6	2.5	1.4	0.7	4.4	76.1	3.3	5.1	5.1	5.3	10.3	45.6	2.8	8.3	22.7	3.8	8.3	22.7	3.8
1. <i>Agrostis vulgaris</i>	13.0	17.5	0.7	0.2	6.3	7.4	2.2	1.4	23.4	7.7	34.1	16.0	7.6	1.1	3.6	3.5	19.8	6.9	2.2	0.5	0.8	2.6	0.8	2.6	2.6	0.8	2.6
2. <i>Aira caespitosa</i>	0.1	0.1	0.1	0.1	0.7	1.4	2.2	3.0	1.0	0.3	3.1	1.0	0.3	3.1	0.1	1.6	0.1	0.4	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
3. <i>Alopecurus pratensis</i>	0.1	0.1	0.1	0.1	0.7	0.6	2.2	1.7	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
4. <i>Alopecurus pratensis</i>	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
5. <i>Arrhenatherum avenaceum</i>	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
6. <i>Avena pubescens</i>	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
7. <i>Avena pubescens</i>	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
8. <i>Cynodon dactylon</i>	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
9. <i>Cynodon dactylon</i>	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
10. <i>Cynodon dactylon</i>	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
11. <i>Dactylis glomerata</i>	9.5	11.3	0.7	3.2	7.0	23.4	13.1	18.3	0.1	1.0	0.6	35.3	35.1	7.7	37.1	34.0	3.2	9.3	8.0	21.1	35.0	9.7	37.7	48.3	31.1	3.1	2.2
12. <i>Dactylis glomerata</i>	28.1	14.3	40.9	15.6	25.9	10.6	15.2	15.4	53.5	79.0	47.9	35.3	35.1	7.7	37.8	4.2	18.3	6.2	26.4	2.8	6.8	31.1	3.1	2.2	31.1	3.1	2.2
13. <i>Festuca pratensis</i>	7.1	22.4	-	-	5.5	10.0	3.5	5.8	1.1	0.1	0.1	17.5	0.2	0.1	0.9	2.4	0.2	8.2	1.3	0.8	0.2	1.5	1.6	0.1	1.5	1.6	0.1
14. <i>Holcus lanatus</i>	0.6	0.4	0.2	-	3.9	1.8	2.3	1.3	7.7	1.2	0.3	-	12.6	12.8	6.3	0.3	0.4	2.2	6.9	5.4	0.2	4.4	6.3	1.1	4.4	6.3	1.1
15. <i>Poa pratensis</i>	0.4	-	-	-	0.4	-	-	-	0.1	0.1	-	-	0.2	-	-	0.1	-	-	-	-	-	-	-	-	-	-	-
16. <i>Poa trivialis</i>	0.4	-	-	-	0.4	-	-	-	0.1	0.1	-	-	0.2	-	-	0.1	-	-	-	-	-	-	-	-	-	-	-
17. <i>Poa trivialis</i>	0.4	-	-	-	0.4	-	-	-	0.1	0.1	-	-	0.2	-	-	0.1	-	-	-	-	-	-	-	-	-	-	-
18. <i>Stalks</i>	78.9	86.4	95.2	94.6	72.6	77.8	83.6	83.3	93.6	98.7	92.0	99.7	99.1	98.1	94.6	93.4	96.8	96.2	85.5	96.3	80.8	87.5	94.4	82.9	87.5	94.4	82.9
Total	0	0	0	0	2	2	3	3	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2	0	1	2
LEGUMINOSAE	0	0	0	0	0.5	0.4	1.5	2.0	-	-	-	-	-	-	0.1	-	0.1	-	-	-	-	-	-	-	-	-	-
Number of species	-	-	-	-	0.2	0.3	0.5	2.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1. <i>Lathyrus pratensis</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2. <i>Lonicera corniculata</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3. <i>Trifolium pratense</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4. <i>Trifolium pratense</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5. <i>Trifolium repens</i>	-	-	-	-	0.7	0.7	2.1	4.6	-	-	-	-	-	-	0.1	-	0.1	-	-	-	-	-	-	-	-	-	-
Total	-	-	-	-	0.7	0.7	2.1	4.6	-	-	-	-	-	-	0.1	-	0.1	-	-	-	-	-	-	-	-	-	-
MISCELLANEOUS	7	5	4	5	9	9	12	14	5	6	2	1	2	3	6	5	4	6	6	5	11	5	6	6	5	6	6
Number of species	0.1	-	-	-	1.3	2.1	1.1	0.7	-	-	-	-	-	-	0.1	-	-	-	-	-	-	-	-	-	-	-	-
1. <i>Ranunculus acris et bilbosus</i>	0.1	-	-	-	0.8	0.9	0.2	0.6	-	-	-	-	-	-	-	-	-	-	0.1	-	-	0.1	-	-	-	-	-
2. <i>Centaurea nigra</i>	-	-	-	-	0.1	0.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3. <i>Stachys recta</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4. <i>Stachys recta</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5a. <i>Potentilla reptans</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6. <i>Potentilla reptans</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7. <i>Potentilla reptans</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8. <i>Potentilla reptans</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9. <i>Potentilla reptans</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10. <i>Potentilla reptans</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11. <i>Potentilla reptans</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12. <i>Potentilla reptans</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13. <i>Potentilla reptans</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14. <i>Potentilla reptans</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15. <i>Potentilla reptans</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16. <i>Potentilla reptans</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17. <i>Potentilla reptans</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18. <i>Potentilla reptans</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19. <i>Potentilla reptans</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20. <i>Potentilla reptans</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21. <i>Potentilla reptans</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22. <i>Potentilla reptans</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23. <i>Potentilla reptans</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24. <i>Potentilla reptans</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
25. <i>Potentilla reptans</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26. <i>Potentilla reptans</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27. <i>Potentilla reptans</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
28. <i>Potentilla reptans</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-											

