A fatuous statement ~ Bougainville's expedition was the first to land in the Falklands so far as we know i.e. there were no inhabitants.

MC

PART III.

P A S T U R A G E

There is no evidence that the native pastures were grazed before Bougainville introduced the first animals to the Falklands in 1764. The eary pasturage was reputedly very good, and so continued even in the early days of sheep farming, was commenced. It was described as follows by the late Mr. Herbert Felton:—

"The Northern part of the West Falkland from
"Chartres through Roy Cove and Hill Cove to White
"Rock was covered with grass bogs * reaching to a
"rider's knees, interspersed with fine grass and
"acres of celery. In many places, because of the
"growth, the camp was difficult to get through.
"In those days, the white grass camps as we now
"know them were considered valueless for grazing.
"Cattle were magnificent, enormously fat and very
"plentiful. This wealth of good fodder was des-
"troyed during the fine summer of 1871 when it was
"fired, and the camp was burnt to the soil from
"Chartres to Port Purvis. It took fifteen years
"before there was a semblance of recovery, the
"blue grass was pulled up by the sheep as soon as
"it tried to grow, making the camp look like a hay
"field. Before this, stock kept fat summer and
"winter."

It is obvious that grazing and burning have brought about a considerable change in the composition of the native pastures and a deterioration in their quality. The change is, undoubtedly, much greater, than the elimination of the Falkland tussac from the coastal belt, of which process there is evidence during the past six years. This follows the unrestricted grazing of tussac areas by sheep especially during the summer, and may be seen on Hummock Island to which they were introduced in 1940.

(* Tussocks of grass are termed locally "bags". This statement has been corroborated by F. L. a retired shepherd. It is contained in a letter on the files of the Department.

Professor Davies made a comprehensive report on the grasslands of the Colony supported by an ecological map in 1939, from which it may be seen that white grass (Cortaderia) covers by far the greatest area of any species in the Islands.

It is associated with different species in at least four types of pasture which, together, occupy more than 70% of the Colony.

TABLE VIII *

SHOWING THE PERCENTAGE AREA AND THE ESTIMATED ACREAGES OF THE SEVERAL PASTURE ZONES.

PASTURE TYPE.	East Falkland.* percent.	West Falkland.* percent.	Falkland Islands.* Percent.	Acres.
HARD CAMP.				
Cortaderia (white grass).	26.69	11.19	21.58	647,400
Empetrum (diddle dee).	2.95	23.41	11.92	357,600
Cortaderia-Empetrum (white grass - diddle dee).	9.11	22.10	14.68	444,300
Blechnum-Pernettya etc. (small fern - mountain berry - balsaam etc.).	0.67	2.69	1.55	46,500
Blechnum tabulare+(tall fern).	0.11	0.33	0.21	6,300
Poa annua and Aira praecox (penguin grounds and grassy ridges.)	3.02	2.79	2.91	87.300
Other areas of introduced grasses (including settlement fields and areas of Yorkshire fog).	0.15	0.19	0.16	4,800
Tussac lands (including depleted land).	0.37	1.49	0.86	25,800
Sand drifts and dunes (including replanted sands).	0.79	1.53	1.12	33,600
SOFT CAMP.				
Cortaderia-Oreobolus (white grass-oreob).	23.43	21.98	22.83	684,900
Rostkovia-Astelia (lowland peat banks).	17.80	1.70	10.75	322,500
Mountain Pastures.	11.91	10.60	11.30	339,000
Total HARD CAMP areas:	46.86	65.72	55.12	1,653,600
Total SOFT CAMP+areas:	53.14	34.28	44.88	1,346,400
GRAND TOTAL:	100.00	100.00	100.00	3,000,000

* after Davies, 1939.

* Including adjacent islands.

Present Pasturage.

~~Throughout the Colony the most common grass is undoubtedly white grass (Cortaderia).~~ While Grass (Cortaderia) which is so widely spread ~~It~~ is of low feeding value, having about 48% of soluble carbohydrates, 3% to 8.75% of crude protein, and 3% to 4% of oils. It is low in minerals while high in fibre and silica. The proportion of protein to non-proteins in a food is important, and should be not less than 1: 10, if the food is to be fully digested. For young animals a ratio of 1: 5: or 1: 7 is desirable. These ratios are calculated on the digestible constituents of a food, but since we have no knowledge concerning the digestibility of the protein and non-proteins of any Falkland Island fodder, any ratio that can be arrived at ~~must be~~ is necessarily rather hypothetical. Even so, assessing the digestibility of the fibre and oil at 50%, of soluble carbohydrates at 66%, and crude protein at 100% (which is admittedly unlikely) the ratio of Nitrogen Equivalent to Starch Equivelant for young leaves of Cortaderia is only 1: 11.5 and the average of six samples quoted by Davies (table VIII) is 1: 15.7. The actual ratios are probably even wider, and it seem certain that the local pastures are not only very low in proteins, but also so low that animals cannot obtain the full benefit of the food that is available. This together with the lack of minerals may explain the slow maturation of stock which has been commented on by previous investigators. In fact it seems not unlikely that stock suffer from protein starvation during the winter.

There are very few of the native plants available to sheep that are likely to have a sufficiently close ratio to improve the feeding quality of the pasturage. The most promising would appear to be the leafy kelp (Macrocystis), while the native fog, small rush, native fescue, hair grass and native bent would perhaps approach the desired proportions. This gives further significance to the introduction of a leguminous plant to the native pastures, in addition to the improvement which such plants would have on the soil texture and fertility.

It has established very well at Pat Howard.

Mc

This is just the type of remark that would get under the skin of the SOA. Quite true of course but badly put.

Mc

There can be no doubt concerning the accuracy of Davies statement that "wild white clover may be regarded as a fundamental plant in any scheme of grass-land improvements contemplated in the Falklands." With the introduction of wild white clover to the native pasturage I would predict a new era of prosperity in this Colony, accompanied by a diversity of farming that, under present conditions would be considered fantastic; and this is not without reasonable hope of achievement, for experiments have indicated that clover may be introduced to the native camp at an economic cost (page 79).

At present the Colony has no source of wealth other than it's pastures.

Farming Practices.

Farming in the Falklands is purely sheep-ranching; and is characterized by large paddocks, uncontrolled grazing, low carrying capacity and the grazing of stock continuously through the larger part of the year on the same ground. Since the paddocks are very large, (often more than 10,000 acres) they include areas of different type of pasture possessing different palatabilities. On most stations an unpalatible bulk of Cortaderia accumulates, so that it must be burnt every three or four years. Sheep graze most heavily during the subsequent eighteen months on the young growth which follows the burn. But in settlement paddocks where the concentration of stock is higher the accumulation of 'burn' does not occur. Often this is due to grazing by horses and cows in addition to sheep. To those with discernment this definitely points the way to a more enlightened form of management which would include the subdivision of large paddocks, intensive grazing of the resulting fields, and the rotation of stock, both in place and type.

Something of this method of management has been adopted at Port Howard which is probably the only station that is sufficiently subdivided to attempt the control of grazing and pasture management. A modified application of the method is found on three or four of the smaller properties where coastal tussac plantations have been establis

These plantations are grazed by sheep during three to five months of the winter, when native pastures are at their worst. They provide winter grazing comparable to that supplied by swedes or turnips, and with less effort by the manager. For the remainder of the year such plantations are closed to stock. They are often invaded by penguins and seals during the summer and are thereby richly fertilized so that growth is luxuriant. These areas of fenced tussac (among which may be included the islands which are specially reserved for the wintering of horses) constitute almost the sole attempt to provide a special winter forage for stock.

A continuance of the present methods of uncontrolled grazing and burning, without replacing any of the minerals that are removed from the soil, can result only in a continued deterioration of the natural pastures. Since the exportation of wool commenced about 1860 nothing that it contained has been returned to the soil. A further loss of minerals has accompanied the slaughtering of surplus stock on the beaches, where, by custom, their carcasses have been left to the scavenging of gulls. The annual losses of potash and nitrates through the export of wool alone has been assessed at the equivalent of 162 tons of sulphate of potash and 548 tons of nitrate of soda each year, while every sheep killed and left on the beach removes the equivalent of 54 lbs. of nitrate of soda; 5 lbs. of Calcium phosphate and 2 lbs. of potash. (Some part of these minerals must undoubtedly be obtained from the kelp cast upon the beaches.)

Early Attempts to Improve Pastures.

Grass Seeding. About 1900 the Chief Stock Inspector (Mr. James Robertson) endeavored to interest the land owners in the establishment of English grasses. Experiments were laid down at Darwin, Lively Island, Fitzroy and at the Quarantine Paddock in Stanley. In 1903 he reported that rye grass, cocksfoot and white clover had struck well, and that a few of the more enterprising farmers had ordered large quantities of grass seed. Later (1907-8) he reported that English grasses would grow on suitable places in the Falklands, and that the

These plantations are grazed by sheep during three to five months of the winter, when native pastures are at their worst. They provide winter grazing comparable to that supplied by swedes or turnips, and with less effort by the manager. For the remainder of the year such plantations are closed to stock. They are often invaded by penguins and seals during the summer and are thereby richly fertilized so that growth is luxuriant. These areas of fenced tussac (among which may be included the islands which are specially reserved for the wintering of horses) constitute almost the sole attempt to provide a special winter forage for stock.

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best time for sowing was the latter part of the autumn or during the winter.

Little remains of these plantings other than occasional cocksfoot plants near settlements or along the tracks. The seeds appear to have been broadcast on unprepared native camp from which it is unlikely that stock would have been removed. We now know, from recent work that grasses and clovers rarely become established by such methods unless the seeds are sown with fertilizers, or on ground that has been broken up and weathered. It is possible, however, that brown top, Agrostis tenuis, which has formed a very tough turf about the main settlements was introduced at this time; for there is evidence about Stanley that when Brown top bearing turfs are planted in soft camp the Brown top will spread slowly through the surrounding pastures though clover contained in the turfs may die out.

Interest in the sowing of English grasses appears to have flagged when Robertson left the Stock Department in 1909, and it does not appear to have been renewed until 1920-24 when tillage was first practised by two of the more progressive owners[θ] and it became necessary to grass down areas that had been ploughed.

Trials with Fertilizers. About this time Governor Middleton arranged with the Rowett Institute, for a survey of the mineral content of Falkland Island pastures. Unfortunately, this work appears to have been discontinued after only one year, and we have no report concerning the analyses of the large number of samples which were submitted in 1925. The general report on the analyses of fifty five samples of grasses submitted in 1924 is presented in tabular form hereunder.

θ F. I. C. and Holmstead & Blake Co.

Mineral content of Falkland Island pasturage.

TABLE IX (*)

Falkland Islands.	Lime.	Phosphoric acid	Soda.	Potash.	Chlorine	Nitrogen.
	CaO.	P2O5.	Na2O.	K2O.	Cl.	N.
Average of all samples.	.22	.44	.27	1.92	.56	1.60
Average of grass not eaten.*	.14	.25	.23	1.28	.34	1.10
Average of grass eaten.×	.27	.51	.31	1.76	.63	1.76
Average of grass near sea.	.23	.49	.37	1.70	.50	1.38
Average of grass from inland.	.15	.42	.21	1.66	.43	1.39
British.						
Average of grass eaten.	.43	.61	.33	2.26	.53	2.41
Average of grass not eaten.	.28	.34	.14	1.14	.20	1.35

(* Extract from M.P. 84/24, original dated 3/12/44).

This indicated that the native pastures are particularly low in lime as compared with the average of English pastures. In submitting the report, the Rowett Institute expressed the opinion that "without the addition of lime, little or no improvement of pasturage could be expected in the Falklands." As a result of this, a small experiment with lime and phosphatic fertilizers was laid down in Government House Paddock in 1924 and some four hundred tons of lime were spread at Shallow Bay on the Hill Cove property.

The fertilizers applied in the Government House Paddock produced a considerable improvement in the pasturage, and caused the grassing over of the bare ground; but at Shallow Bay no benefit has been observed by the managers, shepherds or visiting agriculturalists.

No attempt was made to introduce English grasses or pasture plants in connection with the liming at Shallow Bay. I understand that British native hill country pastures devoid of clovers do not exhibit any response to liming, but responses are clearly visible on the same areas after better ~~strains~~ species of grasses and clovers have been sown. The fact, that the native pasture plants in the Falkland Islands are accustomed to grow on soils of low lime content, possibly masked any response that might have occurred at Shallow Bay. Since Shallow Bay has always been considered good land, the conditions of stock on that area would normally be attributed to the quality of the land, rather than to any benefit the lime may have given to the pasturage. When I ~~viewed~~ inspected the area in October, 1944 I

(* Davies 1939, P. 18). (× From ungrazed areas). (× From well grazed areas)

At least six have spoken to me of the futility of closing it down before it had been given a chance to show its worth and it was undoubtedly one of the more mischievous of the late Sir A. Hodson's activities.

MC

X Mem. for note in foreword.

I really do not think that P.E. required much "stimulation" from anybody.

MC

He has once again topped the wool prices!

MC

I have little reason to doubt that he would give the information for the asking – if asked in the right way.

MC

could see no evidence of differential grazing on the limed and unlimed ground nor could I discern any other difference that could be attributed to liming, unless it were possibly a more complete cover by Christmas bush (Baccharis magellanica).

Anson Experimental Farm.

Munro's report on the sheep farming industry (1924) recommended inter alia the establishment of an experimental farm. The site of the farm was acquired and the erection of buildings was commenced in 1926, but it was closed down on the grounds of public economy in 1928 and all buildings and equipment sold. ~~Only one sheep-owner is recorded as voicing a protest to the closing down of the farm.~~

~~At the time of closing,~~ Some 100 acres had been ploughed and sown to pasture, but the work of establishing the Anson Farm, the fencing, and the provision of buildings and stocking, had barely been completed.

~~The closing down of the farm was a great~~ early abandonment of this project can be looked upon as the greatest setback to agricultural progress in the Colony, and it is difficult to understand how such a reversal of policy ~~was~~ could have been permitted within a matter of three or four years.

Munro stimulated the Manager at Port Howard, the Honourable Mr R. C. Pole-Evans O.B.E., M.L.C. to carry out a policy of cultivation and of pasture improvement. This policy has been maintained by the Owner Company (Messrs Holmstead & Blake) and ~~and there are now possibly 700 or 1,000 acres~~ at Port Howard the acreage there now approaches the 1000 mark. of English pasture grasses which have been established on cultivated land. Unfortunately, this enterprise received no active support from the Colonial Government and has been ridiculed as 'uneconomic' by ~~the~~ his neighbours. It is greatly to Mr. Evans' credit that he persisted with his venture and overcame the difficulties ~~that are~~ inherent in working peat with horses, and in a country where cultural practices ~~are~~ were hitherto almost unknown. ~~and it is understandable that he should wish to keep to himself such information as he has acquired in the process.~~ He has used these paddocks for the maintenance of a flock of stud sheep, and has disposed of the surplus rams at a ~~sufficient~~ price which justified the expense of establishing such pastures. They have also provided him with a large part of the hay which is harvested at Port Howard every year.

I should much like to hear RPE's reactions to this; his pastures are a sight for sore eyes on Mrs Colony.

WC.

White clover is plentiful in the home paddocks at Port Howard, and there are also fields or strips of pure associations of species or strains of grasses. There is something unsatisfactory and lifeless in a sward composed of only one species of grass, even when combined with white clover; but the plots provide ample evidence that cocksfoot red creeping fescue, timothy, Yorkshire fog and brown top will grow satisfactorily in the Colony, and that perennial ryegrass though unthrifty will persist. This last grass does not appear to be so suitable as the previously mentioned grasses, for local field conditions, though it is growing well as a sheltered lawn in Stanley, and on a tilled patch on the Common where lime was spilt.

The best areas at Port Howard in 1940 were the '1926 Paddock' and the 'Point'. In the former were sown strips of different mixtures of grasses. The best contained white clover, cocksfoot, crested dogstail, red fescue and perennial rye-grass and some lotus major. On the 'Point' experiments have been made with meat refuse, fish manure, tidal mud, peat mould, crushed bone, basic slag and whale guano. As a result of these treatments the grass strips have taken on a characteristic colour, and ~~the strips~~ can be seen at a distance. The meat refuse was stated to have produced the greatest bulk of hay, but there was less clover than on the basic slag strip ~~on~~ which contained ~~was~~ the best turf.

Pastures of English grasses have been long established at Hill Cove, and this and other stations, particularly Chartres, Lafonia, San Carlos and Pebble Island have sown pasture seed mixtures during the past ten years, with success.

At Douglas Station some ten varieties of clover and grass were sown on small plots in 1939. By 1944 (November) the red fescue and brown top had formed a complete cover on their respective plots; tall oat grass occupied about 20% of the space on which it was sown, but of the subterranean clover, tall fescue, Poa pratensis, meadow foxtail, and wood meadow grass there was no trace were not to be found. Welsh white clover was present only as isolated plants.

9

Where are these strips

See Davies, pp. 13 & 14.

There are 33 plots on 15 separate properties. D.G.

Aberystwyth Experiments.

It was due, I believe to Mr. Pole-Evans' activity that Mr. Davies M.Sc. of the Welsh Plant Breeding Station, Aberystwyth visited the Colony in 1937-38 to report on the grass lands. His report and recommendations were published in 1939 and give a very comprehensive picture of the types and condition of the native pastures ~~of this Colony~~.

Some two years before ~~he arrived~~ his arrival the Aberystwyth Station requested that some small experiments with grass seed and artificial fertilizers should be laid down, and they supplied the necessary materials. These small observation plots are described in Davies' report and have yielded, and continued to yield, valuable information on the problem of establishing English grasses in the camp. Since they consitute what appears to be the first satisfactory demonstrations that English pasture plants can be established bu surface seeding, a brief outline may not be ~~out of place~~ of interest.

The experiment consisted of five sub-plots to four of which were applied ~~which received respectively~~ superphosphate at five cwt. per acre, basic slag at ten cwt. per acre ~~no fertilizer~~, basic slag at five cwt. per acre, and rock phosphate at five cwt. per acre, one plot was left unfertilised. In addition a strip was sown across all plots with a fertilizer supplying potash, some phosphate and nitrogen. The experiment was then sown with a mixture of grass seed at the rate of forty two pounds per acre.

The experiments were placed on different types of ground; (a) on tilled ground with a proper seed bed; (b) on native pasture which had been given rough surface cultivation and (c) on land receiving not previously cultivated.

On ploughed ground all the English grasses appear to have become well established though they are less vigorous and less palatable on the unfertilized plot.

On the other types of land Yorkshire fog though sown at only four ounces

per acre is the dominant grass ~~on hard and shift camp~~ though in areas naturally carrying hair grass or native fescues, cocksfoot, timothy, crested dogstail and occasional ryegrass ~~plants~~ preponderate. Agrostis species are slowly coming into these plots. White clover is present only on the plots that received basic slag at ten cwt. per acre and it has not become established on all of these. In fact, with experience it is possible, without recourse to notes, and even where the pegs are missing to pick out subplots and to detect errors in their order. ~~and this, even though the pegs are missing.~~ This may be due to ~~is possible chiefly through~~ the response of clovers and cocksfoot to the heavy dressing of slag, and the better establishment of grasses on the rock phosphate plot as compared with the superphosphate plot.

The addition of fertilizers, espcially of basic slag, is the important factor, for there is very little of any English grass, even fog, on the unmanured plot. The phosphates, ~~have,~~ in addition to bringing about the establishment of English grasses, have made the native pasturage more palatable. Thus the whole experiment, with the exception of the unfertilized plot, is well grazed while the surrounding native grasses are rank. This becomes very obvious when the surrounding white grass is burnt leaving the camp blackened up to the edge of the plots which, being well grazed, do not carry the fire and therefore remain green.

The value of these plots is that they ~~indicate~~ demonstrate the ability to establish English grasses. But they achieve their end at too great a cost for economic application in this Colony, where the present average gross revenue is in the nature of one shilling and sevenpence to two shillings per acre. It is necessary, therefore, to develop a more economic method of introducing pasture plants to the camp; though on small areas and for special purposes the methods used in these plots might be of economic value.

Experiments on the Establishment of English Pasture.

Between the spring of 1940 and the present time (March 1946) some twenty five experiments have been laid down to obtain information con-

cerning (i) the suitability of different grasses, or strains of grasses and clovers as pasture plants in the Colony, (ii) to determine the most suitable types of mixtures of grass seeds, and (iii) to ascertain whether there are cheaper methods of introducing them to the camp than by ploughing and tilling the land.

Species and Strains. The first series of three experiments each contained from seventy to eighty plots (in which there were no replicates) of different species or strains of grasses and clovers. One of these was sown on the ashes of a burnt diddle dee area which had been slightly loosened by chain harrowing before sowing. The remaining experiments were placed on land which had been cultivated and planted in oats during a previous season. Two of the experiments were sown in the autumn, and one (on ploughed land) in the spring. No fertilizers were applied to any plot, but the clover seeds were inoculated though without apparant success, with sub-cultures made locally, from a culture of Rhizobium that was brought from New Zealand..

RHIZOBIUM

There was some uniformity in the reaction of the grasses to Falkland Islands conditions as may be seen in TABLE X, but the strike and growth of the experiments was poor. In each location Yorkshire fog provided a complete cover of its plot, and Astpria bent provided the next best cover, (about 50% in eighteen months) but appeared to be of low yield.. Cocksfoot, timothy, perennial ryegrass (especially New Zealand certified (Ba 6425) and tall oat grass produced a few plants which grew more or less vigorously. Apart from the white clover strain, Cornell 201, only occasional plants of white clover appeared and then only on cultivated land. Neither crested dogstail nor fescues were included in these sowings.

The most important information that was obtained from these yield experiments was the confirmation of the impression, at that time only being appreciated, concerning their confirmation of the importance of applying fertilizers with grass seeds at the time of sowing.

TABLE X

Name of Grass.	On Seed Beds.		On Diddle Dee Ash.	
	Chartres.	Pebble Is.	Stanley.	
Date examined	2/42	3/2/42	26/3/42	13/3/42.
				Germination
Brage Orchard Grass.			✓	good
Aberystywth Hay Orchard Grass.	✓	✓	✓	poor
Orchard Grass Hay Pasture JW201.		✓	poor	very poor
BC337 Cocksfoot.		✓		very poor
Commercial Cocksfoot.	✓			very poor
Commercial Timothy.		✓	✓	fair
Bd153 Timothy.		✓	✓	fair
Medford Bulbous Blue Grass.			✓	poor
Astoria Bent (A. tenuis).	✓✓	not sown	✓✓	good
New Zealand Certified Ryegrass.		poor	poor	poor
BA 6425. (Ryegrass Perennial)	✓	✓	✓	poor
Grimm Alfalfa.	not sown	not sown	✓	fair
Yorkshire fog.	✓✓✓	✓✓✓	✓✓✓	good
Rough stalked Meadow Grass (Poa pratensis).		✓	poor	poor
Wild White Clover.	✓	✓		
Ontario Variegated Alfalfa.	not sown	not sown		fair
Seaside Creeping Bent. (A. palustria).	✓			fair
Victoria Perennial Ryegrass.	✓		fair	poor
Commercial Tall Oat Grass.	✓		very poor	very poor

✓ signifies some good health plants though not a good cover.

✓✓ signifies a reasonably good cover; not vigorous.

✓✓✓ signifies vigorous growth and good cover.

EXPERIMENTS WITH PASTURE MIXTURES, STANLEY.

Seed Mixtures for Pasture Establishment. Three mixtures were made up to obtain information concerning their suitability for pasture establishment. Mixture 'a' was intended to produce pasture containing as dominants, ryegrass, white clover, crested dogstail; and 'b' cocksfoot, red and white clover and meadow fescue. Both these mixtures were designed for use on rich cultivated ground. The mixture 'c' contained mainly bents, Poa pratensis, and Yorkshire fog and was intended for poorer quality ground. All were sown during December 1941, 'a' and 'b' on good seed bed on sandy peat, and 'c' on the upturned furrow of a diddle-dee area that had been ploughed three months previously, and boarded but not deeply cultivated. (see Photos P.M.: 28-6-23 pp 279-280).

TABLE XI

EXPERIMENTAL GRASS-SEED MIXTURES.

	a	b	c	d	e
Perennial ryegrass.	20*	4	-	-	-
Italian ryegrass.	-	4	-	8	8
Cocksfoot.	6	10	-	8	10
Timothy.	-	4	-	-	4
Poa pratensis.	-	-	3	2	4
Crested dogstail.	3	2	2	2	3
Brown top.	½	½	3	2	3
Red top.	½	½	1	2	-
Meadow fescue.	-	6	-	-	-
Yorkshire fog.	-	½	3	-	-
White clover.	2	2	2	2	1
Suckling clover.	-	1	1	1	1
Subterranean clover.	-	-	1	1	2
Red clover.	-	2	1	-	-
Total:	32	36½	17	28	36 - lbs. per acre.

(* Italian ryegrass was used in error).

Each area received half a ton of lime and one cwt. of basic slag per acre at sowing. The 'a' and 'b' areas had received previously, a dressing of three cwt. of lime, three cwt. superphosphate, and one cwt nitrate of soda during 1940, but the diddle-dee area had received nothing. The strike of grasses was very good and cocksfoot was very prominent in the 'b' mixture. The ryegrass has never appeared ~~too~~ vigorous or healthy excepting where, during a subsequent year, several tons of bagged lime ~~was~~ were dumped pending distribution on adjoining ground. On this site cocksfoot and Italian ryegrass became very thick and produced a hay crop some forty inches tall, ~~a~~ the result ~~due to~~ undoubtedly of a large amount of spilt lime.

On the newly cultivated diddle dee ground the strike of mixture 'c' was poor and consisted mainly of subterranean clover and Yorkshire fog. This plot has been allowed to seed and the area is now (1946) covered with Yorkshire fog, white clover, brown top, red top and a sprinkling of red clover. Subterranean clover germinated well but failed to establish.

The whole area of these experiments was unfortunately and unavoidably heavily over-grazed by sheep during late autumn of 1942, and a large part of the cocksfoot in mixture 'b' was exterminated. (See Photo C.10 p.249) Its place was taken by Yorkshire fog, which was included in the mixture against such an ementuality. A further ten of lime per acre was applied to each plot during the spring of 1942, and white clover now is very well established throughout these plots which have been cut for hay annually since 1943.

The mixture 'b' has produced easily the best sward and hay crop, (Photos C.8 + pp 248-9) and though weights have not been taken, the mixture 'c' after having set and cast its seed for two seasons now appears to be more productive than mixture 'a', except where the latter was heavily limed.

Grassing Down of Sand Drifts.

Drifting sand is one of the most serious forms of soil erosion in the Colony. It has been controlled readily by fencing, and the planting of marram grass or native Poas. (See photos P.M. 15, 18, & 25) The planting of marram grass appears to have been commenced in Cape Pembroke Peninsular near Stanley about 1905, but the main planting was done in the early twenties.

In January 1942 about seven acres on which drifting sand has been controlled by marram grass, was disced and sown with the grass seed mixture 'd' in TABLE XI. A mixture of phosphates (all that were available at the time) was broadcast at one cwt. per acre, together with carbonate of lime at ten cwt. per acre when the seed was sown. The seed was lightly harrowed and the sand firmed down with a board immediately after sowing No.

Bees do not seem to thrive here — maybe because we have no expert knowledge available to us? cf Palagonia where they do well apparently

MC

A dressing of 12 cwt. lime per acre was applied in October 1942 and 6 cwt. of a mixture containing equal quantities of superphosphate and lime during the spring of 1944.

The Clover, Italian ryegrass, cocksfoot and crested dogstail all struck well but the Italian ryegrass never became vigorous. Subterranean clover, though it buried its seed was not observed after the summer of 1942-43. The area is now well covered with white clover, crested dogstail and cocksfoot while ~~this~~ red top and brown top are infiltrating. An experienced camp manager has pronounced this as undoubtedly the best 'take' of clover that he has seen in the Colony. (See photos PM 24 ~~p. 27, pp. 280-1~~ also photos C. 11, C13-14 pp 249-250)

A very noticeable feature has been the superior development of cocksfoot plants, situated in the midst of the clover, as compared with those on nearby areas without clover. There would be no difficulty in grazing a ewe to the acre over this ground if ~~it were~~ suitably fenced.

Such an area could be used for the production of clover and crested dogstail seed, though to produce the former would necessitate the maintenance of a beehive. Several heavy gales have removed the sand from a nearby beach, but there has been no tendency of sand to drift from the areas on which the pasture mixtureswas sown.

Mixture 'e' TABLE XI was sown on an adjoining part of the sand area in February 1943 and was fertilized with 6 cwt. of a mixture of superphosphate and lime. The strike is ~~uneven~~ not uniform, due apparently to an uneven distribution of seed and fertilizer, and possibly to a less efficient covering with the board. (See photo PM 28 p 281 & C. 12 p. 69. The land was not chain harrowed after seeds were sown, and the operation was not so closely supervised as was the first sowing 'd'. One is very apt to forget that the ~~Islander~~ local farmer has had little or no previous experience of broadcasting and is therefore not familiar with the significance of the technical details.

The Introduction of Grasses and Clovers to the Camp.

Because of the expense involved in ploughing native camp, and the

Would it not assist to grow seed locally?

MC

There has been far too much indiscriminate burning here — it should be controlled by Regulations.

MC.

cost of seed and fertilizer it does not appear economical under the present system of ranching to lay down pastures as they would be laid down in Britain or New Zealand. An attempt was made to sow mixtures of grass-seed and clover on the ashes of a diddle dee burn which had been lightly scarified with grass harrows. Eleven mixtures of grasses were sown on plots of 1/8 of an acre. The rates of seeding varied from nineteen and a half pounds per acre to five pounds per acre; and the experiment included mixtures which were intended to make pastures with the following grasses dominant, ryegrass, cocksfoot, red clover, Yorkshire fog, Poa pratensis, timothy, white clover, red clover and subterranean clover. Two mixtures containing all available grasses were sown at seventeen and a half and ten and a half pounds per acre respectively.

The object of sowing these mixtures was not to establish a pasture sward but to provide a nucleus of plants which, if protected from stock, might produce seed and thereby, over a period of years, bring about the grassing of the area with English grasses. The trial was sown in January 1941 and was not fertilized. Practically all the species that were sown, were found growing on the plots five months after planting. The most vigorous plot contained chiefly ryegrass and cocksfoot which were included in a mixture sown at the maximum rate. In no case was the cover of the ground even fair by normal standards, but the best was obtained from Yorkshire fog sown at three pounds per acre in a mixture sown at the rate of seven and a half pounds per acre. Red clover struck very well. On all plots there was more grass in the hollows and on the stock tracks than over other parts of the plot.

During the following summer all the grasses except Yorkshire fog were burnt off because of the dryness of the plots. Since 1942 Yorkshire fog alone has spread on these plots, but there is still a considerable amount of bare ground. This method of introducing English grasses is not at present to be recommended. The burning of the diddle dee destroys also the associated native pasture which does not recover for several years. Consequently, after burning, there is less forage for several years than before the burn.

Impatant. Underline as shown →

Method of Inoculating Clover.

Owing to the isolation of the Colony and the difficulties of obtaining cultures of Rhizobium, the clover nodule organism, the following technique has been developed for inoculating clover seed.

Nodules are stripped from the washed roots of a vigorous large leafed clover plant until approximately a teaspoonful or more has been collected. The nodules are then crushed to pulp on a plate with a flexible knife. A quarter pint of skimmed milk is then added and the suspension so formed used for twelve lbs. of white clover seed. The seed is placed in an enamel or china bowl and the suspension stirred in until all the seed are moistened. The quantity of fluid recommended is just sufficient to moisten all the seeds.

The seeds are then spread out on a sack or paper and left to dry in a shady place. If exposed to the direct rays of the sun the bacteria are likely to be destroyed, and they also succumb when the seed is mixed with superphosphate. This disadvantage may be avoided by mixing the superphosphate with an equal quantity of carbonate of lime twenty four hours or more before the seed is mixed in. So far the clovers have never failed to become nodulated when sown within a few days of being inoculated in this summer.

It is a complete waste of seed and money to sow clover in the Falklands without taking some steps to inoculate the seed or soil with the nodule organism, unless it is being sown on land that has already supported a crop of clover.

Clover and Lime Experiments.

The Aberystwyth experiments (page 61) showed that clover sometimes became established if ten cwt. of basic slag per acre were applied at the time of sowing. On the chance that a similar result might be achieved more economically if carbonate of lime were sown in place of slag, ten identical four by four latin square experiments in which lime

was applied at 20 cwt., 10 cwt., 2 cwt., and nil per acre were sown with inoculated clover seed at the rate of 2 lbs. per acre . These were laid down on different types of ground characterised by short fern diddle dee slopes, white grass, moist rich valleys and Christmas bush on five stations.

Some plants of white clover have been found on all the (seven) experimental areas that have been examined to date especially on the plots that have received most lime. An odd clover plant has become established on the unlimed plots on the experiment situated on short fern ground near the coast (Pebble Island). This type of land seems well suited to clover which has spread so that after four years it was difficult to determine the boundaries of the individual plants, though only thirty three plants were observed on the experimental area at the end of the first twelve months. (See photos C.15-18 pp. 250-251)

At Chartres on white grass the twenty cwt. of lime plots can be located by the presence of clover, though the pegs have ~~become lost~~ disappeared.

Establishment of clover by this method is slow. Very few plants have been observed at the end of the first twelve months, though in the early stages there appears to be a good strike of seedlings which become etiolated and disappear. The take has been better on ~~more~~ moister ground associated with the better type of white grass pastures, and seems to improve on such areas during the second year. It is very poor on diddle dee slopes and the Christmas bush area, both of which are dry.

Again, it must be admitted that the cost of introducing clover even through spreading only one ton of lime per acre, is prohibitive under local conditions and prices.

These experiments, however, have given rise to a modification which appears to offer a suitable method of introducing clover, and pasture plants which spread by rhizomes, into native pastures at a reasonable cost. (Page 79).

Sowings of Pasture Mixtures at Camp Stations.

Seed Mixture for Pasture Establishment. Davies recommended (1939) seed mixtures in which ryegrass, cocksfoot, timothy, creeping red fescue and rib grass respectively were dominant. He has not included in these either of the bents, (brown top or red top) or crested dogstail, all of which have a wide application in the Colony.

The following experimental mixtures have been made up and sown on cultivated fields in Stanley or on Camp Stations.

TABLE XII

Experimental Mixtures sent to Camp Stations.

	Mixture No.												
	A	B	C	D	1 E	2 F	3 G	H	I	J	K	L	M
Perennial ryegrass.	4	12	6	-	10	-	-	10	-	15	15	6	-
Italian ryegrass.	-	4	6	-	10	8	20	-	-	-	-	-	-
Cocksfoot.	12	6	2	-	10	2	6	6	-	-	15	10	-
Timothy.	4	1	4	-	4	-	6	4	10	-	6	6	-
Poa pratensis.	-	-	-	6	-	1	-	-	1	-	6	-	-
Poa trivialis.	-	2	2	2	2	2	-	-	-	-	-	-	-
Crested dogstail.	2	2	4	2	2	-	-	2	2	-	3	2	12
Brown Top.	½	½	½	4	-	3	½	½	1	-	1½	1	3
Red top.	½	½	½	2	-	2	-	½	1	-	-	-	-
Meadow foxtail.	-	-	2	-	-	-	3	2	-	4	-	-	-
Meadow fescue.	-	-	-	-	-	-	2	2	-	4	-	-	-
Yorkshire fog.	1	½	½	1	-	-	-	½	½	-	-	-	453
White clover (Cert.NZ)	2	2	2	2	2	3	2	2	-	2	3	3	3
Suckling clover.	-	-	2	2	1	1	-	1	-	-	1½	-	3
Subterranean clover.	-	-	-	-	-	-	-	-	-	-	-	-	-
Red clover (Montgomery)	-	-	-	-	-	-	-	-	6	2	-	-	-
Lotus major.	-	-	-	-	-	-	-	-	1½	1	-	-	-
Lotus corniculatus.	-	-	-	-	-	-	-	-	-	-	-	-	-
Strawberry clover.	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Wt.	26	31½	40½	21	41	22	39½	30	22¾	28	51	28	-

A-D sown at North Arm in plots 12 yards wide near trough between house and cottages.
E-G were sown at San Carlos as 1, 2, 3.
H-J were sent to Hill Cove on ~~20th.~~ November 1941 as mixtures 1, 5, 18.
K was sent to Fox Bay West in September 1942.
L was sent to Roy Cove ~~6th.~~ February 1944.
M was sent to Teal Inlet ~~29th.~~ August 1944.

Grasses in order of dominance 4/10/44.:

Mixture.

A Timothy, crested dogstail, cocksfoot, white clover, ryegrass. Bents not noticeable.
B Yorkshire fog and crested dogstail, white clover, ryegrass poor, more like a fescue. Bents more prominent.
C Yorkshire fog, timothy, crested dogstail, cocksfoot, white clover a little more bent than A.
D Brown top, Yorkshire fog, crested dogstail, red top, trivialis.

No detailed notes are available concerning the remainder of these plots.

In preparing these mixtures an attempt has been made to obtain pastures dominated by specific groups of grasses. In most cases bents, Yorkshire fog or other bottom-forming grasses have been included to fill up spaces that may occur through failure of the desired species to deminate. White or other clover has been included ih every mixture. Clover seeds were always inoculated. Neither creeping red fescue nor chewings fescue were available for these experiments, but their addition would doutbless improve the mixtures especially as they are the earliest spring grasses that thrive under Falkland Islands conditions.

So far as reports have been received, the germination and 'take' of all the mixtures which were sown on cultivated land has been satisfactory Unfortunately, at least one of the experimental areas involving four of the mixtures was severely overgrazed by sheep during the first twelve months after sowing. This caused great damage to the cocksfoot and a large proportion of the plants were pulled out and destroyed. Yorkshire fog rapidly filled up the spaces so formed and the pastures which were intended to be dominantly cocksfoot, timothy, white clover are now dominantly Yorkshire fog and white clover.

On the areas intended to be dominantly ryegrass, cocksfoot, crested dogstail, there is plenty of weak thin ryegrass which tillers poorly and becomes bronzed in cold weather. Where Yorkshire fog was not included in the mixture, dogstail is prominent and is associated with bents and some cocksfoot, but the addition of half a pound of Yorkshire fog seed per acre has thickened the bottom, and made the Yorkshire fog at least as prominent as the other grasses. The bents (brown top and red top) are slow to establish, but are gradually covering the ground, and compete strongly with Yorkshire fog. Crested dogstail is also prominent in those plots dominated by bents. In general, one should allow here at least double the time for the establishment of a sward or species ~~in the Falklands that is usual in New Zealand or~~ advocated in text books.

A weed at home but a useful grass out here nevertheless. Mc

They will need to be checked up early by the new A.O. Mc

Mem. to see Bonner Mc

The most amazing feature of these experiments is the facility and rapidity with which Yorkshire fog, though sown at only one pound per acre or less, dominates the sward. So far, no attempt has been made to measure the productive capacity of the different types of pasture. There can be do doubt that all are immensely superior to the native pasturage they have replaced. Another inexplicable feature is the failure of Poa pratensis to become established. This species is almost a native on some coastal areas, and in valleys subject to flooding, espectally near settlements. It has not yet been established in any of our sowings by seeding. In fact, the vigour of the indigenous plant gives cause to support a theory that though the vegetative characters are those of Poa pratensis, it may be a rather better strain than is available on the market.

It will be some years before the experimental areas have settled down, and the persistence of the different species can be determined.

Judging by the results of these trials the inclusion of cocksfoot is useless in seed mixtures unless the grazing is controlled so that the plants are not damaged. The growing point of cocksfoot is usually above the ground and is easily damaged by stock or cold weather. The pasture should be left with sufficient foliage to protect the growing points during the winter. For hay, cocksfoot would probably provide the cheapest and most productive crop over a period of years, provided it is treated as meadow and is never grazed by stock.

At San Carlos a seed mixture, E, dominantly ryegrass, cocksfoot, and timothy, and another, G, dominantly Italian ryegrass, timothy, cocksfoot have produced satisfactory crops of hay, while the bent mixture, F, though it formed a closer sward and contained more white clover is considered unsatisfactory by the manager. This mixture has become dominated by Yorkshire fog though it is not recorded in the mixture. I have not seen these plots since they were sown and am unable to make a personal report on them.

Reports are not available at present concerning the mixtures that were supplied to other Camp Stations.

SEEDING AND NATURAL DISSEMINATION OF CLOVER.

Davies has recorded, concerning white clover, that at the time of his visit when bees did not exist in the Falklands, only one floret in 2,500 produced seed, but that when florets were hand pollinated seed was freely set. This failure to set seeds is a great handicap to the natural development of white clover in the native pastures. Since the spring of 1940 the Department has possessed at least two hives in Stanley, and supplied one hive each to Port Howard and Hill Cove stations Seed has set freely on white clover wherever the bees were present, and has been distributed by animals to which hay bearing clover seeds has been fed. Evidence of this is apparent in a paddock at Government House in which a careful examination failed to reveal any plants of white clover in 1940. At a similar examination in 1942 seven plants were found and by February 1945, eighty nine plants were located. Clover plants which probably arose from seeds which have been distributed in the dung of animals, have been observed on Stanley Common, particularly about Goose Green and some of the sheltered spots where animals camp. White clover has become a weed in Government House Garden during recent years where it has been introduced with animals' manure, albeit such manure was used there for many years before bees were ~~introduced~~ Kept without introducing clovers. There is appreciably more clover within the township of Stanley, so much so that townspeople have remarked on the manner in which it has increased.

There is no doubt, therefore, if seed were formed, that clover would gradually encroach on the native camp, especially about animal camping grounds. To this end it would probably pay each station to introduce at least one hive of bees, or when clover becomes sufficiently plentiful, several hives. Even if the bees did not survive the winter the cost of their introduction each year would be justified, if some attempt were made to protect the seeds until they were mature, and to assist their distribution to the camp. The latter process need not be expensive. Animals crushed on a seed-bearing paddock for twenty four hours would carry away a belly full of seed-bearing forage, and the process could be repeated until the paddock had been fully grazed.

No difficulty about this, surely?

The mouse must have had a blunt tune or are they stung-proof?

Experience in Keeping Bees in the Colony.

Bees require nectar, pollen and a limited amount of wax to thrive. I doubt whether there is, at present, any location in the Colony that would provide sufficient of the first two to maintain even a small hive throughout the year. In general, the only crops available are gorse (Ulex europea) and white clover (Trifolium repens), supplemented quite inadequately by garden flowers. At many Stations the quantity of white clover is insufficient to maintain a small hive even during the flowering period. Consequently, bees must be fed artificially with sugar solution, a process which is described in any manual on bee-keeping.

This could be overcome or at least reduced if suitable crops were provided for the bees. A succession commencing with turnips, cabbage or swedes followed by gorse, broom (Cytisus scoparius), Iceland Poppy (Papaver) and white clover planted on a sufficient area would no doubt provide sufficient food to maintain a hive throughout most of the year. Since the winter extends from the end of February until, at the earliest, mid October, it would even then be necessary to provide additional food during the winter. This is best, provided, during March and early April. In our experience each hive has taken in about forty pounds of sugar in solution during this period at the rate of three to four pounds per day.

The wax is obtained from the leaves of cabbage and from pine needles and appears to be available in sufficient quantities in Stanley.

About Christmas 1940, two hives were sent to West Falkland and located at Port Howard and Hill Cove. The former swarmed during the summer and though the swarm was gathered, it did not survive the winter. The hive at Hill Cove took in about forty pounds of sugar solution during the autumn and over-wintered well; but the bees suddenly left it in February 1942 and were not seen again. There was evidence that a mouse had gained entrance to the hive. Though this hive seemed overcrowded early in 1942 the bees could not be induced to enter a super that was added.

The hives ~~that were~~ introduced to Stanley did not thrive even during the summer and made very little new wax. They were fed with sugar solution inside the hive during the winter of 1941 and entered the summer of 1942 reasonably strong. Both swarmed during the summer, and the swarms were taken, but did not thrive. The new queen did not commence laying for a considerable time; in fact the weather following each swarming has appeared to be unfavourable for nuptial flights, and from four to six weeks have normally elapsed before young queens commenced to lay. This is a serious setback when the working season is so short. During this period the bees were housed in single walled hives and made very little wax. They were frozen out during the winter of 1942 though protected by an extra wall and woollen blankets.

The new hives received during the following spring were lined externally with fibre insulation and kept continually within a second box. One of these swarmed on 8th. December. The swarm, carrying the old queen housed as described above, drew out a complete hive of ten sections within three weeks, but though the hive appeared to be full, the bees could not be induced to enter the super. Both hives became practically starved by 25th. March and toffee was inserted in each as an emergency measure. Syrup was fed externally and about eighty pounds were taken in by each hive. (i.e. about 40 lbs of sugar).

A swarm and a cast had been taken from each hive. None of the hives housing a new queen survived the winter though there was food in each when they were examined in the spring. (Owing to climatic conditions it is practically impossible to examine them during the winter).

~~One hive, made intentionally weak, was kept in a conservatory from which the bees had a exit through the glass. This hive, being warmer, and subject to examination promised to survive the winter, but lost most of it's strength during a bright cold day in spring when the bees, because of the warmth of the conservatory were tempted into the bright snow where they quickly became too stiff to regain the hive.~~

~~The bees are very active during the period~~ when the gorse is in bloom and appear to thrive, but the hives become depleted of food, even in

Speculative

MC

They should tune in to the Stanley Kirst Station!

MC

Stanley, during January before the clover blooms. They should be fed during this period. During 1946 an early clover year, there was no reserve of food in the hives on 10th. February and bees had become discouraged. But the provision of syrup provided a great burst of activity and breeding which had practically ceased was resumed. It would doubtless be desirable to provide sugar solution during the spring and summer, at probably not more than one pound per hive per day in a narrow necked bottle, so that only a few bees could work it at a time. Experience would indicate the most desirable quantities to offer, the object being to provide a steady supply to encourage the bees to build up their hives to a satisfactory strength. There is no chance at present of taking honey from the hives. Their maintenance is solely to provide the means of fertilizing the clover florets, thereby providing seeds for pasture improvement. ~~But when the succession of crops mentioned above has been established the taking of honey may become possible.~~

Once a hive has been established it would probably be better to import a fertilized queen rather than to attempt to breed queens locally, because of the uncertainty of the weather for nuptial flights

The Strip Method of Introducing Clover.

In February 1945, clover seed was sown in strips seven inches wide in some plots with lime, and in others, with lime and superphosphate. The strips were sown from each end of a modified drill which was driven on parallel traverses either eleven or twenty two feet apart. (see photos PM 29-32 p 282.) The clover germinated well, and though there has been a reduction of the stand on the lime plots, some plants have become established on every treatment. (see photos C 1918 24, pp 251-252) The most satisfactory strike was secured on the plot where forty cwt. lime and six cwt. superphosphate were sown with three or four pounds of clover seed per acre. In twelve months the clover had formed a complete mat on the sown strip. In many places clover plants extended to a width of twelve to fifteen inches and occasionally the strip had become eighteen inches wide. The runners of the white clover were particularly robust and vigorous and the plants were all nodulated.

A similar though less spectacular result was obtained on the plot receiving lime and superphosphate at the rate of thirteen and two cwt. per acre respectively; but the mat of clover and its vigour was much less. Many of the plants which originally appeared on strips receiving lime alone have disappeared during the first year, but there are still a number of vigorous plants and only time will tell as to whether they will make a marked alteration in the turf.

During March 1946 further plots were sown by the same method. The following grasses and clover seeds were mixed with a ton of fertilizer containing equal quantities of superphosphate and carbonate of lime, brown top, red top, Poa pratensis, red creeping fescue, crested dogstail, alsike clover, red clover, suckling clover, lotus major, black medick and Yorkshire fog.

The seeds and fertilizers were applied at the following rates on plots one and a half acres in extent - forty cwt. per acre, twenty cwt. per acre, ten cwt. per acre and five cwt. per acre. A further plot was sown with a mixture containing twenty cwt. of lime and five cwt. of superphosphate per acre. These are designed to obtain information concerning the most economic application of phosphates and lime and on the behavior of bottom-forming English grasses when sown by this method.

Prohibitive?

Economics of Pasture Improvement.

In 1940 basic slag and carbonate of lime were both available in Stanley at £3.12 per ton. The former is not now available but superphosphate at £15 per ton has taken its place and the cost of lime has risen to £5 per ton. Grass seeds probably average about two shillings a pound landed in Stanley. Freight from Stanley to local stations varies according to distance from sixteen shillings a ton to forty eight shillings a ton and is subject to a 20% surcharge for war-time conditions. When it is remembered that the sheep farming industry depends on wool, skins and tallow for its income, and that the average carrying capacity of the Colony is very slightly more than one sheep to five acres, it is apparent that the average gross revenue per acre must lie between one shilling and sixpence and two shillings. Such a low return restricts considerably the ability to carry out improvements, especially when grass seeds and fertilizers are so expensive. Even if phosphates can be reduced to half their present costs through bulk purchasing in other markets, there is, as yet, no evidence that an economic or indeed any return can be obtained by broadcasting at the rate of three or five cwt. per acre over a given area of native pastures. The high costs coupled with a lack of experence concerning the use of artificial manures, has deterred most owners from experimenting with fertilizers on other than cultivated ground.

On one or two stations where phosphates have been applied to native camp they have brought about an increased palatibility of the native pasturage, but at an uneconomic expenditure on fertilizers. The capital which may be invested economically on the improvement of the native pastures must depend on the increased return which results. It seems unlikely in the absence of clovers and English grasses, that sufficient response can be acheived from native forage plants merely by the addition of artificial fertilizers to the camp.

As will be shown later, ploughing is very expensive and surface seeding, even with ten cwt. of basic slag per acre, does not produce sufficient bulk of feed to be an economical practice. The only method which apperas to offer the chance of success over large areas is that

Economics of Strip method

Rhizomes

Underline

Single strip cost
5/3
plus freight which
Govt. ed. subsidise
But still costly?

described as the 'strip method' (page 79), whereby a relatively small amount of fertilizer is used to bring about the establishment of wild white clover and certain English grasses which have the power to spread by rhizomes.

There is evidence at Port Howard, Hill Cove and on Stanley Common that when clover has become established in native pasturage, it frequently spreads over a considerable amount of ground even though no lime or phosphates have been applied. By spreading over the land between the strips in which the seeds and phosphates are sown, clover will bring about an improvement in the productive capacity of the ground with less cost than can be achieved in any other way.

Economics
Costs of the Strip Method. The cost of this method may be modified considerably by varying the distances between the strips, by increasing and ~~reducing~~ reducing the number of strips sown simultaneously, and by altering the proportions in which the fertilizers are mixed and the rates at which they are applied. Our present technique has been to sow strips (from either end of the drill) on either side of the centre lines twenty two feet apart. The distance from a strip on one line to the nearest on the next is then sixteen or seventeen feet. Using this method the application of super and lime to a strip of seven inches wide at the rates of six cwt. and forty cwt. per acre respectively cost, in February 1945, fifteen shillings and eightpence for each acre of ground so covered. By sowing but one strip at intervals of sixteen feet six inches the cost of the treatment could be reduced to approximately ten shillings and sixpence per acre covered, without increasing the distance between rows. A treatment which is satisfactory, has been made at a cost of seven shillings and tenpence per acre, using the double strip method. By using the single strip method the cost would be reduced to five shillings and threepence per acre. These prices are for materials landed in Stanley. The additional cost at the most remote station due to freight from Stanley would vary from thirty nine pence to twenty five pence per acre, for the two methods respectively.

Underline →

This is highly significant remembering that the present bearing is 1 sheep to 5 acres. MC

This would have to go hand in hand with improved drainage. ?

MC

I have since examined the 'strip' experiments at Eliza Cove – there is no indication of spreading of the clover though it persists in the strips

MC.

Probable Returns from Introduction of Clover to Camp. As the clover spreads over the ground the palatibility and yield of the native pasturage is increased in addition to the forage which the clover itself provides. It is not unreasonable to expect, when the whole of the area between the strips is covered by clover, that the carrying capacity would be raised to approximately one sheep per acre and this is I believe a conservative estimate.

Besides increasing the carrying capacity of the land clover will bring about a change of the nature of the peat and improve soil texture and fertility.

When clover bearing ground about Stanley, has been ploughed and sown in turnips the growth has been comparable to what may be expected in parts of New Zealand. On such ground it would be possible to provide supplementary winter forage at an economic cost, thereby still further increasing the carrying capacity of the land. Furthermore, it must be remembered that this method of improvement is still in its infancy, even experimentally, and it is likely that a cheaper method of introducing clover will be evolved through varying the proportions of lime and phosphates. The sowing of a strip of lime and superphsophate at the rate of forty six cwt. per acre, with three lbs. clover seed per acre at intervals of sixteen feet six inches, costs (at present prices, March 1946) ten shillings and ninepence per acre for materials. By a small reduction in quantity of fertilizers the price could be reduced to ten shillings per acre without affecting materially the strike of clover or its rate of spread.

The following table is an estimate of the return that may be expected from average white grass camp if two hundred acres were treated annually for a period of twelve years at a cost of ten shillings per acre and an initial cost of £50 for the manure distributor:-

Probable Returns from Introduction of Clover to Cane. As the clover spreads over the ground the palatibility and yield of the native pasturage is increased in addition to the forage which the clover itself provides. It is not unreasonable to expect, when the whole of the area between the strips is covered by clover, that the carrying capacity would be raised to approximately one sheep per acre and this is I believe a conservative estimate.

Besides increasing the carrying capacity of the land clover will bring about a change of the nature of the peat and improve soil texture and fertility.

When clover bearing ground about Stanley, has been ploughed and sown in turnips the growth has been comparable to what may be expected in parts of New Zealand. On such ground it would be possible to provide supplementary winter forage at an economic cost, thereby still further increasing the carrying capacity of the land. Furthermore, it must be remembered that this method of improvement is still in its infancy, even experimentally, and it is likely that a cheaper method of introducing clover will be evolved through varying the proportions of lime and phosphate. The sowing of a strip of lime and superphosphate at the rate of forty six cwt. per acre, with three lbs. clover seed per acre at intervals of sixteen feet six inches, costs (at present prices, March 1915) ten shillings and ninepence per acre for materials. By a small reduction in quantity of fertilizers the price could be reduced to ten shillings per acre without effecting materially the effect of clover or its rate of spread.

The following table is an estimate of the return that may be expected from average white grass camp if two hundred acres were treated annually for a period of twelve years at a cost of ten shillings per acre and an initial cost of £20 for the manure distributor:-

TABLE XIII

Estimated Expenditure and Income Associated with the Introduction of Clover by the Strip Method.

Year.	Total capital invested. £	Total acreage treated.	Annual return. £	Percentage of amount invested.
First.	150.	200.	nil	nil
Second.	250.	400.	nil	nil
Third.	350.	600.	8. 6.	2.37
Fourth.	450.	800.	24.18.	5.53
Fifth.	550.	1,000.	49.16.	9.05
Sixth.	650.	1,200.	83. -.	12.77
Seventh.	750.	1,400.	124.10.	16.6
Eighth.	850.	1,600.	174. 6.	20.5
Ninth.	950.	1,800.	232. 8.	24.5
Tenth.	1,050.	2,000.	298.16.	28.46
Eleventh.	1,150.	2,200.	373.10.	32.48
Twelvth.	1,250.	2,400.	453.10.	36.21
Thirteenth.	1,250.	2,400.	533. -.	42.64
Fourteenth.	1,250.	2,400.	613. -.	49.04
Fifteenth.	1,250.	2,400.	685. -.	54.8
Sixteenth.	1,250.	2,400.	748. 8.	59.87
Seventeenth.	1,250.	2,400.	803. -.	64.24
Eighteenth.	1,250.	2,400.	850. 2.	68.01
Nineteenth.	1,250.	2,400.	880. 4.	70.42
Twentieth.	1,250.	2,400.	902. -.	72.16
Twentyfirst.	1,250.	2,400.	915.10.	73.24
Twentysecond.	1,250.	2,400.	920.14.	73.65

The estimates in this table are not considered unreasonable, but even should the return be only half of that estimated, the investment would be thoroughly justified and would provide a greater return than is likely to occur from other investments. If the cost of introducing the clover can be reduced to eight shillings per acre or less, the annual returns from each

These figures are based on the yield of wool alone and do not take into consideration increased production per sheep through better feed or the sidelines that would be developed as a result of heavier stocking as for example, frozen mutton and lamb and possibly the sale of stud animals.

Pasture Management.

A visitor to the Falkland Islands cannot but be impressed by the quantity of rank growth on the white grass pastures that remains uneaten by stock. (see photo PM. 5 p. 275) As has been mentioned, this is usually burnt off every three or four years and sheep thrive on the young growth which follows the burn. It would be very much more profitable if the accumulation of unpalatible grass could be consumed before it became so rank, and such an object would be the aim of good management. We have accumulated definite evidence that this can be achieved, provided the paddocks are of such size that they can be efficiently stocked.

A mob of 500 cull sheep was confined for a month on an area of twenty three to thirty acres which had not been grazed for at least two years. During this period they consumed all the edible feed and trampled in and blackened the rank dead grass. The consolidation ~~from tramping~~, and their manure improved the quality of the ground considerably and the sheep actually improved in condition during this period. The growth of white grass during the following spring was free from burn and provided more suitable food than had been available during previous seasons.

On another area of sixty acres of which some thirty four had been ploughed and carried oat stubble, 2,500 scrogs were confined for four to six weeks during the autumn. The pasture was eaten completely bare and the paddock became blackened. (see photo PM. 4. P. 274, & PM. 5 p. 275) The sheep suffered somewhat from lack of food, but the growth during the following spring was fresh and green and of the best quality provided by white grass.

Such stocking should be repeated each year, until a permanent improvement in the composition of the pasture has been obtained. ~~(see photos PM 1-3 p 274)~~ The

These figures are based on the yield of wool alone and do not take into consideration increased production per sheep through better feed or the sidelines that would be developed as a result of heavier stocking as for example, frozen mutton and lamb and possibly the sale of stud animals.

Pasture Management.

A visitor to the Falkland Islands cannot but be impressed by the quantity of rank growth on the white grass pastures that remains uneaten by stock. As has been mentioned, (see photo PM. 5 p. 275) this is usually burnt off every three or four years and sheep thrive on the young growth which follows the burn. Cattle do follow sheep on white grass. It would be very much more profitable if the accumulation of unpalatable grass could be consumed before it became so rank, and such an object would be the aim of good management. We have accumulated definite evidence that this can be achieved, provided the paddocks are of such size that they can be efficiently stocked.

Of course, but it is something to aim at. and the economics of the problem are not unsuperable Start in a small way and extend gradually; it will of course mean more shepherds? And where do they come from. MC

A mob of 500 pull sheep was confined for a month on an area of twenty three acres which had not been grazed for at least two years. During this period they consumed all the edible feed and trampled in and blackened the remaining dead grass. The consolidation from tramping and their manure improved the quality of the ground considerably and the sheep actually improved in condition during this period. The growth of white grass during the following spring was free from burn and provided more suitable food than had been available during previous seasons.

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Such stocking should be repeated each year, until a permanent improvement in the composition of the pasture has been obtained. The change should progress from white grass through [illegible]

native fescues which have a much higher carrying capacity than the white grass.

However, it is not economical to use sheep for such severe methods of pasture management unless they are 'scrogs' which it is intended to slaughter. It would be better management to graze the ground heavily with sheep, and to remove them before they begin to lose condition. If this is done judiciously the sheep are removed about the time they have consumed all the feed that is suitable for them in the paddock. Cattle should then be crushed on to the ground immediately the sheep are removed and when they will reduce the rank growth ~~which~~ was left by the sheep. One would prefer to see the different classes of sheep rotated so that hoggets or gimmers had the first grazing, followed by ewes and then wethers as the ~~quality~~ of the feed became less. ~~but I fear this refinement of management is far too advanced for the present development of the Colony.~~ The adoption of such a system of rotational grazing ~~the above method~~ would necessitate a complete ~~change of~~ departure from present ideas of management, it would involve more work for managers and shepherds, but and would, in itself, at least double the carrying capacity of the Colony. It would involve also, the subdivision of large paddocks, an increase in the number of cattle, and ~~would mean that~~ the transfer of sheep ~~would have to be removed~~ from field to field at intervals of from four to six weeks. It is probable, further ~~also~~, that the present six-wire fences would not be sufficient to hold the cattle while they were eating out the rank growth, but a good seven-wire fence should ~~be suffice~~ serve.

Electric Fences.

So far electric fences have not been tried in the camp ~~and like most innovations in the Falkland Islands are deprecated by managers~~, but the animals grazing on Stanley Common have been successfully excluded for two years from an area reserved for tree plantings by an electric fence of two light wires. (see photo PMG. p276.) Another fence has been used to control pigs and horses at the Agricultural Station. It was found satisfactory for all except young pigs. Such fences are used fairly frequently in New Zealand for cattle and sheep and there seems no reason why they should not be equally satisfactory in the Falklands. There will be some animals that will

native fescues which have a much higher carrying capacity than the white grass.

However, it is not economical to use sheep for such severe methods of pasture management unless they are scrogs which it is intended to slaughter. It would be better management to graze the ground heavily with sheep, and to remove them before they begin to lose condition. If this is done judiciously the sheep are removed as soon as they have consumed all the food that is palatable to them in the paddock. Cattle should then be crushed on to the ground immediately the sheep are removed and they will reduce the rank growth which was left by the sheep. One would prefer to see the different classes of sheep rotated so that hoggets or gimmers had the first grazing, followed by ewes and then wethers as the quality of the feed became less; but I fear this refinement of management is far too advanced for the present development of the Colony. The adoption of the above method would necessitate a complete change of management, would involve more work for managers and shepherds, and would, in itself at least double the carrying capacity of the Colony. It would involve, also, the subdivision of large paddocks, an increase in the number of cattle, and would mean that the sheep would have to be removed from field to field at intervals of four to six weeks. It is probable, also, that the present six-wire fences would not be sufficient to hold the cattle while they were eating out the rank growth, but a good seven-wire fence should be suffice.

Superfluous rather than timely if the innovation is "deprecated" by managers. See bottom of last page. M.C.

Electric Fences.

So far electric fences have not been tried in the camp and like most innovations in the Falkland Islands are deprecated by managers, but the animals grazing on Stanley Common have been successfully excluded for two years from an area reserved for tree plantings by an electric fence of two light wires. (See photo PH19 p.276.) Another fence has been used to control pigs and horses at the Agricultural Station. It was found satisfactory for all except young pigs. Such fences are used fairly frequently in New Zealand for cattle and sheep and there seems no reason why they should not be equally satisfactory in the Falklands. There will be some animals that will

break through during the first few months; but if they are trained * or have become accustomed to the electric fence they treat it with respect. The wear and tear on such fences is very much less than on ordinary post and wire fence against which stock will rub or through which they graze what can be reached.

A word of warning concerning the fencing units may be timely. So far we have found that some units we have tried cause interference on short wave radio reception, whereas other units are constructed to prevent such interference. The former is not entirely without advantage, since, if it becomes short circuited, the fact may be ascertained by lack of the interference on the radio.

* Training consists of holding a mob of sheep in the corner of a paddock or yard by a single wire coupled to an electri fence unit until all have come in contact with the wire and received a shock. They learn quickly to avoid contact wit the wire).

Winter feeding – lucerne plantations.

(Desirable object for subsidy?)

Underdrainage

PART IV.

SUPPLEMENTARY CROPS AND CULTIVATION.

On three or four stations a paddock of English grass pasturage is reserved to provide succulent grazing for the stud flock about lambing time; but the great majority of sheep in the Colony must survive winter and summer on such forage as is provided by ~~the native pasturage.~~ mature this and there is very little nourishment in ~~it~~ during the late winter and early spring.

Undoubtedly, the death rate among sheep would be reduced, and lambing percentages increased if the sheep wwre better fed during the winter. The now denuded coastal areas that have at one time carried tussac, if fenced and replanted, would provide a most economic and suitable supplement to the native pastures.

At present the only fodder that is provided for stock, over and above native pasturage, consists of hay ~~either~~ grass or oaten. This is usually consumed by two or three horses, milking cows and working cart-horses ~~while working~~. It is fed to stud sheep on a few farms only. The fenced areas of coastal tussac, and tussac islands provide winter grazing for the majority of horses.

Tussac (Poa flabellata) is provided for sheep only on the smaller properties where it is treated as a perennial crop. On these stations it has been replanted on denuded coastal areas from which grazing sheep had killed it. Grazing is controlled in the replanted areas, is limited to the winter, and does not injure the tussac.

In its natural condition tussac grows into large plants which sometimes stand some five to six feet above the surrounding land. The peat beneath is almost saturated, even during dry weather, and is gene-

rally overrun by penguins and seals, which enrich the land with their droppings. Tussac does not thrive on consolidated ground, and when unthrifty or newly planted, cannot compete with Yorkshire fog or the bents which smother it.

The management of tussac plantations should be designed (i) to smother any grasses that encroach on them, even if to do so necessita closing the plantation to stock for several years,* (ii) to prevent the consolidation of the peat and (iii) to maintain a high humidity the crop during dry weather.

Whereas on Cape Pembroke Peninsular, erosion of the one time areas has proceeded to such an extent that only the lower layer of remains and young plants will not grow, establishment has been assi by an application of basic slag at ten cwt. per acre. This may se expensive but at pre-war prices was much less than the cost of plou

Tall Sedge, or Sword Grass, (Carex trifada). This plant which is now fo only in places inaccessible to stock, compares favourably with tuss in productive capacity, palatibility and suitability for winter graz It has been used by Mr. Jason Hansen in his tussac plantation at Ca Island, and has been established by surface seeding on tussac peat areas from which animals were excluded. Individual plants grow fr thirty to forty inches high during the summer, and produce a wealth fodder which remains green during the winter. Whether this species grow on inland peat areas has not been determined but it is the only plant with which I am familiar that could fulfill the conditions desc by the late Mr. Herbert Felton as prevailing on the West Falklands pri to 1871. (Page 54a) There is no doubt that research into the uses and requirem of this plant will be highly remunerative.

(*Low growing grasses cannot thrive in the shade of a vigorous plantation.)

These two native species offer a means of providing supplementary forage without having to cultivate the ground. Several other crops might be provided if the difficulties of cultivation can be overcome economically.

SOILS AND CULTIVATION.

Soil Types.

There are at least eight types of soil in the Falklands. Undoubtedly, peat is the most widely distributed, but all peat is not identical The types of soil may be described briefly as follows:

A. Peat Types.

(1) The most productive peat appears to be that which is formed over a more or less porous (sandstone) subsoil. It carries the typical white grass - pig vine pasture, and is rarely more than 12 to 15 inches deep. In comparison with other types it may be cultivated without undue effort, and breaks down readily into a better tilth than does the softer camp.

(2) The type of peat associated with diddle dee may be up to eight or twelve feet deep. It weathers readily when exposed to frost or drying winds. When cultivated and broken to a tilth it often remains wet because of the impervious nature of the underlying peat. Because of this, and the lack of support afforded by the deep peat subsoil, it is difficult to work especially with horses. Diddle dee also occurs on peat overlying hard rotten rock subsoils and here the peat is shallow. I am not familiar with it but understand that it responds to cultivation as described above.

(3) The most intractable land is the soft camp (white grass - oreob and Astelia-Rostkovia) which has formed on an impervious subsoil of rock or clay and is characterized by a tough mass of fibrous roots which penetrate some ten or twelve inches into the peat. The roots make both ploughing and pulverisation of the furrow difficult. The peat may be from two feet to several feet deep and has the same defects as the preceding types. Applications of lime and weathering by frost appear to assist materially in breaking up this type. When cultivated, it frequently becomes saturated by outbreaks of subterranean water which spread over the land making cultivation difficult, and restricting growth.

It is this type of land, probably one of the worst for cultural operations, that surrounds Stanley, and with which we have had most experience.

B. Friable Types. (1) Some of the best soil is found on outlying islands near the coast. It supports, characteristically, the fine native grasses (fescue and hair grass) and sometimes a sprinkling of diddle dee. It is typically a shallow light black soil which, on continued cultivation, become powdery and difficult to consolidate. It is fertile and supports English grasses and white clover readily. On dry areas care must be taken to avoid over cultivation, or the land may become difficult to grass down and be lost in a dust storm.

(2) A similar type of formation occurs on low lying wet ground as an alluvial accumulation, sometimes overlying peat. It carries typically Juncus scheuchzeripides, Ranunculus and Poas pratensis or native bents.
The same types occur in the beds of certain lagoons and these respond well to drainage and surface seeding with English grasses.

(3) At higher altitudes balsam and associated fine grasses thrive on a similar formation usually overlying a well drained subsoil.

C. Tussac Peat Types. (1) Near the coast occurs the typical tussac ground composed of two layers of peat. The surface layer is fibrous, reddish light and spongy and is resistant to erosion. The lower is black, friable on the weathered surface, and of low permeability. It is comparatively readily scattered by wind during the summer, and does not appear to support growth when tussac is planted on it, unless basic phosphates are added.

D. Sandy Types. (1) Drifting sand has covered the native vegetation in several localities both coastal and inland, leaving the invaded areas a barren waste. The movement of such sand can be stopped without difficulty by planting marram grass or local sand-loving plants, provided stock are excluded from the planted area.

(2) Where the movement of sand is less intense it has become incorporated in and improved the peat, and made it suitable for cultivation. After a year or two such land breaks down into a nice loam capable of producing oaten hay, potatoes cabbages and good quality English pasturage.

The easiest types to cultivate are those listed above as B.1., A.1. and D.2. Of these our experience in Stanley concerns only the last, but of necessity we have had to cultivate the less tractable A.2. and A.3. types.

Fertility of Falkland Islands Soils.

Very few analyses have been made of local soils and the only figures available appear to be the averages of sixteen samples submitted to the Rowett Institute in 1924. These were published by Davies (1939). The samples were taken from coastal and inland sites on good and poor camp, but the analyses, as presented, cannot be correlated with any particular type of camp. They indicate, however, that the soils contain sufficient phosphoric acid, potash and nitrogen (though probably in insoluble forms) for good growth but that there is a serious lack of lime. For comparative purposes the results of similar analyses from British sources are included in the tables.

TABLE XIV

COMPOSITION OF DRY SOIL.

(Percentage of dry matter*)

	Phosphoric acid (P_2O_5)		Potash (K_2O)		Lime (CaO)	Nitrogen (N)
	Total.	Available.	Total.	Available.		
Average of 16 Falkland soils.	0.153	0.030	0.336	0.049	0.126	1.230
British soil (good pasture).	0.149	0.010	0.560	0.044	0.800	0.445
British soil (heather and bracken).	0.081	0.004	0.025	0.010	0.050	0.033

(* After Orr, 1925).

cf. Plough made by Ransomes to specification of Pole-Evans for use with tractor or horses. MC

By Whom ordered?

CULTIVATION.

Undoubtedly, the Colony offers better types of camp to cultivate than those about Stanley on which the Department has gained it's experience. Both the types D.2. carrying a cover of white grass and diddle dee, and A.3. white grass - oreob - association requires similar treatment, though the former breaks down more rapidly. Diddle dee ground (the type A.2.) is easier to plough and may be broken down readily with discs, board and harrows, but the underlying peat is so soft that it is impossible to use horses economically on this ground. The diddle dee areas on West Falklands are possibly on shallow peat, and therefore easier to handle.

Ploughing. The strength of the turf produced by the white grass - oreob and Rostkovia - astelia associations makes it necesaary to plough to a depth of ten to twelve inches. When the average plough is used this produces a furrow that is difficult to lay over because of its almost square section. By using shares with extra dip it may be possible to skim plough; but so far skim ploughing has not been practiceable with the equipment available to us as the roots force the plough to the surface. The ideal plough would appear to be one which cuts a furrow twelve inches deep and sufficiently wide to be inverted. This would necessitate a furrow twenty four to thirty inches wide. A plough, Ransome's Unitrac, has been imported during recent years by the Falkland Islands Co. Ltd. and is so satisfactory that three similar implements have been ordered.

There are several methods by which subsequent cultivation may proceed:

(i) When fourteen inch furrows stand on edge, the only satisfactory method of dealing with them appears to be to cross plough. Ordinary mould board ploughs block frequently during this operation. A heavy disc plough is satisfactory and rides over many potential blockages, but even this plough bogs on occasion through inability of the wheels to support it on the soft peat subsoil.

So far, we have not been able to turn a satisfactory furrow when the disc plough is used to break in native camp. (See Plate P 271) This may be due to lack of experience in setting the plough, but the plough, when lifted cannot be made to track in its working position, and no adjustment that can be made has overcome this difficulty. ~~Consequently, it is not performing to best advantage.~~

(ii) An alternative method consists of inverting the furrow, rolling it into place and cultivating the exposed surface with disc-harrows and boards. This method was used successfully over a twenty acre oat paddock at Darwin, which was sown to oats the first year and to grass the following year. Difficulty would be experinaced during the second ploughing unless the first furrow was exceptionally deep for the turf does not rot readily. By sowing to grass reploughing was avoided. The discontinuity between the cultivated soil and the subsoil caused by inverting the furrow must break capilliarity, but does not appear to have affected growth during the first two years.

The Falkland Islands Co. Ltd. at Darwin, possesses a Roto-tiller with which they cultivated several acres in 1944. This machine is stated to be unsatisfactory in white grass camp because the knives become clogged with roots. It is more satisfactory on diddle dee and hard fine grass camp. It produced a fine tilth over the area on which it was used, (hard diddle dee white grass with some native bents and Poa pratensis) but the fibrous light nature of the ground prevented capilliarity even though the land was well consolidated with a heavy roller. A seed mixture was sown without fertilizer but failed to produce more than an occasional plant of cocksfoot or Yorkshire fog. Poa pratensis which was native to the ground was showing promise of becoming strongly established but was not sufficiently thickly distributed.

I have seen recently, the description of an accessory, (shark fin knives), that is attached to the mould board of ploughs to cut and pulverise the furrow as it is turned. This has not been tried in the Falklands. Though it is unlikely to pulverise wet peat, it should

assist

~~prove an asset~~ for the ease of subsequent cultivation is closely associated with the weathering of the furrows, and the greater the exposed surface the greater will be the weathering.

Disc Harrows. Three types of disc harrows are in use in the Colony, eight to ten foot 'horse-drawn' type, the double bank tractor type, and a heavy twenty eight inch disc single bank machine. The first two types are unsuitable when the furrow is dry and make little impression on it. In fact the horse drawn implement is of little use, for if the peat is wet enough tc cut with light discs, it is too wet to support the horses and when dry enough for horses is too dry to be cut with the discs. The double bank tractor type is more or less satisfactory if used immediately after the furrow is turned or when it has again become wet after weathering. There does not appear to be any advantage in the hollow edged discs. The single bank tractor type discs with eight twenty-eight inch discs will penetrate even dry furrows on full cut, but we cannot use it at more than half-set because the tractor cannot secure a sufficient hold on ploughed or cultivated ground when fitted with twelve inch tracks.

Usually more than two double discings are required to break up the weathering furrow. This still leaves the ground covered with fibrous lumps which will not break down with tyne harrows. (See Photo Pl 16 p 272, compare with Pl 15 & Pl 20.)

The Clod Crusher. This consists of a shallow box constructed by nailing one and a half inch or two inch planks to runners made of fence posts in such a way that the long edge of each plank overlaps the plank previously fixed. This box is dragged across the ground with the overlapping edges trailing. Its weight is adjusted by putting stones or soil in the box until, the lumps of soil are rolled one on the other as it is drawn over them. In this way they become broken into a fine tilth. The passage of this implement leaves a relatively smooth surface and should be followed by tyne harrows, which pack the fine soil and bring more unbroken lumps to the surface. Two or three traverses with this implement and tyne harrows will usually reduce the disced ground to a suitable seed bed. We

continue this operation until no more peat mould can be kicked out of the masses of fibre that remain on the surface.

This implement may also be used in place of a roller for consolidation, either before or after the seed is sown. For this purpose the weight is greatly increased by adding rocks to the box so that the soil is squashed flat without any tendency to roll such lumps as may remain.

Tyne Harrows. Heavy tyne harrows are necessary to pack the soil after it has been broken down into a satisfactory tilth. They leave the surface rather too loose for seeding with oats, grass seed or turnips. During the first year or two they are of little value for breaking up the soil but after this they may possibly take the place of disc harrows and thereby reduce the expenses of cultivation.

Cultivators. These tend to bring the white grass bogs, which cultivation seeks to bury, to the surface. They are therefore undesirable during the early years of cultivation.

Rollers. The consolidation of the ground after seeding is most important. Very heavy rollers are necessary but there is tendency for them to bog on certain types of ground. Water filled implements are preferable since the weight can be reduced when they are bogged. The fibrous coverings that remain on the surface after harrowing makes it practically impossible to consolidate the ground sufficiently to bring moisture to the surface. One of the most satisfactory methods of achieving this end is to cultivate the ground during winter so that the early spring rains assist in consolidating and packing the soil.

Drills. Very few seed drills are used in the Colony. Yields of oats would be increased if the seed were drilled with fertilizers (see photo. 0.192 p 264); and the amount of seed that is at present used could be reduced without loss of yield. The advantage of drilling with fertilizers is most pronounced on new ground. We have observed that the crop has failed on occasional strips when the drill has continued to sow seed

after the manure box became empty.

Seed drills should have turnip seeding attachments, since the additional cost is little and the potential value very great.

Distributors. Implements for distributing fertilizers and grass seeds are scarcely used in the Colony. They are essential if any attempt to improve the mineral nutrition of ~~stock~~ pasturage is to be made. The most suitable machines are those which are capable of distributing two tons or more per acre by means of a chain, star or other mechanical feed. The types which possess a slot in the bottom of the manure box through which manures may run freely are unsatisfactory when sowing at high rates per acre. In view of the ability to introduce clover into native camp by the strip method it would appear desirable to purchase only implements which possess attachments for strip sowing.

Horse hoes and moulding ploughs. I have seen very few of these in the Colony. This is understandable since neither potatoes nor swedes are grown on a large scale. Both a moulding plough and a horse hoe would be necessary if potatoes were grown for market, or turnips as a supplementary fodder for sheep. They are difficult to use on soft peat where horses tend to bog. Wide track tractors which are desirable for most cultural operations, cannot be used for intercultivation of crops, and it is probable that some self propelled implement such as a small Roto-tiller or light tractor with suitable attachments would be more useful under our conditions than the conventional horse hoe.

Tractors. There are in the Colony, Fordson tractors with land or road wheels and with half tracks; Caterpillar 22 with twelve inch tracks; a D.4. with twenty inch tracks; an International T.D.6. with twelve inch tracks; a 25 HP Cletrac with nine inch tracks; and three light 12 HP Cletracs.

One of the main objects in importing tractors into the Colony has been to drag home the peat for winter firing, or to sledge and fencin

materials. Their use for cultural operations has been, in most cases, secondary. But when purchasing either tractor or implements it is much wiser to err on the side of surplus power in the tractor and smaller/DB HP requirements of the implement, for excess power is very advantageous when there is a tendency for implements to bog as so often occurs in cultivating Falkland Island peat soils.

The most important considerations in purchasing a tractor for arable work in the Colony, are the width of track in proportion to weight, the DB HP and the stability on hilly land. A TD.6. with 31 DB HP fitted with twelve inch tracks has sufficient reserve of power when used with implements requiring 25 DB HP, but difficulty is experienced in turning with these implements on cultivated ground and in drawing them over soft ground because of the tendency of the tracks to spin and thereby bog the tractor. During war-time when the tractor was obtained, twenty inch tracks were not available . With twenty inch tracks work would be done much more economically, and there would be fewer stoppages through inability to secure a grip of the ground. In emergency we have increased the width of the track with wooden battens bolted on the plates and have found the performance greatly improved.

Wheeled tractors are unsuitable on the greater part of the main islands but would be of use on hard camp such as exists on outlying islands and perhaps on spacial sites, or for special purposes on the larger stations. They tend to dig in and to bog readily on land about Stanley. Owing to the rolling nature of the camp tractors with widely spaced tracks and low centers of gravity are desirable. We have experienced difficulty with one track machine through instability on a field with only a moderate slope.

The diesel type tractor appears to be much more economic in the use of fuel than the paraffin burning models we have tried.

Upkeep, expenses and repairs tend to be heavy because few local men have experience of internal combustion engines and most believe that steel will stand up to any treatment. Most engines have suffered at one

Of academic interest only at present?

MC

time or another through lack of oil. They are often roughly handled, and sometimes put to work for which they were not intended. It is not surprising that some of those which have been imported so far have been considered rather expensive in repairs and maintenance During over three and a half years the only replacements on the machine owned by the Department consists of two shock absorber compression rods and the replacement of studs for the shock absorbers. Though fitted with twelve inch tracks on exerting a pressure of 4.12 pounds per square inch on the ground, the front of this machine has on two occasions sunk thirty inches into the ground when passing over a cultivated field, though no indications of the softness of the subsoil was apparent on the soil surface.

With the 32 DB HP tractor it is probably possible to break in annually only twenty or thirty acres of new ground and to cultivate fifty or sixty acres of land that has been previously cropped. We understand that British experience has placed the area which may be reclaimed from moorland by a tractor of this size at approximately 125 acres annually and that the life of the tractor may vary from six to eight years.[X] During this period the repair bills (including labour) normally amounted to the initial cost of the tractor. In the Falklands where repairs must be carried out with farm labour the costs will be limited to the cost of parts and should not exceed a third to a half of the original cost of the tractor.

Harvesting Equipment. Considerable economy in manpower would be achieved through the use of modern harvesting machinery, swath turners, side delivery rakes, sweeps, hay loading devices and stackers. At present, I believe, that apart from mowers and hay rakes, other harvesting equipment exists only at Port Howard and Stanley. There is no doubt, as more and more ground is brought under cultivation, that such implements will become a necessity.

Silo. Though silage was made on at least two stations between 1915 and 1919 there are no silos at present in the Colony. Ensilage

(X See footnote on page 99)

Far too narrow

FIC have impaled one.

We need an automatic hay presser.

provides a means of saving surplus summer fodder for use during the winter without the worries and risks involved in hay making.

Ditchers. There are several ditchers which have been used in Scotland in connection with the reclamation of peat, but we have had no experience of them in the Falklands. At Port Howard ditching has been carried out with a stripped three furrow 50 gang plough using two discs to cut the sides of the ditch and one mould board to lift out the peat. The Department possess a Killifer 25 ditcher and subsoiler with mole drainage attachments. This machine will excavate a ditch eighteen to twenty inches deep, twelve inches wide at the base and three feet at the top and will place the spoil some eighteen to twenty four inches from the margin. The chief disadvantage of this machine is that the wheels are too narrow to support it on soft ground. Stoppages through the bogging of the ditcher are too frequent. If the wheels were twelve inches wide the implement would be improved and would be capable of digging ditches several inches deeper. Since this was written the ditcher was mounted on a sledge made of two sheets of 1/4" boiler plate and the performance has been greatly improved.

The subsoiling attachments penetrates twenty six inches, and carries the attachments for the moles. So far no mole draining has been attempted and it is doubtful whether mole drains would remain open after they had become dry during the summer.

The mechanical excavator used by the Royal Engineers to drain the Military camp made a satisfactory job but it is far too expensive to justify its acquisition for draining alone.

DRAINAGE.

It is a general opinion within the Colony, that the peat cannot be drained, and in support of this opinion, shepherds and managers will point out pools of water which persist for long periods on 'peat banks', raised above the level of the surrounding ground.

(* Unpublished report by T. Beaty submitted as Appendix XVIII).

G.H. paddocks could have been better drained than they are — similarly the 2 football grounds.

This illustrates the impervious nature of the peat but does not eliminate the utility of drains for such pools present only the type of moisture which is removed by evaporation. The persistence of the pool and the impervious nature of the peat prevents the spread of this water. It therefore does not bring about water-logging of the camp.

Both the native camp and cultivated areas sometimes become very wet. This is due partly, to the slowness with which percipitated moisture is removed by evaporation during the winter, partly to out-breaks of subterranean water and partly to overflowing of ponds which have no natural outlet. Drains, if suitably placed, assist materially in collecting the water which moves on the surface after rain. They are also of direct value in carrying off water from springs which would otherwise spread over comparatively large areas of camp, and they can be used for lowering the level of ponds; but drainage is of little value when the wetness of the camp is due to lack of stationery water and lack of evaporation. In some cases, however, stationery water can be prevented from accumulating by suitably placed drains.

Water-logging occurs when the overflow from a lagoon or pond meanders and spreads over a relatively large area, or when subterranean water breaks the surface as a spring with similar effect. In both cases the source of the trouble is specific. The land may be dried by drains which collect the water at its source and carry it in a definite channel to water-courses or other natural outlet.

By studying the origin of water which has made several acres near Stanley excessively wet throughout the greater part of the year, we have been able to indicate three sources and to connect these with a single drain which has carried, at times, and estimated 700 gallons an hour. This drain was made by the mechanical ditcher and tractor at an overall cost of a third of a penny per yard. Vehicles may be driven over this ground throughout most of the year though before draining it was often too soft to support a vehicle during mid-summer.

Have these been ordered? KIV new AO

Mc

Surely this is the whole object of deleting!

On adjacent land two other drains achieved a similar result, so that fourteen acres of ground that ware previously useless have been cultivated, and, during the second year, have yielded of a crop of oaten hay at the rate of two tons per acre.

Many of the drains that were made prior to 1940 run directly up and down the fall; they ~~would~~ can therefore serve only as main drains or leads, ~~but~~ and unless they tap a spring or underground stream, ~~they~~ gather very little more water than actually falls into them. Better results can be obtained if ditches are drawn across the fall so ~~that they~~ as to intercept surface water ~~that is~~ running down the slopes. Several drains of this type have been made on Stanley Common since 1943 and have brought about a noticeable improvement in the condition of the pasturage. In the making of one drain, 1,000 yards long, five underground streams were tapped and the water led away in surface drains.

A great improvement could be made to certain riding tracks in the camp by placing similar ditches beside them to lead off water ~~which originates~~ descending from higher ground. ~~We have~~ The Department has found the costs of ditching with tractor and ditcher, including such ~~handwork that is normally~~ manual work as may be necessary, to average about a third of a penny per yard and even this ~~cost~~ figure will be reduced when wider wheels are procured for the ditcher.

When the subsoil is ~~of~~ clay or rock there is usually a considerable movement of water between it and the peat ~~and subsoil~~, a Ditches, to be most effective ~~should~~ must therefore penetrate the clay, and the water level in the ditch should be, always, below the level of the clay.

~~By constructing a ditch of this type with a mechanical excavator the site of the camp for the Military Garrison was satisfactorily drained and has remained reasonably dry. There is a marked improvement in the growth of the natural pastures in this area.~~

[1] By mounting the ditcher on a sledge these costs have been reduced by at least ⅓

A large part of the camp would be effectively improved by well placed ditches and by the draining of ponds which give rise to underground streams that in turn break surface again. When draining lagoons and ponds it is often wise to lower the level gradually, and to grass the margin so exposed. Otherwise the bed of the pond may become dry and blow away before the grass seeds have become established. This gradual emptying can be done by deepening the outlet drain and grassing down the exposed areas each year until the desired depth haa been reached.

CROPS.

Oats. Oats are grown on many stations, are cut green and dried for hay. The variety, Storm King, obtained from Chile is preferred. During the war years it has been necessary to rely on seed from Montevideo of an Algerian type. Some experimental sowings made in 1940 indicated that the Welsh brown top (Avena strigosa) and the variety Ayr Bounty may yield more hay than Storm King. The superiority of these varieties was not statistically significant (though in some cases they out-yielded Storm King by more than 60%) because great variation in the soil ruined the experiments from ~~the~~ a scientific point of view. The yields recorded on these experiments where as follows:

TABLE XV

OAT VARIETY TRIALS - 1940.

VARIETY	Estimated yields cwts. per acre of hay Stanley. (virgin soil disced)	Yield of hay. (tons per acre)	
		Hutchinson' Paddock.	Chartres.
Yielder.	1.4	1.471	-
Ayr Bounty.	3.6	1.828	3.375
Early Miller.	1.2	.803	-
Welsh Brown S.171.	2.0	2.214	4.45
Welsh Brown LLW90	3.4	.935	4.859
Spring rye. (English)	2.2	.535	2.575
Spring rye. (Argentina).	3.4	-	3.07
Storm King.	2.2	1.017	2.715
6 Row Barley.	0.0	.070	0.00
Feed Oat (Algerian type).	-	-	3.305

The trial at Stanley was sown on a peat bank after discing. Whale guano was broadcast at two cwt. per acre. Growth was very poor and the figures in this column (TABLE XI) represents the average estimated yield of hay in cwts. per acre after examining five replicated plots of each variety. ~~This crop was not cut.~~

The trial in Hutchinson's Paddock was not replicated. At Chartre the yield of the replicate plots varied so greatly that the difference between the yields is not statistically significant . (~~Analysis of~~ commercial oat crops C.I. 10, pp 264-266)

Harvesting Oat Seed. ~~It~~ There seems to be a general belief that ~~oat seed~~ oats will not mature seed in the Colony. This is fallacious. When oats are sown during the early part of April and allowed to stand over the winter, seed is matured with little difficulty about the end of February, even in Stanley. On northern and western parts of West Falklands, and on outlying islands the growing period is three to five weeks longer than in Stanley and ~~the maturation of oat~~ the seed would ~~be~~ correspondingly mature earlier. Since no attempt has been made to ripen oats on a commercial scale, nothing is known of the suitability of different varieties ~~to~~ in local conditions. I would suggest that, to produce seed, oats would be best sown about 20th. March.

A small trial was carried out during 1945-46 season to determine whether certain varieties of oats, provided by Dr. Waterhouse of Sydney University, would mature seed when sown in Stanley during the spring. The best of these Fulghum (C.I., 699-202) which was sown on the 13th. October and was ready for harvesting at the end of March. Mulga Oats, South African skinless and Belar sown in the same trial produced seed stalks earlier than Fulghum but have taken longer to ripen the seed. At the present time an estimated eighty tons of oats are imported annually for horse feed. There seems no reason why this quantity should not be grown in the Falklands thereby providing a living for one or two small holders and saving Uruguayan exchange.

Wheat. No attempt has been made to grow wheat in the Falklands, other than as a curiosity. At present nineteen strains provided by

Dr. Waterhouse are thriving in a small plot in Stanley. They were late sown (13th. October, 1945) but some contain well formed immature seed (5th. April, 1946). It is not suggested that the Falklands would grow good quality flour wheat, but it should be possible to produce, in selected areas, sufficient fowl wheat to supply the local demand. From this point of view it would be worth while to test a few varieties over several years, under field conditions in the warmer parts of the Colony. One would expect the early strong stemmed winter varieties to be most satisfactory.

Several of the varieites supplied by Dr. Waterhouse have become infected with stripe rust (Puccinia glumarum) but the majority of strains he submitted are resistant to this rust.

Barley. This crop does not thrive when planted during September, when the soil is cold. Odd plants that have occurred as impurities in oats indicate that under some conditions it grows well and may in some seasons produce seed. The varieties known as Cape and Black Skinless have been used in New Zealand to provide forage for sheep and lambs when the rape crop has failed. Sown in January on a warm soil the growth of these crops is so rapid that sheep may be grazed on them within three weeks. They should be useful in the Falklands for similar purposes if sown during December or January, but no experimental work to this end has been inaugurated. Since there is no fat lamb trade the incentive to produce such fodder is lacking; but Barley (green) could be used as a succulent fodder for dairy cattle during February and March. The crop should be fenced into small breaks and the animals allowed to graze on them for one or two hours daily.

Brassicas.

In this genus are included some of the most useful forage plants than can be provided in temperate climates, swedes, turnips, kales, rape and cabbage. Such crops require a soil containing lime and thrive best when kept free from weeds. They involve a certain amount of hand labour for thinning and intercultivation. They may be grazed by stock

Swedes

What about mangel-wurzels?

A splendid cattle food.

Underline →

They would grow here apparently.

in breaks, which involves little trouble to the farmer, and avoids the labour of pulling and carting the crop. All these crops have produced heavy yields when sown on rich garden soil in the Colony, but they cannot be established by normal methods on land which has been newly broken from native pastures. The cause is not known but it is believed to be due to lack of moisture in the seed bed through the difficulty of securing consolidation, to the lack of lime in the soil and, possibly, to the rawness of the peat. No trouble has been experienced in obtaining a crop of winter turnips when sown on land newly broken from clover lea, or after two or three crops of oats have been taken.

Early and late turnips establish better than swedes as the native peat is reclaimed, and, furthermore, the swede crop is very subject to injury by hares. During the early winter we have lost the whole crop on small plots totalling half an acre through this cause. In partly sheltered plots about Stanley, field varieties of swedes have yielded at the rate of forty tons per acre, but the table varieties, which are all that we have been able to procure during the past three years, have not exceeded twenty tons per acre.

As Munro (1924) has pointed out ~~(page 39)~~ 20 acres of turnips or swedes yielding ~~at~~ an average {of, say, fifteen tons per acre} will support 1,000 sheep for a month. Since this fodder is provided during the winter when native forage is at its minimum each acre of such feed means that an additional twenty sheep may be carried for three months and each may be expected to produce an average of seven pounds of wool per head or at present prices a total of £7 per acre. Actually I think the estimate of fifteen tons per acre rather pessimistic and believe that twenty tons per acre would be quite conservative provided lime and fertilizers were used.

The provision of either swedes or turnips should be seriously considered as a winter supplement for rams and stud sheep where clover bearing fields exist near the main settlements.

~~The yields obtained by my predecessor from leafy brassicas grown~~

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Turnips for seed
Sweeds

Since the disease is unknown here why worry?
MC.

[illegible] acres of turnips or swedes yielding at an average (of, say fifteen tons per acre) will support 1,000 sheep for a month. Since this fodder is provided during the winter when native forage is at its minimum each acre of such feed means that an additional twenty sheep may be carried for three months and each may be expected to produce an average of seven pounds of wool per head or at present prices a total of £7 per acre. Actually I think the estimate of fifteen tons per acre rather pessimistic and believe that twenty tons per acre would be quite conservative provided lime and fertilizers were used.

The provision of either swedes or turnips should be seriously considered as a winter supplement for rams and stud sheep where clover bearing fields exist near the main settlements.

For N.Z. market — but how do we get it there?

KIV. Govt. Farm.

MC.

The yields obtained by my predecessor from leafy brassicas grown

~~in garden soil were published in Gazette 9 of 1940 (pp 163-164).~~ These ~~varieties failed~~ to establish during the following season thoug sown twice in drills fertilized with a ~~mixture~~ of superphosphate and lime at two cwt. per acre, on an old oat field (Experiments 41/11 and 41/12).

For the past two years some six acres of turnips have been sown as a winter supplement for milking cows in Stanley. When the RMS "Fitzroy" was laid up in Montevideo, between June and September, 1945 it was this swede crop which enabled milk production to be maintained when the ~~ordinary imported~~ supply of imported fodders had run ~~ran~~ out.

Turnip Seed Crops.

Because of the freedom of turnip crops from dry rot (Phoma lingam) and the isolation that can be secured ~~because~~ on account of the scarcity of susceptible crops, the Colony is well suited for the production of seed free from this disease. Phoma lingam is carried in the seed, and, in New Zealand causes the destruction of whole fields of swedes covering upwards of twenty to thirty acres. ~~The disease appears to be killed in the seed by steeping it in water held at 124°F for fifty minutes (Neill 19~~ x ~~)~~. New Zealand farmers have been heard to offer up to twenty shillings a pound for swede seed if ~~that could be~~ guaranteed ~~to be~~ free from this disease.

We have grown in the Colony and harvested seed of white flesh turnips (Snowball variety) from both selected roots, and stecklings. Seed has also been produced on about a third of an acre from selected transplanted swede roots. The roots were transplanted on ground broken two years before from white grass and were not tended; thirty pounds of good quality seed was harvested but a considerable amount was lost before and during harvesting. Under commercial conditions of seed growing, such losses would not have occurred.

There is reason to suppose that in time the growing of certified disease-free swede seed could be established in the Colony, and that the produce would be readily marketable in New Zealand. Such an

x Treatment developed by J.C. Neill mycologist Plant Disease Division

industry would be best placed in the hands of small holders each of whom would be limited to a few acres of a single variety. The limited distribution of tame bees and the absence of wild bees would reduce the risk of interhybridisation.

The Beet Family. Silver beet, perpetual spinach beet, and red beet thrive in sheltered vegetable gardens. Attempts to grow ~~marigolds~~ mangolds under similar conditions have been very disappointing. Such crops prefer warmer soils and are not likely to be satisfactory in this Colony.

Carrots. In other countries where difficulty is experienced in growing swedes or turnips, carrots may be used as a fodder for stock. They grow very satisfactorily in vegetable gardens, and are eaten by stock, but we have been unable to produce a satisfactory crop under field conditions on light sandy peat.

Potatoes. The Colony grows practically all the potatoes that it requires for local peace-time consumption. These are produced entirely in vegetable gardens associated with private dwellings or cookhouses.

The Department has planted an area of six acres under field conditions at Darwin, and a similar acreage on Stanley Common. (See photos P1-6 & P10-15 pp 267-270) In no case has the crop been kept as free from weeds as it should have been, nor has it received sufficient moulding and intercultivation.

At Darwin, unsprouted seed was used. The crop became badly overgrown with charlock and nettles and was very poor.

Sprouted seed has been used in Stanley, but until 1945-46 season has been heavily cut, so that each seed piece had but one or two shoots. The varieties used and yield obtained were:

What about frost?

NA Argentina I think! Frosts are a perpetual menace and there is also the shipping problem to be considered. But KDV for Good Farm.

MC.

Optimist!

TABLE XVI

Yields in Tons per Acre. 1943-44.

	1943-44	1945-46
Arran Banner.	6½	
White City.	3½	
Great Scott.	4	
Doone Pearl.	3½	
Majestic.	3½	
Mixed Seed, small (Agricultural Department).	2	
Mixed Seed (purchased locally).	3	

The yields of new varieties was not kept. A total of 15 tons was harvested from 3 ac. though one acre produced but 2 tons.

On this type of ground Arran Banner was undoubtedly superior but it was the best seed and was on the best ground. Sprouted seed was noticeably superior to unsprouted. Very small seed when unsprouted was not worth planting. During 1944-45 Arran Banner, White City and Majestic were used. The yields were not kept, but the average of all varieties was about two and a half tons per acre.

A latin square experiment was planted during the spring of 1945 to obtain information concerning the best spacing and size of seed potatoes, but unfortunately the experiment was ruined by pigs, which escaped from a nearby butchery.

The Falkland Islands has shown itself to be capable of producing in sheltered gardens, potato crops which yield up to fourteen tons per acre. The climate is cool. Neither late blight nor aphides have been observed. The conditions appear to be suitable for the production of seed potatoes of high quality with a minimum of virus diseases. And a thousand miles away is a potential market - Uruguay and Argentina. If the problem of producing certified seed potatoes were tackled seriously on a commercial basis I have no doubt that the seed would sell itself in these countries because of its performance, and that the demand for such seed would cause any trade barriers to be lifted.

Lucerne. Lucerne was tried in the Colony in 1913 when it was reported to have established strongly but to have produced mediocre yields

But if affected by salt spray sand dunes would hardly appear to be a suitable locality?

Same process

MC

of hay. There still remain some half dozen plants which are kept as curiosities by managers or householders throughout the Colony.

During February 1941, the variety known as Grimm was planted over an acre and a half of sandy ground near the coast. The seed was inoculated with a culture brought from New Zealand several months previously. A good stand was obtained. By May, plants were three or four inches high, but they had not become nodulated. They were completely burnt off during a south easterly gale in June; but whether the burning was due to the sleet and cold which accompanied the gale, or to the salt spray which it carried is not known. No plants could be found during the following spring.

North American experience in Montana, Idaho and Alberta indicates that the crop is capable of standing very heavy frosts, and it seems probable that the loss of stand was due to salt spray. There would appear to be considerable scope for this crop especially on sand dunes and well drained sandstone areas. The seed must always be inoculated with the nodule organism, which is different from that found on clover roots.

Though interesting, Part V relates to a purely emergency period and could be omitted in toto, saving 10 pages.

PART V. Omit Part V in toto.

VEGETABLE PRODUCTION.

On my arrival in the Colony I was instructed to give precedence over all other activities of the Department, to the provision of food materials, particularly vegetable and milk, for human consumption. The object was to make the Colony as self-supporting as possible against the possibility of isolation during the war, and the necessity to purchase supplies in South American markets which necessitates foreign exchange. A further purpose was the provisioning of visiting naval vessels.

Of its food requirements, the Colony produced, besides meat, only vegetables and potatoes and a limited quantity of milk. The imported vegetable foodstuffs, including some fourteen tons potatoes (during the spring) amounted to approximately a hundred tons in 1939 or approximately 93.3 pounds per head. The importation consisted chiefly of tinned fruits, green peas, tomatoes, and fresh potatoes and onions.

Within the Colony all the vegetables and potatoes were grown privately in kitchen gardens where it was customary to allocate approximately two thirds of the space for potatoes. This left little room for green vegetables. Only those vegetables that yield well during the summer, or stand well during the winter are grown. Crops which take up excessive space in prpportion to the yield of food material such as brussels sprouts, savoy cabbage, peas and broad beans do not find a place in most gardens. The chief vegetables grown for the summer are cabbage, cauliflower, lettuce, white turnip, radish and cress. Swede turnips, carrots and kale are the main winter vegetables Consequently, though there is often a surplus of vegetables during the period from February to the beginning of May, there is little or no surplus for sale during the remainder of the year.

The practice of growing all vegetables that are required in private gardens has prevented the development of a market gardening industry, since there is no demand for fresh vegetables. Neither

private nor Government enterprise has run to the establishment of extensive heated glass-houses for vegetable production. Only manual methods of cultivation have been used.

Such was the position in June, 1940 when an appeal was made to the farmers to grow as many potatoes and vegetables as possible both for thei own requirements and for sale in Stanley. This appeal was followed up by the Stock Inspector who made the round trip in the Fitzroy between the 15th. and 26th. July 1940. He reported that it was doubtful whether any serious attempt would be made in the camp to grow vegetables for sale in Stanley. The reasons:- farmers considered the prices offered were too low, and they had barely sufficient labour for ordinary farm work.

The small properties (on outlying islands), and Hill Cove promised most help; but even so it was estimated that the quantity that might be available (for sale in Stanley) during 1941 was five to six tons potatoes and perhaps a few tons of swedes (which would pay the producer handsomely at twopence ~~halfpenny~~ per pound).

In response to a similar appeal residents in Stanley who had no opportunity of working additional land themselves, offered unused land to the Department for vegetable growing. In this way the area of sheltered town land at the disposal of the Department was increased between June and September 1940, by one and a half acres, and included private lawns, vacant sections and public reserves.

The glass-houses at Sulivan House were used to produce seedlings of cabbage, lettuce and cauliflower for early spring planting. Through this, matured Arctic lettuce was placed on the market early in December, six weeks earlier than hearted lettuces are usually available.

When the Garrison arrived during the winter of 1942 the demand for vegetables increased from five tons per annum to about one hundred and fifty tons, excluding potatoes. As a result of a further appeal to the townspeople of Stanley, another three acres of sheltered land was made available gratis to the Department. And the cultivated area on Stanley

Common was increased from five to twenty acres.

This was made possible by the hiring of a tractor from Teal Inlet with which eight acres were ploughed in 1941 but left fallow, and by the borrowing of a Fordson Tractor from Bluff Cove during the winter of 1942. Six acres of diddle dee ground were ploughed with difficulty with a four horse team. In November 1942 the Department received its tractor and sundry implements which had been ordered early in 1941. Without these implements it would have been impossible to cultivate sufficient land for either the vegetable or dairy schemes.

The area under cultivation was increased as follows:-

1939. 3 acres (of which 2 consisted of newly broken native camp).

1940. 8 acres (of which 3 consisted of newly broken native camp).

1941. 17 acres (of which 8 remained fallow).

1942. 28 acres (of which 4 were planted in oats for hay).

1943. 49½ acres (of which 9 were sown in hay, 14 remained fallow)

1944. 59½ acres (of which 36 were planted in oats for hay and 10 remained fallow).

1945. 74 acres (of which 50 were sown in oats or pasture for hay, 8 remained fallow and 6 were sown in turnips).

The vegetable requirements were carefully estimated each year, and sufficient excess was planted to allow for failures and low yields. The actual yield has been remarkably close to the estimate in each year. The quantity sold year by year was as follows:-

TABLE XVII

Quantities of Vegetables Marketed.

Variety Vegetables. (lbs.)	1941.	1942.	1943.	1944.	1945
Cabbage.	5,069	4,138	34,178	20,590	14,034
Turnips (white).	2,654	909	50,294	2,154	2,644
Swedes.		3,223	10,460	10,670	4,665
Lettuce.	1,384	1,208	10,568	1,743	1,726
Cauliflower.	912	1,093	3,172	3,872	2,195
Carrots.	762	1,709	14,902	8,542	3,962
Parsnips.	80	334	1,295	956	-
Kale.	58	65	6,957	490	44
Broad Beans.	16	180	316	859	120
Savoy.	-	894	7,964	8,697	2,299
Broccoli.	-	243	850	-	-
Onions.	42	60	86	-	-
Potatoes.	-	-	12,540	23,226	26,087
Estimated quantity of surplus fed to stock.	-	-	47,040	246,400	Not estimated.
Total:	10,977 lbs.	14,056	200,622	328,199	57,776

In addition to the vegetables produced by the Department the Government purchased surplus vegetables from private gardens and from the camp. It would have been impossible to obtain any quantity of vegetables from the camp had it not been for occasional trips by H.M.S. William Scoresby and the S.S. San Casto both of which willingly lifted any produce or hay which was available. The quantity of vegetables purchased from the public amounted to:

TABLE XVIII

Year.	Quantity of vegetables purchased from the public.
1941.	nil
1942.	9,911
1943.	58,007
1944.	23,130
1945.	26,220
Total:	117,268

Probably half the vegetables obtained from the camp were grown at Hill Cove privately, by the employees who were encouraged to increas the areas of their vegetable gardens. The main vegetables supplied from the camp were potatoes, carrots and swedes. The towns-people were able to supply greens and soft turnips in addition to the above.

Because of bad packing of potatoes the Department requested that these be graded, and offered twopence and penny three farthings per pound for first and seconds reppectively. Many growers rather than take the trouble to grade their produce preferred to sell to private individuals in Stanley at a penny halfpenny per pound. It was estimated that private individuals purchased some tweny two tons of potatoes from the camp during 1943 and sold then to the Garrison messes These potatoes were partly the surplus from a very good season. During the subsequent year the quantity of potatoes supplied from the camp was considerably less.

Production of Vegetable Seeds. On the receipt of advice from the British Government concerning anticipated difficulties in supplying vegetable seeds, an attempt was made to produce seeds of swedes, turnips, cabbages and carrots, locally, while a small number of cauliflowers and carrots were transplanted into a glass-house for seeding. Simultaneously, instructions were published so that private house-holders could produce swede, turnips and cabbage seed for their own requirements.

Several people succeeded in harvesting seed of turnips and kale, and one or two produced viable parsnip, and leek seed. In many cases, however, the parsnip seed would not germinate. One private grower succeeded in producing cabbage seed though the purity was contaminated by hybridisation, apparently with kale.

The Department succeeded in obtaining seed from transplanted roots of Snowball turnip and Masterpiece swedes, but failed to secure cabbage seed, partly because the variety used, Enfield Market, when carried over the winter produces new hearts rather than seed stalks,

and partly because the breaking of fences during military exercises made it impossible to keep animals out of the plots.

The Intermediate varieties of carrots were too late in resuming growth to produce seed during the local growing season; but the Early varieties set seed though the seed heads were cut by frost before they were mature. Seed of Early varieties and of cauliflower was produced in small quantities in the glass-houses. It is possible that, Early carrots would produce good seed if grown on the West Island, where the growing season is from three to five weeks longer.

Several varieties of kale seeded freely during the summer and should produce profitable crops if a market were found. This should not be difficult with the variety known as Sheep Kale which produces an abundant leafy growth under Falkland Islands' conditions and would make a valuable sheep fodder for local use.

During the 1944-45 season the Department selected some 1,200 roots of table swedes and planted them on arable ground of two years standing. Approximately thirty pounds seed was obtained though little care had been given to the plants. A considerable amount of seed was lost during the harvest, and under normal conditions a higher yield would be expected. The bulbs from which this seed was produced were selected from a crop that appeared to be free from Phoma lingam. If similar seed of field varieties could be produced without contracting this disease, (of which there seems every probability) it would find a market in New Zealand at anything from ten shillings per pound upwards.

Methods used by the Department for Vegetable Production. Field cultural operations were supervised by the Agricultural Officer and the details of production planting intercultivation and harvesting were undertaken by the Government House Gardener.

At the outset considerable criticism of the vegetable scheme was voiced by local 'experts' who thought the attainment of forty tons of vegetables guaranteed by the Department during the 1942-43 season was

utterly impossible. The estimated total yield was placed at eighty four tons and was attained.

To achieve this production several hand seeders and cultivators were imported from North America. All the ground used, received a dressing of carbonate of lime at the rate of two tons per acre, a mixture of equal quantities of lime and superphosphate at ten to twelve cwt. per acre, and nitrate of soda (in later years nitrate of potash) at three cwt per acre. The lime was broadcast on the disced furrows and the other fertilizers on the seed bed before the crop was planted, either with a shovel from a sledge or by hand.

Some of the ground has been ploughed with a hired tractor during 1941. The smaller plots were broken up with a small swing plough, light disc harrows, tyne harrows and clod crusher, while other small areas dug by hand. After November 1942 the cultivation was carried out mainly with tractor and heavy implements.

All cabbage, kale, cauliflower, savoy and broccoli were grown in seed beds and transplanted. This necessitated more labour than was available in Stanley and the Garrison supplied a dozen volunteers who had agricultural or market gardening experience. In return for this assistance, the Garrison received a 25% rebate on all produce purchased from the Department.

Hares destroyed five acres of savoy and kale seedlings during the 1942-43 season and were destructive to both cabbages and swedes during the subsequent season when these were grown on cultivated sections of the Common. No serious loss was occasioned by fungus or bacterial disease among these crops, and the only injury by insects was encountered during the spring of 1945 when soft turnips were decimated by a small maggot, which, as yet, has not been identified. The same insect appeared to be widely spread in Stanley and they destroyed cabbage seedlings in private gardens. It was controlled by sowing a 5% DDT. dust in lime at forty pounds per acre in the drills.

During the period from mid-October to Christmas the supply of fresh vegetables is always short, and is limited to kale, sprouting broccoli, occasional spring broccoli and stored carrots and swedes. The swedes do not keep well in storage after the end of October.

An attempt was made to store cauliflower, by hanging them by the roots from the roof of the barn. The curds dried under this treatment and kept reasonably well for about two months. If soaked for twelve hours before cooking they were quite palatible. I understand that lettuce may be kept similarly during the winter, and that cabbage are stored during the winter in Norway in loosely packed hay, care being taken to prevent them coming in contact with each other. No attempt was made to store surplus cabbage or lettuce since there was always sufficient savoy to carry on. The surplus was fed to dairy cattle.*

Potatoes in storage suffered a heavy loss during 1945 due to a breakdown and discoloration of internal tissues, which was not apparent until the potatoes were cut. This trouble was particularly serious in potatoes received from Hill Cove. Fusarium storage rots, powdery scab, wart and black leg are also encountered in the Colony.

Notes made in Connection with Vegetable Production. The best varieties of vegetables grown by the Department were undoubtedly Hercules lettuce, thirty one tons per acre; Stump Rooted Intermediate carrots, nineteen tons per acre; Walcheren cauliflower, 12.4 tons per acre (see photo V2 P298) and Pride of the Market cabbage, 12.35 tons per acre.

During the 1942-43 season, some hundred and fifty different varieties of vegetables were sown for observation. Owing to the pressure of other work the experiments could not be given the attention they would have received normally. Notes made during the season are appended (Appendix XIX).

Cabbages. Among cabbages, Pride of the Market was undoubtedly the best yielding and most suitable variety. It stood well into the winter without bolting to seed and was resistent to light frosts. But

(* Lettuce produces grave dietetic disorders in cattle and horses).

it does not produce new heads in the spring as does Enfield Market. Enfield Market and Flower of Spring were also very good and the former will, after being cut during the autumn, produce new heads in early spring Of the early varieties Carter's Velocity and Sutton's Earliest were outstanding. Heartwell Early Marrow was assearly but produced a small heart and Little yield. Large Drumhead, Selected Drumhead and Roundhead Maincrop grew very vigorously but did not heart.

Winter Greens. New Year and Rearguard were undoubtedly the best of savoy cabbages and provided a satisfactory succession. New Year was ready for cutting in June and Rearguard carried on from the end of August. DwarfGreen Curled savoy matures early when cabbages are still available and bolts to seed rather too readily. Drumhead varieties of savoy run to seed without producing hearts.

Of the Colworts, the variety known as Rosette thrived well under our conditions and formed hearts. It was preferable to Chou de Burghley and Green Colewort. It comes into production during the winter when other vegetables are scarce and should be grown in all gardens.

Much can be done with kales. The Drumhead variety appeared most promising and resembles cabbage in flavour and in the texture of it's leaves. It is early (May-June) and forms a heart. Dwarf Green Curled kale is rather too early for local conditions, and bolts to seed readily (May). Of the other varieties the tall Scotch type probably produces the greatest bulk and is available late in the winter though it is perhaps less palatible than some of the others.

Roots. Swede turnips undoubtedly provide the greatest part of the winter vegetables. (See Bhols Vol p 298) No comparison have been made of different varieties, but we have obtained better yields from the field varieties, Superlative and Masterpiece, than from the table varieties. They seem sweeter and more palatible than when grown in New Zealand in lower latitudes. Yellow Flesh turnips thrive equally as well and are better on new ground than swedes, but are not so common in the vegetable gardens. Both these crops suffer from a rot caused by a species of Botrytis which attacks the roots in damp weather spreading to them from the decaying leaves. (Selerotia do not form). The symptoms

usually associated with boron deficiencies have been observed in the second and third crop of swedes grown on the same area.

Carrots. In general, the Early varieties of carrots are more suitable for local conditions and do not tend to bolt as readily as the intermediate and late varieties. They may be stored in sand until Christmas. The earliest varieties appear to be Early Gem or French Forcing but for the main crop Early Shorthorn or one of the improved Early Horns appear as good as any. These varieties thrive withvvery little thinning, so that roots push each other about until the row becomes from four to six inches wide.

An exception among the intermediate varieties appear to be Stump Rooted Intermediate, which produced a crop at the rate of nineteen tons per acre and lost only about six cwt. per acre through individual plants bolting to seed. This variety was also grown so closely that the roots were touching and the drill became four to six inches wide.

Lettuce. Among the cabbage-lettuces, the Arctic variety was the earliest of those tried, and has been marketed in early December. However, it bolts to seed rapidly and will stand barely a month.

No variety approached in flavour, succulence or yield the performance of Hercules or Ben Lomond. The former of these varieties yielded at the rate of thirty one tons per acre over an area of 375 square yards.

The varieties known as Perpetual and Holborne Standard are also satisfactory, though neither has yielded nearly as heavily as Hercules.

Of the Cos varieties Improved Self Folding appeared to be more succulent and sweeter than Leviathian or Hardy White Cos.

Legumes. Broad Beans thrive well when they are planted in ground containing nodule organisms. The variety that is most commonly planted is Early Long Pod, but Becks Green Dwarf is also satisfactory. This crop is usually planted in Stanley about the beginning of September and i

is then ready for picking about mid or late February. It continues to produce until cut by frost in May. Planting in June would probably be more satisfactory, assure an earlier harvest, and a longer season.

Chocolate spot has been observed but is not a serious disease on this crop. Neither rust or mildew have been observed .

Stanley is not well suited for the cultivation of green peas. The most successful variety we have grown is one which was purchased locally under the name of Sutton's Early Dwarf; but as it has not been available since 1940 its merits have not been confirmed. Other varieties which have produced well elsewhere in the Colony are Pioneer Thomas Laxton, Hundred-fold and Little Marvel. Even Early Eight-week did not produce a crop in Stanley, under the conditions in which it was grown. A private grower who has perhaps more success with peas than most, manures the crop with lime-phosphate mixture and potassium-sulphate during the growing season.

Melting Sugar peas have been grown on stations situated on the north west of the West Falklands with satisfaction, and have even produced seed for replanting, but they do not appear to thrive in Stanley where the growing period is some three to five weeks less.